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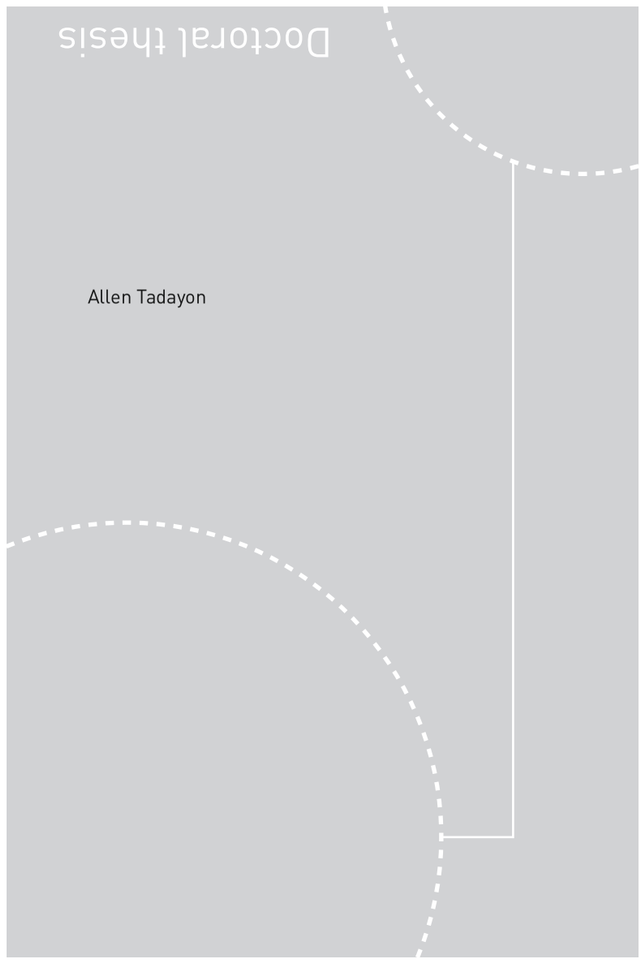
Allen Tadayon

A new look towards relational project delivery models



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Trondheim, December 2018

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This dissertation is lovingly dedicated to my parents for their support and encouragement throughout the entire duration of my education

Preface and Acknowledgments

The work presented in this thesis was carried out at Department of Civil and Environmental Engineering at Norwegian University of Science and Technology. The completion of my Ph.D. has been a long journey, and I would never have been able to finish it without the guidance of my supervisors and colleagues, and support from my family and friends.

First and foremost, I would like to express my sincere thanks for the supportive and inspiring guidance that I have received from my supervisor, Associate Professor Ola Lædre. He has always supported my choices and has kindly and patiently helped me deal with the challenging circumstances involved in the process.

I would also like to thank my co-supervisor, Professor Bjørn Andersen, for his contribution, his support and our inspiring conversations, which have been a great pleasure and have motivated me during my Ph.D. I would also like to express my sincere gratitude to Professor Ole Jonny Klakegg for his invaluable support and contributions during these years.

I want to thank the Statens Vegvesen (Norwegian Public Road Administration) for supporting my Ph.D. study both scientifically and financially. Many thanks also to the Building and Construction Engineering Research Group at NTNU and the Civil and Environmental Engineering Department at the University of California, Berkeley for hosting me for one year. I also want to truly thank my parents, Azim Hosseini and Azra Tadayon, for their support and encouragement throughout the entire duration of my education. I am endlessly grateful to them for all they have taught me.

Throughout my work on this thesis, I have enjoyed discussions with my fellow Ph.D. candidates Amin Haddadi, Paulos Wondimu, Saad Ahmed and Fredrik Svalestuen. I have also appreciated the valuable discussions and cooperation with Professor Nils Olsson, Associate Professor Olav Torp, Glenn Ballard and Agnar Johansen.

My warmest thanks and love go to my girlfriend Bahareh for her patience, support and encouragement during my study.

Allen Tadayon
August 2018 Trondheim, Norway

Abstract

Delivering a project is the core of project management. A key success factor is an adequate Project Delivery Model (PDM). The choice of PDM affects project cost, schedule and success and influence the efficiency of running a project. In many countries, there is a relatively new ambition to adopt a PDM which avoids the adverse objectives and conflicts that have characterized the construction industry for too long. This ambition is increasing interest in promoting collaborative relationships in the construction industry.

Two relational delivery models, namely partnering, and alliance, were selected for further investigation in this Ph.D. work. One of these seems to be more about attitude rather than formal contract regulations (partnering), and the other depends on formal contract regulations (alliance). The aim of this part of the research is to assist decision makers, researchers and practitioners to better understand these concepts by identifying the hard elements of these two models.

The results of this Ph.D. work suggest that each PDM is defined through its components and not its name. Different delivery models use different sets of mechanisms to implement the means needed to achieve the desired effects. Perhaps a few years ago, before the emergence of new PDMs, many of these elements could have been said to be unique to one form of delivery model. Today, however, countries are seeing an increase in innovative and relational PDMs that have adopted many elements used in other methods. This study argues that different models can learn from each other and clients can possibly add elements that are considered unique to a specific model to their shopping list. This is an attempt to fit/harmonize a PDM to a particular project. Which model or combination to choose is a question that needs to be carefully considered.

The outcomes of this Ph.D. work are twofold. The first outcome is clearing the confusion around relational PDM concept by exploring and investigating the components (characteristics) of relational delivery models and how they are practiced in the construction industry (RQ1 and 2). The second outcome is helping the decision-making process by identifying the project characteristics that are suitable for relational PDMs and developing a conceptual model for adopting a relational PDM (RQ3).

Table of Contents

Acronyms

ALT	Alliance Leadership Team
AMT	Alliance Management Team
BOOT	Build-Own-Operate-Transfer
CII	Construction Industry Institute
CM	Construction Management
D&C	Design and Construct
DB	Design and Built
DBB	Design-Bid-Build
ECI	Early Contractor Involvement
IPD	Integrated Project Delivery
JLT	Joint Leadership Team
KPI	Key Performance Indicator
KRA	Key Result Area
NEDO	National Economic Development Office
PA	Project Alliance
PDM	Project Delivery Model
PFI	Private Finance Initiative
PMBOK	Project Management Body Of Knowledge
PMI	Project Management Institute
PO	Project Owner
PPP	Public Private Partnership
RBP	Relationship-Based Procurement
TOC	Target Outturn Price

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PART I: BODY OF THE THESIS

Chapter 1

1. Introduction

1.1 Background

Project Delivery Model (PDM) is a system for organizing and financing design, construction, operations and maintenance activities that facilitates the delivery of a goods or service (Miller et al., 2000). Numerous authors have categorized the range of delivery models in the literature, and there are many PDMs listed in different literatures. The Construction Industry Institute (CII) maintains that all PDMs can be placed into three fundamental PDM categories: Design-Bid-Build (DBB), Design-Build (DB) and Construction Management (CM) (Sanvido and Konchar 1998). However, in later publications, it added 12 new options under the collective term Integrated Project Delivery (Anderson et al. 2003). In a relatively new classification, Walker and Lloyd-Walker (2015) summarized choices for studying the collaborative features of PDMs and investigated the trend toward relational base PDMs.

The choice of PDM affects project cost, schedule and success and influence the efficiency of running a project, while in many cases, delivery methods are chosen based on in-house knowledge or external assistance (Masterman and Duff 1994). Since the suitability of the selected PDM can improve project performance to a great extent (Al Khalil, 2002; Han Kuk et al., 2008; Kumaraswamy & Dissanayaka, 2001; Oyetunji & Anderson, 2006; Udechukwu et al., 2008), this is a challenging issue for stakeholders and decision makers (Al Khalil, 2002; Chan et al., 2001; Kumaraswamy & Dissanayaka, 2001).

As projects become increasingly more critical and complex than before (Azari et al. 2014), and pressure from various stakeholders increases (Sakal 2005), eliminating wasteful, non-value-creating activities such as disputes, over processing, reworking and other incidents is becoming more challenging. At the same time, construction projects are often associated with low efficiency, mostly due to the significant focus on transactions (Winch 2000). On the other hand, meeting customers' needs during such projects may lead to the desire for closer collaboration and the development of delivery models that can handle various challenges caused by complexity and uncertainty. By focusing on relationships rather than transactions, partnership and collaboration facilitate increased efficiency, avoids conflict and eliminate adversarial relationships (Naoum 2003, Chan et al. 2010). The use of such measures may also lead to an increase in innovation and thus better products (Barlow 2000, Chan et al. 2010).

These measures are called by different terms in the literature (e.g., relationship-based procurement (RBP) (Wood 2009, Mills and Harley 2010, Davis and Love 2011) or relational project delivery (Lahdenperä 2012)). At the same time, the shape and form of these relationship-based arrangements differ globally.

For example, Project Alliance (PA) in Australia may differ from European Alliance in the UK or Finland. Furthermore, in Europe, there is other form of close cooperation between the project owner (PO) and service providers through the tendering stage which is called Competitive Dialogue (CD) (Hoezen 2012). Another form of partnership among the PO, contractor and designer has emerged in the United States and is called Integrated Project Delivery (IPD) (Matthews and Howell 2005).

Although the role of these arrangements in delivering better value for money than traditional models has been known for decades (Latham 1994, Egan 1998), *PMBOK Guide* (a guide to the project management body of knowledge) has gaps in its coverage of relational delivery arrangements (Walker and Lloyd-Walker 2015). Therefore, it would be beneficial for POs, academics and practitioners such as delivery contractors to have a better understanding of these emerging project delivery arrangements. This Ph.D. work aims to help narrow the knowledge gap in the industry and academia for relational PDMs with the research undertaken to write this dissertation and through publications.

This Ph.D. study was motived by an upcoming mega project in Norway. The Norwegian Public Roads Administration (NPRA) has planned a coastal highway route (E39) along the western coast of Norway covering a total of 1,100 km. This highway is dependent on eight fjord crossings, and estimates indicate that 269 billion Norwegian kroner will be spent over a 20-year construction period. The E39 program is in addition to other infrastructure projects that will be carried out during the same period. In terms of size, complexity and need for technological innovation, the E39 ferry-free coastal highway represents a major challenge for the NPRA. Based on the capacity of the NPRA, PDMs that guarantee smooth and appropriate project delivery by allocating more responsibilities to the contractor are the main interest of the authority. The NPRA needs to choose the best PDM in the early phase of the project lifecycle based on factors such as project characteristics, client objectives and external environment. In this direction, this study assists the NPRA in the decision-making process by providing hands-on knowledge.

1.2 Research objectives and questions

The research objective dictates the functions that the research attempts to achieve. Background study of the subject led to the following acknowledgments concerning the need for new knowledge:

- A thorough understanding of what relational PDMs (partnering and alliance) are.
- A systematic approach toward adopting a PDM.

Therefore, the key objectives of this research are:

- To develop a better understanding of relational PDMs and theories that can partially fill these knowledge gaps.
- To gain in-depth knowledge of the subject to improve practice in the construction industry.

This topic induces a limitless variety of research questions that must be reduced to only a few, considering the scope and time limitations. Therefore, to fulfill the research objectives, three main research questions have been formulated based on the knowledge gaps and two variables: the author's interests and the availability of empirical data.

***Research question 1**: What are the characteristics of relational PDMs?*

The purpose of this research question is to explore the characteristics of the relational PDMs. To answer this research question, this study limits the scope to identifying the hard elements (as the most tangible component) of two specific models, namely partnering and alliance. This provides a groundwork for a better understanding of these concepts and thus builds a foundation for further investigation as to how different relational delivery models are practiced.

Research question 2*: *How are relational PDMs practiced in the construction industry?

The purpose of this research question is to study how different relational PDMs, namely partnering and alliance, are practiced in the construction industry. This research question concerns the presence in real-life projects of the hard components identified in RQ1. To answer this research question, this study explores and investigates the hard elements of partnering practiced in a broad range of projects in the Norwegian construction industry and the hard elements of alliance practiced in Australian infrastructure projects.

***Research question 3:** How and under what project characteristics should a client consider adopting a relational PDM?*

In many countries, there is increasing interest in and promotion of relational PDMs to avoid the adverse objectives and conflicts that have characterized the industry due to the use of traditional forms. While these countries are new to this concept, shifting from a traditional to a collaborative environment is not easy. Therefore, the purpose of this research question is twofold: first, to explore the project characteristics for which adopting a relational delivery model is a valid option and second, to develop a conceptual model to assist in the decision-making process in client organization.

1.3 Research scope and limitations

Although relational PDM has been studied within different contexts, the research focus in this Ph.D. work is exploring relational PDMs and their application in the *construction industry* within *building* and *infrastructure projects* from the *client's perspective*. As stated before, due to availability of the data, time limitations and the author's interests, the scope of this Ph.D. work is limited to investigating two relational PDMs, namely *Partnering* and *Alliance*. The scope can be divided into three parts. The first part concerns the characteristics of partnering and alliance, including a study of the tangible components (hard elements) of each model to develop a comprehensive list of elements for the two models. Exploring and investigating the soft elements of these models are excluded from the scope of this Ph.D. work. The second part includes the investigation of real-life case projects to understand how these two models are actually practiced

in the construction industry. For this part, the research was limited to case projects executed in two countries, Australian case projects for Alliance and, Norwegian case projects for Partnering. In the third part, after identifying the characteristics of projects for which employing a relational PDM is a valid option, this Ph.D. study suggests a conceptual model by considering the relevant factors that affect the choice of PDM to assist decision makers in the process of PDM adoption. This model focuses on the context around the implementation strategy which may affect the choice of a suitable PDM and alternative approaches which reflect the possibilities. It does *not* provide a decision support system or model in which information is inputted; and the model that then offers the "best choice" PDM to the user.

Since relational PDM is a relatively new concept in many countries and industries, by considering the availability and accessibility of data, the scope of this research is limited to a study of these models in northern European countries and Australia. Although the study of IPD in the United States was part of the initial scope, due to time limitations, it was removed from the final scope and is suggested as a direction for future work. Note that it is outside the scope of this study to compare and evaluate these delivery models against each other for achieving the desired outcomes, although a brief comparison of the structure of these two models is provided in Section 2.1.1.3.

1.5 Structure of the dissertation

This Ph.D. dissertation consists of two major parts: the body of thesis (Part I) and publications (Part II). Part I consists of five chapters that include the introduction, theoretical background, research methodology, key findings and discussion, and the overall conclusion (see Figure 1).

Figure 1 Structure of this Ph.D. Work

Chapter 1 is an introduction to the study that presents the background of the dissertation, research objectives and scope, and structure of the dissertation. In Chapter 2, background on the relevant key theoretical perspectives is provided. Chapter 3 presents the research design and methodology. Chapter 4 provides findings and discusses these as related to each research question. Chapter 5 closes Part I by presenting the overall conclusion, contributions to theory, the main implications for practice and suggestions for future research. Part II includes the 13 publications that were used in composing this Ph.D. dissertation. Table 1 is a list of publications, including authors and publication channel.

Table 1 Publications that form the research body of the dissertation

No	*Authors*	*Title*	*Conference/Journal*	*Publication channel & review policy*
1	Ali Hosseini, Paulos Abebe Wondimu, Ole Jonny Klakegg, Bjørn Andersen, Ola Lædre	Project partnering in the construction industry: practice vs. theory	Engineering Project Organization Journal	EPOJ Double-blind review
2	Brendan K Young, Ali Hosseini, Ola Lædre	What make an alliance an Alliance	Journal of Modern Project Management	JoMPM-Accepted Double-blind review
3	Paulos Abebe Wondimu, Ali Hosseini, Jardar Lohne, Ola Lædre	ECI approaches in public projects procurement	Journal of Public Procurement	JoPP-Accepted Double-blind review
4	Ali Hosseini, Amin Haddadi, Bjørn Andersen, Nils Olsson, Ola Lædre	Relational base contracts: needs and trends in Northern Europe	Projman2017	Procedia-Elsevier Double-blind review
5	Ali Hosseini, Ola Lædre, Bjørn Andersen, Olav Torp, Nils Olsson, Jardar Lohne	Selection criteria for delivery methods for infrastructure projects	IPMA 2015	Procedia-Elsevier Double-blind review
6	Ali Hosseini, Paulos Abebe Wondimu, Alessia Bellini, HenrikTune, Nikolai Haugseth, Bjørn Andersen, Ola Lædre	Project partnering in Norwegian construction industry	SBE 2016	Procedia-Elsevier Double-blind review
7	Brendan Young, Ali Hosseini, Ola Lædre	The characteristics of Australian infrastructure alliance projects	IGLC 2017	Conference proceedings Double-blind review
8	Brendan K Young, Ali Hosseini, Ola Lædre	Project alliances and lean construction principles	IGLC 2016	Conference proceedings Double-blind review
9	Young Brendan K, Ali Hosseini, Ola Lædre	A Comparison of Project Alliancing and Lean Construction	IGLC 2017	Conference proceedings Double-blind review
10	Jenny Wøien, Ali Hosseini, Ole Jonny Klakegg, Ola Lædre, Jardar Lohne	Partnering elements' importance for success in the Norwegian construction industry	SBE 2016	Procedia-Elsevier Double-blind review
11	Vegard Knotten, Ali Hosseini, Ole Jonny Klakegg	"Next Step": a new systematic approach to plan and execute AEC projects	CIB Congress 2016	Conference proceedings Double-blind review
12	Paulos Abebe Wondimu, Ali Hosseini, Jardar Lohne, Eyuell Hailemichael, Ola Lædre	Early contractor involvement in public infrastructure projects	IGLC 2016	Conference proceedings Double-blind review
13	Alessia Bellini, Wenche Aarseth, Ali Hosseini	Effective knowledge transfer in successful partnering projects	SBE 2016	Procedia-Elsevier Double-blind review

Chapter 2

2. Theoretical framework

It is well-known that significant research cannot be performed before understanding the literature in the particular field. According to Boote and Beile (2005), "to advance our collective understanding, a researcher or scholar needs to understand what has been done before, the strengths and weaknesses of existing studies, and what they might mean." According to Creswell (2013) qualitative inquirers use theory in their study in several ways, such as up-front explanation, as an end point or as an advocacy lens. Qualitative researchers in social science increasingly use a theoretical lenses or perspective to lead their research however this Ph.D. work comes from an engineering perspective and did not include an explicit theory lens and employed the theory as a broad up-front explanation much like quantitative research.

During the pilot study in the early phase of this Ph.D. work—as part of the cross-country analysis—I observed that relational delivery models and countries could somehow be grouped in two categories. In Sweden and Denmark, relational contracts seem to be more about attitude rather than formal contract regulations. In the UK, Finland and the Netherlands, relational contracts seem to be more dependent on formal contract regulations. Therefore, I selected two relational models, namely partnering (more about attitude than formal contract) and alliance (dependent on formal contract), for further investigation. The purpose of this chapter is to provide an understanding of PDMs, the concept of relational PDMs and, in particular, partnering and alliance, which were selected for study in this Ph.D. work. This study focuses on components of these models (i.e., hard/soft elements), which are elaborated in this section, as well as briefly discussing Early Involvement of Contractor (ECI) as the supporting skeleton of the relational PDM, and selection criteria and methods for adopting a suitable PDM.

2.1 Project delivery models

As stated earlier, Miller et al. (2000) provided a generic definition of PDM as "a system for organizing and financing design, construction, operations and maintenance activities that facilitates the delivery of a goods or service." Other terms can be found in the literature that refer to similar but slightly different concepts. Project execution models, as an example, seem to be synonymous but the choice of a model varies depending on whether the authors look at projects from the owner (client) side or from the executing (supplier) side (Klakegg 2017). Furthermore, other terms such as contract strategy, which, according to Wang et al. (1996), describe organizational and contractual policies regarding the delivery of a specific project, are used in the literature. Additionally, Kumaraswamy and Dissanayaka (1998) identified construction project procurement systems (contract strategy) as having four sub-systems: work packaging, type of contract, form of contract and selection methodologies. Both of these basically refer to the same four elements: award, organization, contract and scope/work package. Lædre (2006), however, divided contract strategy into eight elements: prequalification, award criteria, contracting method,

work description, delivery method, contract type, incentives and contract regulations. The latter definition covers the descriptions by Gordon, Kumaraswamy and Dissanayaka. To avoid any confusion, from this point on in the study, I use the term project delivery model (PDM), as suggested by Miller et al. (2000).

According to Klakegg (2017), the main components of a PDM are organization form, work breakdown, form of specification, procurement route, contract format, conflict resolution, risk sharing and payment format, with a clear reference to governance. Corporate governance offers an outline for managers' daily decision making (Muller 2011) and involves a set of relationships between a company's management its board and stakeholders (Morris 2002) while project-level governance is often applied through specified roles and responsibilities, policies and procedures, which establish the outline for people's behavior (Muller 2011).

The CII has stated that all PDMs can be placed into three fundamental PDM categories: DBB, DB and CM (Sanvido and Konchar 1998). A classification of PDMs inspired by a very recent Project Management Institute (PMI) book (Walker & Lloyd-Walker, 2015) is presented below:

Segregated forms: A key feature of delivery models in this group is the trend toward the separation of design and construction/delivery. Segregated forms include well-known traditional approaches. The dominant segregated form of delivery, which is used in most countries, is DBB, in which the owner receives bids and awards the construction contract based on the finished designer's construction document. In this model, it is assumed that the project design is sufficiently complete to enable a bidding process to establish the cheapest and/or quickest tender cost. It also assumes that the price of design variations encountered throughout the delivery process will not be excessive (Masterman 1992, Rizk and Fouad 2007, Sanvido and Konchar 1998). The advantage of segregated forms, which is the key reason for selecting this delivery model in many organizations, theoretically lies with market contestability for the lowest cost (bid) combined with the shortest time. Another example of forms in this group is cost reimbursement (Cost-Plus).

Integrated forms: Integrated delivery models to some extent involve either a physically or contractually integrated design and delivery process. A key characteristic of this type of delivery forms is that the planning and control logic that drives the project and the confidence that integration is mainly accomplished through planning and control systems. Some of the delivery models in this group are: Design and Construct (D&C), Management contracting (MC/CM), joint venture consortia, and BOOT (Build, Own, Operate and Transfer) family procurement approaches (Private Finance Initiative (PFI), Public Private Partnership (PPP)). The most recognized model in this cluster is D&C, where one entity, typically called a design-builder, is contractually responsible for producing the design and performing the construction service. It integrates the design and delivery functions through either an integrated firm mechanism, which has in-house design and delivery teams, or the outsourcing of the design by the delivery organization to another team, which becomes the design services provider (Molenaar and Songer 1998, Molenaar et al.

1999, Rizk and Fouad 2007). In all integrated models, the main focus is on integrating design and delivery processes by emphasizing planning and control. While this does not eradicate the importance of collaboration and people management, it does indicate the weight of systems integration through planning and control.

Collective forms: In this cluster, the focus is on integrating the project design and delivery teams rather than the process, by highlighting collaboration and coordination. Collaborative/relational delivery models like Partnering, IPD, Delivery Consortia/Partner (DC/P), Competitive Dialogue (CD) and Alliancing are part of this group. Collective forms provide a framework for establishing mutual objectives among all parties involved. Normally, this also leads to developing an agreed-upon dispute resolution system. Collective forms require strong team-building skills among participants. Compared to other traditional models, these forms require a different paradigm than highly commercial, winner-gets-all and adversarial relations between involved parties. In collective forms, the project owner not only engages with designers but also collaborates from the initial stage of the project with contractors and possibly significant subcontractors. Collective forms are mainly characterized by collaboration, transparency, innovation and accountability.

2.1.1 Relational project delivery model

According to Haddadi et al. (2016), value creation in a construction project depends on three main stakeholders: i) the owner, ii) the suppliers and iii) the users. The owner's prerequisite to create value is can be summarized as the profitable/optimal operation of the building and fulfilment of customers' needs. Suppliers are required to minimize waste (non-value-creating activities) and fulfill customers' (owner and user) needs to create value in the final product. The ultimate objective of the project should be to fulfill users' needs to increase the "customer's perceived value".

As projects become more complex and uncertain (Azari et al. 2014), eliminating waste and non-value-creating activities such as disputes over processing, rework and incidents is more challenging. On the other hand, meeting customers' needs in such projects may result in the desire for delivery models that can face different challenges caused by complexity and uncertainty. In complex projects, changes can occur during the course that have to be managed through contracts in an efficient way (Kadefors 2004). According to Ng et al. (2002), the use of transactional delivery models inhibits flexibility.

Given the nature of today's construction projects as a very high risk, complex, uncertain, multiparty business, conflicts between the diverse participants need to be minimized through better relationships and cooperative teamwork (Dissanayaka and Kumaraswamy 1999). In order to create this type of collaboration, a relationship based on trust between the actors must be established. The literature argues that improving/developing such relationships and teamwork can be achieved through relational PDMs (also known as relationship base procurement or relational contracts) such as alliancing, joint venture, public-private partnership, partnering and IPD (Lahdenperä 2012, Rahman and Kumaraswamy 2002). A primary ambition of relational PDM is

to avoid the adverse objectives and conflicts that have characterized the industry for too long (Ling et al. 2006). According to Macneil (1982), relational contracting (relational PDM) encourages long-term provisions and mutual future planning and introduces a degree of flexibility into contracts by considering a contract to be a relationship among the parties. As indicated in Figure 2, it is frequently assumed that a low level of collaboration is associated with highly transactional contracts.

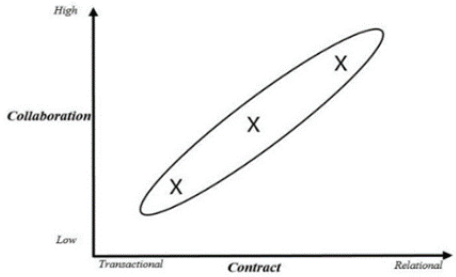

Figure 2 Relationship between type of contract and degree of collaboration that is typically assumed in the literature (Hosseini et al. 2017)

Relational PDMs are structured on the acknowledgement of win-win scenarios and mutual benefits through more cooperative relationships between the parties (Rahman and Kumaraswamy 2002, Alsagoff and McDermott 1994, Ross 2003). According to Rahman and Kumaraswamy (2002), Macneil (1973) stressed that relational arrangements consider contracts as the "ongoing dynamic state" of relations among the contracting parties in the process of projecting "exchange" into the future.

Relational PDMs can intervene with traditional distribution of roles and risk between client and supplier. They can be signed in different project phases and frequently include nontraditional distribution of roles and risk. According to Walker (2015), there are several aspects in contractual relations and project execution models, some of which can be summarized on a scale from high to low such as complexity and uncertainty. Relational models typically have a high level of several of these aspects, as indicated by the right side of Figure 3.

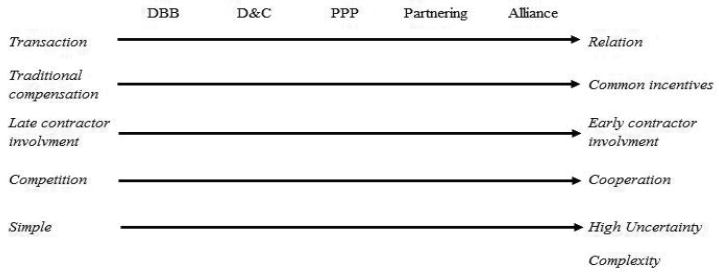

Figure 3 An example of aspects that vary between transactional and relational contracts (Hosseini et al. 2017)

As stated in Section 1.3, this study aims to investigate two relational delivery models, namely partnering and alliance. In this context, it should be noted that both partnering and alliancing can be defined as relational PDMs, in which the client and contractor usually collaborate through informal or formal agreements, including the establishment of trusted-based relationships to achieve common objectives (Lahdenperä 2012). Marcus et al. (2014) stated that Derek et al. (2002) indicated that alliancing is more "all embracing" than partnering. Consequently, alliancing is placed farther to the right than partnering in Figure 3. In the following section, these two models are elaborated.

2.1.1.1 Partnering

What is Partnering?

As one of the institutional forms of collaborative relationship (Rahman and Kumaraswamy 2002, Rowlinson and Cheung 2004, Colledge 2005, Cheung et al. 2006), partnering essentially focuses on improving cooperation within existing frameworks. Partnering is separated from alliancing and IPD because it is a more conservative approach (Walker et al. 2002b, Walker and Hampson 2008). Despite partnering, Alliancing and IPD are typically more explicitly incorporated into the contractual structure and can thus be seen as *independent* contract models. One of the first definitions of partnering was provided by the CII in 1991:

> A long-term commitment by two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organization boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost-effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services (CII 1991).

The popularity of partnering (Hong et al. 2011, Black et al. 2000) has grown in response to the adversarial culture and high levels of conflict typically associated with the construction industry (Eriksson 2008a). Since construction projects often experience scope creep, partnering has been found to be a well-suited method to keep costs low and schedules in line. By focusing on

relationships rather than transactions, partnering facilitates increased efficiency, avoids conflicts and eliminates adversarial relationships (Naoum 2003, Chan et al. 2010).

Despite thoroughly studying the concept for the last few decades, the literature still presents no commonly shared definition of partnering. Many researchers have tried to establish a common definition of the concept, but it has proven difficult due to its ambiguous characteristics (Nyström 2005, Eriksson 2010, Aarseth et al. 2012). According to Saad et al. (2002), partnering is largely misapprehended without a unified definition, which results in major problems for successful implementation (Chan et al. 2003, Glagola and Sheedy 2002). In-depth knowledge and understanding of the partnering concept are essential to creating successful collaboration. According to Chan et al. (2003), limited knowledge and experience in the partnering concept can influence project contributors' understanding of partnership, which could result in the failure of a project.

There are many references in the literature to partnering; Table 2 presents a collection of some of the most-cited descriptions. Many authors have developed their contributions to the concept with the aim of providing a mature, widely accepted definition of partnering. Some studies have proven to be overly broad and generic and do not give the reader a deeper insight into the issues, while others have focused on analysis of partnering details and elements for effective implementation. Some definitions consider partnering to be a process while others see it as a means to build trust and develop good working relationships in a project. This diversity in definitions of partnering may have arisen from the authors' different goals when implementing partnering. For example, Cheung et al. (2003a) listed shared risk, reduced litigation, innovation and increased efficiency as the purposes for his partnering model, which defined partnering as an attempt to enable non-adversarial working relationships.

Despite all of these efforts, a clear, general definition of the concept is still missing (Eriksson 2010). The absence of a consensus on partnering, together with an insufficient understanding of practice development, could increase the complexity for further study and represents a challenge for effective partnering implementation (Bygballe et al. 2010).

Table 2 Partnering Descriptions

Authors	***Description***
Bennett (1995)	A management approach used to achieve business value and increase the efficiency of the construction industry.
Black et al. (2000)	For the creation of effective working relationships.
Børve et al. (2017)	A relationship strategy between major contributors.
Chan et al. (2003)	A framework for improving working relationships between project participants.
Chan et al. (2010)	A process to encourage good working relationships based on commitment, trust, and communication.
Cheung et al. (2003a)	An attempt to enable non-adversarial working relationships.

Cheung et al. (2003b)	A project management approach to improve performance through effective working relationships.
Eriksson (2010)	Cooperative governance based on cooperative procedures in order to facilitate cooperation.
Larson (1995)	Cooperative relationships that enable the creation of a project team with a single set of goals and procedures based on collaboration, trust openness and respect.
Larson (1997)	Formal management designed to overcome adversarial relationships in projects.
Lu and Yan (2007)	A process, initiated at the outset of a project, that is based on mutual objectives and specific tools (workshops, project charter, conflict resolution techniques and continuous improvement techniques).
Naoum (2003)	A framework based on trust, cooperation and teamwork.
Nyström (2005)	Trust and mutual understanding, as the most important components of partnering, define this concept.
Thomas and Thomas (2008)	An integrated teamwork approach that could lead to the creation of value in projects.
Yeung et al. (2007)	Defined by soft components (trust, commitment, cooperation and communication) and hard components (formal components and gain-share/pain-share).

According to Eriksson (2010), the definitions of partnering can be divided into four types. The first type is generic and simple definitions, such as the way Chan et al. (2003) defined the concept. The second type is developed based on defined purposes and the means to achieve them, such as Cheung et al. (2003a) partnering model description. The third type of definition uses Wittgenstein's family-resemblance concept to define partnering based on seizing the core of partnering through focusing on the components of partnering (Nyström 2005, Yeung et al. 2007). The second and third groups of definitions have much in common and although the third group is more comprehensive, both share a similar negative characteristic: they mix apples (procedure) and oranges (outcomes) (Eriksson 2010). The fourth type uses the theoretical aspect of the third group without considering the outcomes. The definition of partnering by Lu and Yan (2007) fits in the last group because it is focused on the partnering procedure rather than philosophy (involving trust and commitment). According to Eriksson (2010), although the fourth type is the most useful definition so far, it still suffers from the lack of a comprehensive list of components. These definitions suggest the need for deeper insight into the partnering component to define the concept.

Obtaining benefits from an operative collaboration in projects is not always easy (Chan et al. 2003, Ng et al. 2002, Wøien et al. 2016). Accordingly, Cowan et al. (1992) underlined that adopting partnering in projects can be hard work; therefore, the advantages might not always be achieved. Changing traditional habits and building a collaborative environment in projects requires significant preparation and commitment from all participants. Many authors, such as Naoum (2003) and Yeung et al. (2007), concur that the absence of a standard agreement constitutes the first issue for partnering implementation. Moreover, Eriksson (2010) argued that without a consensus on partnering, confusion and ambiguity could arise between project participants. If this occurs, cooperation between the parties, and consequently the benefits of that cooperation, will be difficult to achieve.

In the following section, partnering components from the literature are presented, and the Eriksson model is elaborated.

Partnering elements

Analyzing the literature on partnering reveals that while some authors use similar phrasing, others emphasize that the creation of collaborative working relationships depends on the presence of specific elements. For instance, Larson (1995) formulated a definition of partnering that includes a list of success elements such as collaboration, trust, openness and mutual respect. More recently, authors such as Chan et al. (2010), Naoum (2003), Nyström (2005), Lu and Yan (2007) and Yeung et al. (2007) have investigated the relevant elements of partnering. These study results demonstrate that to fully understand this concept, a partnering definition cannot be separated from the presented elements. Table 3 shows a sample of partnering elements identified from the literature.

Table 3. Partnering Elements in the Literature

Element	*Eriksson (2010)*	*Bennett (1995)*	*Bygballe et al. (2010)*	*Nyström (2007)*	*Kadefors (2004)*	*Larson (1995)*	*Naoum (2003)*	*Ng et al. (2002)*	*Yeung et al. (2007)*
Trust	X	X	X	X	X	X	X	X	X
Common Understanding		X	X	X	X	X		X	
Collaborative Contractual Clauses	X							X	X
Early Involvement of Suppliers	X		X					X	X
Incentives/ Pain/Gain Share	X			X	X		X		
Common Goals	X	X			X	X	X	X	X
Team-Building Activities	X	X	X	X	X	X			
Structured Meeting/Workshop	X	X		X	X				X
Facilitator	X	X		X				X	
Committed Participants		X		X				X	X
Conflict Resolution	X	X		X	X	X	X	X	X
Open and Effective Communication		X		X		X		X	X
Open-Book Economy	X								
Continuous Improvement							X		X

Continuous Joint Evaluation	X

As presented in Table 3, some elements, such as trust, common understanding and conflict resolution mechanisms, are identified by the majority of authors as important elements of partnering. Moreover, according to Eriksson (2010), elements of partnering can be further classified as core and optional components, as illustrated in Table 4. Eriksson believes that elements such as an open-book economy, workshops, common goals, team building and conflict resolution mechanisms should be clustered as core components due to their role in the creation of a collaborative environment in projects. Table 4 illustrates that not all elements are equally important according to Eriksson.

Table 4. Core and Optional Components of Partnering (Eriksson 2010)

Core components of partnering	***Optional components of partnering***
Bid evaluation based on soft parameters	Early involvement of contractors
Compensation form based on open books	Limited bid invitation
Use of core collaborative tools (start-up workshops, joint objectives, follow-up workshops, team building, conflict resolution techniques)	Joint selection and involvement of subcontractors in broad partnering team
	Collaborative contractual clauses
	Compensation form, including incentives based on group performance
	Use of optional collaborative tools (partnering questionnaires, facilitator, joint risk management, joint project office, joint IT tools)
	Increased focus on contractor self-control coupled with limited end inspections

Additionally, Bygballe et al. (2010) emphasized the importance of establishing long-term relationships in partnering to ensure the creation of trust, common objectives and commitment between participants. However, the effective development of long-term relationships requires the presence of both soft (relational) and hard (contractual) elements in a strategic perspective.

2.1.1.2 Alliancing

What is Alliancing?

The project alliance is a PDM that has become increasingly popular in recent years as an alternative to both traditional and other forms of relational contracts. As projects become larger and more complicated and pressure from various stakeholders increases (Sakal 2005), alliancing is proving to be a valuable tool for dealing with these challenges. It is currently a well-established model in just a few countries but is beginning to gain traction, with more countries exploring its use. After originating in the UK (Ross 2009), it became a booming success in Australia. Experience in Australia has shown by example that there are alternative methods to delivering projects that allow a move away from the often adversarial, traditional PDMs.

An alliance, in a general sense, is a broad term and is used in many industries and contexts, for example, a trade alliance between two or more countries. Project alliancing, as a PDM, is yet to be commonly defined at an international level (Chen et al. 2010, Yeung et al. 2007). In the construction industry, inconsistency can be created due to these two uses of the term alliance. This lack of consistency has created a confusing situation (Hauck et al. 2004). This problem is compounded by the lack of a clear understanding of what exactly makes a project alliance an alliance. For example, in some cases within the construction industry, "partnering" and alliancing are often used interchangeably despite being fundamentally different models (Chen et al. 2010, Ingirige and Sexton 2006, Rowlinson and Cheung 2004). Combined with the lack of a commonly established, global alliancing definition, it appears that the body of knowledge is also missing a clear breakdown of what elements make up an alliance.

Alliancing requires a large investment in resources, so it is important to ensure that the outcomes of using the model are successful. Jefferies et al. (2014, p. 466) identified that "there is a clear gap in Project Alliancing, particularly with regards to identifying factors for its successful implementation in the Australian construction industry." Due to its structure, alliancing is particularly well-suited to certain projects and not others. Selecting alliancing for the right projects is the first step to ensuring successful outcomes.

Alliancing developed out of the need and desire to improve on, and overcome, the adversarial nature and negative impacts associated with the more traditional forms of project delivery, namely DBB and D&C contracts (Walker et al. 2015, Laan et al. 2011). Alliancing often falls under the umbrella of relationship contracting (Walker et al. 2013, Henneveld 2006); however, in recent years, it is beginning to be placed into its own unique category (Chen et al. 2010, Lahdenperä 2012).

Alliancing is a collaboration between the client, service providers and contractors in which they share and manage the risks of a project together (Chen et al. 2010, Lloyd-walker et al. 2014). All parties' expectations and commercial arrangements are aligned with the project outcomes, and the project is driven by a best-for-project mindset, where all parties either win together or lose together (Walker et al. 2013, Chen et al. 2012). The contract is designed around a non-adversarial legal and commercial framework, with all disputes and conflicts resolved from within the alliance (Henneveld 2006, Lloyd-walker et al. 2014).

This type of project delivery can lead to improved project outcomes and value for money, in part due to the increased level of integration and cooperation between planners, design teams, contractors and operators (Love et al. 2010a, Walker and Lloyd-Walker 2016).

The most widely accepted definition of alliancing in the literature comes from the Australian Department of Finance and Treasury Victoria (Department of Treasury and Finance 2010) which describes alliancing as:

> … a method of procuring … [where] All parties are required to work together in good faith, acting with integrity and making best-for-project decisions.

> Working as an integrated, collaborative team, they make unanimous decisions on all key project delivery issues. Alliance agreements are premised on joint management of risk for project delivery. All parties jointly manage that risk within the terms of an 'alliance agreement', and share the outcomes of the project (p. 9).

The majority of the literature after 2010 refers to this definition when discussing alliancing and does not contribute anything additional of significance (Walker et al. 2015, Chen et al. 2012, Lahdenperä 2012, Walker et al. 2013).

The above definition more recently became accepted in Australia at the national level with the publication of the National Alliance Contracting Policy and Guidelines (Department of Infrastructure and Transport 2011). This document was updated in 2015, with the same definition retained (Department of Infrastructure and Transport 2015), demonstrating that there is consistency within the Australian government of the definition of alliancing. However, this guide does not provide a clear breakdown of the tangible elements that characterize alliancing.

Some studies include definitions that the industry is moving away from. Such definitions include alliancing under the relationship-delivery umbrella, as opposed to defining it in a category of its own. Other definitions compare it extremely closely to partnering (Scheublin 2001), which can lead to the confusion that this research is attempting to prevent. In the following section, similarities and differences between these two models are presented.

2.1.1.3 Alliance vs. Partnering

As stated in Section 1.3, this study aims to investigate two relational delivery models, namely partnering and alliance. According to Lahdenperä (2012), the practice of partnering has evolved, and a new contractual practice has developed today. The Latham Report discussed partnering as a broad term used to describe a collaborative management approach that encourages openness and trust between the parties of a contract (Latham 1994). Drouin (2012) also provided definitions of two categories of partnering—project partnering and strategic partnering; the same categorization exists for alliancing (Ross 2003). The former (project partnering/alliance) aims to improve performance over the life cycle of a single project, and the team usually dissolves after completion of the project. The latter (strategic partnering/alliance) focuses on obtaining a competitive advantage over the long term to foster long-term relationships (Ross 2003).

On the other hand, project alliancing is built on the notion of partnering. Alliancing is a relational PDM and typically involves open-book accounting sharing the risk setting, with the initial target cost generated by the joint project team (Sakal 2005). An alliance agreement defines the targets as well as the risk and reward mechanisms and the interrelationship of different contractors (Halman and Braks 1999).

Partnering and alliancing share the intentions of a win-win game and sharing risk. However, the distinction between them today is not clear (Lahdenperä 2012). While there is no universally

agreed-upon definition of partnering (Hosseini et al. 2016, Wøien et al. 2016), the two terms are used interchangeably, which may cause confusion (Winch 2012).

In the early days of alliancing, project alliances (PA) shared many more similarities with project partnering (PP) than is the case today. It is noteworthy to consider that different variations of partnering existed in the industry, as elaborated in Section 2.1.1.1. PA and PP were previously used almost interchangeably before PA evolved over time away from PP (Ingirige and Sexton 2006). PP and PA continue to share similar elements today, for example, they both aim to improve cooperation, they both have a target cost with bonus/malus (in PA known as pain/gain), and they both employ an open-book approach (Haugseth 2014). The biggest difference today is that PP is not a stand-alone contract strategy and is generally adopted in addition to traditional contracts such as DBB or D&C (Lahdenperä 2012, Yeung et al. 2007, Ross 2004, Hauck et al. 2004, Morwood et al. 2008), whereas PA is a built-for-purpose, stand-alone contract strategy. Furthermore, partnering does not adopt the alliancing principle of win-win/lose-lose in the same way as alliancing; in PP, the partners remain independent within the partnership and thus there is the possibility for some partners to lose while others win and vice versa (Chen et al. 2012, Yeung et al. 2007, Hauck et al. 2004, Lloyd-walker et al. 2014).

According to Derek et al. (2002) substantial differences exist between alliancing and partnering in terms of the management structure, selection process and the nature of risk and reward incentives. Furthermore, he stated that in partnering, partners may gain rewards at the expense of other partners while in alliancing, the commercial outcome for all partners relies on the overall achievement of the project. According to Lahdenperä (2012), these discrepancies between partnering and alliance are the result of definitive differences underlying alliancing's joint organization, which involves the PO and other partners, who have no clear roles and accountabilities established, which is different from partnering.

Further, another PDM known as IPD that is used mostly in the United States has many similarities to Australian alliancing and variation of partnering, with one major difference being that IPD incorporates a number of lean construction elements (Raisbeck et al. 2010, Lahdenperä 2012). Use of IPD is mostly concentrated in the United States, yet the principles of lean are more prevalent worldwide. Alliancing is often considered at the top end of collaborative and relational contracting (Ross 2003) and is more widely distributed globally (Ingirige and Sexton 2006, Chen et al. 2012). One view is that IPD is created by combining the alliancing governance system with the lean construction operating system (Raisbeck et al. 2010).

2.2 Hard elements vs. soft elements

The literature on managing projects differentiates between hard and soft elements (Yeung et al. 2007, Fotopoulos and Psomas 2009). Elements that are directly regulated by the contract or have their basis in the procurement process are considered hard elements. Those that contribute to the relationship between the people in the project are soft elements (Yeung et al. 2007). Having a pain/gain sharing mechanism and the use of a legally binding partnering charter are examples of

important hard elements. Trust, communication, long-term commitment and cooperation comprise the most important soft elements (Eriksson 2010). In some cases, hard contractual elements and soft elements overlap, such as conducting a start-up workshop and working together to develop mutual objectives (Yeung et al. 2007). Table 5 presents a sample list of soft elements.

Table 5. Examples of Soft Elements (Wøien et al. 2016)

Soft Element	*Comments*
Clients' ability to make decisions	Decisions should be made at the lowest operational level for quick clarification and decision making.
Mutual objectives	Includes mutual success criteria and respect for individual objectives.
Trust	Includes openness. It is important that project managers do not have hidden agendas and start litigation processes. Trust must be given unconditionally by the client and lived up to by contractor.
Commitment	Both project participants and top management must show commitment to the project and the established goals. Long-term commitment between client and contractor is desired (Yeung et al. 2007) but is not possible for public clients.
Competence	Partnering competence is vital to establish trust in the project. Success depends on the understanding of the concept of partnering. Construction competence is also important with a view to making the right decisions and choosing the right design.
Communication	Good communication skills and open communication channels. Disputes and conflicts should be solved at the lowest possible organizational level and handled when they occur.

Some elements can be both soft and hard, such as volunteer group composition and mutual objectives (Yeung et al. 2007). Another point to note is that in some cases, hard elements such as workshops force participants to implement soft elements, thereby achieving greater effects.

2.3 PDM selection criteria and selection method

In many cases, the PDM is simply chosen on basis of the knowledge and experiences of in-house experts and/or guidance received from external consultants (Masterman and Duff 1994) without a deep exploration of the strengths and weaknesses of each method, or any regard to the influencing success factors and characteristics of individual projects.

With projects becoming more complex and with the large number of project success factors, there is a need to select suitable PDMs using a more systematic approach. Much research has already been done to identify the criteria that influence PDM selection, but studies have focused on proposing a selection method rather than the criteria themselves (see Table 6).

The selection of an appropriate PDM is the basis of success in every construction project and has never been an easy job due to the characteristics of delivery models. Besides the availability of several PDMs, each varies in several aspects. A PDM that will lead some projects to success may lead others to failure under different circumstances and thus one PDM does not fit all projects. The PDM selection process requires consideration and analysis of different complex and dynamic factors, which can be categorized into three groups: client objectives, project characteristics and external environment (Alhazmi and McCaffer 2000, Luu et al. 2003a).

As mentioned earlier, researchers have pointed out that the suitability of the selected PDM influences project success and is a driving force for developing several PDM selection methods. Examples of PDM selection methods are shown in Table 6:

Table 6 PDM Selection Methods

PDM Selection Method	*Reference*	*PDM Selection Method*	*Reference*
Multivariate analysis	(Chan et al. 2001)	Decision support system	(Kumaraswamy and Dissanayaka 2001)
Selection matrix	(Tran et al. 2013)	Fuzzy multi-attribute decision making	(Mostafavi and Karamouz 2010)
Multicriteria/multiscreening	(Alhazmi and McCaffer 2000)	Analytical hierarchy process	(Al Khalil 2002, Mahdi and Alreshaid 2005)
DEA-bound variable (BND)	(Chen et al. 2011)	Artificial neural network (ANN)	(Ling and Liu 2004)

While these methods meet most of the initial objectives for adoption as a selection method, according to Love et al. (2008), they usually fail to consider collectively the implicit interrelationships between the various procurement selection criteria. The first step in selecting a PDM is to establish the procurement selection criteria (PSC) and interrelationship between the criteria (Love et al. 2008). The PSC should mirror clients' requirements, the project characteristics and the external environment (Kumaraswamy and Dissanayaka 2001). As Kumaraswamy and Dissanayaka (1998) stated, the PSC should be used preliminarily as a guide to assist decision makers with evaluating the attributes of a particular PDM. However, it cannot be the sole basis for selecting a PDM due to the intricacy of matching a PDM with clients' requirements, the project characteristics and other relevant factors such as the market situation. The National Economic Development Organization (NEDO 1985) outlined nine generic criteria for the public sector to priorities their projects: *time, certainty of time, certainty of cost, price competition, flexibility, complexity, quality, responsibility and risk.* In the last few decades, several studies have used the NEDO criteria, or a modified version, to develop a PDM selection model. However, Luu et al. (2003b) believe that the use of a limited version of PSC, like that identified by NEDO (1985), may cause weaknesses in selection methods used to choose the most appropriate PDM for projects. This indicates the need for a comprehensive list of PSCs. This section emphasizes the importance of using the selection criteria based on a project and its context prior to selecting a PDM.

2.4 ECI in relational delivery models

What is ECI?

Early Involvement of Contractors (ECI) plays a significant role in delivering a project with desirable outcomes. According to Walker and Lloyd-Walker (2012), the increasing attention to the front-end of construction projects in recent years has triggered the development of relational PDMs in which a contractor's expertise and advice (involvement) are considered much earlier in the project lifecycle. ECI contributes to better relationships, increases understanding among parties and decreases the potential for adversarial relationships. These beneficial factors of ECI stem from the fact that the approach demands frequent interaction and communication. This close interaction and communication lead to the development of shared goals and objectives that in turn build cooperative relationships (Rahman and Alhassan 2012, Scheepbouwer and Humphries

2011). These arguments indicate the importance of ECI in developing the skeleton of a relational PDM. In line with the categorization outlined in Section 2.1, Walker and Lloyd-Walker (2015) stressed that by increasing the focus on committed relationships, a notional increase in early contractor involvement is expected (see Figure 4). By considering the discussed aspects, this study aims to identify different approaches for implementing ECI.

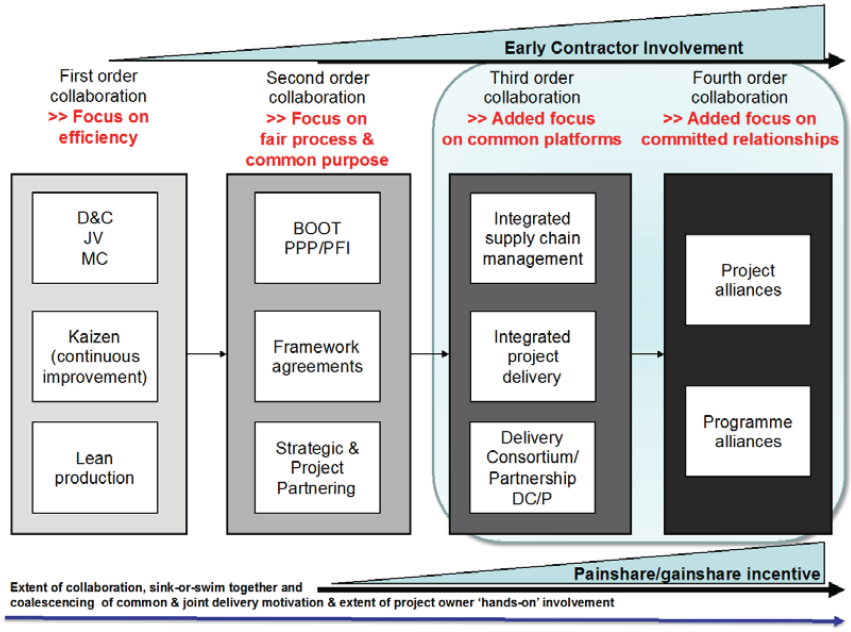

Figure 4 Four Orders of Collaboration and the Extent of ECI across Them (Walker and Lloyd-Walker 2015)

Different terms have been used for the ECI (Turner and Riding 2015). It has also been associated with popular terms such as early supplier involvement and supply chain management (Lenferink et al. 2012). The main idea of ECI involves the competence of a contractor in the early stage of a project. Through teamwork with owners and consultants, contractors contribute construction knowledge during early processes (Scheepbouwer and Humphries 2011, Song et al. 2009). Direct and early involvement of the contractor in the front-end phase increases the benefits of ECI. Better cooperation can be facilitated by direct involvement while better contribution can be facilitated by early involvement (Song et al. 2009).

The main goals of ECI are to facilitate innovation, improve project control and reduce time to completion (Lenferink et al. 2012, Van Valkenburg et al. 2008, Mosey 2009). Furthermore, the literature has discussed several advantages of ECI, including improved constructability, increased product information, better profitability and feasibility analyses, better communication, better risk management and better construction plans (Sødal et al. 2014).

Walker and Lloyd-Walker (2012) developed a model that illustrates the various ECI models. Figure 5 illustrates how ECI occurs in each the phase of the project lifecycle, namely in the internal, project definition and design, and project execution phases.

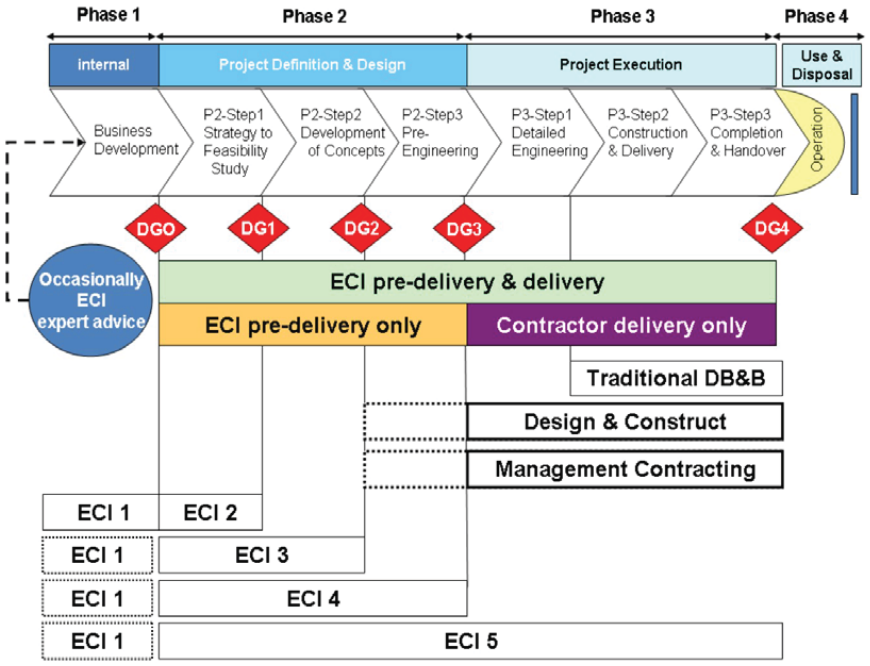

Figure 5 Project Life Cycle Phases and ECI

DG denotes to decision gates: DG0=formally recognized idea, DG1=acceptable initiative to investigate, DG2=choice of concept, DG3=go/no go, DG4=accept outputs for the operation phase: (Walker and Lloyd-Walker 2012) adapted from (Klakegg et al. 2010).

According Walker and Lloyd-Walker (2012), ECI can start in the internal or business development phase and can last until the project completion and handover phase (see Figure 5). They further divide ECI into five models depending on which phase of the project contractor involvement occurs. Their conclusion is that ECI can be implemented through a range of approaches such as traditional DBB, DB, management contracting, project partnering and project alliancing (Walker and Lloyd-Walker 2012).

Different owners have developed different ECI models based on their needs and circumstances. Some owners have developed relationship-based ECI models for the whole life cycle of a project. Other owners have developed hybrid models. In this type of ECI model, the contract starts with a collaborative approach in the early phase of a project and moves to a conventional type of contract in the project execution phase (Rahmani et al. 2013).

Summary

This chapter outlines a review of the research and literature related to the scope of this Ph.D. work. The major aspects relevant to this study discussed in this chapter are:

- PDM, particularly relational PDM.
- Partnering and alliance, a quick review of these concepts, their similarities and differences, and an introduction to hard and soft elements.
- PDM selection criteria and their importance in the selection process.
- ECI and its importance and benefits in developing cooperative relationships.

This literature review highlights the importance of optimal selection of PDM to fulfill clients' need and objectives. Given this, and considering the nature of today's construction projects as high risk, uncertain and complex phenomenon, relational PDMs can represent a suitable solution.

In the course of this literature review, the author came to understand that although some types of relational contracts such as partnering have been practiced for decades, there are discrepancies regarding what these concepts really are. It was also revealed that a full understanding and, consequently, the successful implementation of these concepts are not possible without studying their components.

In the following chapter, the methodology and research design applied for answering the research questions are presented.

Chapter 3

3. Methodology and research design

Although the scholarly literature suggests a wide range of definitions and descriptions of research, the understanding of it is quite unified. Research is about systematically acquiring and analyzing data to fill a knowledge deficit in a particular topic. The process of answering a question or addressing a problem in the course of research is often characterized as "meeting the research aim" or "addressing the research objectives" (Saunders et al. 2009).

To determine the objectives of the research, one must be able to answer the "why" or "how" problems that are associated with a topic. It is important to provide strong justification as to why a topic is important to a particular field. A research objective can also be produced by the expected effect the research will have on its prospective audience.

One of the major aspects that needs significant consideration from the researcher is the choice of methodology, which is the way the research problem is systematically solved (Kothari, 2004). Several factors assert influence over the choice of research methodology, including research question type, the level of control over a behavioral event, the amount of focus on contemporary issues (Yin 2015) as well as the extent of uncertainty surrounding the topic (Zikmund, 1991). However, the factors listed above are not the only determinants in choosing the methodology. According to Holden and Lynch (2004), choosing a research methodology includes something much deeper than practicalities. Subjective and objective theoretical influences as well as ontology (reality) and epistemology (knowledge) should be considered. These philosophical dimensions and an overview of the methodology used in this Ph.D. work presented in this chapter.

3.1 Research design

This work was carried out by developing the following four areas (see Figure 6): research proposal, research strategy and methodology, individual publications and the dissertation. These four phases can be translated into the nine-step research design outlined in Figure 7.

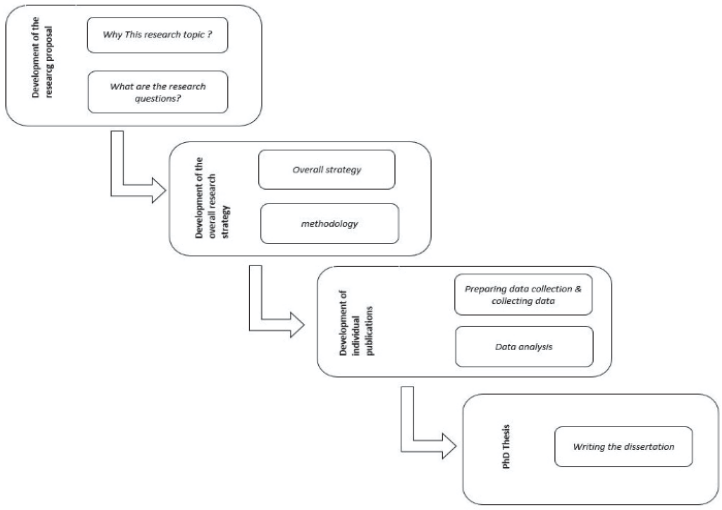

Figure 6 Four Phases of This Ph.D. Work

The development of the proposal began with a background study and the initial identification of research gaps, as well as the initial formulation of research questions (Steps 1 and 2 in Figure 7). The research questions were modified based on the findings of each stage as the research proceeded. In the second phase, the overall strategy of the research was defined (Step 3). The objectives were chosen based on the identified research gaps, the author's personal interest, and available resources (e.g., data from case companies). The objectives provided the basis for development of individual publications (Steps 4 to 7). The individual publications were developed according to the research scope outlined in Section 1.3.

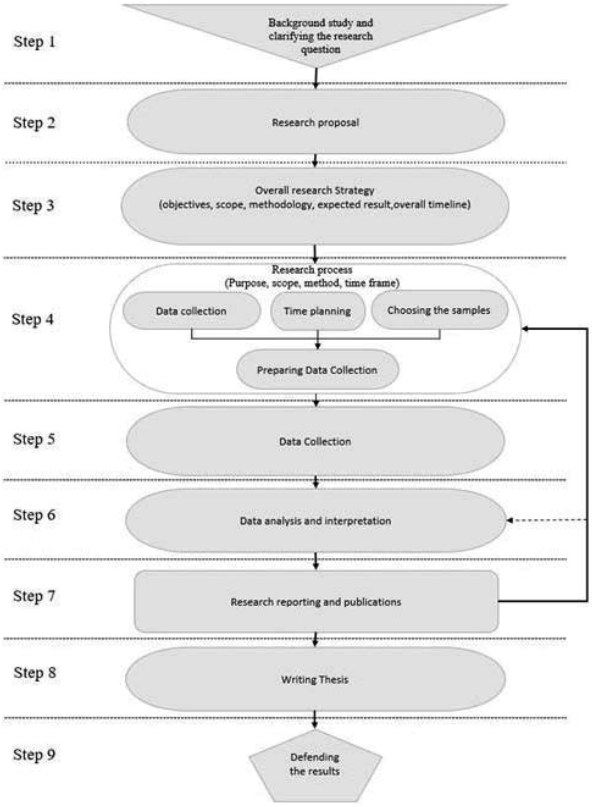

Figure 7 Overall Research Design (freely adopted from (Blumberg et al. 2014))

Following this research design, this Ph.D. work resulted in 18 publications during three years of study. It should be noted that the published journal articles and conference articles have been subjected to extensive peer review and were revised based on the reviewers' comments before acceptance. However, this dissertation is more than the sum of the individual publications. The discussion section provides a synthesis of the individual publications and how the research as a whole contributes to the body of knowledge. This large number of publications is the outcome of a tactic in which master's students were involved in the data collection process and I played an active role in other phases of the research, including literature selection, research design, preparation of interview guides, data analysis, drawing conclusions from the results, and contributing in the actual act of data collection in Publications 2, 4, 5, 7, 8 and 9. This strategy was selected after discussion and consultation with supervisors to increase the amount of collected data and increase the validity and reliability of the data through dividing the research into smaller work packages and triangulation of the methods. Of the resulting publication, 13 were used in writing this dissertation. A list of publications with authors' name and my contribution is presented in Table 7.

Table 7 List of Publications Produced in This Ph.D. work

	Authors	***Paper Title***	***Contribution/Role in Preparing the Paper***
1	Ali Hosseini, Paulos Abebe Wondimu, Ole Jonny Klakegg, Bjørn Andersen, Ola Lædre	Project partnering in the construction industry: practice vs. theory	First author Developing the idea of the paper, designing the research, leading the discussions, and drawing the conclusions together with my fellow researchers
2	Brendan K Young, Ali Hosseini, Ole Jonny Klakegg, Ola Lædre	What make an alliance an Alliance	Co-author Contributing to data collection developing the idea of the paper, designing the research, leading discussions, and drawing conclusions together with my fellow researchers
3	Paulos Abebe Wondimu, Ali Hosseini, Jardar Lohne, Ola Lædre	ECI approaches in public projects procurement	Co-author Contributing to development of the idea of the paper, designing research, participating in discussions, analyzing the data and drawing conclusions together with my fellow researchers
4	Ali Hosseini, Amin Haddadi, Bjørn Andersen, Nils Olsson, Ola Lædre	Relational base contracts: needs and trends in Northern Europe	First author Collecting data, leading discussions, and drawing conclusions with my fellow researchers
5	Ali Hosseini, Ola Lædre, Bjørn Andersen, Olav Torp, Nils Olsson, Jardar Lohne	Selection criteria for delivery methods for infrastructure projects	First author Collecting data, leading discussions, and drawing conclusions with my fellow researchers
6	Ali Hosseini, Paulos Abebe Wondimu, Alessia Bellini, Henrik Tune , Nikolai Haugseth, Bjørn Andersen, Ola Lædre	Project partnering in Norwegian construction industry	First author Supervising the data collection, leading the discussions, and drawing up the conclusions from the work together with my fellow researchers
7	Brendan Young, Ali Hosseini, Ola Lædre	The characteristics of Australian infrastructure alliance projects	Co-author Contributing to data collection developing the idea of the paper, designing the research, leading discussions, and drawing conclusions together with my fellow researchers
8	Brendan K Young, Ali Hosseini, Ola Lædre	Project alliances and lean construction	Co-author Contributing to data collection developing the idea of the paper, designing the research, leading discussions, and conclusions together with my fellow researchers
9	Brendan K Young, Ali Hosseini, Ola Lædre	A comparison of project alliancing and lean construction	Co-author Contributing to data collection, developing the idea of the paper, designing the research, leading discussions, and drawing conclusions together with my fellow researchers
10	Jenny Wøien, Ali Hosseini, Ole Jonny Klakegg, Ola Lædre, Jardar Lohne	Partnering elements' importance for success in the Norwegian	Co-author Contributing to the development of the idea of the paper, designing research, optimizing data collection, participating in discussions, analyzing the data, and drawing

			conclusions together with my fellow researchers
11	Vegard Knotten, Ali Hosseini, Ole Jonny Klakegg	"Next Step": a new systematic approach to plan and execute AEC projects	Co-author Collaborating through developing the idea, leading discussions and drawing conclusions from the work together with my fellow researchers
12	Paulos Abebe Wondimu, Ali Hosseini, Jardar Lohne, Eyuell Hailemichael, Ola Lædre	Early contractor involvement in public infrastructure projects	Co-author Contributing to development of the idea of the paper, designing research, participating in discussions and analyzing the data, and drawing conclusions together with my fellow researchers
13	Alessia Bellini, Wenche Aarseth, Ali Hosseini	Effective knowledge transfer in successful partnering projects	Co-author Contributing to the development of the idea of the paper, designing research, optimizing the data collection, participating in discussions and analyzing the data, and drawing conclusions together with my fellow researchers

Different research approaches and methodologies were planned and used for each publication (Steps 4 through 7). Each individual publication had its own objectives, design, data collection method, and plan for data analysis, which are described in the enclosed publications and presented in Table 11. Table 8 illustrates where different publications are used in this Ph.D.

Table 8 An Overview of Individual Publications in This Ph.D. Work

Contribution in this Phd work	*Publications*
Research question 1	1. 2, 6, 7, 8, 9, 10 ,13
Research question 2	1. 2, 6, 7, 8 , 9, 10 , 13
Research question 3	1. 2, 3, 4, 5, 11, 12

The logical sequence of the publications is presented in Figure 8 while the following sections outline a summary of the research paradigms, research approaches and research methods applied in this Ph.D. work.

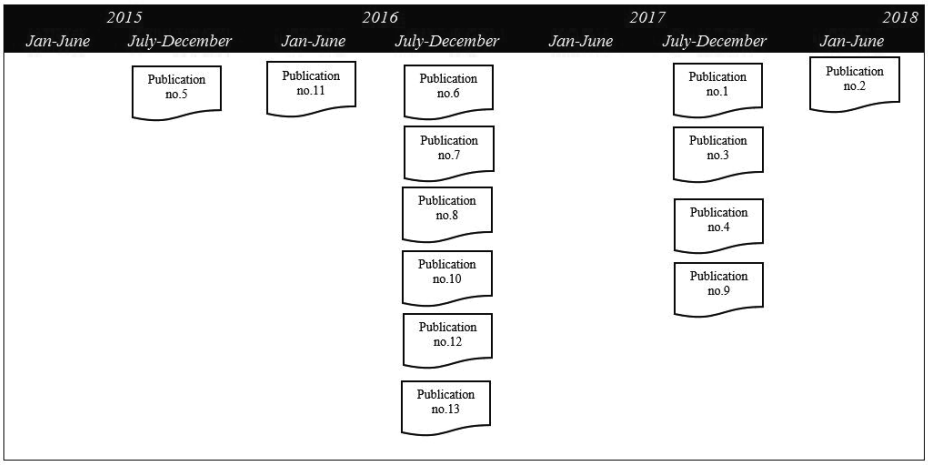

Figure 8 Chronology of the Research and Publications

Pilot study as part of a bigger project

At the early stage of this Ph.D. work, a pilot study financed by NPRA was carried out by a group of researchers including two professors, two associate professors and the author of this Ph.D. study. In this effort, NPRA as the finance party requested for the input regarding the PDMs that could be applied in Ferry Free E39 project as well as a summary of international experiences regarding different PDM. This study maps experiences in some selected countries, with a focus on relational contracts between the client and suppliers. Experiences from Sweden, Denmark, Finland, Netherland, United Kingdom, and Norway are gathered. Publication 4 presents part of the findings resulted in this study.

3.2 Research paradigms

A paradigm, as defined by Webster's Dictionary, is "a philosophical and theoretical framework of a scientific school or discipline within which theories, laws, and generalizations and the experiments performed in support of them are formulated." According to (Kuhn 1970), paradigm is an intellectual structure on which research in a field is based. He stated that paradigm is "the common set of beliefs and agreements shared between scientists about how a problem should be understood and addressed."'

Ontology and epistemology are considered as the main philosophical dimensions when discerning different research paradigms (Saunders et al. 2009, Kalof et al. 2008). Furthermore, Guba (1990) stated that paradigms can be considered through ontology (how things really are), epistemology (the theory of knowledge and the relationship between the inquirer and the known) and methodology (methods for exploring this knowledge). According to Holden and Lynch (2004), these beliefs are consequential to each other, meaning that ontology influences epistemology, which thus affects the choice of methodology.

According to Saunders et al. (2009), ontology is concerned with the nature of the reality. In terms of social science, ontological assumption take the view that the nature of reality is objective (independent of social players) or subjective (dependent on social actors) (Wahyuni 2012).

Epistemology is "the beliefs on the way to generate, understand and use the knowledge that are deemed to be acceptable and valid" (Wahyuni 2012). According to Guba and Lincoln (1994), the epistemological question in social science is: "what is the nature of the relationship between the would-be knower and what can be known?"

Furthermore, according to Wahyuni (2012), in addition to these two philosophical assumptions, two basic beliefs, namely axiology and methodology, influence the way to investigate the reality while axiology is concerned with ethic (role of value in the research) and methodology refers to the model (the overall approach for undertaking the research) behind the research. Table 9 outlined the fundamental beliefs and their relation to research paradigms.

Table 9 Fundamental Beliefs of Research Paradigms in Social Sciences (Wahyuni 2012)

(based on (Guba and Lincoln 1994, Saunders et al. 2009, Hallebone and Priest 2008)

	Research Paradigms			
Fundamental Beliefs	*Positivism (Naïve realism)*	*Post-positivism (Critical Realism)*	*Interpretivism (Constructivism)*	*Pragmatism*
Ontology: the position on the nature of reality	External, objective and independent of social actors	Objective—exists independently of human thoughts and beliefs or knowledge of their existence but is interpreted through social conditioning (critical realism)	Socially constructed, subjective, may change, multiple	External, multiple, chosen to best achieve an answer to the research question
Epistemology: the view on what constitutes acceptable knowledge	Only observable phenomena can provide credible data and facts. Focus on causality and law-like generalizations, reducing a phenomenon to its simplest elements	Only observable phenomena can provide credible data and facts; focus on explaining within a context or contexts	Subjective meanings and social phenomena; focus on the details of a situation and the reality behind these details; subjective meanings and motivating actions	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question; focus on practical applied research, integrating different perspectives to help interpret the data
Axiology: the role of values in research and the researcher's stance	Value-free and etic. Research is undertaken in a value-free way, and the researcher is independent of the data and maintains an objective stance.	Value-laden and etic; research is value laden; the researcher is biased by world views, cultural experiences and upbringing	Value-bond and emic; research is value bond; the researcher is part of what is being researched and cannot be separated and thus is subjective	Value-bond and etic-emic; values play a large role in interpreting the results, the researcher adopts both objective and subjective points of view

Research Methodology: the model behind the research process	Quantitative	Quantitative or qualitative	Qualitative	Qualitative (mixed or multimethod design)

The methodology literature includes several categorizations of various research philosophies. Creswell (2013) pinpointed four worldviews, namely post-positivism, constructivism, transformative and pragmatism. However, according to Dash (2005) there are two principal paradigms, namely positivism and anti-positivism. Rossman and Rallis (2010) referred to anti-positivism as interpretivism.

Four claims that can be made by positivists are described by Giddens (2014) as: 1) reality consists of what is available to the senses; 2) science is the primary discipline; 3) the natural and social sciences share a common unity of method; and 4)there is a fundamental distinction between fact and value.

Anti-positivism or interpretivism is a philosophical idea which proposes that social scientists process information obtained during the research process according to their own ideological biases (Rossman and Rallis 2010). According to Wahyuni (2012) interpretivism paradigm argues that reality is constructed by social actors and people's perceptions of it. Due to subjectivity of the social actors perspectives and experiences, reality may change and can have several perspectives (Hennink et al. 2010).

According to Dash (2005), the anti-positivism paradigm focuses on qualitative approaches such as observation, interviews and case studies while the positivism paradigm focuses on quantitative analysis. This indicates that the emphasis of anti-positivism is on a subjectivist approach while positivism emphasizes an objectivist approach (Dash 2005).

While positivism emphasizes that the truth can be exposed by empirical examination (reality will be revealed through observation by our senses), anti-positivism stresses that the truth is relative and depends on human interactions (subjective experiences of individuals engaging in social interaction).

The pragmatic paradigm, on the other hand, avoids joining the paradigm war between interpretivism and positivism (Tashakkori and Teddlie 1998). This paradigm relies on a mixture of ontology, epistemology and axiology as an acceptable approach to understanding social phenomena while also holding that objectivist and subjectivist perspectives are not mutually exclusive (Wahyuni 2012).

3.2.1 Qualitative and quantitative research

Qualitative research

Qualitative research, unlike quantitative research, does not depend on structured collection methods. Instead, it focuses on elaborating on ideas, hypotheses or opinions, as well as understanding the behavior of individuals in a social context (Bryman 2015). Qualitative methods

are mainly linked to the interpretivist perspective of philosophy (McLaughlin 2011). Creswell (2013) described qualitative research as an approach for understanding individuals' or groups' meaning in terms of a social or human problem. Fellows and Liu (2015) provided a more general description of the qualitative approach, saying it seeks to gain insight and understand people's perception of the world, both as individuals and as groups.

Payne and Payne (2004) stressed that "qualitative" is an umbrella term and refers to a set of approaches that share common features such as:

- Seeking out and interpreting the meaning that people ascribe to their own actions.
- Considering actions as contextualized, holistic and part of a social process.
- Seeking to encounter social phenomena as they naturally occur.
- Working with smaller samples to look for depth/detail of meaning with a less general and abstracted level of explanation.
- Using inductive as opposed to deductive logic, allowing ideas to emerge as the data is explored.

The qualitative research process can be described as a flexible collection of abstract data through multiple channels such as interviews, field observations and documents from which categories are determined and the data is organized. During this process, the researcher is primarily concerned with identifying and interpreting the conceptual views of the participant based on their observations. The theory of interpretivism applies to qualitative research because subjectivity is nearly impossible in situations that require biased human interpretations.

Various data collection methods are associated with qualitative research. Watkins (2012) listed the following as the most common method in qualitative approach:

- Focus groups/group interviews: discussion of a particular phenomenon in a group of six to eight people.
- Individual interviews: interviews to discuss a particular phenomenon.
- Observation: collection of data through observing specific a particular phenomenon.
- Document review: systematic document analysis.

Quantitative research

Quantitative approaches, on the other hand, tend to relate to positivism and seek to gather factual data to study relationships between facts and how the facts and such relationships accord with theories and findings of previous research (Fellows and Liu 2015). Common features of quantitative research, according to Payne and Payne (2004), are:

- The core concern is to describe and account for regularities in social behavior.
- Patterns of behavior can be separated into variables and represented by numbers.
- Explanations are expressed as associations (usually statistical) between variables, ideally in a form that enables prediction of outcomes from known regularities.

- Social phenomena are explored through systematic, repeated and controlled measurements.

Creswell (2013) simplified the definition of quantitative research by expressing it as "an approach for testing objective theories by examining the relationship among variables". He further explained that these variables can be measured, and the numbered data can be analyzed using statistical procedures. He focused on two main designs within quantitative approaches: survey research, which provides a quantitative description of trends, attitudes or opinions of a population by studying a sample of the population, and experimental research, which seeks to determine if a specific action or treatment influences an outcome. According to Bryman (2015), most quantitative data is collected through surveys, recorded observations or a coding frame. Table 10 contrasts qualitative and quantitative approach. While each approach has its own strengths and weaknesses, a combination of both covers pretty much all research needs.

Table 10 Contrasts between QUANTITATIVE and QUALITATIVE RESEARCH

Quantitative	***Qualitative***
Numbers	Words
Point of view of researcher	Point of view of participants
Researcher distant	Researcher close
Theory testing	Theory emergent
Static	Process
Structured	Unstructured
Generalization	Contextual understanding
Hard, reliable data	Rich, deep data
Macro	Micro
Behavior	Meaning
Artificial setting	Natural setting

Mixed method

Mixed method is another research approach that involves both qualitative and quantitative data. The main assumption of this approach is that the combination of both qualitative and quantitative approaches provides a more complete understanding of the research problem than either approach alone (Creswell 2013). Fellows and Liu (2015) used the term "triangulated studies" for this type of approach and pointed out that it may be employed to reduce or eliminate the disadvantages of each individual approach as it combines two or more research techniques. However, McLaughlin (2011) stressed that the researcher still has a responsibility to ensure that the methods work together in such a way that they provide additionality and address the research questions. This

means generated data must still be analyzed rigorously and methodically. Creswell (2013) described the following three primary designs within a mixed method approach:

- Convergent parallel mixed method, where the researcher merges qualitative and quantitative data (which are typically collected roughly simultaneously) to provide a comprehensive analysis of the research problem.
- Explanatory sequential mixed method, in which the researcher starts with conductive quantitative research, analyzes the results and then explains the results in more details through qualitative research.
- Exploratory sequential mixed method, in which the researcher begins with a qualitative research and after analyzing the data, the information is used to build a quantitative phase. The qualitative phase is used, for example, to identify appropriate instruments or questions in a follow-up quantitative study.

3.2.2 Deductive, inductive and abductive

Deductive logic is referred to the approach when the researcher aim is to develop a hypothesis using the existing theory, and then using the research strategy to test the hypothesis (Tjora 2013). This implies that deductive research is a study in which particular instance is deduced from general inferences (Collis and Hussey 2013). According to Gulati (2009), "deductive means reasoning from the particular to the general. If a causal relationship or link seems to be implied by a particular theory or case example, it might be true in many cases. A deductive design might test to see if this relationship or link did obtain on more general circumstances"

Tjora (2013) defines inductive studies as researches where theories are generated based on observations of a particular situation. Inductive research "involves the search for pattern from observation and the development of explanations – theories – for those patterns through series of hypotheses" (Bernard 2011). This suggests that the opposite of deductive approach occurs during inductive studies.

Abductive approach, on the other hand, is set to cover the weaknesses associated with deductive and inductive approaches. Specifically, deductive approach is criticized for the lack of clarity in terms of how to select theory to be tested via formulating hypotheses while inductive approach, criticized because "no amount of empirical data will necessarily enable theory-building" (Saunders et al. 2009). In abductive approach, the research process starts with 'surprising facts' or 'puzzles' and the research process is devoted their explanation. 'Surprising facts' or 'puzzles' may emerge when a researchers encounters with an empirical phenomena that cannot be explained by the existing range of theories (Bryman and Bell 2015). When following an abductive approach, researcher seeks to choose the 'best' explanation among many alternatives in order to explain 'surprising facts' or 'puzzles' identified at the start of the research process.

Dubois and Gadde (2002) stress the parallel development of the theoretical framework in abductive approach, arguing that progressing without such a theoretical platform necessarily adds less to our understanding. According to Dubois and Gadde (2002) this is owing to the possibilities of capturing and taking advantage not only of the systemic character of the empirical world, but also of the systemic character of theoretical models.

This approach creates fruitful cross-fertilization where new combinations are developed through a mixture of established theoretical models and new concepts derived from the confrontation with reality. Furthermore, Dubois and Gadde (2002) note that , an abductive approach is rich if the researcher aims to discover new things — other variables and other relationships. Accordingly, one of the main objectives in an abductive research is related to the generation of new concepts and development of theoretical models, rather than confirmation of existing theory.

3.2.3 Positioning this research

This Ph.D. work justifies its research philosophy by the following statement: “realities are apprehendable in the form of multiple, intangible mental construction, socially and experientially based, local and specific in nature and depend on the individual person or groups holding the construction” (Guba and Lincoln 1994). This work aims to establish a better understanding of the relational PDM concept and how relational PDMs are practiced in real life in the construction industry as well as developing a systematic approach toward adopting a relational PDM. The reality exists in the studied organization and through individual perceptions, and respondents of the study create their own realties influenced by their experiences and situations. These arguments make this research in nature, a combination of descriptive in first two research questions and constructive in later stage. Moreover, this work was carried out in the field of project management and deals with a complex problem without a simple solution. Bredillet (2008) argued that positivism fails to deal with the complexity of reality and that adopting this paradigm in the project management filed may simplify the problem.

To fulfill the research objectives of this Ph.D. work, in consideration of the above discussions, the *interpretivist* approach with abductive logic was adopted as a platform for the research strategy. The abductive approach employed in this study is indeed closer to an inductive approach than a deductive approach. Accordingly, I analyzed the data and presented my interpretation of the result rather than testing a theory. Methodologically, qualitative approach was employed in this Ph.D. work, as it is recommended in the study of phenomena with a complex nature where the objective is developing a new theory and process (Creswell, 2013). This also supports that qualitative data collection and mixed method data collection are appropriate even though the qualitative approach was dominant. It is also noteworthy that none of the studies that are part of this dissertation is purely quantitative. The research approaches employed in this work are elaborated in the following section.

3.3 Research approaches

3.3.1 Literature search and review

A literature review is an essential step in the research process. During this step, published works are investigated to establish what information has already been determined and which information is still absent (Fellows and Liu 2015). A literature review is important because it ensures researchers have a clear understanding of the topic and reduces the likelihood of information duplicity (Aitchison 2007).

The purpose of the literature review in this Ph.D. work is to provide context for the current research as well as elaborate on the general and theoretical background of the topic. An extensive literature study was performed due to the largely descriptive nature of the work.

The literature review, following the prescription of (Blumberg et al. 2014), was undertaken to develop the theoretical background for the concept of PDM. This literature review was influenced by authoritative texts such as academic books, journals, research reports and government publications, which provided a broad perspective of current views of the topic. During this step, I broke down the research question into distinct concepts that can be searched separately while keeping the focus on the concept of relational PDMs. To provide a thorough review, I studied selected articles along with their references to avoid missing any valuable sources, including academic books.

3.3.2 Case study

A case study is a research strategy that focuses on understanding the dynamics present within a single setting (Eisenhardt 1989). According to Yin (2015), case studies provide a method in which a researcher can empirically explore a research topic within a realistic framework when the topic lacks clarity; and in which multiple sources of evidence are used. In addition, according to Eisenhardt (1989), case studies are particularly helpful in underdeveloped research areas.

A common criticism of case studies is their lack of objectivity compared to other research methods within the field of social sciences. However, as long as this is realized, case studies are often considered a useful tool for the exploratory stage of a research project and provide much of the framework for the research process, including surveys and experiments (Rowley 2002).

Generally, due to the vast variety of available cases, researchers choose applicable cases out of convenience. According to Marshall (1996), three key strategies for samples for qualitative case research are: convenience sample, judgment sample and theoretical sample. In a convenience sample, the selection of the most available subjects is the goal, which could be in terms of time, cost or effort. Convenience samples are known for being the least costly to researchers. With a judgment sample, the researcher dynamically picks the most productive sample to fulfill the research objectives. Theoretical samples are described as building interpretive theories from the emerging data and selecting a new sample to inspect these theories.

Fundamentally, my epistemological stance for the present study (my standpoint on the nature of valid knowledge) and my axiological position (indication that this study is of high value) depend on studying the accounts of those involved in the cases (project). Case studies have been proven as useful for researching phenomena from this epistemological viewpoint. To thoroughly scrutinize and understand how different relational PDMs are utilized in different projects, case studies were used as one of the research approaches. For this type of research, the case study approach, which allows a better understanding of a concept from a thorough examination of the specific delivery models in practice, is a suitable solution.

In reality, the dominant criterion is the convenience sample, which is the sample to which the researcher is allowed suitable access. The process of choosing the samples within this Ph.D. work included two steps: choice of industry and choice of case projects. Due to the objectives and focus of this research, I chose to carry out the study within the construction industry. Convenience sampling was selected as the strategy to choose the case projects. Of course, the cases were chosen from those that applied relational PDM as a delivery model. The main data for the partnering study was collected in Norway and the data for the alliance study was collected in Australia. Beside these, I looked quickly into Finland, the UK and the Netherlands to gain an overview of practices in Europe. Lists of case projects are available in individual publications.

3.4 Research methods

As stated before, to triangulate data as described by Yin (2015), this Ph.D. work applies a combination of qualitative and quantitative data collection approaches. These approaches were employed to achieve more precise and accurate results by using a number of different methods or sources. The research methods applied in the descriptive part of this study are described in the following.

3.4.1 Interviews

Interviews contribute a significant portion of information to case studies and are commonly found in case study research (Yin 2015). According to Gill et al. (2008), the type of interview can range from structured, unstructured or semi-structured, depending on the stage of the research. In structured interviews, predetermined questions are asked using a verbally administered questionnaire. In this method, there is little or no variation and no scope for follow-up to help with further elaboration. Therefore, while structured interviews are fairly easy to administer, due to their nature, they allow for only limited participant responses. Conversely, unstructured interviews are usually time-consuming and difficult to manage. Moreover, by their very nature and lack of predetermined interview questions, unstructured interviews may be confusing and unhelpful for participants (who receive little guidance on what to talk about). In general, unstructured interviews are recommended where in-depth knowledge is required or nothing is known about the particular phenomenon. Semi-structured interviews, on the other hand, include key questions (to define the areas to be explored) while allowing the interviewee or interviewer to deviate from the primary direction to discuss aspects in more detail (Gill et al. 2008). The

format of semi-structured interviews, as compared to structured interviews, allows for the elaboration and discovery of evidence that may not have been previously known.

Yin (2015) introduced a different classification for case study interviews as follows:

- Prolonged interviews: The duration of this type of interview could be more than two hours (perhaps over more than one session), and the focus of the sessions is the interviewee's opinion or explanation of ideas, events or people related to certain situations or contexts.
- Shorter interviews: This format take a shorter time, and the focus is simply on validating certain findings that have already been established.
- Survey interviews: This format is the typical survey interview, where the interviewer uses a structured questionnaire.

In this Ph.D. work, following both Yin (2015) and Gill et al. (2008) categorization, prolonged and semi-structured interviews were employed as the primary data collation method. Semi-structured interview were considered the most appropriate structure for this research because they provide the freedom and possibility for the researcher to ask more detailed questions based on the respondent's answers and point of view instead of simply following an interview guide. Moreover, the interviewer can explain questions if the interviewee is not familiar with the topic or confused about the objective of the question.

3.4.2 Documents as a source of data

According to Crinson and Leontowitsch (2011), the study of existing documents within an organization to gain a better understanding of their content is called document research and is also known as document analysis. Furthermore, Bowen (2009) stated that the motivation for document study comes from: 1) its role in methodological and data triangulation, 2) the huge value of documents in case study research and 3) its usefulness as a stand-alone method for particular forms of qualitative research. Documents can serve a variety of purposes as part of research, and Bowen (2009) identified five functions of documents:

- Provide data on the context within which research participants operate.
- Suggest questions that need to be asked and situations that need to be observed as part of the research.
- Provide supplementary research data. Information and insights derived from documents can be valuable additions to a knowledge base.
- Provide a means of tracking change and development. Where various drafts of a particular document are accessible, the researcher can compare them to identify changes.
- Provides material that can be analyzed as a way to verify findings or corroborate evidence from other sources.

The first three functions were part of this study this study. In some cases, interviewees sent documents describing their project, contractual documents, PDMs, incentive arrangements, organization partnering charters and tendering information. These documents served as research

data or supplementary data. In some cases, documents that were received before the interviews helped the authors to ask the right questions and understand the given answers during the interviews (e.g., provided information about the use of different names for the same elements, such as an intention/cooperation agreement).

3.4.3 Survey

According to Forza (2002), considering survey as a research method contributes to the advancement of scientific knowledge in a number of ways. Conducting a survey demands standardized information regarding the studied topic. It is a quantitative method that can be applied to the study of different subjects such as organizations, groups, individuals or projects (Pinsonneault and Kraemer 1993). Moreover, researchers often distinguish between descriptive, exploratory, explanatory and survey research (Pinsonneault and Kraemer 1993, Filippini 1997, Forza 2002)

The survey research design adopted in this study was exploratory in nature to obtain preliminary insights into the subject. The survey proved to be as a useful tool for some part of the research apart from being a data collection method. For example, for the work described in Publication 10, a survey was distributed by e-mail, and all 16 respondents were interviewed after submission. The survey consisted of three parts: (1) project characteristics, (2) the use of partnering elements and (3) the partnering elements' impact on success. During the information retrieval phase, it became evident which questions were the most challenging to answer. This helped the researcher inquire in detail about certain aspects during interviews, where interviewees were given the opportunity to elaborate on their initial survey answers.

Table 11 presents an overview of the research method and research technique applied in each individual publication.

Table 11 An overview of the research method and technique in each publication

No	*Paper title*	*Case study*	*Documents*	*Interview*	*Survey*	*Workshop*	*Conceptual*	*Research Technique*
1	Project partnering in the construction industry: practice vs. theory	44	x	39	13+16			Critical review, qualitative content-based analysis and table cross-tabulation
2	What make an alliance an Alliance	14		22				Critical review, qualitative content-based analysis
3	ECI approaches in public projects procurement	11	x	14				Qualitative content-based analysis and coding the data
4	Relational base contracts: needs and trends in Northern Europe	1	x	14		x		Qualitative content-based analysis and focus group workshop
5	Selection criteria for delivery methods for infrastructure projects	1	x					Critical review, Content analysis of the project documents
6	Project partnering in Norwegian construction industry	26	x	21	13			Critical review, qualitative content-based analysis and table cross-tabulation

7	The characteristics of Australian infrastructure alliance projects	14	x	27			Critical review and qualitative content-based analysis
8	Project alliances and lean construction principles	14	x	27			Qualitative content-based analysis
9	A Comparison of Project Alliancing and Lean Construction		x	27			Qualitative content-based analysis
10	Partnering elements' importance for success in the Norwegian construction industry	10	x	16	16		Critical review, qualitative content-based analysis
11	"Next Step": a new systematic approach to plan and execute AEC projects					x	
12	Early contractor involvement in public infrastructure projects	11		14			Qualitative content-based analysis
13	Effective knowledge transfer in successful partnering projects			10			Qualitative content based analysis and coding

3.5 Reliability, validity and generalization

According to Patton (1990), during the research process (designing a study, analyzing results and evaluating the quality of the study) every researcher should be concerned about the validity and reliability of their work. In this regard, Guba and Lincoln (1994) offered a question: "How can an inquirer convince the audiences of her/his work that the research findings are worth paying attention to?"

Furthermore, Golafshani (2003) referred to reliability and validity as measures for establishing confidence in the research findings, although these terms are not treated separately in qualitative research. Guba and Lincoln (1994) stated that the existence of validity is satisfactory to establish reliability since validity does not exist without reliability. Bryman (2015) presented the same point of view, arguing that if a measure is not reliable, it cannot be valid, although validity and reliability are analytically distinguishable.

Validity is a concern if research truly represents the phenomenon that it claims to measure, while reliability is about assessing the quality of the measures to determine if similar results would be found if another research containing a different set of data were used. Cooper and Schindler (2003) stated that both validity and reliability should be present at the same time to ensure sound research.

The relationship between validity and reliability is illustrated by a metaphor in Figure 9. This figure presents the relationship using targets as a metaphor. If the center of the target is what the research aims for (the target), the shots that are close to the center (as illustrated on the left side of the figure) represent high validity. If the work is reliable, the shots are closely grouped together (as illustrated at the top of the figure).

In this metaphor, reliability occurs if the bullet hits the same spot after each shot, meaning the salvo is reliable while validity is a measure for how well the bullet hits what is aimed for (the center of the target in this metaphor).

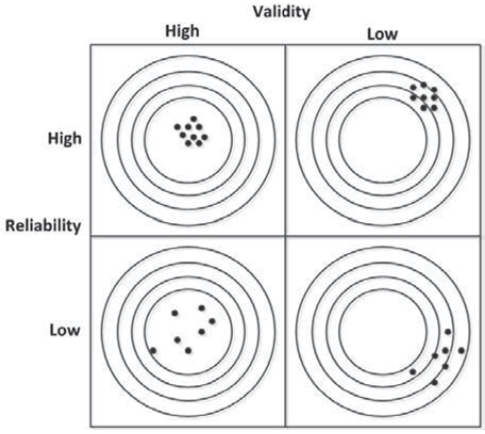

Figure 9 Understanding Validity and Reliability (Cooper & Schindler, 2003, p. 235)

Johnson (1997) stated that a credible and justifiable result of a study is the outcome of maximizing and testing the validity and reliability of the result, which may lead to generalization.

Generalization is an act of reasoning that allows drawing broad implications from particular observations. According to Bryman (2015), there are often concerns about the possibility of generalizing study results beyond the limitations of the specific context under which the study has been carried out. Yin (2015) proposed four design tests, presented in Table 12, to judge the quality of empirical social sciences research by checking and maximizing the validity and, consequently, the reliability of a study.

Interpretivist researchers however, use different nomenclature such as, transferability conformability credibility and dependability to list the criteria by which the quality of research could be evaluated (Healy and Perry 2000, Guba and Lincoln 1985, Thomas and Magilvy 2011) Thomas and Magilvy (2011) make a comparison between different nomenclature criteria. They explain that credibility, similar to internal validity in quantitative terms, refers to the recognition of the experiences contained within the study through the interpretation of participants' experiences. Transferability is equivalent to external validity in quantitative research. Dependability, equivalent to reliability in quantitative terms and conformability, similar to objectivity in quantitative terms, is achieved when credibility, transferability and dependability have been ensured (Thomas and Magilvy 2011).

The research methods applied within this Ph.D. thesis were tested according to these criteria for validity and reliability.

Table 12 Case Study Tactics for Four Design Tests According to Yin (2015)

Test	*Case Study Tactic*	*Phase of Research in Which Tactic Occurs*
Construct validity	Use multiple sources of evidence	Data collection
	Establish chain of evidence	Data collection
	Have key informant review draft case study report	Composition
Internal validity	Perform pattern matching	Data analysis
	Perform explanation building	Data analysis
	Address rival explanations	Data analysis
	Use logic models	Data analysis
External validity	Use theory in single case studies	Research design
	Use replication logic in multiple case studies	Research design
Reliability	Use case study protocol	Data collection
	Develop case study data base	Data collection

Construct validity

Construct validity concerns the accuracy of a case study's measures and how it reflects the phenomena being studied. According to Yin (2015), the researcher should develop a sufficiently operational set of measures, and subjective judgments should not be used when collecting the data.

This Ph.D. study collected data from multiple sources, including interviews, documents and survey. To cover a wider range of cases and increase the potential for generalization of the findings and results, the cases were chosen from vared organizations.

To prevent subjective judgments, collected data such as interview recordings and case documents were evaluated and analyzed in collaboration with co-authors and supervisors. These data were saved in a case study database to establish a sound chain of evidence. The findings that were gathered through interviews and document studies were presented to the respondents and their representatives for confirmation prior to data analysis to avoid any type of failure in the interpretation of the provided data.

Internal validity

In quantitative research, the key concern regarding internal validity is whether the research can definitively demonstrate that the manipulation of the independent variable is caused the observed effects and no other factors. This means a third variable that has not been considered or cannot be controlled by the study may affect the outcomes, consequently preventing internal validity.

According to Merriam (1995) just as quantitative study there are strategies in qualitative study to make strengthen the internal validity of the research and ensure that the findings are valid according to that paradigm 's notion of reality. The following strategies advocated by Merriam (1995) employed in this study to ensure the internal validity:

- Triangulation: Use of multiple investigator, multiple source of data and multiple methods are employed in different stage of this study to confirm the emerging findings.
- Member check: interviews records are translated and was sent back to the respondent from whom the data was derived and confirm if the interpretation was plausible.

- Peer/Colleague examination: findings of this study were constantly checked and examined the supervisors, fellow researchers as well as being subjected to double-blind review procedure to be published.
- Submersion/engagement in the research situation: the duration of each individual interview was long enough to ensure the in-depth understanding of the phenomenon. This extensive interview gave the interviewees enough time to sufficiently answer all interview questions.

External validity (generalization)

External validity is concerned with the possibility of generalizing the results from a specific setting to other situations that were not part of the original study (Yin 2015). Since a researcher often cannot work with the entire population of interest, external validity confirms that conclusions can be generalized to a broader population. Yin (2015) suggested replication logic to partially ensure external validity. To apply replication logic, two or more cases should be selected within a multiple case study. This is also noted by Merriam (1995) as *multi-site design* tin which the researcher use several sites, cases especially those which represent some variation to allow the result to be applied to a greater range.

This study has endeavored to ensure external validity by choosing the several case projects from various organizations within the construction industry. However, there are other organization in different industries and contexts that have not been considered within this Ph.D. work due to scope and time limitations. Further, as presented in the individual publications, the majority of studied case projects are located in Norway and Australia within the construction industry, and thus the results cannot be easily generalized to all types of projects in different contexts. However, due to common universal characteristics of projects and considering that Norway and Australia are both industrialized countries, the results can be partially used as the basis for further research on projects within different contexts.

It should be mentioned that in this study, external validity was not the main objective. Rather, the intention was to enhance understanding of the concept of the relational delivery model and elaborate on its components and characteristics.

Reliability

Reliability, as stated earlier in this section and according to Yin (2015), is the consistency and repeatability of the applied research procedures in a study. The reliability of research can be confirmed by showing that the results produced by a study can be repeated with the same procedures. According to Rowley (2002), documentation of research procedures and proper record keeping is necessary to achieve this.

This Ph.D. work attempts to establish reliability by developing a case study database, which consists of the case projects by type, interview results and the data collected through document studies. Moreover, according to (Merriam 1995) some of the strategies used to ensure the internal validity of the research can ensure the reliability of the study i.e. peer examination. Triangulation,

another strategy that is introduced in the literature to improve the reliability of research findings (Golafshani 2003) was also employed in this Ph.D. work. According to Bryman (2015), triangulation is "The use of more than one method or source of data in the study of a social phenomenon so that findings may be cross-checked." Following Miles and Huberman (1994) suggestion, the five kinds of triangulation methods for qualitative research that are applied in this study are outlined in Table 13.

Table 13 Triangulation Methods Applied in This Study Based on Miles and Huberman (1994) Suggestions

Triangulation Method		***Approach***
Triangulation by data source	Data collected from different persons, times, or places	Data collection from different projects in various organization; none of the case studies is based on a single case project or single interview
Triangulation by method	Data collected through observations, interviews and documents	Data collection via interviews, documents and survey; a minimum of two sources of data is employed in all case studies; interviews and document studies are often employed in addition to the literature review
Triangulation by researcher	Data interpreted and analyzed by more than one researcher; this is comparable to inter-rater reliability in quantitative methods	Involvement of other researchers in the data collection and analysis phases, resulting in all publications being a collaboration with co-authors
Triangulation by theory	Use of different theories to explain results	Development of a theoretical background for all case studies; application of different theoretical perspectives
Triangulation by data type	Collections of different types of data, for example combining quantitative and qualitative data	Combination of both qualitative and quantitative data collection approaches

Interpretivism was the philosophy used in this research. Although this approach has limitations and weaknesses due to its subjective nature, all the findings and results were carefully examined and assessed together with supervisors and fellow researchers to address the limitations and weaknesses. In addition, only journals and conferences with a double-blind review procedure, in which other researchers assess the work and comment on the findings and results, were chosen as publishing platforms.

Chapter 4

4. Findings and discussion

4.1 Characteristics of relational PDMs

***Research question 1**: What are the characteristics of relational PDM?*

The main purpose of this research question is to explore the characteristics of relational PDMs. As stated in Sections 1.2 and 1.3 and the introduction of Section 2, the scope of this study is limited to identifying the hard elements (as the most tangible component) of two specific models, namely partnering and alliance, as their characteristics to answer this question. This will provide the groundwork for a better understanding of these concepts and thus build a foundation for further investigation on how these relational delivery models are practiced.

Partnering

There are many references in the literature to partnering. Many authors have developed their contributions to the concept, aiming to create a mature, widely accepted definition of partnering. Some studies have proven to be overly broad and generic, not giving the reader a deeper insight into the issues, while others have focused on the analysis of partnering details and elements for effective implementation. The literature review indicates a link between partnering's definition, its purpose and its elements.

Researchers listed different purposes for adopting partnering in construction projects. This diversity might be the reason behind the confusion around a partnering definition. This diversity in definitions of partnering may arise from the authors' different goals when implementing partnering. For example, Cheung et al. (2003a) listed shared risk, reduced litigation, innovation, and increased efficiency as the purposes for his partnering model. This resulted in defining partnering as an attempt to enable non-adversarial working relationships. Further, he also presented elements that can help achieve these purposes.

According to Aarseth et al. (2012) and Chan et al. (2003), one of the major challenges for implementing partnering in the construction industry is the lack of agreement on what partnering is and what it means. Analysis of the literature on partnering reveals that while some authors use similar phrasing, others emphasize that the creation of collaborative working relationships depends on the presence of specific elements. For instance, Larson (1995) formulated a definition of partnering that includes a list of success elements such as collaboration, trust, openness and mutual respect. More recently, authors such as Chan et al. (2010), Naoum (2003), Nyström (2005), Lu and Yan (2007) and Yeung et al. (2007) have investigated the relevant elements of partnering. These study results demonstrate that to fully understand this concept, a partnering definition and successful implementation cannot be separated from the presented elements.

In general, the partnering model in the Norwegian environment is still under development, and efforts have been made to change the culture from adversarial to cooperative. The idea that introducing partnering in projects will provide more overall value for money and a more rational building process is persuading clients that significant involvement and knowledge engagement are needed to gain awareness and implement best practices.

Project partnering has been the subject of research projects at NTNU since almost two decades. Several research projects were carried out by IBM concerning this concept. As a result, an initial list of the hard elements of partnering that was identified prior to this research by Haugseth et al. (2014) became the basis for developing a comprehensive list in this study. Therefore, beginning with the elements identified by former research projects, this study concluded on the elements presented in Table 14. Descriptions of the identified partnering elements are discussed in the following. The frequency of the use of these elements in a sample Norwegian construction project is also presented in this Ph.D. work.

Table 14 Final List of Partnering Elements

Partnering Elements	
Start-up workshops	Inclusion of sub cntractors (SC) in the partnering group
Partnering based on turnkey/design-build contract	Measurement during project
Early involvement of contractors	Prequalification
Contractual right to replace people	Final workshop
Functional description	Conflict resolution mechanism
Value-based procurement	Operational responsibility of contractor
Inclusion of architect in partnering group	Co-location of partnering group
Inclusion of consultant in partnering group	Remuneration for accepted offers
Target document (partnering charter)	Inclusion of SC in bonus/malus
Intention/cooperation agreement	Inclusion of consultant in bonus/malus
Binding cooperation agreement	Inclusion of architect in bonus/malus
Contractual right to replace firms	Inclusion of a consultant in the partnering contract
Open-book economy	Inclusion of an architect in the partnering contract
Continuous workshops	Inclusion of SC in the partnering contract
Target price with bonus/malus	Building information model
Meeting to ensure alignment between design phase and design and build contract	Volunteer group composition

Start-up workshops. These are used to establish a common set of procedures and goals for a project as well as lay the foundation for effective working relationships (Barlow and Cohen 1996). Swan and Khalfan (2007) identified the goal of workshops as awareness raising, with appropriate mutual objectives, performance measurement frameworks, roles and responsibilities, and tools and processes. Workshop participants should be limited to the core team (Swan et al. 2005).

Partnering based on turnkey/design-build contract. This is the preferred contract model for applying partnering and is a substitute for having a real partnering contract format. There is a need for a formal contract, and this is the least unfit contract currently available.

Early involvement of contractors. Incorporating contractors' expertise, specifically on constructability, in an early project stage can lead to decreased design costs, increased efficiency, better solutions and building trust. Operational procedures for ECI necessitate regular interaction and improved communication between the involved actors (Rahman and Alhassan 2012). This close collaboration leads the actors to appreciate and accept each other's goals and objectives (Ng et al. 2002, Mosey 2009). Most respondents emphasize the importance of early involvement as a fundamental factor in achieving cooperation in projects.

Contractual right to replace people/firm. A successful partnership encourages overcoming destructive, competitive attitudes. Therefore, having the right partners and right people onboard is crucial. This necessity indicates that not everyone is fit for partnering. If the unsuitability of a partner becomes apparent after a project has started, it might be necessary to replace a partner, firm or individual project members to be able to continue with the partnering process (Olsson and Espling 2004). The contractual right to replace people during partnering projects is established differently in each organization. According to the interviewees, it may be necessary to substitute a person or a firm if they do not act according to the mutual partnering agreement, but this could leave a gap in project information and knowledge.

Functional description. This is a description of the work that the contractor needs to deliver. Instead of stating elements like time and quantity, the description introduces the work. Hartmann and Bresnen (2010) explained functional description through the example of an asphalt repair project. Instead of stating when and how many instances of asphalt damage have to be repaired, the functional description refers only to the crack width and acceptable bumpiness of the asphalt. The contractor is accountable for identifying and fixing deviations from the given criteria and at the same time, has the freedom to improve and optimize their own work progression. Using functional description as a basis for procurement can lead to better solutions and cost savings.

Value-based procurement. While the standard emphasis on the lowest bid among public owners is not prescribed by law, the principle of best value (for money) allows other factors to be assessed (Eriksson et al. 2008). Value-based procurement is concerned with factors such as quality and expertise and requires proper knowledge and experience from project participants, in addition to a general understanding of the partnering idea (Haugseth et al. 2014).

Inclusion of architect/consultant/SC in partnering group. Relevant key competencies should be available early (and throughout) the process. An architect or consultant can strengthen the partnering arrangement, but subcontractors often choose not to participate in the partnering group to limit their risk. Ng et al. (2002) argued that key subcontractors should be included in at least the initial workshops to provide a better perspective of the project for the stakeholders.

Target document (partnering charter). A partnering charter can be developed at the start of the partnership (start-up workshop) or after the selected partner has worked for years (strategic partnering). The partnering charter should state precise objectives and the mission statement of parties, decoded into specific goals as a means of measuring success (Conley and Gregory 1999, Swan and Khalfan 2007). The charter includes partnering behavior and can act as a guideline for principles. It is likely that some of the cooperation agreement components are repeated but are usually addressed in greater depth in the partnering charter.

Intention/cooperation agreement. This is a principal agreement that the project process will characterize a recognizable partnering project (Haugseth et al. 2014). It is a statement of goodwill. The cooperation agreement is typically a project-based agreement although it could be a long-term relationship.

Binding cooperation agreement. Cooperation is the essence of partnering and a basic means of building trust and steering toward targets. This agreement presents the scope of collaboration and legally binds the parties.

Contractual right to replace firms. As stated before, it may be necessary to substitute a person or a firm if they do not act according to the mutual partnering agreement, but this could leave a gap in the project information and knowledge.

Open-book economy. This arrangement equates to the disclosure of financial information among all participants. It is stated in the literature that a necessary condition for an open-book economy is trust (Axelsson et al. 2002, Kulmala 2002). The existence of mutual trust among the partners allows financial data to be revealed, as misapplications are considered unlikely (Kajüter and Kulmala 2005). However, an open-book economy could improve relationships, with trust a result of rather than a precondition for open-book accounting. Although the realities of "open book" are debated and contested, by using this type of economy, the client can see where money is spent, and this helps to create more trust and confidence between the parties involved.

Continuous workshops. According to Bennett (1995), partnering is based on three factors: mutual objectives, an agreed-upon method of problem resolution and an active search for continuous measurable improvements. Kadefors (2004) also listed workshops for structured team building as a key partnering measures. By maintaining continuous workshops, relationship can be evaluated continuously and team building strengthened (Jin and Yng Ling 2005, Wilson Jr et al. 1995). An additional effect of enacting team building through workshops is that trust may develop quicker than it otherwise would (Kadefors 2004). Conducting continuous workshops plays an important role in continuous improvement, increased cooperation, conflict resolution, implementation of new procedures. Further, it ensures that participants are following procedures and monitoring team goals and stakeholders' commitment.

Target price with bonus/malus. This practice is identified as an essential interaction element since it gives the contractor a strong incentive to save costs (e.g., pursuing the best deals with subcontractors) and to increase productivity. The target cost is established after a negotiation

wherein both parties should be content with the pricing of the project and the incorporated risk reserve.

Measurement during the project. According to Crane et al. (1999), there are three types of partnering measures: result measures, process measures and relationship measures. Result and process measures are “hard” measures based on performance and progress, while relationship measures are often called ‘‘soft’’ measures and are used to track team activities and efficiency of the partnering team (Crane et al. 1999). Furthermore, Kadefors (2004) listed partnering measures as: workshops for structured team building, joint goal formulation and formalized systems for conflict resolution and assessment of goal accomplishment.

An operationally efficient measurement system that is designed with appropriate time intervals is a fundamental element of partnering to retrieve information as desired without unnecessarily burdening participants. This information assists the project manager and active parties with evaluating the performance of the partnering relationship and making strategic adjustments.

Prequalification. Construction projects are characterized by various risks and complexity, which makes contractor selection a critical and crucial task for any client (Palaneeswaran and Kumaraswamy 1999). Many clients choose to engage in prequalification to minimize the risk of contractor failures (Palaneeswaran and Kumaraswamy 1999, Hatush and Skitmore 1997). Wilson Jr et al. (1995) suggested that organizations should conduct prequalification and certification exercises before entering into a partnering relationship, due to the importance of selecting appropriate partners.

Several researchers have identified contractors’ attributes, including human resources, safety, technical aspects, financial aspects, quality of work, suitability and availability of equipment, past performance and experience, as criteria for contractor prequalification (Palaneeswaran and Kumaraswamy 1999, Russell and Skibniewski 1988, Rankin et al. 1996).

Final workshop. The main purpose of the final workshop is to perform a formal review of project performance and efficiency of the partnering team. The long-term improvement of all the involved parties is at the heart of this process (Van der Merwe and Basson 2006, Kumaraswamy et al. 2003). Despite its importance, in most cases, even if a final meeting is planned, the participants downgrade it because of the many things to focus on during the completion phase of any project.

Conflict resolution mechanism. Inherent interdependencies between involved actors often cause conflict in inter-organizational relationships (Mohr and Spekman 1994).A formalized system for conflict resolution is listed by Kadefors (2004) as a partnering measure and by several other researchers (Li et al. 2000, Cheung et al. 2003a, Chan et al. 2004, Mohr and Spekman 1994) as a critical element for successful partnering. Although one of the goals of partnering is to talk about difficulties and create procedures before an issue arises and conflict occurs, it is important that disputes be resolved at the lowest possible level, so as not to impact the effectiveness of a project.

Operational responsibility of the contractor. This item corresponds to the use of turnkey/DB contracts. Someone must be responsible if the partnering does not work, which also works as an incentive for the contractors to contribute their best to the partnering.

Co-location of partnering group. Co-location of the partnering group is commonly observed as an advantageous element as it brings the team together, allows greater accessibility and permits more timely and informal communication (Bresnen and Marshall 2002). The importance of face-to-face communication to execute a successful partnering project is emphasized in this element. However, according to some of the case projects, frequent workshops have replaced co-location, but this condition is often unavailable in traditional arrangements (Walker et al. 2013).

Remuneration for accepted offers. The main purpose of remuneration in partnering is to cover the costs of tendering and pay contractors for their efforts.

Inclusion of SC/consultant/architect in bonus/malus. The inclusion of all parties in a fair bonus/malus system can improve motivation and promote collaboration.

Inclusion of a SC/consultant/architect in the partnering contract. Although inclusion of key competences in a partnering group can strengthen the collaboration, it is uncommon to regulate it through the main contract of the partnering arrangement. Most clients include architects and SCs in the partnering group but not the formal contract. Such inclusion may strengthen the partnering arrangement, but many subcontractors prefer to be left out of such an arrangement to avoid carrying risk. Naoum (2003) recommended involving subcontractors as well as consultants in the bonus/malus arrangement, as this has been done in a number of successful partnering projects.

As part of data collection in each interview, the respondents were asked if any element was missing from our list. Consequently, three elements were identified:

- **Use of building information models (BIM)** when dealing with users (intended users of a project). BIM makes it easier to understand what the actual building plan is. Interviewees indicated it is an important communication tool for clients' coordination with users. It is also an effective design tool.
- **Meetings to ensure alignment of the plans with the preliminary design phase and the design and build contract**. Respondents maintain that this is best done with one or more meetings at the end of the preliminary design phase. This aspect also represents the time needed to transfer risk from client to contractor. Whether the entire risk is transferred to the contractor or shared between the partners in the group varies by project.
- **Volunteer group composition.** This was used in five of the case projects. It encourages contractors, consultants and architects to compose teams that will likely work well together. Volunteer group composition makes it possible to construct good teams that can have a long-term commitment to each other.

Alliancing

A preliminary list of elements identified by the literature study serves as the basis for determining the characteristics that define alliancing. Determining the key elements of alliancing through the literature was an involved process. Almost all the literature on alliancing includes a brief definition of alliancing in the introduction. These definitions were collected, and common themes were elicited. To delve deeper, the literature was carefully analyzed to identify defining elements that were thought to be key to an alliance.

Lahdenperä (2012) identified a number of defining elements of alliancing, beginning with those elements this study concluded on a number of key elements from the literature that were of interest to this study. Table 15 shows the elements of an alliance as identified in the studied literature. They are arranged by the number of citations. Also included is a preliminary indication, based on the literature review, of whether the element is unique to the alliancing PDM. The following are detailed descriptions of the elements identified by the literature. Some elements are better defined in the literature than others, and this is reflected by the level of detail of the descriptions.

Table 15 Elements of an Alliance – Results from the Literature (Publication 2)

Elements of an Alliance	*References*	*Only Alliancing?*
Pain/Gain Share	1,3,4,6,7,8,9,10,12,14,15,16,17,18,21,23,24,25,26,29,30,31,32,	No
Open-Book Approach	1,6,7,8,9,12,14,15,16,17,18,19,21,23,25,26,27,29,30,31,32,33,35	No
Risk/Reward Sharing	4,5,6,8,9,12,14,17,18,19,20,21,22,23,25,26,29,31,32,33	Possibly
No Dispute Clause/No Blame/No Fault Mentality	1,6,7,9,10,12,14,15,16,18,20,23,25,26,29,30,32,33,35	Yes
Alliance Leadership Team (ALT) (Board)	1,5,6,9,10,12,16,17,18,19,23,25,26,29,31	Yes
Alignment of Client and Commercial Participants Objectives	6,9,10,12,14,17,18,20,22,21,23,25,29,30	No
Auditing	1,6,9,15,16,17,18,19,21,23,25,29,30,32	No
Integrated Project Team	9,12,14,16,17,18,19,20,23,25,26,29,32,33	No
Unanimous Decision Making	1,6,7,9,10,16,18,23,25,26,29,30,32,33	Possibly
Target Outturn Cost (TOC)	1,5,6,9,10,14,17,18,19,21,26,29,32	No
Virtual Organization	5,6,9,14,15,17,18,19,21,23,25,26,29	Yes
Alliance Management Team (AMT)	1,5,6,9,10,12,16,18,25,26,29,31	Yes
Incentivized Cost-Reimbursement	4,5,9,10,15,16,17,19,20,26,27,29	No
Co-location of Alliance Team	4,7,10,14,16,17,23,25,28,29	Possibly
Alliancing Workshops	1,7,12,14,16,17,21,25,29	Yes
Fee to Cover Corporate Overhead and Profit	1,9,17,18,19,21,25,26,29	No
Formal Contract	3,6,7,17,20,21,25,29	No
Minimum Reimbursement of Direct Costs	1,9,15,16,18,23,26,29	No
Dispute Resolution Kept within Alliance	6,7,9,18,23,25,27	No
Key Result Areas	1,9,10,18,29,30	No
Three-Limbed Contract	1,6,9,18,26,29	Possibly
Joint Responsibility	9,17,21,25,29	Possibly
Price Competitive	7,8,9,29	No
Relationship Development	7,12,23,29	Possibly
Alliance Facilitator	9,25,29	Yes
Alliance Uniform and Stationary (Branding)	5,12,29	Yes
Collaborative Problem Solving and Decision Making	6,9,10	No
Common Goals	9,17,29	No
No Latent Condition Clauses	5,9,29	Possibly
Single Alliance Culture	5,25,29	Yes

Early Involvement of Alliance Partners	3,14	No
Internet-Based Information Management System	25,28	No
Built from the Ground Up	25	Possibly

Pain-gain share. Pain-gain share is an essential component of an alliance and was the most-cited element in the literature study. All participants share in the profits and losses of the project and ensure that no single participant is held accountable for financial performance (Laan et al. 2011). This helps to reinforce the mindset of we all win, or we all lose (Chen et al. 2010).

The pain/gain model forms part of incentive arrangements and is a measure of how a project performs against the target outrun cost (TOC) (Walker and Lloyd-Walker 2013). If the project is delivered under the target price, the non-owner participants (NOP) share in the savings, whereas if the project is delivered above the target price, the participants lose a proportional amount of their overhead and profit (Cocks et al. 2011). This is detailed further under the three-limbed contract element (which is elaborated later in this section). The Australian Department of Infrastructure and Transport (2015) simply explains this as: "the Participants share the benefit of a cost underrun, and the 'pain' of a cost overrun, under the Risk or Reward Regime."

Financially, the maximum risk, or most adverse situation, for NOPs is that they receive compensation for Limb 1 only (Ross 2003, Chen et al. 2010). Pain/gain-share is a result of risk-sharing arrangements in alliancing. Operating hand in hand with the no-blame culture, risk sharing ensures that all participants work together to overcome any challenges that may arise during the delivery of the project (Henneveld 2006)

Open-book approach. A key component of alliancing, but not unique to alliancing, is the open-book approach, which equates to the disclosure of financial information among all participants (Rowlinson et al. 2006, Chen et al. 2010). This approach helps to reinforce the *everyone is working on the same team* mindset and helps to provide accurate and real-time information on the financial performance of the project. This approach is a major benefit for clients who, through this method, get an insight into the real cost of construction (Henneveld 2006).

Risk and reward regime. This is the key mechanism in the commercial framework used to encourage and reward exceptional performance (if required by the owner), address poor performance, align the NOPs' commercial interests with the owner's project objectives and drive the NOPs to meet their behavioral commitments (Department of Infrastructure and Transport 2015). A risk or reward regime determines the risk or reward amount, which is a performance-based payment to the NOPs. There are many ways to structure the risk and reward regime, but it is usually separated into two components:, a cost component (pain-gain share for performance against the TOC) and a non-cost component (performance against the owner's non-price objectives such as performance against pre-agreed-upon key result areas (KRAs) (Department of Infrastructure and Transport 2015).

No-dispute clause. The alliance agreement is structured so that everyone is working on the same team. A key component of this arrangement is the development of a no-blame culture, which is

often backed up by a no-dispute clause in the alliance agreement (Chen et al. 2010, Lloyd-walker et al. 2014). The commercial drivers and integrity of the participants, combined with the requirement of consensus decision making, ensure that all disputes are handled internally within the alliance. This eliminates the expensive and lengthy court battles often associated with traditional contracting methods (Ross 2003, Walker et al. 2015).

Alliance leadership team (ALT). The ALT, otherwise known as the alliance board, is made up of an equal number of representatives (senior executive managers) from each party (Chen et al. 2010) and is formed precisely for the purpose of the alliance (Mills et al. 2011). The ALT provides strategic leadership and governance for the alliance, meets monthly, and makes all decisions unanimously with best-for-project outcomes (Henneveld 2006, Cocks et al. 2011).

Alignment of the client's and commercial participants' objectives. The structure of the alliance and a number of the elements mentioned previously create a situation where the client's and commercial participants' objectives are aligned (Rowlinson et al. 2006, Jefferies et al. 2014). That is, that the business goals of each party are aligned with the alliance and the outcomes of the project (Henneveld 2006).

Auditing. To establish correct overhead and profit values for the NOPs, audits are undertaken by independent auditors to assess the typical overhead and profit margins for each NOP (Henneveld 2006, Cocks et al. 2011). Throughout the duration of the alliance, all transactions are conducted completely open book and are subject to audit (Chen et al. 2010, Ross 2003).

Integrated project team. An alliance team is an integrated project team, which means that people from all disciplines and parent companies work together in one team, allowing for the sharing of expertise and resources (Henneveld 2006). To create the "perfect" team, each member is selected on a best-for-project basis, regardless of the company for whom he or she works. The integrated project team is part of the concept of the virtual organization.

Unanimous decision making. Within an alliance, each party gets an equal say in the decision process and all decisions must be made unanimously (Chen et al. 2010, Henneveld 2006, Ross 2003) Collaborative problem solving and decision making are a key characteristic of alliancing (Walker et al. 2013). This element emphasizes that all parties work together to overcome problems that arise.

Target outturn cost (TOC). The TOC is an estimation, based on market competition and actual production rates, of what it will cost for the alliance to deliver the agreed-upon scope of work (Henneveld 2006, Ross 2003). It is subject to scrutiny by independent consultants, who validate the estimate (Lloyd-walker et al. 2014). Sometimes mentioned is the direct cost target (DCT), which Cocks et al. (2011) defined as "the cost of planning, designing, and constructing the work, excluding corporate overhead and profit for the non-owner participants."

Virtual organization. An alliance operates as a virtual organization (Ross 2009) in the sense that all individuals from all parent organizations are, for all intents and purposes over the duration of

the contract, employees of the alliance, and it is the alliance that delivers the project (Chen et al. 2010, Cocks et al. 2011).

Alliance management team (AMT). The AMT, formed for the purpose of the alliance (Mills et al. 2011), handles the day-to-day management of the alliance (Chen et al. 2010). The members that make up the AMT are generally managers of the different disciplines and teams within the alliance (Cocks et al. 2011).

Incentivized cost-reimbursement. In addition to pain/gain share, alliances include other forms of incentivized cost reimbursement. These can include incentives for non-cost factors such as innovation, quality and delivery time (based on the KRAs).

Co-location of alliance team. Co-location of the project team is a mechanism for realizing the full effects of an integrated project team. Although not a strict must-have, it is an element consistent with many successful alliance projects and is often identified in the literature as a key success factor (Laan et al. 2011, Walker et al. 2002a). It is implemented as a way of developing a single alliance culture and leads to effective communication and improved innovation in that members have close and immediate contact with each other, which is a condition that is often unavailable in traditional arrangements (Walker et al. 2013).

Alliancing workshops. Workshops are conducted to develop and maintain the alliance culture and the best-for-project mindset. They are often cross-team and cross-disciplinary to encourage collaboration and innovation (Walker et al. 2015).

Fee to cover corporate overhead. See Limb 2 under three-limbed contract in the below text.

Formal contract. The alliance contract, otherwise known as the alliance agreement, is a stand-alone contract that is not associated with any other contract type. The key principles of alliancing are explicit and contractual (Walker et al. 2015). Henneveld (2006) provided a comprehensive overview of the formal contract element in the description of an alliance agreement:

> Alliances are characterized by the Legal and Commercial Framework created by the alliance agreement. The alliance agreement is a non-adversarial contract that is based on the principles of equity, trust respect, openness, no dispute and no blame. The commercial framework of project alliance agreements is structured in a way that assigns collective financial responsibility and liabilities to the parties.

Minimum reimbursement of direct costs. Minimum reimbursement of direct costs also falls under the three-limbed contract; however, it is an important element that warrants its own section. As a minimum, all NOPs of an alliance are guaranteed to be reimbursed for all their actual direct costs (Henneveld 2006). This rewards the NOPs for being part of the alliance and taking on a share of the project's risks and helps to maintain a culture of good faith.

Dispute resolution kept within the alliance With the exception of willful default and insolvency, all issues and conflict are kept within the alliance and resolved on a unanimous basis with no recourse to litigation or arbitration (Henneveld 2006, Chen et al. 2010).

KRAs. See incentivized cost reimbursement above and three-limbed contract below.

Three-limbed contract. In recent times, alliance contracts have been structured around the three-limbed approach, where (Walker et al. 2015, Ross 2003):

- Limb 1 consists of all the directly reimbursable costs, including project-specific overheads.
- Limb 2 is made up of the corporate overhead and profit for each NOP, determined by an independent auditor. This is placed "at-risk" according to the pain/gain arrangement.
- Limb 3 consists of the incentivized cost-reimbursement, where all participants share in the pain/gain associated with how the alliance performs against the pre-arranged targets in cost and non-cost KRAs. Financially, the maximum risk, or most adverse situation, for the NOPs is that they receive compensation for Limb 1 only (Ross 2003, Chen et al. 2010).

Joint responsibility Each party, as a member of the alliance, has a joint responsibility to deliver the project outcomes and to overcome any obstacles encountered along the way. This is reinforced by contract terminology in which obligations are expressed collectively, for example "the alliance shall…", as opposed to mentioning individual participants, for example "the designer shall…" (Ross 2003).

Price competitiveness. A price competitive alliance has been adopted in some cases as a method to demonstrate higher value for money by including the element of price competition. In this process, two potential alliances develop the project definition and TOC side-by-side and the client selects the winning team to implement the project (Love et al. 2010a).

Relationship development Due to the importance placed on the relationship of the parties within the alliance, alliances engage in active relationship development and maintenance (Henneveld 2006, Cocks et al. 2011). Relationship development is a large part of maintaining the single alliance culture.

Alliance facilitator. Although it is not an element that necessarily defines alliances, it is normal practice for alliances to engage the services of an alliance facilitator or alliance champion (Ross 2003, Morwood et al. 2008). The alliance facilitator provides advice, runs workshops and promotes the alliance culture. Alliance facilitators remain until sufficient alliance competency is developed in the industry and companies gain enough alliancing expertise and establish their own in-house alliance facilitation skills (Ross 2003).

Alliance uniform and stationary. As part of maintaining a single alliance culture, alliances use their own alliance uniform and stationary, complete with the alliance's name and logo. It is usual practice to prohibit the use of any uniform or stationary that shows the name and logo of any of the parent companies (Cocks et al. 2011).

Collaborative problem solving and decision making. Collaborative problem solving and decision making are key characteristics of alliancing (Walker et al. 2013). This emphasizes that all parties work together to overcome problems that arise.

Common goals. The alliance is structured in a way that ensures all parties are working toward a set of common goals (Transport 2011).

No latent condition clauses. A key element that separates alliances from traditional contracts is the absences of a latent conditions clause (Transport 2011, Cocks et al. 2011). A latent conditions clause is not included in an alliance agreement as any impacts associated with latent conditions are taken account of in the risk and contingency provisions when setting the TOC (Transport 2011).

Single alliance culture. A single alliance culture is one of the significant aspects of an alliance. All team members, regardless of their parent organization, are part of the same team—the team of the alliance. This culture is reinforced through the co-location of the team, alliance and team-building workshops, and alliance uniform and stationary complete with the alliance name and logo (Cocks et al. 2011, Ross 2003).

Early involvement of partners. The early involvement of alliance partners refers to the fact that all parties participate in defining the scope, the calculation of the TOC and the creation of the alliance agreement (Love et al. 2010a, Chen et al. 2010). This is in contrast to traditional contracts, where the client generally develops the scope and contract details before engaging a contractor or consultant.

Internet-based information management system. Alliances can make use of internet-based information management systems to ensure every member has access to the same programs and files. This point may not be a defining element of alliancing.

Built from the ground up. Alliances are built from the ground up for each project, in that they are independent of any previously established history between any of the participating parties (Ross 2003).

Further analysis was required to reduce and combine the lists so that they contained the most relevant elements. Each piece of literature was analyzed again to check for references for each identified element. A closer look at the definition of each element provided a starting point for refining the list. It was possible to see which elements were related and could be combined, and which elements were not necessarily "defining" elements and could be considered unimportant for the purpose of this study.

Further analysis resulted in the following points of note. *Joint Responsibility* can be seen as a result of the structure of an alliance, for example, *Risk and Reward Sharing* create a situation where each party has to work together to manage the risk and implying joint responsibility. *Early Involvement of Alliance Partners* is a result of other key alliance elements. All parties are involved early in that they all participate in defining the scope, calculating the TOC and creating the

alliance agreement. An *Internet-Based Information Management System* can be seen as a tool used by an alliance, or any other PDM for that matter. *Collaborative Problem Solving and Decision Making* were deemed to go hand in hand with *Unanimous Decision Making* and thus the two elements could be combined under the name of the latter.

Common Goals can be seen to relate to *Risk and Reward Sharing*, *Key Result Areas, Alignment of Client and Commercial Participants' Objectives* and *Incentivized Cost-Reimbursement*, since they all work together to create a situation where parties are working toward a set of common goals. *Built from the Ground Up* was a point of confusion in the case study, was highlighted in only one piece of literature and was not mentioned in the interviews. The principle of *Built from the Ground Up* could be incorporated into the element *Formal, Stand-Alone Contract*.

No Latent Condition Clauses is an element that can be seen as a component of *Risk and Reward Sharing*. The *No-Dispute Clause/ No Blame, No Fault Mentality* is a combination of hard and soft elements. Therefore, only the hard side should be included in this study. In addition, the *No-Dispute Clause* is a similar element to *Dispute Resolution Kept within the Alliance.*

The description of a *Three-Limbed Contract* ties in with the identified elements *Incentivized Cost-Reimbursement*, *Minimum Reimbursement of Direct Costs, Target Outturn Cost* and *Fee to Cover Corporate Overhead*. Finally, *Single Alliance Culture* is a result of an alliance implementing the elements of *Alliancing Workshops, Relationship Development, Alliance Facilitator* and *Alliance Uniform and Stationary*.

As discussed, a number of elements were identified as related yet were deemed important enough to secure their own place. This is represented by the use of dots, which indicate when an element/s relates to one of the 14 "parent" elements in final list. Table 16 presents the final list for the Australian alliance.

Table 16 Final List of Elements of an Alliance (Publication 2)

Elements of an Alliance
Open-Book Approach
No Dispute Clause No Blame, No Fault Mentality
• Dispute Resolution Kept within Alliance
Risk/ Reward Regime
• Pain/Gain Share
• No Latent Condition Clauses
Unanimous Decision Making
Integrated Project Team
• Co-location of Alliance Team
Alliance Leadership Team (ALT) (Alliance Board)
Auditing
Alignment of Client and Commercial Participants Objectives
Alliance Management Team (AMT)
Virtual Organization
Three-Limbed Contract
• TOC
• Incentivized Cost-Reimbursement

• Minimum Reimbursement of Direct Costs
• Fee to cover Corporate Overhead and Profit
Single Alliance Culture
• Alliancing Workshops
• Alliance Uniform and Stationary
• Relationship Development
• Alliance Facilitator
Formal, Stand-alone Contract

Summary

This study argues that fully understanding the relational delivery model concept, definition and successful implementation cannot be separated from the presented elements. Therefore, the answer to this research question resulted in a comprehensive list of hard elements of alliancing and partnering.

4.2 Relational PDMs in practice

Research question 2**:** *How are relational PDMs actually practiced in the construction industry?*

The purpose of this research question is to study how different relational PDM, namely partnering and alliance, are practiced in the construction industry. This research question concerns the presence in real-life projects of the hard components identified in RQ1. To answer this research question, the study explores the hard elements of partnering practiced in a broad range of projects in the Norwegian construction industry and alliance elements in Australian infrastructure projects.

The refined lists of elements, which resulted from the first research question, became part of the interview guide. In the case-specific interview sessions, these lists were used to crosscheck which elements were present in the case projects. The elements present in each case project were tabulated in two matrices (see Appendix 1 for partnering and Table 21 for alliance).

Partnering

Through the case projects and interviews, I identified the elements that were most frequently included in the 44 studied Norwegian construction projects. The results are presented in Appendix 1, which provides an overview of the frequency of elements by project. In this matrix, the case projects are listed in descending order, with projects with more elements on the left side of the matrix and those with fewer elements on the right. Partnering elements are listed in descending order by the frequency of use (see Appendix 1). An overview of the statistics from Appendix 1 is provided in Table 17. As part of the questionnaire, practitioners were asked to identify any additional key elements that were not shown in our list. This process uncovered three new elements, which are listed as part of the RQ1 findings.

Table 17 Overview of the Partnering Elements in Appendix 1 (Hosseini et al. 2018)

Partnering Elements	***Frequency***	
	P	*%*
Start-up workshops	37	84%
Partnering based on turnkey/design-build contract	36	82%
Early involvement of contractors	35	80%
Contractual right to replace people	34	77%
Functional description	34	77%
Value-based procurement	27	61%
Inclusion of architect in partnering group	27	61%
Inclusion of consultant in partnering group	25	57%
Target document (partnering charter)	24	55%
Intention/cooperation agreement	24	55%
Binding cooperation agreement	24	55%
Contractual right to replace firms	24	55%
Open-book economy	23	52%
Continuous workshops	23	52%
Target price with bonus/malus	20	45%
Inclusion of SC in the partnering group	17	39%
Measurement during project	15	34%
Prequalification	14	32%
Final workshop	14	32%
Conflict resolution mechanism	13	30%
Operational responsibility of contractor	8	18%
Co-location of partnering group	6	14%
Remuneration for accepted offers	5	11%
Inclusion of SC in bonus/malus	4	9%
Inclusion of consultant in bonus/malus	4	9%
Inclusion of architect in bonus/malus	4	9%
Inclusion of a consultant in the partnering contract	1	2%
Inclusion of an architect in the partnering contract	1	2%
Inclusion of SC in the partnering contract	1	2%

The matrix in Appendix 1 is an important tool to understand how partnering is performed in the Norwegian construction industry; specifically, it shows which elements are most often implemented in projects. The first observation that emerged from Appendix 1 is that no single partnering element is used consistently in all the studied projects. In fact, it is interesting to note that each client adopted basic partnering elements that were entirely different from the other clients. This observation highlights the significant diversity in the ways partnering arrangements are implemented.

To compare the findings from the case projects and the literature as well as findings from other contexts, after studying all references, I decided to anchor this section on the work performed by Eriksson (2010) as this is one of the most often cited sources (95 citations according to Google Scholar) and because it synthesizes other work by categorizing partnering definitions into four types. These four groups are presented in the theory section. Surprisingly, only two of the core

components of partnering described by Eriksson (2010) appear in the top ten identified elements in Appendix 1. Table 18 shows a comparison of top seven elements from Eriksson's theory versus findings from the case projects.

Table 18. Comparison of Top 7 Elements: Eriksson's Theory versus Findings from the Case Projects (Hosseini et al. 2018)

Partnering Elements from Eriksson (2010)	***Most Repeated Elements from Cases***
Bid evaluation based on soft parameters (value-based procurement)	Start-up workshop
Compensation form based on open book (open-book economy)	Partnering based on design-build
Start-up workshops	Early involvement of contractor
Joint objectives	Contractual right to replace people
Follow-up workshops (continuous workshops)	Functional description
Team building	Cooperation
Conflict resolution techniques	Contractual right to replace firms

By reviewing Eriksson (2010) minimum requirements and applying them to Appendix 1, it becomes clear that only six of the analyzed projects met the requirements underlined by Eriksson. This discrepancy may be related to the different research contexts; this study focused on the Norwegian contracting industry while Eriksson (2010) developed his research based on the Swedish construction industry. As an example, according to Eriksson, early involvement of the contractor is an optional component, while the respondents in our study clearly indicated it as the most important partnering element, was used in 80% of the studied projects. This discrepancy could be an indication that successful implementation of partnering is different in different contexts and environments. However, there may be other explanations. For example, target cost is stated as a core partnering element by Cook and Hancher (1990) and Black et al. (2000), but it was not used in more than half of the projects. One explanation for this is that the use of target cost requires a certain level of complexity and uncertainty to be advantageous. The findings also show that in addition to facilitating trust and commitment between parties, using target cost requires a client who is willing to share risk with the contractor during execution. In projects where uncertainty is low after the initial design and/or the client is not prepared to share risk with the contractor during execution, a fixed price contract is more suitable than target cost. The interview findings also support this argument, as one of the respondents from the client side simply noted, "*Why should [we] take the risk when all the design elements are fixed*?"

During the interview sessions, a table of identified hard elements was provided for each interviewee, and he/she was asked to prioritize the elements according to their importance to determine which elements were most recommended by practitioners to be included in partnering projects. The goal was to monitor different points of view and compare the results with the most repeated elements found in the literature and case projects. This goal proved difficult to implement due to the interdependency between the different elements and the absence of discussion regarding soft elements.

Table 19 was generated based on the rankings from the answers the interviewees gave when they were asked to prioritize the partnering elements based on their importance for the successful implementation of a partnering project.

Table 19 Partnering Elements Recommended by Respondents Ranked by Priority (Hosseini et al. 2018)

Rank	Partnering Element	Rank	Partnering Element
1.	Early involvement of contractors	16.	Value-based procurement
2.	Target price with bonus/malus	17.	Inclusion of consultants in bonus/malus
3.	Inclusion of consultants in partnering group	18.	Final workshop
4.	Co-location of partnering group	19.	Target document
5.	Inclusion of subcontractors in partnering group	20.	Binding cooperation agreement
6.	Inclusion of architects in partnering group	21	Intention agreement
7.	Continuous workshop	22.	Remuneration for accepted offer
8.	Functional description	23.	Prequalification
9.	Inclusion of subcontractors in bonus/malus	24.	Inclusion of subcontractors in the contract
10.	Start-up workshop	25.	Inclusion of consultants in the contract
11.	Operational responsibility of the contractor	26.	Inclusion of architects in the contract
12.	Inclusion of architects in bonus/malus	27.	Conflict resolution mechanism
13.	Open-book economy	28.	Contractual right to replace people
14.	Measurement during the project	29.	Contractual right to replace firms
15.	Partnering based on turnkey		

Although Table 19 mirrors the respondents' subjective points of view, the results are illuminating. I found it difficult to identify an element with the same weight in the three datasets from the literature, respondent's rankings and case projects. There are several examples of this kind of discrepancy, clearly demonstrating the lack of consistency in partnering and making it hard to find a standard definition (/list of elements) of partnering or to establish recommendations for partnering practices in the construction industry. These findings confirm that partnering is characterized by a high level of contingency in different situations and contexts. This aspect further increases the complexity in defining a standard means for implementation (Ng et al. 2002).

Furthermore, to cope with uncertainty around the partnering concept, some clients operated with the minimum requirement for every project, assuming that a partnering project is one that includes at least one partnering element. Other elements can be implemented in the project according to the specific case and situation. According to Bresnen and Marshall (2000b), one of the main issues is the decision of the owner as to whether to define a best practice for partnering that applies to every case or to customize partnering practices for each project.

Table 20 contrasts the elements recommended by respondents in this study to the set of core partnering components described by Eriksson (2010).

Table 20. Comparison of Eriksson's Theory with Interview Findings (Hosseini et al. 2018)

Partnering Elements from Eriksson (2010)	Most Recommended by Respondents
Bid evaluation based on soft parameters (value-based procurement)	Early involvement of contractors

Compensation form based on open books (open-book economy)	Target price with sharing bonus/malus
Start-up workshops	Co-location of partnering group
Joint objectives	Inclusion of consultants in partnering group
Follow-up workshops (continuous workshops)	Continuous workshops
Team building	Inclusion of architects in partnering group
Conflict resolution techniques	

An interesting observation from the interviews is that some of the elements that are weighted by respondents are not repeated in the majority of projects. Examples are the inclusion of a consultant in the partnering group (57%), continuous workshops (52%), target price (45%) and co-location of the partnering group (15%). These findings can imply that implementation of the theory requires more available resources and practice.

The soft partnering elements listed in Table 5 are, to a large extent, present in all successful construction projects and are not limited to only partnering projects. Some of the elements can be both soft and hard, such as volunteer group composition and mutual objectives (Yeung et al. 2007). Another point to note is that, in some cases, hard elements such as workshops force participants to implement soft elements and thereby achieve greater effects. One of our respondents supported this argument by saying: *"[we] built up a better relationship [between involved parties in the project] by more meetings and social gatherings."*

Finally, there is a conspicuous discrepancy when comparing the elements that have been used in real projects and the recommended elements identified from the literature. Despite the fact that elements such as co-location of the partnering group and the inclusion of consultants have a high ranking of importance (see Table 19), they were actually implemented in only a few projects. It is important, then, to consider whether application of the theory in practice requires experience, resources and knowledge, especially when some elements are still new for many industry players.

Alliance

In the study of alliance projects, the elements present in each case project show that each element was present in every project, with the exception of co-location of alliance team, which was only partially present in one project. Table 21 shows the list of alliance elements and their presence in the target projects.

Table 21 Elements Present in the Alliance Case Projects (Publication 2)

Elements of an Alliance \ Project	***Perth City Link Rail***	***Perth Busport***	***Gateway WA***	***Karatha Tom Price***	***Windsor Rd***	***Hunter Expressway***	***Springvale Rd Rail***	***Anzac Bridge***	***Lawson***	***Ballina Bypass***	***Cotter Dam***	***Seacliff Bridge***	***Inner West Busway***	***Sydney CBD***	***Leikke***
Formal, Stand-alone Contract	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Virtual Organization	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pain/Gain share	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Risk/Reward Sharing	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• No Latent Condition Clauses	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Alignment of Client's and Commercial Participants' Objectives	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Three-Limbed Contract	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• Incentivized Cost Reimbursement	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• Minimum Reimbursement of Direct Costs	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• Target Outturn Cost (TOC)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• Fee to Cover Corporate Overhead and Profit	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
No Dispute Clause/No Blame, No Fault Mentality	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• Dispute Resolution Kept within Alliance	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Open-Book Approach	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Auditing	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Alliance Leadership Team (Alliance Board)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Alliance Management Team (AMT)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Unanimous Decision Making	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Integrated Project Team (Incl. Client)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• Co-location of Alliance Team	x	x	x	x	x	x	*	x	x	x	x	x	x	x	x
Single Alliance Culture	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• Alliancing Workshops	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• Relationship Development	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• Alliance Facilitator	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
• Alliance Uniform and Stationary	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

*Partial

It appears from this sample of projects that the structure of alliancing within Australia is highly consistent. As part of the questionnaire, practitioners were asked to identify additional key elements that were not shown in Table 21. This process did not uncover any new elements, providing some confirmation that the list of elements is comprehensive, with the exception of co-location of alliance team, which was only partially present in one of the projects.

Elements Unique to Alliancing

The literature search identified a number of elements as unique to alliancing (see Table 15). Firstly, the majority of elements that contain the word alliance in their title are considered to be unique to alliancing. One exception is *Alliancing Workshops*. The intention of alliancing workshops is to develop the culture of the team. In partnering arrangements, such workshops are used to develop the partnering mindset and are thus not unique to alliancing. Secondly, the elements *Virtual Organization, No Latent Conditions Clauses, Three-Limbed Contract* and *No-Dispute Clause* are also considered unique to alliancing. They do not appear in the studied literature that references other PDMs. It should be noted that a comprehensive literature study was not performed for other PDMs and thus these results are not necessarily a 100% accurate representation of current usage. The remaining elements have been, to some degree, mentioned in the literature in relation to other PDMs. For example, studies on partnering indicate that partnering can include elements such as *Co-location of Team, Target Cost with Bonus/Malus* and *Open-Book Economy.*

During the interview series, particularly the interviews that involved the discussion of the case projects, the participants were asked to identify whether they thought a particular element was

unique to the alliancing PDM. The results from the responses of the case-specific interviews are presented in Table 22. For the remaining interviews, while the table of elements was not specifically reviewed with the participants, a number of elements were mentioned as being unique to alliancing during the general discussion. The number of mentions is in the second-to-last column of Table 22. The total number of times an element was mentioned, from both the case studies and the remaining interviews, is shown in the last column of the table.

Table 22 Elements Unique to Alliancing as Identified by Australian Practitioners (Publication 2)

Elements of an Alliance	***Indicated as Being Unique to Alliancing by the Interviewees***													***#***	***Total***
Case Specific Interview Number:	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	
Pain/Gain Share				x				x		x					2	5
Open-Book Approach		x	x	x			x	x					x		1	7
Risk Reward Sharing	x							x		x					3	6
No Dispute Clause/No Blame, No Fault Mentality							x	x		x			x	x	2	7
Alliance Leadership Team (Alliance Board)	x	x		x	x			x								5
Alignment of Client's and Commercial Participants' Objectives						x		x					x		1	4
Auditing				x	x		x	x					x			5
Integrated Project Team (Including Client)		x		x				x					x		2	6
Unanimous Decision Making		x		x	x		x	x					x	x	1	8
Target Outturn Cost (TOC)		x		x			x	x					x			5
Virtual Organization				x			x	x					x			4
Alliance Management Team (AMT)	x	x		x	x			x								5
Incentivized Cost-Reimbursement		x		x			x	x					x			5
Co-location of Alliance Team		x		x	x			x		x			x		1	7
Alliancing Workshops		x		x	x	x	x	x								6
Fee to Cover Corporate Overhead and Profit		x		x			x	x					x			5
Formal, Stand-Alone Contract																0
Minimum Reimbursement of Direct Costs		x	x	x			x	x					x			6
Dispute Resolution Kept within Alliance							x	x					x			3
Three-Limbed Contract		x		x		x		x					x		1	6
Relationship Development		x		x		x *	x	x								5
Alliance Facilitator		x		x		x	x	x								5
Alliance Uniform and Stationary		x		x	x	x	x	x					x		1	8
No Latent Condition Clauses				x			x			x				x	1	5
Single Alliance Culture		x		x		x	x	x							1	6

 # This column indicates the number of times a particular element was mentioned as being unique to alliancing in the interviews that were not case-specific.

Table 22 reveals a significant amount of inconsistency among practitioners as to which elements are unique to alliancing. The elements that received the most mentions were *No-Dispute Clause*, *Open-Book Approach*, *Unanimous Decision Making*, *Co-location of Team* and *Alliance Uniform and Stationary*. Of the elements considered unique based on the literature, all were mentioned to some extent by some of the interviewees. Interestingly, some elements that were considered not

to be unique to alliancing based on the literature were mentioned as unique by some of the interviewees.

Based on the findings from the interviews, the greatest cause for inconsistency in identifying unique elements stems from practitioners' experience and background. For example, if a practitioner had only worked on D&C projects prior to working in an alliance, they might believe that the majority of alliancing elements are unique to alliancing, as they do not appear in D&C projects. Other practitioners may have worked in different partnering projects, and the elements used in these particular partnering projects (given that there is no consistency with partnering elements) will determine what they believe to be unique to alliancing. Some practitioners are actively working on new and innovative contracts that are based on the alliancing model and thus they consider none of the elements unique. As stated by one participant: "*Most of the alliance elements are now found in Delivery Partner* (the model used to build the infrastructure for the London Olympics)" (Participant 9). The most likely case is that no single element is unique to alliancing, and it is the unique combination of elements that makes the Australian alliancing model unique in the world of PDMs. One participant stated: "*The unique combination of all the elements are what make an alliance, not the individual elements*" (Participant 10).

One participant mentioned an aspect that is not directly related to a unique element but is unique to the alliancing experience: "*Everyone gets a better understanding of all the parties' drivers. Contractors and consultants have said that they never really understood some of the client perspectives, and because you have those discussions all together in an alliance everyone gets to understand that and why you would want to do certain things and why you've gone down a particular path*" (Participant 4). This communication can also be considered one of the benefits of alliancing.

It is also worth mentioning that several countries, particularly in Europe, have begun adopting alliancing. In addition, countries such as Finland, who adopted alliancing in 2007, have begun experimenting with adopting lean ideology (lean construction elements) in their alliance projects (Lahdenperä 2012). Such knowledge could be useful to practitioners looking at incorporating lean principles and tools into the alliancing model; such is the case in Finland. It could also prove useful to those looking at developing improved collaborative contracting models.

Summary

The purpose of this RQ is to shed more light on two relational PDMs (alliancing and partnering) by studying the tangible areas (hard elements) implemented in real-life case projects. This purpose is achieved through developing Appendix 1 and Table 21.

In general, the Appendix 1 matrix represents a helpful tool to understand how partnering can be implemented, but it does not show which specific partnering elements must be adopted in projects. It is not possible to recommend specific partnering elements over others without looking at the purpose, situation and context of a project and the combination of soft elements used to promote the partnering culture in the project. In contrast, what separates Australian alliancing from

partnering is the unique combination of all the elements listed in Table 16. However, in some countries, such as Finland, more elements were added to this list, resulting in the unique form of alliancing in the particular country. Therefore, by considering hard elements as the mean of defining a PDM, in practice, a relational PDM could take one of the following forms: 1) a known combination of hard elements (well-defined relational model) such as Australian alliances (all the hard elements are presented), 2) a customized version of a well-defined relational model (by adding/removing some of the hard elements) such as alliances in Finland and 3) a new combination of hard elements such as a variation of partnering in Norway. This indicates that different relational contracts could possibly include a dissimilar list of hard elements while having some elements in common.

When it comes to uniqueness of elements, before the emergence of new PDMs perhaps a few years ago, many elements could have been said to be unique to alliance, partnering or other forms of relational models. However, countries today are seeing an increase in innovative and relational PDMs, which have adopted many elements used in alliances or other models. Additionally, soft elements are essential for achieving full benefits in coordination with hard elements. This means that hard and soft elements are interdependent and that success of a relational model is a result of both.

4.3 How and under what project characteristics should the client consider adopting a relational PDM?

Research question 3: *How and under what project characteristics should a client consider adopting a relational PDM?*

In many countries, there is increasing interest in promoting relational PDMs to avoid the adverse objectives and conflicts that have characterized the industry due to the use of traditional forms. For countries that are new to this concept, deciding on and shifting from a traditional environment to a collaborative one is not easy. The purpose of this research question is first to investigate the project characteristics that suggest considering relational delivery models and second to develop a conceptual model based on contributions from the previous RQs and other research projects that were carried out during this Ph.D. study to assist with decision making regarding selection of a relational PDM.

According to Love et al. (2008), factors such as familiarity, straightforwardness, culture of uncertainty escaping and economic aspects are drivers for a client to utilize a single-stage contractual model as a common practice. In this model the main contractors are appointed only in the construction phase which means gaining using the influence of all involved actors to achieve a successful outcome through this model is unlikely. In response to this shortfall, a number of methods for delivering a project have arisen; these are progressively dependent on the relationship between all parties (client, designer and constructor). Despite the benefits of relational PDMs, models such as alliancing and partnering are not suitable for every project (Henneveld 2006, Chew 2004, Ng et al. 2002, Thompson and Sanders 1998). In this regard, the main objective of the first part of this research question is to explore the project characteristics

for which clients should consider relational PDMs as a valid option to achieve the project goals. The answer to the first part of this research question does not concern any specific relational PDM and thus factors that suggest relational PDMs in general and not a particular relational PDM are mapped.

4.3.1 Characteristics of a project that are suitable for a relational PDM.

Project characteristics identified thorough partnering and pilot study

While using an appropriate PDM is one of the key factors leading to project success, deciding which PDM to adapt is a challenging task due to the variety of available options and diversity of project/client needs and objectives. Therefore, identification and formulation of PDM selection criteria is the first step while evaluating the available options against those criteria is the second step for a logical approach for selecting a suitable PDM (Love et al. 2008).

A primary list of selection criteria for adopting a suitable PDM was identified through the cross-disciplinary literature review (see Publication 5). The criteria that need to be considered in the decision-making process are categorized into three groups, namely project characteristics, owner characteristics and external environment. At an early stage of this Ph.D. work, this list of selection criteria was used as a reference in interviews for a pilot study financed by NPRA concerning experiences with different relational PDMs in Northern European countries. During this pilot study, respondents pointed out two reasons for utilizing a relational PDM. The first reason reflects the need for *improving the project contributor's attitude*, which may result in efficiency though decreasing the number of disputes and incidents. The second reason addresses demand for *innovation* and innovative solutions as a result of project becoming more *complex*, *uncertain, larger and longer*. The majority of respondents described relational PDMs as the ideal solution to deal with these project characteristics.

According to Bresnen and Marshall (2000a) the set-up cost for an extensive relational delivery model is not justified for small, less complex projects of low strategic importance. In this regard, the contract law literature, particularly studies referring to transaction cost economics (TCE), stresses that a delivery model in which competition is facilitated (traditional approaches) are most appropriate for standardized, occasional and simple transactions, while relational delivery models, created on a collaborative foundation, are better for complex, recurrent and customized transactions (Macneil 1977, Williamson 2007, Eriksson 2010). Based on this (including TCE logic), several researchers have suggested that increased collaboration is required for construction projects characterized by *customization, uncertainty, complexity, and long duration (large size)* in addition to *time constraints* (Palaneeswaran et al. 2003, Lu and Yan 2007, Eriksson 2008b). Eriksson (2010) conducted a comprehensive study on partnering and concluded that partnering should be used in *customized* projects, which can be described as *complex, uncertain, large in size, and with severe time pressures*. He stressed that by increasing the level of these project characteristics, a higher level of collaboration and less competition is essential.

Project characteristics identified through alliance study

Prior to the study of alliance projects in Australia, a literature review was conducted to identify the situation in which a project is suitable for an alliance. Table 23 illustrates the characteristics suitable for an alliance arranged in order of the number of articles that have attributed these project characteristics to the selection of an alliance.

Table 23 Characteristics of Projects Suitable for Alliancing Identified by the Literature Study (Publication 2)

Project Characteristic	*References*	*Total*
Tight Time Constraint/ Need for Early Start	3,5,6,8,9,11,16,23,25,26,29,31,35	13
High Risk	3,6,5,8,9,11,16,25,29,30,31,35	12
High Complexity	3,6,11,13,16,18,23,25,26,29,31	11
Multiple/Complex Stakeholders	3,6,11,13,14,16,23,25,26,29,31	11
Unclear/Broad Scope/Risk of Scope Change	1,3,8,11,13,16,18,25,26,29	10
Complex External Threats	3,6,11,16,25,26,31	7
High Uncertainty	1,3,9,16,29,30,35	7
Need for Innovation	8,12,18,23,29,31	6
Tight Cost Control	3,16,23,29	4
Environmental Challenges	14,16,29	3
Large Project/High Cost	8,9,14	3
Need for Owner Involvement	11,25,26	3
Resource Shortages	8,29,35	3
Need for Flexibility	12,29	2
High Visibility	18	1
Special Requirements	3	1

A number of the characteristics can be combined based on their similarity. For example, if a project has the *Need for Flexibility* or *High Uncertainty*, in terms of how alliancing addresses this issue, it is very similar to having an *Undefined Scope* or having a *Risk of Scope Change*. In all these cases, participants work together to solve issues as they arise by maintaining a high degree of flexibility in the process. *Special Requirements* was mentioned briefly by just one source, so with limited information on this characteristic, it is not considered relevant to this study. However, it was noted that this descriptor could potentially cover other characteristics mentioned here, such as complexity, innovation, need for owner involvement, depending on the view of the PO.

In addition, a number of drivers that influence the selection of alliancing was identified through the interviews in Australia. According to respondents in the study of Australian alliance projects, alliances may be a valid option when a project has one or more characteristics from the list in Table 24.

Table 24 - Characteristics of Projects Suitable for Alliancing Identified by 14 Australian Alliance Projects (Publication 2)

Characteristic / *Case Specific Interview Number*	*Dis Characteristic Influence Project*													
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
Unclear/ Broad Scope/ Risk of Scope Change		x		x	x	x	x	x	x	x	x	x	x	x
Tight Time Constraint/ Need for Early Start	x			x	x	x	x		x		x	x	x	x
Need for Owner Involvement	x	x	x	x	x		x	x	x		x			x
High Risk	x	x	x	x	x		x		x					x
Multiple/Complex Stakeholders	x			x			x	x	x	x				x
Multiple Interfaces	x	x	x		x		x	x	x					x
High Complexity	x			x	x	x	x	x	x		x			x
Large Project/High Cost				x	x				x					
Need for Innovation		x		x	x						x		x	

Tight Cost Control		x	x			x				x
Environmental Challenges			x	x				x		
Client Organization (Internal Factors)			x			x				
Complex External Threats	x							x		
Other: Reputation (Internal Factors)		x								
Market Situation (External Factor)										

The results in Table 24 show the three most referred to project characteristics are *Unclear/Broad Scope/ Risk of Scope Change*, *Tight Time Constraint/ Need for an Early Start*, and *Need for Owner Involvement*. Other notable mentions are *Multiple/Complex Stakeholders*, *High Risk*, *High Complexity* and *Multiple Interfaces*. While going through the table of characteristics with interviewees, the interviewers asked if there were any additional reasons why the client chose an alliance or other relational model. This resulted in the addition of new characteristics to the list: *Reputation, Market Situation* and *Political Commitment*. However, it should be noted that *Reputation*, should be categorized along with the characteristic of Client Organization, since being internal factors, as they are the internal logic of the organization and not necessarily project characteristics. Following the same logic, *Market Situation* and *Political Commitment* can be identified as external factors that influence selection of a model, not project characteristics. They have been included here to show that they were considered during the selection process. Since they are not (obvious) project characteristics, they will not be considered in detail; hence, they are used in the following developed conceptual model for selecting a relational PDM. Table 25 outlines the final list of characteristics that indicate a project is suitable for alliance.

Table 25 Characteristics that Make a Project Suitable for Alliancing

Project Characteristics	
Tight Time Constraint/Need for Early Start	Need for Innovation
High Risk	Complex External Threats
Unclear/Broad Scope/ Risk of Scope Change	Tight Cost Control
Multiple/Complex Stakeholders	Large Project/High Cost
High Complexity	Multiple Interfaces
Need for Owner Involvement	Environmental Challenges

Most often, several characteristics of a project are taken into consideration when determining the choice of delivery model for a project. However, in some cases, the decision to use an alliance is based purely of one or two project characteristics. For example, Jefferies et al. (2014) highlighted:

> The Queensland State Government, in the form of both their Public Works and Main Roads departments, use Alliance and Partnering arrangements as default contracts on projects with construction periods of over 12 months and/or with a dollar value of A$10 million (p.477).

Final list of characteristics of projects suitable for relational PDM.

Although Table 25 provides a comprehensive list of project characteristics, some of the identified characteristics are related particularly to the alliance delivery model. To finalize the list of key characteristics that is valid for relational PDMs in general, relevant data collected from the alliance, partnering and pilot study (literature, interview notes and records) were reviewed and

analyzed for content. Table 26 outlines the related findings of this review, followed by a discussion of each factor.

Table 26 Findings Related to Project Characteristics Suitable for Relational Delivery Model Identified in This Study

	Source of the Findings		
Characteristic	*Alliance Study (E & T*)*	*Pilot Study (E)*	*Partnering Study (T)*
Fairly High Level of Uncertainty	x	x	x
Fairly High Level of Complexity	x	x	x
High Risk	x	x	x
Large Size	x	x	x
Time Constraints	x		x
Need for Innovation	x	x	
Multiple/Complex Stakeholders	x		
Need for Owner Involvement	x		
Complex External Threats	x		
Multiple Interfaces	x		
Environmental Challenges	x		
Tight Cost Control	x		
External Threats	x		
Improving Project Participants' Attitudes		x	
Customized Project			x

**E = empirical, T = literature review result*

In the pilot study, *Improving Project Participants' Attitudes* through building a collaborative environment was stressed as one of the reasons for utilizing different relational models. This criterion was identified as a client objective and not a project characteristic, so it was excluded from the final list. Moreover, this factor was not mentioned in Australian interviews as a reason for selecting a relational model. One of the participants pointed to this issue by saying: "[*A] culture of collaboration in delivering a project is recognized by the people [project participants] here [Australia]; we know that collaboration is good, so it can't be a reason for selecting a relational model.*" This criterion can also be considered one of the outcomes of utilizing a relational PDM, as it creates a different way of working and may result in encouraging trust, teamwork and commitment to overcome uncertainty through developing a collaborative mentality throughout the lifecycle of a project (Walker and Lloyd-Walker 2013). This argument supports the importance of other criterion in the findings, such as *Uncertainty*. Uncertainty ,according to Perminova et al. (2008), is "an event or a situation, which was not expected to happen, regardless of whether it could have been possible to consider it in advance." Additionally, it is important to distinguish risk from uncertainty. Perminova et al. (2008) stressed that uncertainty occurs when established facts are questioned and thereby the basis for calculating risks (known negative events) or opportunities (known positive events) is questioned.

According to Hibberd (1996), risk is a project principle that regulates the choice of delivery model. Respondents also mentioned the factor of risk as well, where the majority of interviewees in Australia identified a risky profile as one of the key factors affecting the selection of a relational PDM (alliance). Projects with high risk are suited for alliancing while partnering is more suitable for projects with high risk but less risk than with a typical alliance. While a relational PDM facilitates joint risk assessment through the early involvement of the competence, one participant highlighted that pure relational delivery models such as alliances are not suitable for straightforward projects, stating: "*[I] would go alliance every single time for the most high risk and important projects if you had the right competent staff. Don't do alliances for routine work.*"

Complexity, according to Klakegg et al. (2010), is the presence of codependent variables that are interrelated in a non-simple way. For the majority of respondents, *Complexity* is one of the factors that would influence their choice of PDM. Further, complexity receives significant attention in the literature as one of the main selection criteria for utilizing a PDM (see Publications 2 and 5). Based on the respondents' points of view, the existence of a fairly high level of complexity is a reason to utilize relational models, in which the contractor contributes to both the design and risk identification, which may result in major savings. It is noteworthy that partnering may not be a proper choice when there is a high level of complexity. According to Chen (2012), an alliance is a preferable choice in this situation.

Time Constraints were repeatedly mentioned in the interview sessions in Australia, mirroring one of the main factors supporting the decision to adopt a relational model. Findings from interviews in Australia indicate that for a project that needs an early start, relational delivery models such as alliancing are a preferred option since construction could start through ECI while design development is still in progress and could benefit from the early involvement of the contractors. While ECI has been identified as one of the most important hard elements of a relational delivery model in this Ph.D. work, according to Li et al. (2005), it also influences whether the earlier completion of a project can be achieved through accelerating project development.

While estimated value or time usually mirrors the *Project Size*, this was identified in the reviewed literature and by respondents as a criterion for selecting a relational model. Although some participants believed that a large size means a complex project, according to Baccarini (1996), some high-value projects are not complex and technically do not carry a high degree of complexity. Furthermore, Vidal and Marle (2008) argued that although the size of a project is a required condition for the complexity, it is not sufficient. Therefore, complexity and size of a project are considered separately as selection criteria in this Ph.D. work.

Most of the respondents identified *Innovation* as a driving force for selecting a relational PDM, especially when there is a lack of in-house competence and expertise in design competencies, methods of construction and technologies to achieve the project goals. A C*ustomized Project*, according to Eriksson (2010), calls for collaborative models such as partnering while high customization refers to a situation in which no existing product is available and process development is required. This characteristic could fall under *Innovation* or the need for innovative

solution and thus the criterion is not mentioned in the final list. When the client notices the need for innovation, they may pursue an alternative PDM, which would enable the adoption of innovation. Moreover, Kumaraswamy and Dulaimi (2001) studied the effect of PDMs in encouraging innovation and discovered that innovation is significantly enhanced by utilizing a relational delivery model such as alliancing.

Through the study of the alliance literature and Australian alliances, other criteria such as *Need for Owner Involvement, Multiple Interfaces*, *Complex Stakeholders, Tight Cost Control, Environmental Challenges* and *External Threats* were identified. However, these characteristics were not mentioned in other interviews regarding the selection of a relational PDM. This may indicate that not all relational PDMs (such as some variation of partnering) are able to deal with these characteristics as effectively as an alliance model due to the lack of relevant hard elements. In situations where the continuous involvement of contractors during the life cycle of a project is required, a form of pure relational PDM such as an alliance is an appropriate choice (Ma and Xin 2011). When it comes to the *Need for Owner Involvement*, despite findings from the Australian interviews that this criterion is recognized as an important project characteristic for the alliancing model, it cannot be justified for all relational models. An alliance PDM includes elements that deal with this need. An ALT, otherwise known as an alliance board is made up of an equal number of representatives (senior executive managers) from each party (Chen et al. 2010) and is formed precisely for the purpose of the alliance (Mills et al. 2011). Additionally, in the alliance model, the *Integrated Project Team* is very useful when there is a need for owner involvement, as the client is embedded in the team for the duration of the project and can maintain a level of influence over the project outcomes. These elements are not present in other relational models. The *Integrated Project Team* is also crucial for enabling an alliance to deal with *Complex Stakeholder Issues*. Having the most suitable person for the job in each position means issues can be managed very effectively. For example, as identified by one of the practitioners among respondents in the alliance study, the client often has well-established community consultation systems and networks, while contractors may not have such systems and networks in place. Thus, it makes sense to have key client personnel in relevant positions within the alliance or partnering team. In some cases, alliances were chosen for a project due to the *Tight Cost Control* needed. For example, some projects were given a problem and a budget and told to find the best solution that solves the problem and fits the budget. Alliances have a certain freedom to change solutions on the go, as they are not locked into a pre-design. Combine this factor with the fact that it is in the best interest of all parties to find the best solution, meet the incentivized KRAs and reduce the project cost to make money, and it becomes clear that alliancing is well-suited to dealing with *Tight Cost Control*.

Moreover, in an alliance, *Shared Risk* and *Pain/Gain* arrangements combined with the *Alignment of Client's and Commercial Participants' Objectives* creates an entity that is adept at dealing with projects that are *High Risk* or have *High Levels of Uncertainty*. When problems arise, it is in the best interest of all the parties to find the best-for-project outcome and find it quickly. In addition,

these elements work together to enable the alliance to deal effectively with *Complex External Events*. The previously mentioned elements, combined with *Unanimous Decision Making, No-Dispute Clause* and *Open-Book Economy*, help to ensure the win-win principle of alliancing necessary to deal effectively with the issues that arise. Therefore, as discussed, the unique combination of the hard elements of an alliance make it possible to deal with these characteristics while the consistent combination of such elements does not exist in partnering. In this regard, while these criteria are not included in the final list of project characteristics, which suggests selecting a relational PDM in general, they are included in the list of project characteristics that greatly influence the selection of an alliance PDM.

It is noteworthy that although all selection criteria should be considered during the decision-making process for selecting an appropriate PDM, due to nature of the first part of this research question, only project characteristic criteria pertinent to all relational PDMs are considered in the final result. These characteristics are: *Fairly High Level of Uncertainty and Complexity, Time Constraints, High Risk, Large Size* and *Need for Innovation.*

4.3.2 PDM selection model based on hard elements

As stated earlier, the choice of PDM is critical for both clients and contractors and greatly influences project outcomes. There is evidence that one of the most important factors that determine a project's success is the adoption of a suitable PDM (Al Khalil 2002, Chan et al. 2001, Kumaraswamy and Dissanayaka 2001, Naoum and Mustapha 1994, Luu et al. 2005). While this has been the motivation for developing different PDM selection methods, in many cases, the PDM is chosen without considering relevant factors such as market situation and characteristics of the project. Although some clients select a PDM that has worked for them before, Lædre et al. (2006) argued that the traditional selection of "what has worked before" is a pitfall and one of the reasons why PDMs fail. The difficulty of selecting a relational model is more intense in many countries due to lack of experience with or limited knowledge about these concepts on one hand and a wide range of choices due to the large number of available options in the industry on the other hand. Therefore, adopting a relational PDM should be done through a disciplined process while meeting the client's overall strategic objectives.

The first part of this research question is focused on identifying the project characteristics that suggest a relational PDM should be considered as a valid option. Moreover, it is important to stress that project characteristics should not be the only consideration in the decision-making process. In this regard, the conceptual model developed as a culmination of this Ph.D. work is based on the previous RQs' contributions and the findings of other research projects carried out during this Ph.D. study. A simplified version of the model is illustrated in Figure 10.

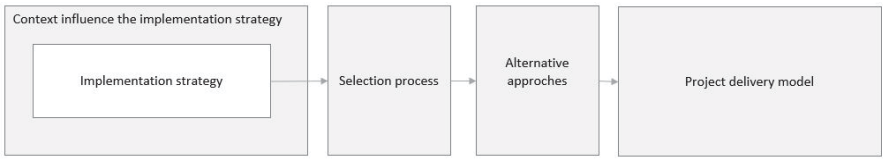

Figure 10 Conceptual Model for Adopting a Suitable PDM

This model can assist decision makers with client organization during the selection process when they are considering the hard elements of relational models as the means of defining them. Each component of the model is broken down into a level of detail and elaborated below from right to left.

Figure 11 illustrates the structural elements of a PDM according to Klakegg (2017), followed by a description of the elements. Each element describes how the project should be formed and executed while PDM is the base that joins them all together.

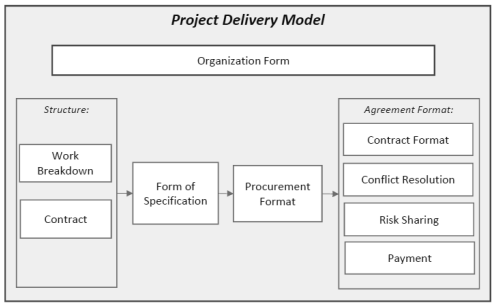

Figure 11 Main Components of PDM According to (Klakegg 2017)

Organization form. This involves the choice of how principal structures should be to secure efficient decision making and project governance. It includes the use of steering groups or project boards when relevant. An important issue is the relationship between the owner, sponsor and other key roles, including who decides what, the distribution of competences and mandates, the choice of working format (e.g., co-location).

Form of specification. This involves how the deliverables should be described as the basis for procurement and how the performance should be defined and measured. A key question is whether the resulting infrastructure should be specified or defined by function. This defines the bidding party's room to maneuver.

Work breakdown structure. The task at hand needs to be broken down into manageable pieces for control. This structure holds the key to most other control issues, like responsibility (organizational breakdown structure), cost (cost breakdown structure) and scheduling. It also defines the structure that is mirrored in the contract.

Contract structure. This involves the choice of how the scope is divided into work packages fit for contracts. This determines how many and what contracts the client will sign and thus how

complex the administrative tasks will be on the owner's side. Examples of procurement forms are DBB, DB, and project partnering contracts.

Procurement route. This involves the choice of how to recruit the best resources for a project and secure the right suppliers to match the needs of the project. There are many different ways to arrange this process, including direct orders, open bidding, negotiations and complete procurement methods like best value procurement or competitive dialogue. Some limitations occur in public sector, which should be considered in the implementation strategy.

Contract format. This involves the choice of contract formats for a project. There are numerous forms available, including standardized or specially fitted to one organization. The main choice is a transactional or a relational contract. As in the case of PDMs, organizations may have a standard contract type as a general guideline for all contracts or may carefully select the best format for each specific contract. The contract format specifies the rules of the game and outlines risks and incentives for the contract parties.

Conflict resolution form. One of the elements in the contract that must be chosen is how to secure effective conflict resolution in situations where the parties do not see eye to eye. This is an important choice as it is seen as an expression of the intended qualities of the resolution process.

Risk-sharing format. This is another specific element in the contract worth mentioning. Every contract involves sharing risks and opportunities between the contract parties. There is a plethora of choices for what responsibilities should linger on the owner's side and what should be transferred (in return for a risk premium) to the supplier's side.

Payment format. The choice of payment format is triggered by specific deliveries or services. The selection includes fixed price, unit prices, cost remuneration or sharing models, among others. Price format is another term used for this element.

Alternative approaches and selection processes for adopting a PDM.

Various PDMs are adopted for different construction projects. CII presented a traditional perspective while placing different delivery models into three fundamental PDM categories: DBB, DB and CM (Sanvido and Konchar 1998). However, in a later publication, it added 12 new options under the collective term integrated project delivery and contract strategy (Anderson et al. 2003). In a relatively new classification, Walker and Lloyd-Walker (2015) summarized the choices for studying the collaborative features of PDMs and investigated the trend toward relational base PDMs. These sources can be used when a client decides to use an existing model, yet the conceptual model proposes that searching for the best-fitting PDM among existing models is an approach. Figure 12 illustrates the three identified approaches in this Ph.D. study through answering RQ2 and considering the hard elements of relational models. These approaches are elaborated below.

I. Selecting a PDM: One approach is to select a well-defined relational model such as Australian alliancing and use it as is.

II. Customize a PDM: In this approach, the client customizes an existing model by changing its components (adding or removing hard elements).

III. Developing a PDM: A situational or standard PDM can be built from the scratch.

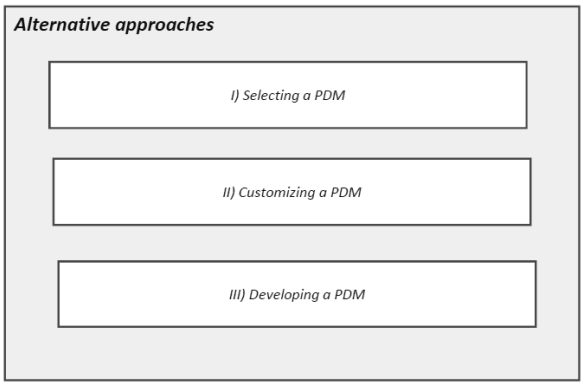

Figure 12 Alternative Approaches for Adopting a PDM

A metaphor can make these approaches easier to understand. Think about hard elements as ingredients and different types of PDMs as different dishes. Countries/organizations, may have their own traditional dishes, which may share some ingredients with other countries/organization. In this case, if you want to make a dish, you have three options: I) using a "set recipe" and cooking a well-known dish for which you know all the ingredients from a recipe. This scenario refers to set PDMs such as an alliance in Australia in which, according to the findings of RQ2, the hard elements (ingredients) are presented in the target projects. The next option is: II) customizing a set recipe by adding or removing some of the ingredients based on your diet and needs. This scenario represents alliancing in Finland, where the Australian alliance recipe is customized by adding ingredients, namely lean tools and BIM. Finally, the last alternative is: III) cooking your dish without a pre-defined recipe. In this scenario, you use the ingredients that fit your needs and diet to cook your own dish. Therefore, you need a "shopping list" (list of ingredients) to make for your dish. This study helps to build up a shopping list by providing comprehensive lists of hard elements of partnering and alliancing from which to pick up. An example of this set-up is the diverse variations of partnering in the Norwegian construction industry identified and discussed in RQ2. Accordingly, as stated in the summary of RQ2, by considering hard elements as the constituents of different models, these three alternatives represent a known combination of elements (alternative I), a customized version of an existing model (alternative II), or a new combination of elements (alternative III).

The next component of the model is *selection processes*. There are many different selection methods that clients could utilize to select a PDM for their projects. The literature (Gordon 1994, Love et al. 2008, Love et al. 1998, Love et al. 2010b, Luu et al. 2005, Masterman and Duff 1994, Ng et al. 2012, Skitmore and Mills 1999, Skitmore and Marsden 1988) identifies a variety of

methods that can be practiced in the construction industry. Different organizations and clients employ different methods, which vary in their levels of subjectivity and formality. Some of these methods are presented in Table 6. These methods and tactics can be clustered into three groups:

- External consultation: In this group, the client uses counsel and advice from an external organization or consultant with relevant experience.
- Systematic process: The client uses a formal process (established process or instruction) such as a structured framework or quantitative methods to identify a single suitable PDM or make a list of relevant and irrelevant solutions.
- Judgmental selection: In this group, the client uses in-house knowledge and expertise for selection of PDM largely based on subjective judgment through a subjective process.

There is a wide range of views in academia and industry concerning which method works better, but an in-depth study of different approaches and the strength and weaknesses of each is beyond the scope of this Ph.D. work. Additionally, this study introduces a new view toward utilizing relational PDMs (using hard elements). Therefore, to the author's knowledge no established research exists that can be referred to in this regard.

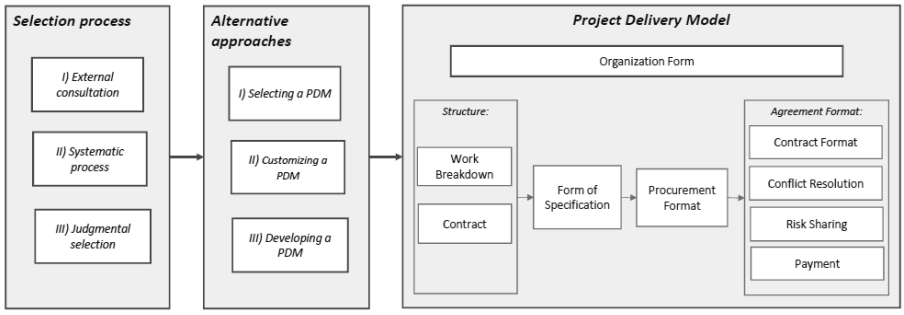

Figure 13 Part of the Project Delivery Model in Detail

Based on the level of experience in a client organization (experienced or inexperienced) the selection of a PDM can be carried out internally (by the parent organization itself) or by using the experience of experts through an external consultancy (Love et al. 2008). Figure 13 presents the described part of the model in details. Regardless of the selection process and method, the final decision should be made through considering and assessing the project characteristics and client objectives against valid options to select the most suitable PDM to meet the defined objectives (Morledge et al. 2006). By this point, the question is: what factors or information lead us to the most suitable PDM for a particular project? Various researchers interduce PSC, or PDM selection criteria, to answer this question (Love et al. 2008, Luu et al. 2005, Ng et al. 2012). These criteria are usually clustered into three groups, namely project characteristics, owner characteristics and market characteristics (or external environment) (see Publication 4). However, this model presents a new setting by introducing the context around the implementation strategy (see Figure 14). This new setting differentiates between owner objectives and characteristics and gives other factors such as political influence and an organization's policies more

weight/importance by securing them their own place. The following section elaborates on this new setting.

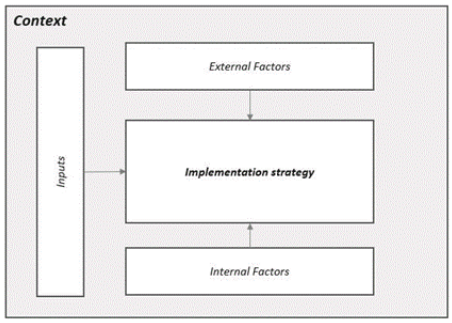

Figure 14 Context influences the implementation strategy

Implementation strategy and its context

According to Klakegg (2017), all projects start with an idea of solving a problem or addressing a need. This needs declaration, if elucidated into objectives, leads to the identification of a set of tasks required to address the need or solve the problem. Furthermore, *implementation strategy* defines what qualities are required or desired throughout a project's life cycle. Examples are: whether the client wants to be very close to and involved in the process or keep an arm's length distance, whether it is an ambition to implement new technologies or stick with proven solutions, whether to require a fully digitalized process, or whether to stimulate development of new markets or strengthen competition. (Klakegg 2017). These considerations indicate a project owner's essential need to develop an implementation strategy prior to the decision of whether relational PDM is a valid choice and which relational PDM is best for the project. Figure 15 illustrates the implementation strategy and the detail of its context.

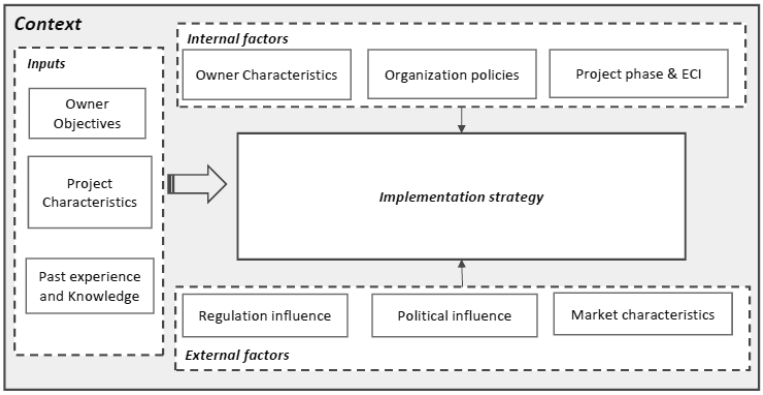

Figure 15 Details of Context around the Implementation Strategy

To develop the implementation strategy, input is needed for the decision-making process to make it work. Input should be specified and qualified. Along with the progression of the decision-making process's workflow, the input is progressively transformed into the implementation strategy (this is illustrated in Figure 15 with a thick arrow pointing from input to implementation strategy). As stated earlier, based on needs (project itself) and objectives (client's objectives), the project owner or a consultant develops the project implementation strategy.

The more that is known about a project and its characteristics, the better the decisions that can be made. This model is concerned with construction project which vary in terms of *size* and *complexity*. Characteristics that make a project suitable for a relational delivery model were discussed earlier. Other characteristics might come with the project proposal, such as *delivery time*, *quality* and *standards*. According to Rowlinson and McDermott (2005), considering factors such as cost, time and quality are not sufficient to serve as the basis of PDM selection although most selection methods revolve around these factors.

The owner is the initiating and financing party, who normally has a long-term interest in the investment that a project represents. Bertelsen and Emmitt (2005) identifies the owner, user, and society as important groups that a "client" should represent: "These three groups of interest each value different things at different times in the life of the building." Identifying these perspectives early may help to change and understand the focus of the stakeholders. According to Masterman and Duff (1994), the selection of the PDM largely rest on the client's objectives and needs, which are different in each organization. An important client objective, according to Masterman (1994), is demonstrating value for money. When value for money is a central objective, the use of partnering and other variations of relational models is preferred over a pure relational model (non-price basis such as an alliance PDM). Despite the wide acceptance of the alliance delivery model, according to Davies (2008), most alliance projects fail to establish value for money because of the absence of price competition in setting the project cost. Another client objective that may influence the choice of relational PDM is formality of contracts. During this Ph.D. study, I observed a tendency among clients' organization toward relational models that grant a formal contract, such as partnering, although the literature argues that managing project activities through a contract is detrimental to relationships (Suprapto et al. 2015, Ross 2003, Lloyd-walker et al. 2014). Examples of owners' objectives clearly demonstrate that owners' objectives and characteristics are distinguishable.

Apart from the project characteristics and clients' objectives and needs, other factors (internal and external) play important roles in shaping the project implementation strategy. *External factors* influence from outside of an organization. Market characteristics (e.g., contractor capability and availability, market competitiveness) have a great influence on the choice of PDM through the project implementation strategy. Political impacts and regulatory feasibility (e.g., EU public procurement regulations or any procurement regulation) are also important external factors. The influence of politics and politicians has been identified by many authors (Gordon Murray 2009,

Rowlinson and McDermott 2005), although this influence could be negative (e.g., it could dictate the choice of PDM based on an unrealistic timeframe or logic).

Internal factors are concerned with aspects which have their route inside an organization. Client characteristics, as an internal factor, play a significant role in forming the implementation strategy. Client organization is a complex system (Masterman and Gameson 1994), which influences the implementation strategy. The nature of an organization, financial ability, technical capability, willingness to be involved in a project and risk-sharing arrangements are examples of important client characteristics. According to Luu et al. (2005), clients should evaluate their ability to use in-house competences to achieve their project goals. During the Australian interviews and the pilot study, a majority of the respondents stated that in a situation where clients recognize the lack of required competences for a particular project, the potential for utilizing a relational PDM is increased. An organization's policies also restrain the choice of PDM while moving toward specific models or adding/removing some hard elements from the contract.

Project phase and ECI consideration. A challenge in delivering a project is determining at what stage (phase) consultants and contractors should be procured. A typical problem today is that some strategies are constantly considered too late in the process so potentially advantageous choices are no longer available. Thus, great potential is lost. Knotten et al. (2016) introducde a framework to help actors of the AEC industry define key tasks that need to be fulfilled in the different stages of a project and to help coordinate their involvement (see Publication 11). Some PDMs require the involvement of all parties at an earlier stage than other models. The framework developed by Knotten et al. (2016) helps deal with this challenge by explicitly stating the stage at which different PDMs should be considered to be valid alternatives.
As stated earlier, the benefits of ECI were recognized by both the alliance and partnering studies in this Ph.D. work as being a key advantage of relational models. In this regard, through one of the research projects carried out during this Ph.D. study, 16 approaches from literature and seven new approaches from case studies were identified to implement ECI (see publication 3). While the literature focuses on advanced ECI approaches that can be implemented for complex projects, the findings in Publication 3 indicate that there are relatively simpler ECI approaches that can be implemented for less complex projects. Moreover, the stage at which the contractor is involved in a project is considered the most important factor for achieving the potential benefits of early involvement (see Publication 3). Therefore, this model includes ECI consideration when developing the implementation strategy. Likewise, findings related to ECI in this Ph.D. work can assist decision makers in client's organizations to identify valid ECI approaches for their project based on the time of adoption and their possibilities.

Figure 16 presents the model in detail. It is notable that although this Ph.D. work aimed to identify independent factors for choosing a relational PDM, according to Luu et al. (2005), implied interrelationships and possible overlap among the selection criteria exist.

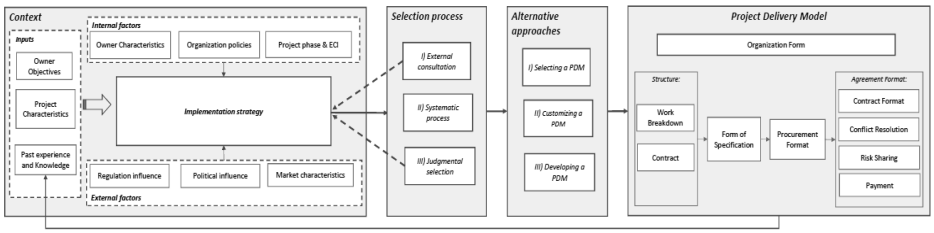

Figure 16 Detailed Version of the Model for Adopting a PDM

How does it work?

The literature argues that relational delivery models may not be suitable for all types of projects (Henneveld 2006, Clifton and Duffield 2006, Chew 2004, Ng et al. 2002). Some projects, however, have key characteristics that make them highly suitable for relational delivery models. While in the first part of this research question the characteristics that make a project suitable for a relational PDM in general were identified, this model emphasizes that the project characteristics should not be the sole consideration.

This conceptual model works simply. The decision for selecting an appropriate PDM is predominantly directed by the development of an adequate project implementation strategy. The main categories involved in developing the implementation strategy are demonstrated in the dashed boundaries (see), with possible overlaps between some of the identified criteria. According to Rowlinson and McDermott (2005), due to these overlaps and amalgamation of these factors, it is not possible to adopt a simple set of rules to formulate which criteria should be considered separately. In reality, project owners use in-house knowledge and experience or external consultation to identify these criteria and, as a result, develop an implementation strategy (this procedure is demonstrated by dashed arrows from external consultation and judgment selection toward implementation strategy). This development is undertaken by identifying the project characteristics and client's objectives while considering the aspects that may influence the outcome and valid solutions.

After developing the implementation strategy, in the next step, the model presents the situations in which some clients prefer to use external consultation while others rely on a systematic process or the intuitive judgment of key internal personnel to select a suitable PDM. It is important to note that *one* of these selection processes can be used (this is illustrated by an arrow from implementation strategy to the selection process box) while all mentioned processes can be operative/acceptable if practiced correctly. The identified solution can be employed through *one*

of the identified alternative approaches (this is illustrated by an arrow from selection process to alternative approaches).

To put it succinctly, after formulating the implementation strategy, project owners evaluate the suitability of different PDM models or different hard elements for their project through one of the selection processes (systematic process, judgmental or external consultation). The employed selection process may result in a suitable PDM—through utilizing one of the alternative approaches—that is aligned with the developed implementation strategy.

This model does not discuss the advantages or disadvantages of the different selection processes, alternative approaches or existing PDM models; rather, it introduces the possibilities and priorities in the process of adopting a PDM, particularly relational PDMs. Furthermore, this Ph.D. study and developed conceptual model outlines the relational models using their components (hard elements) and roles in delivering a project, while arguing that the suitability of a PDM is based the fittingness of its components to the project implementation strategy. Therefore, it is noteworthy that this model is valid for all types of projects while based on the developed implementation strategy, it may drive the decision toward adopting a set of collaborative elements, particularly a relational delivery model.

Summary

This Ph.D. work identifies *Fairly High Level of Uncertainty and Complexity, Time Constraints, High Risk, Large Size* and *Need for Innovation* as the key project characteristics that trigger the questions of the validity and suitability of relational PDM for delivering a particular project.

The section introduces a conceptual model for adopting a relational PDM. This model suggests a process for adopting a relational PDM, in which the client needs to formulate an implementation strategy based on the project itself, their objectives and external/internal factors. This model suggests that the characteristics of different PDMs and their components (hard elements) should be examined and evaluated against the developed implementation strategy to select the appropriate combination of hard elements. This section summarizes that a satisfactory implementation strategy is needed to find the best solution and demonstrates that several factors influence the shaping of an adequate implementation strategy.

Chapter 5

5. Conclusions and further work

This section takes a final perspective on the contributions on this Ph.D. dissertation to provide a conclusion and point out suggested areas for further research within this field. This chapter also outlines the way that the main contribution of this study enhances the body of knowledge in the project management field.

5.1 Overall conclusions

Delivering a project is the core of project management. A key success factor is an adequate PDM, which is a system for organizing and financing design, construction, operations and maintenance activities and facilitating the delivery of a good or service.

In many countries, there is a relatively new ambition to avoid the adverse objectives and conflicts that have characterized the construction industry for too long. This ambition is increasing interest in promoting collaborative relationships in the construction industry. To create this type of collaboration, a relationship based on trust between the actors must be established. The literature argues that this can be achieved through relational PDMs such as alliancing and partnering.

The core of this Ph.D. work addresses three main research questions:

1. *What are the characteristics of relational PDM?*
2. *How are relational PDMs actually practiced in the construction industry?*
3. *How and under what project characteristics should a client consider adopting a relational PDM in the future?*

The starting point of this Ph.D. work was a pilot study concerning experiences with different relational PDMs in Northern European countries. During this pilot study, I observed indications that present a trend toward increasing the use of relational base models in the construction industry, especially in the public sector and for execution of complex projects with uncertain scope. These indications include: efforts to gather positive/negative experiences from executed and ongoing projects, an increased number of pilot project and many research projects concerning the relational contract strategy paradigm.

When it comes to why owners are willing to adopt a relational PDM (in the targeted countries in this pilot study), two reasons crystallize.

The first is a need to improve project participants' attitudes and thereby decrease the number of disputes and incidents. The second is that projects are changing; they are becoming more complex, larger and more uncertain while demanding more innovative solutions. To meet these changes, clients look for new strategies, and relational PDMs may represent an answer.

Other observations suggest that there are two kinds of standpoints regarding relational delivery models. In the first (examples observed in Sweden and Denmark), relational contracts seem to be

more about attitude rather than formal contract regulations. In the second (examples observed in the UK and Finland), relational contracts seem to be more dependent on formal contract regulations.

Furthermore, I looked at how relational PDMs have been applied in different countries and how a PDM was selected. In this study, it was not easy to identify patterns in factors that influence the choice of a PDM. Rather, it seems that each country's selected approach is incidental, with experts advocating or practitioners applying a certain model.

By considering all of the discussed aspects and three research questions, the outcomes of this Ph.D. work are twofold. The first outcome is clearing the confusion around this concept by exploring and investigating the components (characteristics) of relational delivery models and how they are practiced in the construction industry (RQ1 and 2). The second outcome is helping the decision-making process by identifying the project characteristics that are suitable for relational PDMs and developing a conceptual model for adopting a relational PDM.

Two models, namely partnering, and alliance, were selected for further investigation. One of these seems to be more about attitude rather than formal contract regulations (partnering), and the other depends on formal contract regulations (alliance). The aim of this part of the research is to assist decision makers, researchers and practitioners to better understand these concepts.

I explore these two models by studying the tangible components of each. A comprehensive literature study was undertaken to identify the hard elements of these two models. A preliminary list of elements identified from the literature formed the basis of determining the characteristics of these two models. Later, in interview sessions, the respondents were asked if any elements were missing from this list. Consequently, three additional elements were identified for the partnering list while alliance list was determined to be comprehensive. Through this phase, a better understanding of these models, their elements and their role in accomplishing desired outcomes or supporting other elements was achieved. It is noteworthy that none of the identified hard elements are considered unique to any specific model. However, while a number of elements were pointed by our interviewees as unique to alliances, this Ph.D. work concluded that many of these elements could be adopted by other models and are not unique to any specific model.

In the next phase, the lists of hard elements for alliance and partnering—developed through RQ1—were used to explore how these two models are practiced in real-life case projects. For the alliance model, Australian infrastructure projects were targeted, and for partnering, Norwegian construction projects were examined. Through the study of sample alliance projects, it appears that the structure of alliancing within Australia is very consistent (all elements presented in all projects). However, partnering projects may share the partnering label but use completely different sets of hard elements. This indicates that while different variations of partnering projects can be identified as relational contracts, the most likely case when considering Australian alliancing is that the specific combination of elements really makes the alliancing model unique in the world of PDMs.

Combining the findings of RQ1 and RQ2 and relevant findings from the literature concerning the characteristics of relational models, a few simplified conclusions can be drawn. Fundamentally, all of these models intend to integrate—either contractually or physically—the design and delivery processes while committing to procuring the best value for money. Consequently, each of these approaches can deal with a problem (project) efficiently and effectively. To do so, a purposeful dialogue about the project's needs, stakeholder values and constraints must be held. This dialogue will eventually be translated to a set of common objectives and targets, which provides a full sense-making for all involved parties. Although each model uses a different set of mechanisms, their novelty is largely based on common objectives and understanding of the project scope, early involvement of competences and transparency. Utilizing these means through different mechanisms may result in better quality, shorter execution time, more innovative solutions and less risk and conflict throughout the project lifecycle. Hence, the name (of the model) does not really matter as the components of each model are the most important to make a difference.

The second outcome of this study consists of two parts. In the first part, a list of project characteristics that may suggest considering relational PDM as a valid option for the client are identified and discussed. In the second part, a conceptual model is developed to assist in the decision-making process within the client's organizations for selecting/developing a suitable relational PDM. The fundamental logic behind this model is a two-step interdependent procedure, where the first step concerns the primacies and the second step evaluates different options for choosing the proper model. The first step translates into the development of an implementation strategy in this model, and the next step is formulated in two parts: the selection process and alternative approaches.

The developed adequate implementation strategy determines if a relational delivery model is a valid and proper solution while this and other studies argue that relational PDMs are not the best solution for all types of projects. This development should be made through formulating the inputs and considering internal and external factors. These factors and characteristics are presented in RQ3. The selection process concerning the evaluation of different PDMs and their components includes three substitutes. In the case that the client does not have the necessary knowledge and expertise, external consultation is suggested, while judgmental selection, on the other hand, relies on the subjective evaluation of in-house experts and decision makers. The least subjective, the systematic process, limits the involvement of intuition in decision-making process. Any of these selection processes can be used to find an appropriate PDM through one of the identified alternative approaches:

I. Selecting a PDM: This searches a wide range of well-defined relational model to find a suitable one (such as Australian alliances), which is used as is.

II. Customize a PDM: In this approach, decision makers select a PDM that is semi-fitted to the project situation and customize it by altering its components (adding/removing hard

elements) to make it fully aligned with the implementation strategy (such as alliances in Finland).

III. Developing a PDM: This explores the components of different models to pick elements that are aligned with the implementation strategy and meet the project's needs and requirement. This approach suggests that there is always a possibility to build up your situational or standard PDM from scratch (such as a different version of partnering).

The results of this Ph.D. work suggest that each PDM is defined through its components and not its name. Different delivery models use different sets of mechanisms to implement the means needed to achieve the desired effects. Perhaps a few years ago, before the emergence of new PDMs, many of these elements could have been said to be unique to one form of delivery model. Today, however, countries are seeing an increase in innovative and relational PDMs that have adopted many elements used in other methods. This study argues that different models can learn from each other and clients can possibly add elements that are considered unique to a specific model to their shopping list. This is an attempt to fit/harmonize a PDM to a particular project. Which model or combination to choose is a question that needs to be carefully considered.

5.2 Theoretical contribution

Aligned with the objective of this Ph.D. work, this study makes a number of contributions to the body of knowledge through introducing a new perspective toward relational delivery models. The novelty of this research is based on the use of tangible components (hard elements) as the mean for defining, selecting and developing a relational model. Prior to this study, there was no inclusive research that provided a comprehensive list of hard elements for relational delivery models, namely partnering and alliancing, and employed it as a tool to investigate how these models are selected and practiced. While a full understanding of the relational delivery model, its definition and successful implementation cannot be detached from the existing elements, these lists prove to be noteworthy contributions.

In addition, the conceptual model for utilizing a relational PDM developed as a result of this Ph.D. work makes an important contribution to the project management body of knowledge by combining a number of theories. This model, which is based on several theoretical foundations, including PDM selection criteria, selection process and alternative approaches, outlines the dimensions that collectively shape the implementation strategy. This model and the study behind it follow the research direction recommended by Winter et al. (2006) to ensure a contribution to the body of knowledge. Winter et al. (2006) suggested a framework including five directions, namely project complexity, social process, value creation, project conceptualization and practitioner development, as an agenda to inform and stimulate current and future research activity in developing the field of project management.

5.3 Practical contribution

This study introduces three alternative approaches for adopting a relational delivery model based on the presence of the hard elements in the construction projects. The two lists of hard elements provided in this research may be useful for practitioners who are aiming to employ one of these alternative approaches. They could be used in the process of adopting one of these models, and the lists can be used as references in developing their situational PDM (i.e., for developing a shopping list).

Moreover, this research identified the key project characteristics that give the clients an inkling of whether they should consider a relational PDM as a valid option.

The project delivery selection model developed as a result of this study can be used as a selection tool by client organizations. This model deals with the PDM selection process in a practical and simple manner. It provides a set of conceptual tools to be used by client organizations to assess the suitability of a PDM for a particular project by formulating an implementation strategy that mirror their needs and necessities. Moreover, this model, by combining several theories and tools, which were developed during this Ph.D. study in a collaboration with other researchers, such as PDM selection criteria, identified ECI approaches and a "next step" framework, - became a guide in itself and makes a significant contribution to practice.

5.4 Further work

This study was designed to develop a better understanding of relational delivery models and theories of how a relational PDM should be selected for a construction project. This study used the tangible components of relational delivery models as the core factor for achieving the research objectives.

The research initiated in this Ph.D. study could be expanded in diverse directions for future studies focusing on the concept of PDM and, in particular, relational PDMs. This study suggests the following aspects as suggestions for future research while also addressing the limitations of this study.

As stated in Section1.3, the scope of this study is limited based on time and resource constraints. This study focused on two relational delivery models (partnering and alliancing) within building and infrastructure projects from the client's perspective. Although the respondents were selected based on their notable experience and organizational position, their responses reflect the subjective view of a single person mirroring their own reality; therefore, more varied audiences within different countries and contexts are needed for a greater objectivity. This Ph.D. work focused on partnering and alliancing although these are only two of the several relational PDMs practiced in the industry. Consequently, a similar study of other relational delivery models and their components is recommended.

Clients, designers and contractors are the key actors in delivering a construction project while this study focuses mostly on the client's perspective. Therefore, considering contractors and designers

for exploring the different dimensions of relational delivery models and selection models is recommended for future research.

While the selection model in research question three was developed based on a series of theoretical grounds, this model can be beneficial to suggest effective and operational practices for the process of selecting a suitable PDM. By considering the importance of the suitability of a nominated PDM to a project and the increasing interest toward adopting relational PDMs, clients' need to employ more practical and tangible tools in their organizations is apparent. This study could eventually result in tools for assisting clients' organizations in their selection process. These tools could be produced in different forms (such as standards, reference lists, computer base mean) while relying on components of the model to help clients consider all the relevant factors (e.g., internal and external factors, selection criteria) before selecting/developing a delivery model.

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PART II: INDIVIDUAL PUBLICATIONS

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PUBLICATION 2

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PROJECT DELIVERY

KEYWORDS
Alliance • project delivery model • relational delivery • public procurement • infrastructure.

WHAT MAKES AN ALLIANCE AN ALLIANCE

Experiences from Australian Infrastructure Projects

• ABSTRACT •

The purpose of this research is to explore what alliancing means in the context of Australian infrastructure projects. It aims to define alliancing in this context by identifying its hard elements and to explore the relationship between the academic and practitioner points of view. This paper explores the concept of alliancing in the context of large infrastructure projects by comparing the results of a literature and document study with results obtained from an interview series conducted in Australia.
This research shows that alliancing can be identified by 25 hard elements. It seems the case that no single element is unique to alliancing, but rather it is the combination of elements that really makes the alliancing model a unique project delivery model. The study identified twelve project characteristics that make a project suitable for alliancing, along with an explanation of how the alliance elements address these characteristics.
These findings will help assist academics and practitioners new to the alliancing model understand what alliancing is and when it is suitable to use.

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1. INTRODUCTION

The project alliance is a Project Delivery Model (PDM) that has become more popular in recent years as an alternative to both traditional and other forms of relational contracts. As projects become larger and more complicated, and the pressure from various stakeholders increases [1], alliancing is proving to be a valuable tool for dealing with these challenges. It is currently a well-established model in just a few countries but is beginning to gain traction with more countries exploring its use. Having originated in the UK [2], it has become a booming success in Australia. The experience in Australia has shown by example that there are alternative methods to delivering projects in order to move away from the often-adversarial, traditional project delivery models.

An alliance, in a general sense, is quite a broad term and is used in many industries and contexts, for example, a trade alliance between two or more countries. Project alliancing, as a Project Delivery Model (PDM), is yet to be commonly defined at an international level [3, 4]. In the construction industry, we have a situation where inconsistency can be created due to these two uses of the term alliance. This lack of consistency has created a confusing situation [5]. This problem is compounded by the lack of a clear understanding of what exactly makes a project alliance an alliance. For example, in some cases within the construction industry, "partnering" and alliancing are often used interchangeably despite being fundamentally different models [3, 6, 7]. Combined with the lack of a global commonly established alliancing definition, it appears that the body of knowledge is also missing a clear breakdown of what elements make up an alliance.

Alliancing does require a large investment in resources (cost to establish, dedicated leadership board etc), and so it is important to ensure that the outcome of using the model is a success. Jefferies, John Brewer [8] have identified that "*there is a clear gap in Project Alliancing, particularly with regards to identifying factors for its successful implementation in the Australian construction industry*". Due to its structure, alliancing is particularly well suited to certain projects and not others, and the body of knowledge does not seem to contain a clear summary of the characteristics of a project that determine its suitability for alliancing. Selecting alliancing for the right projects is the first step to ensuring a successful outcome.

The purpose of this study, therefore, is twofold: One, to give a clear picture of what exactly makes an alliance an alliance, in terms of formal elements, in order to resolve the confusion surrounding the term when it applies to delivering construction projects. And two, to identify the characteristics of a project that make it suitable for the alliancing PDM in order to assist practitioners who are exploring the adoption of project alliancing. This is presented succinctly by the following two research questions:

1. What makes an alliance an alliance?

2. What characteristics of a project make it suitable for alliancing?

To determine what makes and alliance an alliance, this study looks to the country that is most experienced when it comes to using the alliance PDM, Australia. Australia began using project alliancing in the mid 90's and has since completed billions of dollars' worth of projects using the model. In addition, client organisations who are exploring the adoption of alliancing often begin with the Australian model. Thus, it seems like a logical place to start to establish a point of reference for determining what makes an alliance an alliance. To establish this point of reference, a literature and document study was undertaken alongside an interview series with experienced practitioners in Australia.

In the literature, alliancing is often defined using both hard and soft elements. To increase rigidity of the study, we only include the hard, tangible elements,

without the inclusion of purely soft, intangible elements, such as trust.

2. METHODOLOGY

The research questions were addressed by conducting a thorough literature and document study of publications from Australia and other countries. In addition to academic articles and papers, documentation from government organizations were also reviewed (national contract guidelines, procurement guides etc.).

The results from the literature study were compared and contrasted with findings obtained from questionnaires conducted with a number of construction industry practitioners from Australia. The results contributed to developing the interview guide for the face-to-face interviews conducted in Australia.

--- 2.1 Literature Study ---

A literature study, following the prescription of Ellis [9], Blumberg, Cooper [10], was undertaken to develop the theoretical background for alliancing. Search terms included – but were not limited to – words as alliance, Australia, infrastructure etc. A combination of journal articles and conference papers was used to gain a theoretical perspective of the current views of the topic. A study of documents from both government and industry covering alliancing – as for example contracting guidelines and a guide to participants in alliances – was undertaken to broaden this perspective. This document study was undertaken in order to identify the government and industry perspectives on alliancing and to supplement the theoretical background. Thus, these two studies gave insight into both the theoretical and practical aspects of alliancing. From here on, the use of literature/theory includes both scholarly articles and practical written guidelines.

--- 2.2 Interviews ---

Face-to-face interviews were conducted with alliance practitioners in Australia. Twenty-two semi-structured in-depth interviews were undertaken face-to-face with a total of 27 key industry professional in Australia, following the prescriptions of Arksey and O'Malley [11]. One interview consisted of three interviewees, three interviews consisted on two interviewees together, and the remaining 18 interviews were conducted one-on-one. Fourteen of the twenty-two interviews were case specific – one interview for each case, respectively – and the remaining eight were general in nature. The interviews ran over a period of three weeks during March and April 2016, and they were conducted in Perth, Sydney, Brisbane, Melbourne and Canberra. The interviews lasted between 30 and 90 mins. The interviewees were contacted based on their experience with alliances. One of the authors knew some of the interviewees after a former work employment within an Australian road authority, some of the interviewees were selected since they had written scientific or practical publications on the matter, and the rest were contacted after they were recommended by the other interviewees (mainly because they possessed first-hand knowledge from alliance projects). For practical reasons, not all of those suggested as interviewees were contacted. Participation in the interview series was voluntary. Respondents were chosen among project managers and contract specialists, mostly from client side (government), as in the Australian infrastructure industry, it is the government organisations that own the projects. In addition, a number of respondents from contractors (8), consultants (3), and academia (1) were included to gain a wide industry perspective on the current state of alliancing. It should be noted that six of the participants have had experience with alliances while sitting on both sides of the fence, i.e. as both the Non-Owner Participant (NOP) and the Project Owner (PO). The interviews proved valuable as they offered a great starting point for developing the tables of elements and characteristics.

--- 2.3 Case Studies ---

Data from fourteen Australian alliance projects was collected during the interview series (**Table 1**). Multiple-case design was performed in order to check for replication, as described by Yin [12]. This method suited this study as an overall picture of alliancing within the infrastructure industry could be achieved by analysing multiple alliance projects. A limitation of a project value of greater than $50M AUD was chosen to ensure that each project was considered a large infrastructure project. The case projects that were analysed varied in size from $52M up to $1B AUD.

Project	Value (M AUD)	Number of Parties	Duration (yrs)
Lawrence Hargrave Alliance	$52	4	2
Anzac Bridge Upgrade	$61	4	3
Karatha Tom Price Stage 2	$80	4	2
Windsor Rd Alliance	$105	4	1.5
Springvale Rd Rail Alliance	$120	6	< 1
Sydney CBD Alliance	$150	2	2.5
Inner West Busway / Vic Rd	$155	4	4.5
Lawson Alliance	$220	3	4
Perth Busport Alliance	$250	3	3
Perth City Link Rail Alliance	$339	3	2
Cotter Dam Enlargement	$410	4	4
Ballina Bypass Alliance	$640	5	5
Hunter Expressway Alliance	$825	4	4
Gateway WA	$1,000	6	4

TABLE 01. Details of Case Study Projects from the Interview Series

The results from the case projects represent the experiences of practitioners and are limited by their memories. They provided us answers to the best of their knowledge. Where possible, facts were cross-checked against project documentation. This discussion presents the authors' interpretation of the studied literature and interviews.

3. THEORETICAL BACKGROUNDY

This section begins by exploring current definitions of alliancing. Following, is an insight into the disambiguation between alliancing and other forms of PDMs, and a look at the present state

of alliancing around the world. Furthermore, this section presents the elements identified from the literature as being key elements of alliancing along with identified project characteristics.

--- 3.1 Introduction ---

Alliancing has developed out of the need and desire to improve on, and overcome, the adversarial nature and negative impacts associated with the more traditional forms of project delivery, namely design-bid-build (DBB) and design and construct (D&C) contracts [13, 14]. Alliancing is beginning to be placed into its own unique category [15, 16], however, it often falls under the umbrella of relationship contracting [17, 18].

Alliancing is a collaboration between the client, service providers and contractors where they share and manage the risks of the project together [15, 19]. All parties' expectations and commercial arrangements are aligned with the project outcomes and the project is driven by a best-for-project mindset where all parties either win together, or lose together [17, 20]. The contract is designed around a non-adversarial legal and commercial framework with all disputes and conflicts resolved from within the alliance [18, 19].

This type of project delivery can lead to improved project outcomes and value for money, in part due to the increased level of integration and cooperation between planners, design teams, contractors and operators [21, 22].

--- 3.2 Current Definitions of Alliancing ---

The most widely accepted definition of alliancing in literature comes from the Australian Department of Finance and Treasury Victoria [23] which describes alliancing as:

"... a method of procuring ... [where] All parties are required to work together in good faith, acting with integrity and making best-for-project decisions. Working as an integrated, collaborative team, they make unanimous decisions on all key project delivery issues. Alliance agreements are premised on joint management of risk for project delivery. All parties jointly manage that risk within the terms of an 'alliance agreement', and share the outcomes of the project" (p.9).

The majority of studied literature after 2010 refer to this definition when discussing alliancing and do not contribute anything of significance in addition to that mentioned above [13, 16, 17, 20].

The above definition more recently became defined in Australia at a national level with the publication of the National Alliance Contracting Policy and Guidelines [24]. This document was updated in 2015, retaining the same definition [25], demonstrating that there is consistency within the Australian Government of what the definition of alliancing is. However, this guide does not provide a clear breakdown of the tangible elements that characterise alliancing.

Some literature includes definitions that the industry is moving away from. Such definitions include alliancing under the relationship-contracting umbrella, as opposed to defining it in a category of its own. Other definitions compare it too closely to partnering [26], which can lead to the confusion that this research is attempting to prevent. These points are explored more in depth in the next section covering the disambiguation of alliancing.

--- 3.3 Disambiguation ---

In the early days of alliancing, project alliances (PA) shared many more similarities with project partnering (PP) than is the case today. PA and PP used to be used almost interchangeably before PA evolved over time down its own path and away from PP [6]. PP and PA do share similar elements today, for example, they both aim to improve cooperation, they both have a target cost with bonus/malus (in PA known as pain/gain), and they both employ an open-book approach Haugseth [27], [28, 29]. The biggest difference today, is that PP is not a standalone contract strategy and is generally adopted over the top of traditional contracts such as D&Cs [4, 16], whereas PA is a built-for-purpose, stand-alone contract strategy. Furthermore, partnering does not adopt the alliancing principle of win-win/lose-lose in the same way that alliancing does; in PP the partners remain independent within the partnership and thus there is the possibility for partners to lose while others win and vice versa [4, 19, 20, 30].

Integrated Project Delivery (IPD) is a model used mostly in the United States of America that has many similarities to Australian alliancing, with one major difference being that IPD incorporates a number of lean construction elements [16, 31, 32]. IPD's use is mostly concentrated in America, yet the principles of lean are more prevalent worldwide. Alliancing is often considered at the top end of collaborative and relational contracting [33] and is more widely distributed across the globe [6, 20]. In addition, IPD and Alliancing have often been used for different types of projects, alliancing in infrastructure projects and IPD in building projects [16]. One view is that IPD is created by combining the alliancing governance system with the lean construction operating system [31]. The key differences between IPD and alliancing will not be explored further in this paper but can be found in the studies of Lahdenperä (2012) and Rassback et al [31].

--- 3.4 Alliancing Elements ---

The literature on alliancing often focuses on just one or two particular aspects of an alliance, whether that be key success factors, achieving value-for-money or case studies on alliance implementation, with few articles providing a general overview. As such, the articles reviewed as part of this study would frequently mention key elements of alliances or project characteristics without defining or expanding upon them.

Determining what alliancing is through the literature can be confusing, but it is possible to identify defining elements that appear to be key to an alliance. These were collected, and the number of times they were referenced in literature was recorded. Some elements were easier to identify than others were. It proved useful to start with recording anything that could be a defining element of

an alliance and then to refine the list through cross-referencing and analysis of case studies.

Table 2 shows the elements of an alliance as identified in the studied literature. They have been arranged by number of citations. Included is a preliminary indication, based on the literature review, of whether the element might be unique to the alliance PDM.

Elements of an Alliance	References	Only Alliancing?	Total
Pain/ Gain share	1,3,4,6,7,8,9,10,12,14,15,16,17,18,21,23,24,25,26,29,30,31,32	No	23
Open Book Approach	1,6,7,8,9,12,14,15,16,17,18,19,21,23,25,26,27,29,30,31,32,33,34	No	22
Risk/ Reward Sharing	4,5,6,8,9,12,14,17,18,19,20,21,22,23,25,26,29,31,32,33	Possibly	20
No Dispute Clause/ No Blame/ No Fault Mentality	1,6,7,9,10,12,14,15,16,18,20,23,25,26,29,30,32,33,34	Yes	19
Alliance Leadership Team (ALT) (Board)	1,5,6,9,10,12,16,17,18,19,23,25,26,29,31	Yes	15
Alignment of Client and Commercial Participants Objectives	6,9,10,12,14,17,18,20,22,21,23,25,29,30	No	14
Auditing	1,6,9,15,16,17,18,19,21,23,25,29,30,32	No	14
Integrated Project Team	9,12,14,16,17,18,19,20,23,25,26,29,32,33	No	14
Unanimous Decision Making	1,6,7,9,10,16,18,23,25,26,29,30,32,33	Possibly	14
Target Outturn Cost (TOC)	1,5,6,9,10,14,17,18,19,21,26,29,32	No	13
Virtual Organisation	5,6,9,14,15,17,18,19,21,23,25,26,29	Yes	13
Alliance Management Team (AMT)	1,5,6,9,10,12,16,18,25,26,29,31	Yes	12
Incentivized Cost-Reimbursement	4,5,9,10,15,16,17,19,20,26,27,29	No	11
Colocation of Alliance Team	4,7,10,14,16,17,23,25,28,29	Possibly	10
Alliancing Workshops	1,7,12,14,16,17,21,25,29	Yes	9
Fee to cover Corporate Overheads and profit	1,9,17,18,19,21,25,26,29	No	9
Formal Contract	3,6,7,17,20,21,25,29	No	8
Minimum Reimbursement of Direct Costs	1,9,15,16,18,23,26,29	No	8
Dispute Resolution Kept Within Alliance	6,7,9,18,23,25,27	No	6
Key Result Areas	1,9,10,18,29,30	No	6
Three Limbed Contract	1,6,9,18,26,29	Possibly	6
Joint Responsibility	9,17,21,25,29	Possibly	5
Can be Price Competitive	7,8,9,29	No	4
Relationship Development	7,12,23,29	Possibly	4
Alliance Facilitator	9,25,29	Yes	3
Alliance Uniform and Stationary (Branding)	5,12,29	Yes	3
Collaborative Problem-Solving and Decision-Making	6,9,10	No	3
Common Goals	9,17,29	No	3
No Latent Condition Clauses	5,9,29	Possibly	3
Single Alliance Culture	5,25,29	Yes	3
Early Involvement of Alliance Partners	3,14	No	2
Internet Based Information Management System	25,28	No	2
Built from the Ground Up	25	Possibly	1

TABLE 02. Elements of an Alliance – Results from the Literature

--- 3.5 Project Characteristics ---

Alliancing is not a project delivery model that is suitable for every infrastructure project [18, 34]. Some projects, however, have key characteristics that make them highly suitable for the alliance model.

A preliminary list from the literature study of the characteristics suitable for an alliance is shown in **Table 3**. The characteristics are arranged in order of the number of articles that have attributed these project characteristics to the selection of an alliance.

Table 8 in the Appendix identifies the numbered references used in both **Table 2** and **Table 3**.

Most often, several characteristics of a project are taken into consideration when determining the choice of delivery model for a project. However, in some cases, the decision to use an alliance is based purely of one or two project characteristics. For example, Jefferies [8] highlights that *"The Queensland State Government, in the form of both their Public Works and Main Roads departments, use Alliance and Partnering arrangements as default contracts on projects with construction periods of over 12 months and/or with a dollar value of A$10 million."* (p.477).

4. RESEARCH FINDINGS

This section will identify the findings from the interviews and discuss them in relation to the findings from the literature study and case studies.

--- 4.1. What Makes an Alliance an Alliance? ---

4.1.1. What Elements Make Up an Alliance?

A preliminary list of elements identified by the literature study formed the basis of determining the characteristics that define alliancing. A further analysis was required in order to reduce and combine the lists so that they contained the most relevant elements. Each piece of literature was analysed again to check for references made for each identified element

Project Characteristics	References	Total
Tight Time Constraint/ Need for early start	3,5,6,8,9,11,16,23,25,26,29,31,34	13
High Risk	3,6,5,8,9,11,16,25,29,30,31,34	12
High Complexity	3,6,11,13,16,18,23,25,26,29,31	11
Multiple/ Complex Stakeholders	3,6,11,13,14,16,23,25,26,29,31	11
Unclear/ Broad Scope/ Risk of Scope Change	1,3,8,11,13,16,18,25,26,29	10
Complex External Threats	3,6,11,16,25,26,31	7
High Uncertainty	1,3,9,16,29,30,34	7
Need for Innovation	8,12,18,23,29,31	6
Tight Cost Control	3,16,23,29	4
Environmental Challenges	14,16,29	3
Large Project/ High Cost	8,9,14	3
Need for Owner Involvement	11,25,26	3
Resource Shortages	8,29,34	3
Need for Flexibility	12,29	2
High Visibility	18	1
Special Requirements	3	1

TABLE 03. Characteristics of a Project that Suit Alliancing Identified by the Literature Study

and a closer look at the definitions of each element provided a starting point for refining the list. It was possible to see which elements were related and could be combined, and which elements were not necessarily 'defining' elements, and could be considered unimportant for the purpose of this study.

Further analysis resulted in the following points of note. Joint Responsibility can be seen as a result of the structure of an alliance, for example, Risk and Reward Sharing creates a situation where each party has to work together to manage the risk, and implying joint responsibility. Early Involvement of Alliance Partners is a result of other key alliance elements. All parties are involved early in that they all participate in the defining of scope, in the calculation of the Target Outturn Cost (TOC) and in the creation of the alliance agreement. An Internet Based Information Management System can be seen as a tool used by an alliance, or any other PDMs for that matter. Collaborative Problem Solving and Decision-Making was deemed to go hand-in-hand with Unanimous Decision Making, thus the two elements could be combined under the name of the latter.

Common Goals can be seen to relate to Risk and Reward Sharing, Key Result Areas, Alignment of Client and Commercial Participants' Objectives and Incentivised Cost-Reimbursement, since they all work together to create a situation where parties are working towards a set of common goals. Built from the Ground Up was a point of confusion in the case study, was only highlighted in one piece of literature and was not mentioned in the interviews. The principle of Built from the Ground Up could be incorporated in the element Formal, Stand-Alone Contract.

No Latent Condition Clauses is an element that can be seen as a component of Risk and Reward Sharing, both of which fit together under the pain/gain sharing model. The No Dispute Clause/ No Blame, No Fault Mentality is a combination of hard and soft elements. Therefore, just the hard side should be included as a result in this study. In addition, the No Dispute Clause is a similar element to Disputes Resolution Kept within the Alliance.

The description of a Three-Limbed Contract ties in with the identified elements Incentivised Cost-Reimbursement, Minimum Reimbursement of Direct Costs, Target Outturn Cost and Fee to Cover Corporate Overheads. The three-limbed contract is made up of [13, 33]:

- Limb 1 consisting of all the directly reimbursable costs including project-specific overheads
- Limb 2 consisting of the corporate overheads and profit for each NOP, determined by an independent auditor. This is placed 'at-risk' according to the pain/gain arrangement
- Limb 3 consisting of the incentivised cost-reimbursement where all participants share in the pain/gain associated with how the alliance performs against the pre-arranged targets in cost and non-cost key result areas (KRAs).

Finally, the Single Alliance Culture, which is also a soft element, is a result of an alliance implementing the hard elements of Alliancing Workshops, Relationship Development, Alliance Facilitator and Alliance Uniform and Stationary.

The refined list of elements, which resulted from the literature study, became part of the interview guide for the interviews. In the interviews that were case specific, the list of elements (see row 1 of **Table 4**) was used to crosscheck the elements that were present in the case projects. The elements present in each case study were collected and the results a showed that each element was present in every project, with the exception of Colocation of Alliance Team, which was only partially present in one of the projects. It appears, from this sample of projects, that the structure of alliancing within Australia is very consistent. As part of the questionnaire, the practitioners were asked if they could identify any additional key elements that were not shown in **Table 4**. This process did not uncover any new elements, providing some confirmation that the list of elements is comprehensive.

4.1.2 Elements Unique to Alliancing

The literature search identified a number of elements that can be identified as being unique to alliancing. Firstly, the majority of elements that contain the word alliance in their title are considered to be to unique to alliancing. One exception is Alliancing Workshops. The intention of alliancing workshops is to develop the culture of the team. In partnering arrangements, such workshops are used to develop the partnering mindset and therefore it is not unique to alliancing. Secondly, the elements Virtual Organisation, No Latent Conditions Clauses, Three-Limbed Contract and No Dispute Clause are also considered unique to alliancing. They have not appeared in the studied literature to be referenced to other PDMs. It should be noted that a comprehensive literature study was not performed on other PDMs and thus these results

are not necessarily a 100% accurate representation of current usage. The remaining elements have been, to some degree, mentioned in the literature in relation to other PDMs. For example, the work of Hosseini et al. [28] has shown that partnering can include such elements as Colocation of Team, Target Cost with Bonus/Malus and Open-Book Economy.

During the interview series, in particular the interviews that involved the discussion of the case projects, the participants were asked to identify whether they thought a particular element was unique to the alliancing PDM. The results from the responses of the case specific interviews are presented in **Table 4**. For the remaining interviews, despite not specifically going through the table of elements with the participants, a number of elements were mentioned as being unique to alliancing during the general discussions. These were counted, and the number of mentions appear in the second-to-last column of **Table 4**. The total number of times an element was mentioned, from both the case studies and the remaining interviews, is shown in the last column the table.

Elements of an Alliance	Indicated as being unique to alliancing by the interviewees													#	Total
Case Specific Interview Number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Pain/ Gain Share				x				x		x					2	5
Open Book Approach		x	x	x			x	x					x		1	7
Risk/ Reward Sharing	x							x		x					3	6
No Dispute Clause/ No Blame, No Fault Mentality							x	x		x			x	x	2	7
Alliance Leadership Team (ALT) (Alliance Board)	x	x		x	x			x								5
Alignment of Client and Commercial Participants Objectives						x		x					x		1	4
Auditing				x	x		x	x					x			5
Integrated Project Team (including client)		x		x				x					x		2	6
Unanimous Decision Making		x		x	x		x	x					x	x	1	8
Target Outturn Cost (TOC)		x		x			x	x					x			5
Virtual Organisation				x			x	x					x			4
Alliance Management Team (AMT)	x	x		x	x			x								5
Incentivized Cost-Reimbursement		x		x			x	x					x			5
Colocation of Alliance Team		x		x	x			x		x			x		1	7
Alliancing Workshops		x		x	x	x	x	x								6
Fee to Cover Corporate Overheads and Profit		x		x			x	x					x			5
Formal, Stand-Alone Contract																0
Minimum Reimbursement of Direct Costs		x	x	x			x	x					x			6
Dispute Resolution Kept Within Alliance							x	x					x			3
Three Limbed Contract		x		x		x		x					x		1	6
Relationship Development		x		x		x	x	x								5
Alliance Facilitator		x		x		x	x	x								5
Alliance Uniform and Stationary		x		x	x	x	x	x					x		1	8
No Latent Condition Clauses				x			x			x				x	1	5
Single Alliance Culture		x		x		x	x	x							1	6

This column indicates the number of times a particular element was mentioned as being unique to alliancing in the interviews that were not case specific.

TABLE 04. Elements Unique to Alliancing as Identified by Australia Practitioners

What can be seen in **Table 4** is that there is a lot of inconsistency amongst the practitioners as to what elements are unique to alliancing. The elements that received the most mentions were No Dispute Clause, Open Book Approach, Unanimous Decision Making, Colocation of Team and Alliance Uniform and Stationary. Of the elements considered unique based on the literature, all were mentioned to some extent by some of the interviewees. Interestingly, some elements that were considered not to be unique to alliancing based on the literature were mentioned to be unique by some of the interviewees.

Based on the findings from the interviews, what appears to be the biggest cause for the inconsistency of identifying the unique elements stems from the practitioners' experience and background. For example, if a practitioner had only worked on D&C projects prior to working in an alliance, they might be lead to believe that the majority of the alliancing elements are unique to alliancing, as they do not appear in D&C projects. Other practitioners may have worked in different partnering projects, and the elements used in these particular partnering projects (given that there is no consistency with partnering elements [35]) will determine what they believe to be unique to alliancing. Some practitioners are actively working on new and innovative contracts that are based on the alliancing model, thus they consider none of the elements unique. As stated by one of the participants – "*Most of the alliance elements are now found in Delivery Partner* (Delivery Partner is the model used to build the infrastructure for the London Olympics)." (Participant 9).

One of the participants mentioned an aspect that is not directly related to a unique element, but is unique to the alliancing experience: "*Everyone gets a better understanding of all the parties' drivers. Contractors and consultants have said that they never really understood some of the client perspectives, and because you have those discussions all together in an alliance everyone gets to understand that and why you would want to do certain things and why you've gone down a particular path.*" (Participant 4). This communication could also be considered to be one of the benefits of alliancing.

The most likely case, is that no single element is unique to alliancing, but it is the unique combination of elements that really makes the alliancing model unique in the world of PDMs. One participant, who stated, "*The unique combination of all the elements are what make an alliance, not the individual elements*" (Participant 10), seconded this finding.

--- 4.2 Characteristics of a Project That Make it Suitable for Alliancing ---

The purpose of this research is to consider the project characteristics. It is outside the scope to consider internal and external factors of the project in detail. It can often be the case that the nature of the project will dictate the choice of PDM [36]. For example, a project may have a very tight timeframe that can only be achieved if all parties are involved from the very beginning. This way, certain aspects of planning, design and execution can happen concurrently. Such a situation lends itself to alliancing. That being said, alliancing is not a form of project delivery model that is suitable for every infrastructure project [18]. Some projects however, have key characteristics that make them highly suitable for the alliance model.

A review of the characteristics identified by both the literature and the interviews was undertaken. Each characteristic was analysed for uniqueness; where similarities were identified between characteristics, they were combined. In addition, the characteristics were judged by the weight placed on them in the literature and interviews, and the number of times they were cited by different sources.

A number of the characteristics can be combined based on their similarity. For example, if a project has the Need for Flexibility or has High Uncertainty, when it applies to how alliancing addresses this issue, it is very similar to the project having an under-defined scope or having a Risk of Scope Change. In all these cases, every participant works together to solve the issues as they arise and they do this by maintaining a high degree of flexibility in the process. Special Requirements was mentioned briefly by just one source, so with limited information on this characteristic, it is not considered as being relevant to this study. However, it was noted that this descriptor could potentially cover other characteristics as mentioned here, such as complexity, innovation, need for owner involvement, etc., depending on the view of the PO.

After taking a closer look at the initial results from the literature, a table of characteristics was developed that was used in the case specific interviews in Australia (note, **Table 5** is the result of the analysis of **Table 3** and thus appears slightly different). The interviews identified a number of different drivers that have influenced the selection of alliancing in Australia. Alliances have been the preferred PDM when the project has one or more characteristics from the list in **Table 5**. This finding is consistent with the results from the literature review in that eleven of the sixteen characteristics identified by the interviews appear in **Table 3**.

Project Characteristics	**Characteristic influenced project**														**Total**
Case Specific Interview Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Tight Time Constraint/ Need for Early Start	x			x	x	x	x		x		x	x	x	x	10
High Risk	x	x	x	x	x		x		x					x	8
High Complexity	x			x	x	x	x	x	x		x			x	9
Multiple/ Complex Stakeholders	x			x			x	x	x	x				x	7
Unclear/ Broad Scope/ Risk of Scope Change		x		x	x	x	x	x	x	x	x	x	x	x	12
Complex External Threats		x									x				2
Need for Innovation		x		x	x						x		x		5
Tight Cost Control			x	x				x	x	x				x	6
Environmental Challenges				x	x							x			3
Large Project/ High Cost				x	x				x						3
Need for Owner Involvement	x	x	x	x	x		x	x	x		x			x	10
Multiple Interfaces	x	x	x		x		x	x	x					x	8
Market Situation (External Factor)															0
Client Organisation (Internal Factors)				x					x						2
Other: Reputation (Internal Factors)			x												1

TABLE 05. Project Characteristics Suitable for Alliance as Identified by Fourteen Australian Alliance Projects

While going through the table of characteristics with the interviewees, the interviewers asked if there were any additional reasons why the client went with an alliance. This identified two new characteristics to the list: Reputation and Political Commitment. However, it is noted that Reputation should be identified, along with the characteristic of Client Organisation, since being internal factors, as they are internal logic of the organisation and not necessarily project characteristics. Following the same logic, Market Situation and Political Commitment can be identified as being external factors that influence PDM selection, not project characteristics. They have been included here to show that they were considered during the selection process. However, since they are not (obvious) project characteristics, they will not be considered in detail.

The results in **Table 5** show the three most referred to project characteristics to be Unclear/Broad Scope/ Risk of Scope Change, Tight Time Constraint/ Need for an Early Start, and Need for Owner Involvement. Other notable mentions are Multiple/ Complex Stakeholders, High Risk, High Complexity and Multiple Interfaces.

The findings show that there was a general consensus among the participants that projects that are high risk, complex, and/or uncertain are best suited to an alliance. One participant highlighted that alliances are not suitable for straightforward projects stating "*[I] would go alliance every single time for the most high risk and important projects if you had the right competent staff. Don't do alliances for routine work.*" (Participant 2). Other characteristics mentioned were *tight timeframes, multiple interfaces, need for owner involvement and complex stakeholder issues*.

When comparing the findings from the interviews with the findings from literature, it can be seen that the literature does not reflect reality when it comes to recognising the Need for Owner Involvement and Multiple Interfaces as being project characteristics suitable for the alliancing model. Despite influencing nine and seven projects respectively, these characteristics were only identified by three

and zero publications respectively. However, overall, the results from the interviews do show alignment with the results from the literature study, thus helping to confirm the findings of this research.

It should be noted that, one reason why some characteristics are mentioned more than others in the literature, could be that many publications build from the work presented in previous publications. Thus, a particular publication that mentions a certain characteristic can influence the publications that come after it, multiplying the number of mentions of that characteristic. It was outside the scope of this study to take an in depth look at this.

4.2.1 The Ways Alliance Elements Address the Identified Characteristics

The structure of alliances lends itself very well to addressing the issues created by the identified project characteristics. *The shared risk and pain/gain arrangements combined with the alignment of client and commercial participants' objectives creates an entity that is adept at dealing with projects that are high risk or have high levels of uncertainty*. When problems arise, it is in the best interest of all the parties to find the best-for-project outcome and find it quickly. In addition, these elements work together to enable the alliance to deal effectively with complex external events. The elements mentioned previously, combined with unanimous decision-making, no dispute clause and open book help to ensure the win-win principle of alliancing necessary to deal effectively with the issues that arise.

The fact that all parties become involved in the project from the very beginning creates an environment where innovation can thrive. All options can be considered and explored for their merits. Many different perspectives all working together in the early phase can lead to very innovative solutions. This benefit was recognised by many of the interview practitioners as being a key advantage to the alliancing model. "*[Alliances] generate innovation, can change standards, [and put you] in a better position to generate this because you have got experts together, good people, it's a positive work environment and you can throw in extra resources if you need to get these outcomes. This doesn't happen in other forms of contracting, there is a lot more negative tension, in D&C in particular, it's us and them.*" (Participant 11). "*A lot of risk mitigation is done when developing the design with all the participants. [It creates a] promotion of/breeding ground for innovation [and] continuous improvement.*" (Participant 18).

This arrangement of concurrent engineering creates an environment where normally successive stages can run in parallel. For example, the contractor can begin with the early works while the designers are finalising the design and the client is working on planning permissions and community consultation. This reduces the duration of the project significantly and allows for an early start. Many interviewees stated this as a reason for their project being delivered ahead of time.

In some cases, alliances were chosen for a project due to the tight cost control needed. For example, some projects were given the problem, and a budget, and told to find the best solution that addresses the problem and fits the budget. Alliances have a certain freedom to vary solutions on the go, as they are not locked into a pre-design. Combine this factor with the fact that it is in the best interest of all parties to find the best solution, meet the incentivised KRA's, and reduce the project cost in order for them to make money, and it becomes clear that alliancing is well suited to dealing with tight cost control.

The integrated project team is crucial for enabling alliances to deal with complex stakeholder issues. Having the most suitable person for the job in each position means that you can manage the issues very effectively. For example, as identified by one of the practitioners, often the client has well established community consultation systems and networks, while contractors may not have such systems and networks in place. Thus, it makes sense to have key client personal in the relevant position within the alliance. The integrated project team becomes very useful when there is a need for owner involvement as the client is imbedded in the team for the duration of the project and can maintain a level of influence over the project outcomes.

5. CONCLUSION

Due to its relatively new breakthrough into the world of large infrastructure delivery, alliancing is still finding its place amongst the more establish project delivery models. This development has been increasing rapidly since alliancing's birth in the 80's. The rapid development has led to much confusion surrounding alliancing, in particular, what separates it from other relational or collaborative contracts. It seems that the body of knowledge has not yet fully addressed this confusion. This paper supplements the existing body of knowledge by answering the questions:

1. What makes an alliance an alliance?

2. What characteristics of a project make it suitable for alliancing?

This list identifies elements that make up an alliance and recognise the elements unique to the alliancing PDM. **Table 6** contains the final list of twenty-five elements that make an alliance an alliance.

Throughout the analysis, a number of elements were identified as being related, yet deemed important enough to secure their own place. This is represented by the use of dot-points to show when an element/s relates to one of the fourteen 'parent' elements. All the attributes in **Table 6** either define alliancing or are key elements that make up an alliance, and have been observed by the fourteen case studies.

When it comes to the elements that are unique to alliancing, the situation is not so clear-cut. Perhaps a few years ago, before the emergence of new PDMs, many of the elements could have been said to be unique. However, today, Australia

Elements of an Alliance
Open Book Approach
Risk/ Reward Sharing
• No Latent Condition Clauses
• Pain/ Gain share
No Dispute Clause/ No Blame, No Fault Mentality
• Dispute Resolution kept within alliance
Unanimous Decision Making
Integrated Project Team
• Colocation of Alliance Team
Alliance Leadership Team (ALT) (Alliance Board)
Auditing
Alignment of Client and Commercial Participants Objectives
Alliance Management Team (AMT)
Virtual Organisation
Three Limbed Contract
• Target Outturn Cost (TOC)
• Incentivized Cost-Reimbursement
• Minimum Reimbursement of Direct Costs
• Fee to cover Corporate Overheads and profit
Single Alliance Culture
• Alliancing Workshops
• Alliance Uniform and Stationary
• Relationship Development
• Alliance Facilitator
Formal, stand-alone Contract

TABLE 06. Elements That Make an Alliance an Alliance

Project Characteristics
Tight Time Constraint/ Need for early start
High Risk
Unclear/ Broad Scope/ Risk of Scope Change
Multiple/ Complex Stakeholders
High Complexity
Need for owner involvement
Need for Innovation
Complex External Threats
Tight Cost Control
Large Project/ High Cost
Multiple Interfaces
Environmental Challenges

TABLE 07. Project Characteristics Suitable for Alliancing

is seeing an increase in innovative and relational PDMs that have adopted many elements used in alliances. What could be said is that what separates alliancing from other PDMs is the unique combination of all the elements listed in **Table 6**.

In addition to determining what makes an alliance an alliance, this research has identified twelve characteristics of a project that make it suitable for alliancing. Based on the literature studied, and the results from the interview series, it can be concluded that alliancing is a very effective PDM, which is suitable for projects with particular characteristics, provided it is selected for the right reasons. **Table 7** contains the final list of project characteristics based on the results of the methods contained within this study.

Where a project identifies one or more characteristics shown in **Table 7**, an alliance can be highly considered during the selection process for the project's delivery model. By looking closely at the elements of an alliance, it was shown how they address the identified project characteristics. For example, the integrated project team drives innovation and gives the owner more control within the project. The win-win culture created by the combination of a number of alliance elements enables the alliance to handle complex or high-risk projects and projects with great uncertainty.

Based on the results of this study, a conclusion of, what makes an alliance an alliance and what characteristics of a project make it suitable for alliancing, is reached. These findings will help assist those academics and practitioners who are new to the alliancing model, understand what alliancing is and when to use it.

The conclusions are based largely on the Australian experience, however, the lessons learned are transferable to other countries. Continued research into this area can build upon this conclusion to ensure that the identified research gap is fully addressed.

6. FURTHER WORK

The first departure point for further work would be to improve and build upon this study by addressing the identified limitations of this study. This study could be improved by drawing results from a larger number of both academic and industry publications. Additionally, further interviews could be undertaken to expand, confirm, and/or challenge the findings presented here. Furthermore, this study focused on the "hard" tangible elements of alliancing. To build upon these results, further work could be undertaken to include all the "soft" elements of alliancing.

This study also highlighted a number of other departure points for further work. The findings highlighted that there are many new PDMs being developed in Australia, and around the world, in the area of collaborative or relational PDMs, many of which stem from the alliancing model. The body of knowledge could benefit from research into these new models. One of the participants, in relation to the Australian alliancing experience, highlighted the importance of involving academia into emerging fields. "Australia began studying alliances after it was so successful and then became controversial. So it was difficult to study after the event. Many studies performed were deeply flawed. A much more intelligent collaboration between academia right from the start and consistently involved would have allowed much better knowledge and intelligent data from the actual experiences with some academic rigour."

7. ACKNOWLEDGEMENTS

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• APPENDIX •

Paper	#	Authors
Performance of Project Alliancing in Australasia: A Digest of Infrastructure Development from 2008 to 2013	1	[13]
Alliances in construction: Investigating initiatives and barriers for long-term collaboration	2	[6]
Overview of alliancing research and practice in the construction industry	3	[20]
Reducing opportunistic behaviour through a project alliance	4	[14]
Delivery of Low-Volume Road in Pilbara Region of Western Australia by Alliance Contracting	5	[37]
Overview of the Australia-based Studies on Project Alliancing	6	[15]
Making sense of the multi-party contractual arrangements of project partnering, project alliancing and integrated project delivery	7	[16]
Price Competitive Alliance Projects: Identification of Success Factors for Public Clients	8	[21]
National Alliance Contracting Guidelines Guide to Alliance Contracting (including guidance note 3)	9	[24]
Longitudinal Study of Performance in Large Australasian Public Sector Infrastructure Alliances	10	[17]
In Pursuit of Additional Value A benchmarking study into alliancing in the Australian Public Sector, Melbourne, Department of Treasury and Finance	11	[38]
Alliancing in Australia - No-litigation contracts: A tautology?	12	[39]
The Case for an Alliance	13	[40]
Using a Case Study Approach to identify Critical Success Factors for Alliance Contracting	14	[41]
RMS and Alliance Contracts - Fact Sheet	15	Roads and Maritime Services
Procurement Methodology Guidelines for Construction	16	[42]
Project Alliancing at National Museum of Australia—Collaborative Process	17	[30]
Project Alliancing: A Relational Contracting Mechanism for Dynamic Projects	18	[1]
Project Alliancing vs Project Partnering: A Case Study of the Australian National Museum Project	19	[43]
A review of the Concepts and Definitions of Various forms of Relational Contracting	20	[44]
The definition of alliancing in construction as a Wittgenstein family-resemblance concept	21	[4]
Conceptual Model of Partnering and Alliancing	22	[45]
Alliance Contracting Removing the Boundaries for Infrastructure Delivery	23	[18]
Project alliance contract in The Netherlands	24	[26]
Introduction to project alliancing	25	[33]
Alliance Contracting in Australia- A brief introduction 2009	26	[2]
Optimising Contracting for Alliances in Infrastructure Projects	27	[46]
Enthusiasm, commitment and project alliancing: an Australian experience	28	[43]
Alliancing: A Participant's Guide	29	[34]
Enabling Construction Innovation – the role of a no-blame culture as a collaboration behavioural driver in project alliances	30	[19]
Infrastructure Development Using Alliances- Lessons and Observations	31	[47]
Innovation through alliancing in a no-blame culture	32	[48]
Overview of Collaborative Contracting	33	[49]
Understanding the motivation and context for alliancing in the Australian Construction Industry	34	[22]

TABLE 8. Numbered Reference List for Tables 2 and 3

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PUBLICATION 3

EARLY CONTRACTOR INVOLVEMENT APPROACHES IN PUBLIC PROJECT PROCUREMENT

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ABSTRACT

Early contractor involvement (ECI) faces many barriers when it is implemented in public procurement, given that it is different from traditional business practices. Primarily, public owners face a major challenge, as they should treat all bidders equally. The purpose of this paper is to explore suitable ECI approaches that public owners could use. In addition to a literature and document study, fourteen semi-structured in-depth interviews with key personnel from eleven cases selected from Norwegian public bridge projects were carried out. In all, 23 unique approaches of ECI were identified during this research (16 from literature and 7 new from case projects). The findings provide a new direction to ECI through introducing new approaches of ECI from the case projects.

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INTRODUCTION

Public owners have the objective to realize projects in a timely and cost-effective manner, but they are increasingly facing complex projects. For example, the Norwegian Public Roads Administration (NPRA) is currently planning a mega project, E39 Coastal Highway Route, along the west coast of Norway. One of the main ambitions of this project is to make the E39 ferry free. Eight long and deep fjords need to be crossed by bridges and tunnels. Most of them will be crossed by bridges of unprecedented complexity. The project is estimated at a cost of approximately 40 billion U.S. dollars (NTP, 2016). NPRA needs innovative solutions for this project. How to procure contractors for these complex bridge projects to obtain innovative solutions– and how to use their knowledge and experience to make the project time and cost-effective – is challenging for the NPRA. In response to this challenge, early contractor involvement (ECI) has been identified as one of the solutions proposed by an NPRA group of experts (Vegvesen, 2012).

In the literature, it is widely accepted that contractors have better construction knowledge and experience than the client and the designer (Song et al., 2009; Walker and Lloyd-Walker, 2012). Traditional project delivery methods (for example, Design-Bid-Build with unit price contracting, open bidding and owner quality control) facilitate transparent checks and balances. One shortcoming of the traditional methods is that contractors – who are going to carry out the projects – are not involved in developing them. However, the growth of increasingly more complex projects demands alternative (evolving) project delivery methods to ensure appropriate project delivery, contract compliance, and quality assurance (Molenaar et al., 2007). One of the evolving approaches is ECI (Lahdenperä, 2016; Molenaar et al., 2007).

The main ambition of ECI is typically understood to be bringing construction knowledge and experience into the pre-construction phases of projects. Of particular interest is the improvement in value for money and project delivery time in comparison to traditional project delivery methods (Scheepbouwer and Humphries, 2011).

The integration of construction knowledge and experience is most beneficial in the early phases of the project (Lahdenperä, 2013). These phases are usually characterized by having the largest potential to influence the design with minimum impact on cost (Kristensen et al., 2015; Rekonen and Björklund, 2016). Research identifies that the construction industry has had positive experiences from practicing ECI (Lahdenperä, 2013; Naoum and Egbu, 2016).

Even if ECI has several advantages, it faces many barriers to implementation. These barriers mainly arise from the fact that the practice involved differs from traditional business practices (Song et al., 2009; Lahdenperä, 2013). Of particular importance are the formal barriers - such as international and national legislation - to the implementation of ECI (Kolman, 2014). Predominantly, public owners face a major challenge if they want to implement ECI since the contractor selection methods involved typically defy established standards (Lahdenperä, 2013). For instance, it is demanding for European public owners to involve the contractor before the project is described in detail since EU public procurement directives oblige owners to use competitive and transparent team selection procedures. It is difficult to use competitive and transparent team selection procedures before the project is detailed. Furthermore, they are obliged to use both price and quality as selection criteria during the early team selection. However, in an early phase of a project, it is challenging to use price as one of the selection criteria due to various uncertainties (Lahdenperä, 2013; European Parliament, 2004; European Parliament, 2014).

Norwegian public owners are obliged to follow international agreements throughout national public procurement regulations. This includes the World Trade Organization (WTO) and European Economic Area (EEA) agreements (Lædre, 2006). The main purpose of these agreements is to achieve the equal treatment of all bidders by obliging public owners to specify clearly what procurement procedures they intend to use before starting to procure (Lædre, 2006; Schnitzer, 2010). However, these agreements create additional challenges for public owners considering early contractor involvement (Lahdenperä, 2013).

The few sources identified from within the EU context have documented how public owners implement ECI in their projects and faced the existing (mainly legal) barriers. Likewise, many authors have not discussed the success factors of ECI with the intention of increasing the understanding of the ECI concept from a public procurement perspective. By using a multiple-case study approach, this paper addresses the knowledge gaps.

The research questions addressed are:

- What do public owners do to implement ECI?
- What are the success factors for ECI?
- How could the implemented ECI approaches be improved in practice?

The first research question is addressed through a literature review and empirical research in eleven Norwegian bridge projects. The second research question is addressed through empirical research into these bridge projects. The third research question is addressed by analyzing the findings from the first and second research questions.

METHOD

The research reported in this study was based on a multiple case study approach, carried out according to the recommendations of Yin (2013). The multiple case study approach was favored in order to understand the topic better by studying similarity and differences between the cases. Furthermore, it was favored to discover the research questions from a wider perspective, to generate strong and reliable evidence and to create a more convincing theory (Gustafsson, 2017). Following the initial literature study, a document study of selected cases, in addition to fourteen interviews with key actors from the selected cases, were carried out.

The review of the contemporary literature was undertaken using the search engines Oria and Google Scholar. Oria is a Norwegian University library resource that includes academic journal papers, conference papers, reports, dissertations, etc. The search words used included ECI, public procurement, EU, infrastructure projects, success factors and the combination of these. Besides, citation chaining according to the principles laid out by Ellis (1993) was also used to find new literature. To filter the relevant literature, abstracts of the articles were read. Based on the literature review, a theoretical framework with case-specific challenges was established after the recommendations of Blumberg et al. (2014).

Based on recommendations from 20 key professionals with several years of experience with in NPRA and from studying NPRA's yearly internal project reports from 2001-2013, eleven bridge projects were identified as cases relevant for study, notably:

Table 1: Description of the Projects and Informants

Cases	Informants	Project description	
		Length	Year completed
1.Tresfjordbrua	PM([1]) &CM	1,290m	2015
2.Gullibrua	CM & the contractor PM	740m	2014
3.Paradisbrua	PM, PuM &DM	53m	Not started
4.Sykkylvsbrua	CM	860m	2000
5.Lepsøybrua	PM & CM	800m	Not started
6.E6*E16 Flyplasskrysset	CM	350m	2016
7.Smålenenebrua	DM	300m	2011
8.E39 Godsterminalenbrua	APM	-	Planning phase
9.Linesøybrua	CE	315m	2011
10.Tjønnøybrua	PM([1])	270m	2003
11.Straumsbrua	PM ([1])	290m	2004

[1]In three of the projects the project manager (PM) was the same person.

The 20 key professionals (most of them are regional managers of NPRA and the rest are senior representatives from NPRA's head office) recommended these projects. The argument behind their recommendation was that these projects were announced for bid in a manner that was relatively open to using contractors' knowledge and experiences. The 11 bridge projects included in the study were characterized by using a contract form (design-build) and implementation strategy (announcing with alternative technical solutions) that differ from the traditional design-bid-build. Four of the projects were/will be announced for bid using design-build contracts, six projects were/will be announced for bid with alternative technical solutions, and one was announced with both.

Given that one of the authors was an employee with NPRA during the research, full access to the internal digital case documents and interviewees was ensured. This access was another

determining factor for the choice of case projects. However, some of the projects were old, so digital documents were not available in the NPRA database. In the selected cases, copies of relevant material, including contract documents, project end reports, and tender documents, were requested, obtained, and analyzed. These documents supported opinions and information gathered during the interviews. After the interviews, these documents were scrutinized closely in order to validate the information provided in the respective interviewees.

Fourteen semi-structured, in-depth, case specific interviews were conducted. Each interview was conducted at the interviewee's office based on an interview guide that was established based on research questions (see Appendix). The interviews lasted between one and two hours. All the interviews were recorded and later transcribed into written dialogues. Thirteen of the interviews were with client personnel and one with contractor personnel; all interviews were conducted according to the methodological approach described by Yin (2013). More client representatives were interviewed because this study aims to explore ECI approaches from the client's perspective. Furthermore, the fact that the client is the party that selects the contract strategy supports this selection. The professional role of most respondents was a manager. The functions included one assistant project manager (APM), one purchasing manager (PuM), one control engineer (CE), three project managers (PM), three design managers (DM), and five construction managers (CM). The choice of using semi-structured interviews was based on a desire to give flexibility for the interviewees and to identify new ways of seeing and understanding the topic. The nature of the questions was open-ended with the intention to bring the most out of the respondent's own reflection, while the interviewees were encouraged to express their views on the subject without being restrained by the predetermined questions related to the studied cases.

The interviewees were considered reliable since all the respondents were actively involved in the procurement phase of the case projects. The validity of the interviewees was considered as the case projects were picked based on the recommendation of the 20 key professionals. Then, the project managers of these case projects were contacted in each case. In some of the cases, the project managers were not available, were not the most knowledgeable persons in the procurement process, had changed employer or retired. These unavailabilities resulted in contacting the other key informants through the project managers' channel.

After data collection, data analysis continued based on the description of Creswell (2013). Data analysis steps described by Creswell (2013) are:

1) organizing and preparing raw data (transcripts, field-notes, images, etc.) for analysis
2) reading through all data
3) coding the data (hand or computer)
4) use the coding process to generate themes or description
5) interrelating themes/description
6) interpreting the meaning of themes/descriptions.

The data were hand coded and analyzed hand-in-hand with data collection and findings write up. The codes were developed based on the theory being examined. They are success factors and ECI approaches. Through the coding process, themes or categories were generated. These themes were interrelated and appeared as major findings and are also used as sub-headings in the findings section.

THEORETICAL BACKGROUND

Early contractor involvement definition

Different terms have been used for the phenomena here called ECI (Turner and Riding, 2015). ECI has also been associated with popular terms such as early supplier involvement and supply chain management (Lenferink et al., 2012). The main idea of ECI consists of involving the competence of a contractor in the early stage of a project. Through teamwork with owners and consultants, the contractors contribute construction knowledge to the early processes (Scheepbouwer and Humphries, 2011; Song et al., 2009). Direct and early involvement of the contractor in the front-end phase increases the benefits of ECI. Better cooperation can be facilitated by direct involvement while better contribution can be facilitated by early involvement (Song et al., 2009).

Sceepbower and Humphries (2011) have identified the difference between ECI practices in the U.S. and countries such as the UK and Australia. The ECI approach in the U.S. is a type of construction management (CM) contracting. In this ECI approach, the owner holds two contracts, one with the designer and the other with the contractors. In the ECI approach that is practiced in the UK and Australia, however, the owner holds a single contract with the

contractor. This latter type of ECI resembles alliancing during the design phase and design-build (DB) contract during the project execution phase (Scheepbouwer and Humphries, 2011).

Through the literature review leading up to this paper, it was observed that there is ambiguity on the subject of the definition of ECI.

Song et al. (2009) define ECI as contractor involvement in the design phase of a project, implemented by a design-build (DB) contract instead of design-bid-build (DBB). The aim of ECI in design is to integrate construction knowledge into the design process. Through this type of ECI, it is possible to improve information flow, drawing, material supply and construction schedule performance

Lenferink et al. (2012) and Valkenburg et al. (2008) analyzed road projects and defined ECI as contractor involvement in the planning phase of projects. Based on their definition, the aim of this ECI approach is to involve the contractors in the procurement process before the decision of the route determination is made. The purpose is to gather support from the contractors in determining the route of the road.

Recently, Walker and Lloyd-Walker (2012) have developed a comprehensive definition of ECI and the different models of ECI. According to their definition, ECI can start in the internal or business development phase and can last until the project completion and handover phase. That means it can take place in the internal phase, planning phase, design phase and in the project execution phase. They further divide ECI into five different models depending on which phase of the project the contractor involvement occurs. Their conclusion is that ECI can be implemented by a range of approaches that could include traditional DBB, DB, management contracting, project partnering and project alliancing (Walker and Lloyd-Walker, 2012).

Different owners have developed different ECI models based on their necessities and circumstances. Some owners have developed relationship-based ECI models for the whole life cycle of the project. Other owners developed a more hybrid model. In the later ECI model, the contract starts with a collaborative approach in the early phase of a project and moves to a conventional type of contract in the project execution phase (Rahmani et al., 2013). The contractor can be involved through various approaches to implementing ECI (Rahman and Alhassan, 2012).

Walker and Lloyd-Walker (2012) developed a model that illustrates the various ECI models. Figure 1 illustrates the three contract forms and how the five models of ECI can be mapped onto three of the identified four project life cycles phases.

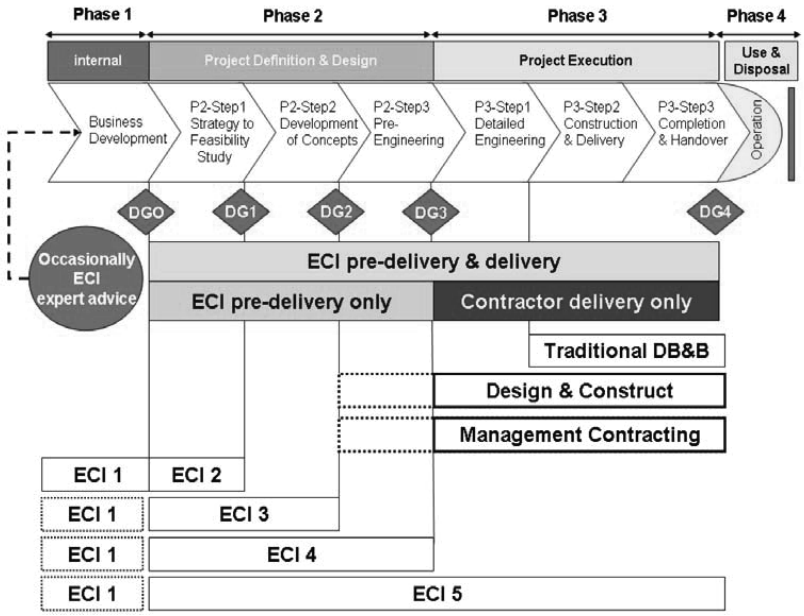

Figure 1: Project Life Cycle Phases.

DG denotes to decision gates: DG0=formally recognized idea, DG1=acceptable initiative to investigate, DG2=choice of concept, DG3=go/no go, DG4=accept outputs for the operation phase: (Walker and Lloyd-Walker, 2012) adapted from (Klakegg et al., 2010):

The main goals of ECI are to facilitate innovation, improve project control and reduce time to completion (Lenferink et al., 2012; Van Valkenburg et al., 2008; Mosey, 2009). Furthermore, the literature has discussed several advantages of ECI, including improved constructability, increased product information, better profitability and feasibility analyses, better communication, better risk management, better plan for construction (Sødal et al., 2014). ECI contributes to better relationships, increases understanding among parties and decreases the potential of adversarial relationships. These beneficial factors stem from the fact that the approach demands frequent interaction and communication. This close interaction and

communication lead to the development of shared goals and objectives that in turn builds cooperative relationships (Rahman and Alhassan, 2012; Scheepbouwer and Humphries, 2011).

The authors understand ECI to be a measure to involve construction knowledge and experience in early phases of a project, directly or indirectly. The early phases of a project are understood in the following as the internal phase, planning phase and design phase. However, in line with the argument of Walker and Lloyd-Walker (2012), we equally consider some ECI activates to take place in the execution phase of a project (see Figure 1).

ECI approaches

Table 2 presents possible approaches of ECI that public owners in the EU can implement. The table is based on a contemporary literature review of the authors of this paper.

Table 2: ECI Approaches Identified from the Literature.

No.	**Approaches of ECI**	**Literature (Authors)**
1	Building Information Modelling (BIM) – tool and process, enabling a high level of design integrity through the common use of BIM platform in early phases.	(Gransberg, 2016), (Kent and Becerik-Gerber, 2010), (Walker and Lloyd-Walker, 2015)
2	Integrated Project Delivery (IPD) – integrates people, systems, business structures and practices through relational contracting.	(Gransberg, 2016), (Kent and Becerik-Gerber, 2010), (Lahdenperä, 2012) (Gokhale, 2011)
3	Most Economical Advantageous Tender (MEAT) – qualifications-based selection of design and construction parties.	(Scheepbouwer and Humphries, 2011), (Lahdenperä, 2013), (Falagario et al., 2012)
4	Open book target pricing – pricing process is to make the contractor to design or construct the project on budget.	(Gransberg, 2016), (Scheepbouwer and Humphries, 2011), (Rahman and Alhassan, 2012), (Molenaar et al., 2007)

5	Cost led procurement – procurement methods that have been developed in the UK comparable to target pricing.	(Ciribini et al., 2016), (Williams et al., 2013)
6	Integrated Project Insurance – an alternative form of insurance providing single cover for the construction project team as a whole.	(Ciribini et al., 2016), (Connaughton and Weller, 2013)
7	Opening for alternative tenders – the client, allow variant solutions by the bidders during the tendering phase.	(Riemann and Spang, 2014)
8	Alliancing – is a project delivery method where the client and contractor participants work together as an integrated, collaborative team and making unanimous decisions.	(Walker and Lloyd-Walker, 2012), (Rahmani et al., 2014), (Lahdenperä, 2012),(Rahman and Alhassan, 2012)
9	Competitive dialogue – procurement procedure for awarding complex public projects.	(Lenferink et al., 2012), (Hoezen, 2012), (Kolman, 2014), (Lenferink et al., 2013), (Marique, 2013), (European Parliament, 2014)
10	Best value procurement (BVP) – It is an award method to procure contractor with the best expertise to complete the task.	(Hoezen, 2012), (Kashiwagi, 2016)
11	Negotiated procedure – Procurement procedure like competitive dialogue but can be applied in simpler public projects.	(Van Valkenburg et al., 2008), (Lenferink et al., 2012), (Hoezen, 2012), (European Parliament, 2014)
12	Partnering – a long-term commitment between the client and contractor for the	(Rahman and Alhassan, 2012), (Walker and Lloyd-Walker, 2012), (Lahdenperä,

	purposes of achieving specific business objectives.	2012), (Löwit and Dostálová, 2014), (Chan et al., 2004)
13	Framework agreement – a procurement arrangement to buy goods and services over a certain period of time.	(Walker and Lloyd-Walker, 2015), (Albano and Sparro, 2010)
14	Design & construct contract / Design & build contract – contract form where the contractor has the responsibility of design in addition to the construction of the project.	(Rahmani et al., 2014), (Song et al., 2009)
15	Management contracting – contract form when a project owner outsources the project management.	(Rahmani et al., 2014), (Walker and Lloyd-Walker, 2015), (Rahman and Alhassan, 2012)
16	Public private partnerships (PPP) –a design-construct-operate-maintain contract and it is similar to Build Own Operate Transfer (BOOT).	(Walker and Lloyd-Walker, 2012), (Rahmani et al., 2014), (Jacobsson and Walker, 2013), (Löwit and Dostálová, 2014), (Hans Voordijk et al., 2016)

All of the 16 approaches fall within the understanding of ECI outlined in the previous section.

Success factors

In order to ensure successful project completion and to minimize surprising variations during the project implementation phase, early identification of success factors is crucial (Torp et al., 2006). The idea behind the identification of success factors is that there are certain major factors that have considerable influence on project performance, and if identified during the front-end phase, will enhance the successful completion of projects (Torp et al., 2004). The purpose of identifying success factors is not to avoid problems; it is rather to aim at knowing how to respond before the problems occur. It is found equally to help project teams minimize firefighting, minimize spontaneous approaches in managing uncertainties and minimize the changes encountered during project implementation (Torp et al., 2004). For these reasons, the

authors of this paper have found it essential to study the success factors of ECI in public projects.

FINDINGS AND DISCUSSION

ECI approaches implemented in the Norwegian public owned bridge projects

Twelve ECI approaches were identified during interviews. A) Findings from interviews and B) discussions as well as recommendations are presented in this section. Of the twelve approaches identified in the interviews, seven are not found in the 16 approaches identified in the literature. The implication of these unidentified approaches is that the literature focuses on advanced ECI approaches that can be implemented for very complex projects; however, the findings from the case studies indicate that there are relatively simpler ECI approaches that can be implemented on less complex projects.

Approaches one to nine have been implemented in the studied projects during different phases of the project. Whereas, approaches ten to twelve were not implemented in the target projects. Instead, interviewees proposed them as a potential approach for future use.

Table 3 presents a matrix of approaches versus projects to show which approaches are mutually implemented in the target projects. Only three ECI approaches occur in an individual manner; i.e., without any other approach being co-implemented. It shows the twelve approaches identified by this study in the first columns and the eleven target projects in the first row. The approaches are presented based on a sequence from most implemented (A1) to least implemented (A12). The projects are arranged by the project that used the most approaches (6) to the project that used the fewest (2). In column two of the table, L stands for approaches identified in literature and P stands for approaches identified by the case projects.

Table 3: ECI Approaches Identified by Interviewees (1-12) x projects (1-11) matrix

No	L/P	ECI approaches	1	2	3	4	5	6	7	8	9	10	11	Total
A1	P	Indirect approaches	X	X	X	X	X	X	X	X	X	X	X	11
A2	P	Information meetings	X	X	X	X	X	X	X		X			8
A3	P	A front-end partnering process	X	X	X	X	X	X	X	X				8
A4	P	Announcing the project with alternative technical solutions	X	X		X		X	X			X	X	7
A5	L/P	Design & construct contract		X	X		X			X	X			5
A6	P	Direct contact with specialist contractors in the front-end phase of projects	X			X								2
A7	P	Idea competition	X											1
A8	P	Contractors sell their idea to the owner in the early phase		X										1
A9	L/P	Negotiated bidding procedure			X									1
A10	L/P	Opening for alternative tenders												0
A11	L/P	Competitive dialogue												0
A12	L/P	Project partnering												0

In the following sections, the twelve approaches identified during the interviews are briefly described and discussed.

1. Indirect approaches

A) This is a set of approaches. The interviewees have mentioned the use of consultant and in-house construction experience as an approach to implement ECI. Furthermore, the involvement of contractors in the preparation of handbooks and standards are also mentioned. In the case projects, this approach was implemented in all phases of projects.

According to interviewees, there is an ongoing bridge component standardization project initiated by the NPRA. With the intention of integrating contractors' knowledge into the standardization project, the NPRA has invited contractors to participate in this project. Furthermore, the NPRA, depending on necessity, invites contractors into a project's price estimation process as well as to updating handbooks and standards workshops.

B) These approaches of integrating construction knowledge into the front-end of projects are categorized under indirect approaches by the authors of this paper. The reason for this is that there is no direct involvement of contractors in a specific construction project. Even when the approaches are indirect, it is possible to use contractors to integrate construction knowledge into the front-end phase of projects. Furthermore, the approaches do not involve public procurement complications like the other approaches identified by this study.

2. Information meetings

A) The interviewees have mentioned information meetings with the contractors' branch as one of the appropriate approaches to implementing ECI. The approach was used to various degrees by the studied projects. In case project 1, the NPRA has used this approach to obtain feedback from the contractors on the contract strategy plans of the project. On this occasion, a meeting was held during the very early phase of the project and the feedback was used to determine the contract strategy of the project. This was not in conflict with public procurement regulations since the client has invited the entire contractors' branch to this meeting and the same information was provided to all contractors. However, in most of the case projects, information meetings were held during the later phases, just prior to announcing the project for tender or after the tender announcement at the tender conference (see Figure 2). The NPRA's intentions during such meeting, when it is held in the later phases, are to attract contractors to the project, to explain the project, and to answer questions that may arise, but it is not to achieve input from the contractors.

Yet according to most of the interviewees' experience from such informational meetings, contractors do not usually contribute much in these meetings. The primary reason for the lack of contractor contribution in information meetings is a fear of revealing the company's strategies. One of the interviewees stated:

Apparently, no contractor dares to expose the company's strategies for solving the project challenges to competitor contractors.

Indeed, such kinds of information meetings are held publicly while all the contractors are gathered in one meeting room.

B) To obtain the most out of an open information meeting, it is best to hold them as early as possible in the front-end of a project. In addition, the client should be willing to accept the inputs and to implement them in the project. Undoubtedly, this openness by the client should be met by contractor willingness to share their knowledge in public meetings. It appears that it is not easy for public owners to have a closed meeting with contractors in the front-end phase of a project.

The influence of an information meeting is significantly dependent on which phase of a project it is held. If it is held in the early phase of the project, it is easier for the client to include the inputs from the meeting in the front-end phase of a project. However, if it is held during the later phases of the project, like during the case of a tender conference, it is difficult to adopt the inputs into the project. This is because most of the important work is already done and the fundamental decisions have already been made during the tender conference of a project. Encouraging contractors to share their knowledge in early phase meetings is consequently essential.

3. A front-end partnering process

A) According to NPRA internal regulations, all NPRA projects should pass through a front-end partnering process phase. This approach overcomes the legal barriers since this phase starts after the contract signing. This phase should be completed before the contractor commences with construction. The length of this phase can vary depending on project needs. The main aim of this process is to create an opportunity for the project team to get to know each other, as well as to set common goals. However, since the contractor has not started with the execution phase of the project yet, during the front-end partnering process phase there is still the possibility for the contractor to come up with optimization ideas.

According to the interviewees, the success of this approach depends on what optimization ideas the contractor comes up with, and how flexible the owner is to accept new ideas from the contractors during this phase. The common challenges are limited time for the contractors to come up with new ideas and the fact that it is mostly those in the management level, not technical people, who are involved in this meeting. As a result, it is difficult to discuss technical details. As a solution to the second challenge, in case project 2, the NPRA has arranged two

parallel meetings in the front-end partnering process phase. The purpose of the first meeting was to discuss general conditions of the project; the purpose of the second meeting was to discuss technical details to find optimal technical solutions.

In some of the studied cases, the NPRA has not designed the project in detail but instead postponed the detailed design until after contract signing. Eventually, in the front-end partnering phase, both the owner and the contractor worked to find an optimal solution for the project. A pain-share gain-share agreement in this phase motivates the contractor to come up with optimization ideas. In case project 2, the pain-share gain-share agreement was 60/40; that is, 60 % to the contractor and 40% for the client. The reference point for the pain/gain share was related to the bid from the contractor.

B) This approach should be combined with an open contract document, i.e., conditions that can be decided after contract signing, to earn the most benefit out of it. Experience shows that both parties become motivated to work for optimization in a pain-share, gain-share arrangement. This explains why the front-end partnering process should be combined with a more open contract document, proper compensation, and flexibility of the owner to accept changes during this phase to succeed with this approach.

4. Announcing the project with alternative technical solutions

A) As mentioned by interviewees, for some projects the NPRA prepares contract documents with several technical alternatives. The aim of the NPRA in providing alternatives is to give the contractors the ability to influence the production method and material selection during the project delivery phase. The alternatives include all necessary detailed designs and respective procurement documents. The primary motive of the NPRA while using this approach is to reach a wider supplier market and obtain multiple bidders for a project to increase the competition and to obtain the cheapest price to build the project.

This approach has been/will be used in seven of the studied eleven projects. In addition, the NPRA has had a positive experience using it, according to interviewees. The planning cost can be comparatively higher since all the alternatives should be planned to a reasonable detail before the tender announcement. However, the NPRA's experiences so far verify that it is a rewarding early investment, considering that the benefit on the latter phase is rather high. One of the interviewees who was involved in several of projects that used this approach stated:

It was possible to get higher market interest for the projects when they were announced in several alternatives. The increase in market interest has secured enough competition for bid. As a result, the NPRA has obtained lower construction cost, which was one of the aims behind using this approach. The approach should be used more in the future complex bridge projects.

In the case projects, this approach has been used in the concept development and pre-engineering phases of the projects. In some of the case projects, the bridge type is announced with several alternatives. In the other cases, the bridge type was already resolved but the construction methods, the foundation type, and other bridge components were announced with several optional technical solutions. During the implementation of this approach in the case projects, legal barriers were not encountered.

B) To implement this approach, it should be technically possible to use alternative technical solutions without affecting the quality of the construction. Apparently, the contractors' willingness to evaluate all the alternatives presented by the owner and to calculate the cheapest option for the owner is equally important. The contractors do not get paid directly for this work but they get an indirect benefit since their probability of winning the bid increases significantly if they consider all options thoroughly.

According to the findings, the direct purpose of the owner while using this approach is to achieve low construction costs for the project. While indirectly, the contractors gain some possibilities of using their experience and knowledge to propose the optimal solution out of the options given by the owner. The limitation of this approach is that the contractors' options are restricted by the owner's options and their involvement is neither direct nor early enough.

5. Design build contract (DB)

A) A DB contract based on an open procurement procedure was used as an approach to involve a contractor starting from the design phase of the projects. In this approach, the contractor gets the freedom and responsibility to design the project even if the NPRA Vegdirektoratet (Head office) for quality assurance should approve the design later on. This approach has been used in the case projects during the execution phase, starting from detail engineering.

The interviewees mentioned four major reasons why the NPRA decided to use a turnkey contract in these projects. The first reason was to save time since they had quite a short time until the opening of the road. The second reason was due to the unavailability of in-house

competence, skill, and experience with special construction materials and construction method. The third reason is due to the fact that there was interest from the contractor branch in using turnkey contracts. The last reason is due to the desire of the NPRA to try a new type of contract form.

As declared by the interviewees of case project 6, even if a DB contract is a suitable approach to implementing ECI, the downside of it is that the owner loses some control and the ability to contribute to the detailed-design phase of the project. The interviewee from case project 6 stated:

When the owner loses control in the design phase, consequently it is difficult to regain control in the construction phase.

The interviewee proposed resolving this control issue by implementing a longer front-end partnering process phase and assuring the involvement of the owner in the detailed-design phase.

Both interviewees and the literature argued that there are different types of turnkey contracts. They range from the functions description of one of the processes in a DBB contract, in its simplest version, to public private partnership (PPP) without private financing for complex projects, in its complex version. They also vary depending on to what extent the project owner has designed the project (preliminary design) and based on the compensation format.

In case project 6, the owner has divided the bridge into two contracts. A turnkey contract with a fixed sum compensation format was used for the super structure of the bridge, the part of the bridge where the owner expected less risk and uncertainty. In contrast, a performance contract with a unit-price compensation format was used for the underwater section of the bridge, the part of the bridge where the owner expected high risk and uncertainty. Furthermore, as stated by the interviewees, function descriptions were used in several suspension bridge projects for the steel section of the bridge. This indicates that it is possible to adapt a turnkey contract and use it for a range of projects to achieve ECI.

B) To get enough bidders and decrease the probability of conflict afterward while using a DB contract, the project should have neither very high uncertainty nor high complexity. Therefore, the owner should be able to define the project to an optimal level to minimize the

risk and uncertainty and know what the owner expects from the contractors. It can also be discussed that effective control is evidenced by the achievement of objectives. If this can be done by aligning the commercial interests of the contractors with the owner's objectives, it can be considered a different method of control than giving orders or directing contractor decisions and actions.

The challenge in DB contracts is to avoid bids being inflated to buffer against uncertainty and complexity. However, that concern should be balanced with the ability of aligned and collaborative design and construction to handle uncertainty and complexity. The problem, of course, is that many DB projects do not align the commercial interests of the DB players and do not promote collaboration between them. If these elements can be specified as requirements for selection and payment, a DB contract can be appropriate for complex and uncertain projects.

6. Direct contact with specialist contractors in the front-end phase of projects

A) According to the interviewees, in order to implement ECI, the focus should not only be on the main contractors. Instead, enough attention should also be given to specialist contractors. Specialist contractors are those that have special equipment and competence that both project owners and main contractors are dependent on to execute a project. Examples of specialist companies are bridge foundation specialists, diving companies, and pile foundation specialist companies. This approach has been used in the concept development and pre-engineering phases of the case projects.

The NPRA uses this approach often and benefits significantly from the competence of specialist contractors by having a professional discussion in the front-end phase of projects. The approach was described as an effective ECI approach since it is based on direct contact, not indirectly through the main contractors. In addition, it mostly addresses one specific challenge and discusses it with highly experienced and specialist contractors. According to some interviewees, this approach is just on the boundary of the EU public procurement law; others explained that if the owner takes care not to expose project specific information, it is a legitimate procedure. According to the advocates of the approach, since specialist contractors are not directly involved in the bid for the construction of projects, this approach does not create problems regarding the EU public procurement regulations. In addition, the NPRA takes great care not to expose project specific information.

As argued by interviewees, three important factors should be considered while using this approach. The first factor is that public owners need to have proper competence in the procurement procedures. The second factor is the specialist contractors' ability to understand the owner's challenge with limited information. This factor is important since public owners cannot ask project-specific questions directly for fear of exposing project-specific information that could give them a competitive advantage later on in the bid for the construction phase. Limited information about the project limits the benefits that the specialist contractors can provide the owner. Finally, the client's description of the challenges should be satisfactory.

B) It can be anticipated that this is a potential approach for future projects; however, the owners' public procurement competence plays an important role here. At the same time, it is also important to know which specialist contractor to contact since it might be misleading if the contacted specialist contractor does not have enough experience on what the client is asking. The simplest way to get around the regulatory concern of unfair advantage and still benefit from specialist contractors participation in project design is to award the contract to an integrated team of designers, engineers, specialty contractors, and a main contractor prior to design.

7. Idea competition

A) As identified by both the interviews and the document study, idea competition is one of the approaches used by public owners to implement ECI in the planning phase of projects. Idea competition is an approach in which the client gathers initial ideas about how to solve a project through a bidding process in the front-end phase of a project. In case project 1, this approach was used in the concept development phase of the project. However, the participants in the idea completion are mostly consulting companies and companies that provide both consultancy and construction services. One of the interviewees stated:

The challenge of public owners in using this approach is whether contractors involved in the idea competition should or should not be disqualified from the bid for construction of the same project.

The cause of the dilemma is how to treat all contractors equally during the use of this approach; i.e., not to give project specific information to some contractors that could give a competitive advantage over other contractors during the bid.

Regarding this approach, three undesirable scenarios that could make the competition imbalanced in the bid for the construction were compiled from the interviews. The first one is that bidders that are not involved in the idea competition may not have the same information as those who are involved. The second scenario is that patent and compensation related problems may arise. The last scenario is that contractors who participate in the idea competition may come up with ideas that are suitable for themselves but are not an optimal solution for the project. In all of the undesirable scenarios described above, it is difficult for public owners to practice the EU public procurement requirements. A possible alternative could be design competition, with the award for detailed design, procurement, and construction going to the winner. Competing alternatives could be evaluated for benefits relative to cost.

B) It can be seen that the crucial advantage of the idea competition approach is that it has a high potential to integrate the contractors' knowledge into the project due to its use early on in the front-end phase. The primary disadvantage of this approach is that it is a one-time involvement and lacks continuity and interweaving throughout the whole project life cycle. In order to decrease the probability of occurrence of the undesirable scenarios described above, proper documentation during the idea competition process could be used as a protective measure. In addition, a well-prepared contract document could also be used as protective measures. Furthermore, owners should be proactive in evaluating each idea before selecting one.

8. Contractors sell their idea to the owner in the early phase

A) In case project 2, one contractor has taken the initiative to promote an idea to the NPRA during the pre-engineering phase. The contractor strongly believed that the company had the appropriate knowledge and equipment to deal with the project in an optimal way. In this case, the contractor thought they were the only competitor able to execute their idea. The NPRA used their idea after detail designing as an alternative technical solution in order to avoid legal issues.

B) Obviously, it is not too common that the contractors take such initiative. This is because they don't know the owner's challenges in the front-end phase. By using various approaches, public owners can inform contractors about the project challenges to motivate them to take the initiative to share their ideas. For example, by using an information meeting and promoting the project challenges, the client can advocate that contractors promote their ideas.

9. Negotiated bidding procedure

A) Negotiated bidding procedure is one of procurement procedures accepted by the EU. The NPRA is planning to use this procedure by combining it with a turnkey contract in case project 3. The reason why the project owner is planning to use this approach is due to a lack of internal competence in the subject matter regarding this specific project. Thus, the NPRA needed to use the contractors' experience in the pre-engineering phase of the project to obtain help for the decision process. This will be the case for all the E39 fjord-crossing projects. The NPRA's challenge in using this approach is a lack of experience with this procedure.

B) By using this approach, it is possible to achieve both direct and early involvement of contractors. However, it can't be used in all types of projects since the procurement process is demanding for both the client and the contractors. To reduce the challenge of a lack of experience, the NPRA can implement various measures. Ensuring proper experience transfer from one project to another can be the first measure. The second measure can be a continuous use of the approach. By taking these measures, the client can ensure the continuous accumulation of experience.

10. Opening for alternative tenders

A) The interviewees mentioned opening the project for alternative offers in addition to what the owner provides. In this approach, the contractors can give bids based on alternative solutions to a project. However, this approach was not practiced in the case projects.

B) In most projects, contractors are not permitted by the NPRA to submit alternative offers because of two major reasons. The first reason is that it is usually challenging to control the features of the alternative offers in the short period between the bid opening and the awarding of the contract. Secondly, it is difficult to compare bidders based on different competition grounds, as the lowest price is most commonly used as the competition base. The first reason is particularly the case with bridge projects since these have relatively longer control and approval process. The entire project delivery will most probably be delayed if the contractors come up with alternative tenders based on a new solution. This demonstrates that the owner may need to be careful of this approach since the cost and duration of a project could be affected by the variety of alternative offers.

11. Competitive dialogue

A) Competitive dialogue is one of the procurement procedures which are approved by EU. It was introduced in 2004 for particularly complex projects by the European Parliament. This approach was not implemented in the studied projects; however, interviewees have proposed this procurement procedure as a potential approach for the future projects to implement ECI.

B) This approached has only been tried on five road projects by the NPRA so far. The experience from these projects should be studied before further practicing the approach.

12. Project partnering

A) Project partnering is a long-term commitment between the client and contractor for the purposes of achieving specific business objectives. Interviewees have proposed project partnering as a potential approach for the future projects even if the NPRA has no experience with this approach.

B) This approach is practiced more in the building sector than in infrastructure projects in Norway. Therefore, the Norwegian bridge sector should learn from the building sector in order to ensure successful implementation of the approaches.

Success factors for ECI

The interviewees have described several success factors of ECI. The authors of this paper have analyzed, compiled and categorized them into six major success factors. They are presented in Table 4. Brief descriptions and detailed discussions are presented in the following sections.

Table 4: ECI Success Factors

No.	Identified ECI Success factors
1	Timing of ECI application
2	Risk distribution
3	Project owner's competence
4	Appropriate compensation
5	Qualification of the contractors
6	Trust

1. Timing of ECI application

According to most of the interviewees, to involve contractors early enough when they can make a real difference and offer them a real possibility of influencing the outcomes of the project is important.

When the contractors are involved too early, their contribution and influence on major decision-making can be too high. Despite this, for standard and less complex projects there may be less value that can be added by using ECI. Furthermore, contractor involvement too early in the process increases bureaucracy and expenses due to the procurement process. On the other hand, if contractors get involved too late, it is difficult to accept their contributions and implement them in the project. This is due to the time required to complete the control and approval process of projects, as well as due to client resistance.

The findings from the case studies prove that ECI is not a "one size fits all quick fix" solution for all projects. Instead, it is important to develop different models of ECI, depending on the level of contractor involvement needed for each project. The consensus is that if the project is very complex, the contractors should be involved at the earliest during the business development phase (see Figure 1).

2. Risk distribution

The interviewees indicated that having a fair risk distribution between the contractor and the client is a success factor for ECI. Due to lack of information and project uncertainties, the risk level of projects is high in the early phases. A project owner should work on risk

distribution of a project to make it fair in order to make the project attractive for contractors and to motivate them to participate in the early phases. This effort could also help to avoid conflict afterward in the project execution phases. If the project risk level that will be transferred to the contractors is high, it could be difficult to find a capable contractor that is willing to carry it.

This discussion indicates that unfair transfer of risk to the contractor could make the project unnecessarily expensive for the owner. Lack of participation in the bidding of such projects would likely be accompanied by a higher risk buffer being set by the contractors. Based on the experience of the case projects, there could be three different approaches to minimizing project risk. The first approach would be to divide one extra-large project into manageable smaller contracts, which could contribute to significant risk reduction. The second approach would be to have a compensation format that suits the risk level. The third approach would be to try to decrease the uncertainties of the project by performing a detailed study before announcing for bid.

3. Project owner's competence

The project owner's competence and experience in ECI public procurement were raised as an important success factor by interviewees. This concern is due to the fact that ECI procurement procedure can be demanding. If the owner makes a minor mistake during the procurement process, it may cause a major interruption in a project. Furthermore, it may lead to difficult court proceedings and damages.

The interviewees have also raised discrimination issues. Regardless of what the client does to avoid disputes and court proceedings, there is always a certain level of risk if the owner includes some, and not all, of the contractors in the early phase of projects. The contractors who are not included may believe that they have been discriminated against. They may also feel that they do not have the same project background information as those who are included in the early phase.

The project owner's competence should not be limited to ECI public procurement procedure; technical knowledge competence is also essential. Even if, in some of the ECI models, owners transfer a significant amount of a project risk and responsibility of the technical design work to the contractor, the owners should still have control over what they have ordered and what they shall receive at the end of the project. Furthermore, the owners should also be

able to describe appropriately the scope of a project. Therefore, in-house technical competence is vital success factor of ECI. In cases where ECI approaches are used due to the lack of in-house competence, other quality assurance mechanisms should be used. These mechanisms could be transferring the operation/maintenance responsibility of the project to the contractor or selection of the contractor based on past performance like in the case of Best Value Procurement (BVP).

These potential issues demonstrate the significance of using a suitable procurement procedure that outfits a project. Additionally, they identify the necessity for the owner to be competent in technical and public procurement. Similarly, transparency during the procurement process, as well as making available all project information for all contractors afterward, could forestall charges of discrimination.

4. Appropriate compensation

Appropriate compensation for the contractors' contribution is another success factor the informants raised during the interviews. The main goal for contractors is to receive profit from a project. Therefore, a client should compensate contractors properly in order to ensure that the contractors share their knowledge with the client. Based on the experience of the interviewees, the contractors' interest in participating in an early phase of a project and their eagerness to contribute varies significantly depending on the compensation format.

This finding confirms the significance of developing an appropriate compensation format that suits the different ECI models. Furthermore, it also illustrates the importance of developing a compensation format that facilitates a win-win situation for both contracting parties.

5. Qualification of the contractors

Assuring the qualifications of contractors that get involved in the early phase was raised as success factor of ECI by several interviewees. When a public owner permits contractors to become involved during the early phases of a project, the intention is to use the experience the contractors have from other comparable projects. Therefore, the contractor should be generally capable and be able to contribute to the new project based on previous experience. How public owners can be assured that the contractors have the necessary qualifications should be identified in advance of the choice of each contractor. Therefore, the contractor's preceding practice in comparable projects could be used as a selection principle.

The findings validate the significance of using ECI with a combination of various qualifications-based selection criteria, such as the most economically advantageous tender, instead of using only the lowest price. By using qualifications-based selection criteria, public project owners could be relatively certain regarding the qualifications of the contractors that are involved in the early phases of a project.

6. Trust

The trust between the client and the contractor is another success factor identified from interviews. No contractor wants to share their knowledge, experience or ways of solving project challenges with their competitors. Based on most of the interviewees' experience, if an owner brings together several contractors in one place to obtain solutions for project challenges, it is seldom that there will be a beneficial discussion in these meetings. Therefore, public project owners should first develop an appropriate plan to assure a method of keeping the contractors' solutions confidential before inviting them for early involvement. One-on-one dialogue in a closed environment increases the contractors' trust level regarding the client. As a result, their openness to share creative ideas increases significantly.

Mostly, contractors want to have contractual protection for their creative ideas, feel safe and be sure about how the information they deliver will be used by the client. Furthermore, due to the nature of the business, they want to be compensated for their expertise as well.

The importance of trust indicates the significance of closed and one-on-one dialogue between the contractor and the client supported by contractual protection and can result in obtaining the most out of the contractors' early involvement. The higher trust level could lead to a more openness and facilitate more input from the contractors.

On the other hand, interviewees also raised the issue of the client's trust in contractors. The owner's trust level with the contractors is the critical factor for how much accountability the owner transfers. For example, in a DB contract, an owner does not precisely know before the project is completed what he will get at the completion of the project. So when a public owner favors DB instead of DBB, it indicates that the owner has a greater level of trust, allowing him to hand over accountability to the contractors by involving them early.

How could the implemented ECI approaches be improved in practice?

The analysis shows that time of contractor involvement is the most important factor for a successful implementation of ECI approaches. The benefits of ECI in terms of value for money and project delivery time are higher when it is carried out as early as possible. As a consequence, this paper uses *time* as evaluation criteria of the implemented ECI approaches in practice.

Figure 2 illustrates the phases-steps in which the nine ECI approaches were implemented. In addition, it illustrates in which phases-steps the twelve ECI approaches could have been implemented in, based on the understanding of the authors of this paper. The latter information is provided to illustrate the potential of each of the twelve ECI approaches identified during the interview. In the figure, A1-A12 stands for ECI approaches identified by interviewees (see Table 3). Solid lines indicate when the approaches were implemented in the case projects. Dashed lines indicate when the approaches could have been implemented. Solid lines overlay dashed lines.

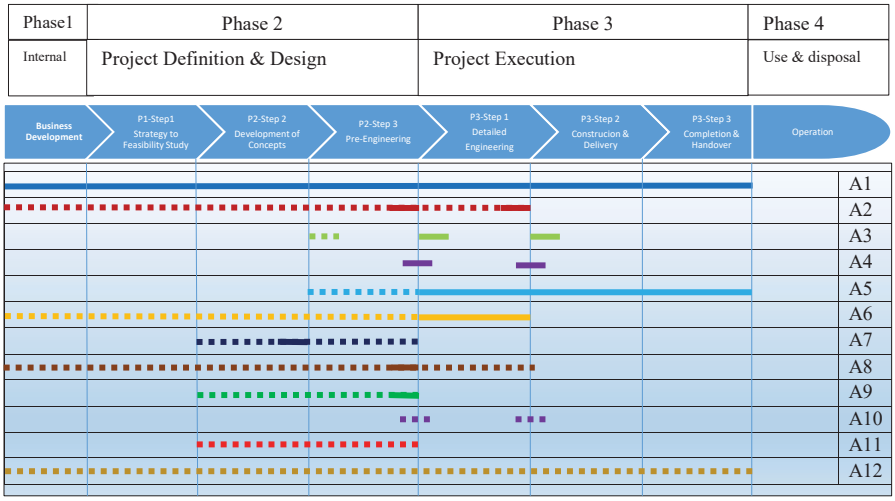

Figure 2: Illustration of the phases-steps during which each ECI approach was implemented and which phases-steps they could have been implemented.

During the evaluation of the implemented approaches by the determined evaluation criteria, *time*, it is observed that most of the identified ECI approaches were implemented during relatively late phases of the projects. However, as shown in Figure 2, most of the approaches have a higher potential of being implemented earlier in the target projects. This disconnect indicates that the full potential of the implemented ECI approaches was not exploited by NPRA. The first success factor that was identified by the client interviewees themselves was not realized when approaches of ECI were in use. Based on this observation, we concluded that with regard to bridge projects, the NPRA has a lot to learn when it comes to implementing ECI. In many cases, the perceived barriers seem to stop public owners from implementing ECI even though they are surmountable. A lack of familiarity with ECI approaches, lack of awareness on the importance of ECI, and a lack of experience in the use of the ECI approaches could all be the barriers to full implementation.

In the future, public owners should give emphasis to the success factors of ECI while implementing ECI approaches. The recommendation of this paper is that the implemented ECI approaches could be improved if public owner give appropriate consideration to the success factors of ECI while implementing the approaches.

CONCLUSION

The research questions addressed in this study are as follows:

- What do public owners do to implement ECI?
- What are the success factors for ECI?
- How could the implemented ECI approaches be improved in practice?

The literature reports that severe barriers exist – primarily legal ones – that exclude the public owners from introducing contractors into the earlier phases of a project. The research reported on in this paper shows that – based on experiences in Norwegian bridge construction– the difficulties of overcoming these hindrances are exaggerated. The analysis presented in this paper shows that lack of experience, lack of awareness regarding the importance of ECI and lack of familiarity with ECI approaches are equally important barriers. ECI is, in fact, possible

and several approaches to it are explored above. The overall finding of this paper is that involving contractors earlier in a project than is practiced today is highly recommended.

The literature study identified 16 approaches and the case studies identified 12 approaches. Of these twelve approaches, 7 are not found in the 16 approaches identified in the literature. The implication of these unidentified approaches is that the literature focuses on advanced ECI approaches that can be implemented for very complex projects; however, the findings from the case studies indicate that there are relatively simpler ECI approaches that can be implemented on less complex projects. The addition of these seven approaches not recognized by the literature enriches the selection possibilities of public owners. Furthermore, it provides a new direction for the literature of ECI by introducing new approaches as potential topics of further study.

This paper has also identified six major success factors of ECI from the interviews, notably the timing of ECI application, risk distribution, project owner's competence, appropriate compensation, qualification of the contractors, and trust.

The evaluation of the approaches was based on *time*, which is also one of the success factors identified by this study: timing of ECI application. The evaluation shows that most of the identified approaches were used in the late phases of the case projects. The analysis shows, however, that most of the identified approaches could have been implemented earlier in the process. Based on this observation, it is possible to conclude that the primary success factor for the use of ECI identified by the owners themselves was not realized when approaches of ECI were implemented. As a result, the potential of the ECI approach was not fully exploited by NPRA. Public owners who plan to implement ECI should also consider the other five success factors. Therefore, the recommendation of this paper is that the implemented ECI approaches could be improved if public owners give appropriate consideration to the success factors of ECI while implementing the approaches.

The study involved some limitations. The empirical study was based only on Norwegian bridge projects, specifically projects of the NPRA. Moreover, the scope of the study was restricted to bridge projects that were completed after 2001 and to bridge projects which were in the planning and design phase during the course of this study.

Although this research is based on Norwegian public bridge projects, the study findings and practical experiences may be used as a basis for similar investigations by other public owners

in Norway or in other parts of the world. The study contributes to the field of public procurement by introducing new ECI approaches from the case studies. Furthermore, it provides useful insights to assist public owners in selecting and implementing ECI approaches.

In the future, more case studies in other infrastructure projects, as well as projects other than bridges, may reveal new approaches and validate the findings. The international experience of ECI could also be studied to investigate what others outside Norway have done. For example, Finland and the Netherlands have extensive experience with engaging contractors in the project definition and design phases within the EU public procurement directives. Furthermore, each of the approaches identified in this paper could be studied in-depth in order to relate them to international experience. It may then be possible to prioritize one approach over the other for future use. This investigation could be conducted by weighing potential benefits against associated efforts and risks.

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APPENDIX: INTERVIEW GUIDE

1. Introduction
   - Can you tell me about your background?
   - Information about the case project (a separate cheek list was used to gather information about the case projects).
2. How can public owners integrate contractors' knowledge and experience in project planning/project design (general questions)?
   - In your opinion, what kind of implementation strategies and contract forms can public owners use to integrate contractor knowledge and experience in project planning/project design?

- How can these implementation strategies and contract forms help to integrate contractors' knowledge and experience in project planning/project design?
- What are the advantages and disadvantages of these implementation strategies and contract forms?
- What could government owners achieved by integrating contractors' knowledge and experience in project planning/project design?

3. What did NPRA to integrate contractors' knowledge and experience in project planning/project design (project specific questions)?

<u>Previous project specific experience</u>

- What is your prior experience with integrating contractors' knowledge and experience in project planning/project design?
- Based on your prior experience, what are the advantages and disadvantages of integrating contractor knowledge in project planning/project engineering? Can you give me some specific examples?

<u>Specifically on the case project</u>

- Can you tell me about what you have done / will you do differently to integrate contractors' knowledge in project planning/project design in this specific project?
- Why do you want to integrate the entrepreneurs' knowledge in project planning/project design?
- Why were this specific contract strategy, contract form, and procurement procedure chosen?
- What did/will NPRA achieve by integrating contractors' knowledge in project planning/project design in this specific project?
- Which challenges bring this contracting strategy? Why?
- What can be done to improve this strategy for future use? Or what should be done differently?
- Do you have experience from other projects with similar or other contractual strategies that are used to integrate contractors' knowledge and experience in project planning/project design?

4. What are the success factors for integration of entrepreneur knowledge in project planning/project engineering (project specific questions)?
    - In your opinion, what were the success factors of integrating contractor knowledge and experience in project planning/project design in this specific project?
    - In your opinion, what were the challenges for NPRA by integrating constrictions` knowledge in project planning/project design? Why?
5. How can NPRA integrate contractor knowledge and experience in project planning/project engineering in future projects (general questions)?
    - Do you think that there is a need to integrate contractors' knowledge in project planning/project design in NPRA's future projects?
    - When shall the contractor's knowledge integrate into project planning/project design?
    - In general, what are the success factors of integration contractors' experience or knowledge and experience in project planning/project design in NPRA's future projects?

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Relational base contracts – Needs and trends in Northern Europe

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Abstract

Starting from a large case project in Norway, a research gap was identified concerning analyses of experiences in the use of different relational contract models. This study explores the experiences with relational contracts in large infrastructure projects in selected countries. We looked at what types of contracts were applied, why these, what were the experiences, and what contract strategies will be used in the future. Based on findings of this study, it is not easy to identify patterns in factors that influence the choice of contract. Rather, it seems that each country's selected approach is incidental. Each country selected approach after experts advocated a certain model or practitioners who have applied a certain model. We observed that targeted countries could somehow be grouped in two. In Sweden and Denmark relational contracts seem to be more about attitude rather than formal contract regulations. In the UK, Finland and the Netherlands relational contracts seem to be more dependent on formal contract regulations. The future trend seems to be a more widespread the use of relational contracts.

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Keywords: Contract, Relational, Transactional, Purchasing, Procuremen;

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1. Introduction

By moving the construction projects toward getting more complex and uncertain [1], relational contracts, where a contractor offers wider services packages, are increasingly used in construction projects. Several types of relational contracts have been formed in the construction industry, mostly in the last few decades, to comfort public owners achieving their targets in terms of time, cost and quality.

Starting from a large case project in Norway, a research gap was identified concerning analyses of experiences in the use of different relational contract models in large infrastructure projects. Although type of contract should be selected based on project characteristics, owner characteristic, and market situations [2-4], it often appears that the choice of contract is more subjective than educated selection among the alternatives available for public owners.

The main goal of this study is to allow researchers and practitioners to learn from experiences from the main infrastructure actors in Northern European markets with relational contracts (Sweden, Finland, Netherlands, UK and Denmark), as well as helping the infrastructure industry to focus on the main positive experiences with each relational contract.

By spotting the lack of consolidated knowledge about relational contracts, this study provides an excellent opportunity to learn from different countries and differing relational contract used in these countries. This paper is the result of a pilot study, where we have mapped experiences from different countries with relational contracts in procuring big infrastructure project.

This paper answers the following four research questions:

1. What types of relational contracts are applied?
2. Why were these contract strategies used?
3. What are the experiences with these contract strategies?
4. What contract strategies will be used in the future?

This pilot study directly connected to an infrastructure mega project in Norway. The Norwegian Public Roads Administration (NPRA) wants to establish a ferry free coastal highway E39 from the city of Kristiansand to Trondheim. This highway is dependent on eight fjord crossings, and the estimates say that 269 Billion Norwegian kroner will be spent over a 20 years construction period. This comes in addition to other infrastructure projects that will be carried out during the same period. Both in terms of size and need for technological innovation the ferry free coastal highway represents a challenge for the NPRA.

Another major change will be the way, which the NPRA is going to procure roads. Based on the capacity of the NPRA, contract types that guarantee smooth and appropriate project delivery by allocating more responsibilities to the contractor will be the main interest of the authority. The NPRA needs to choose the best contract procedure in the early phase of the project lifecycle based on project characteristics, client objectives and the external environment. In this direction, this study provides the challenges and experiences with relational contracts to assist the NPRA in the later decision-making process

2. Method

To answer the research questions of this study, two main approaches have been used; a literature study and a multiple case study. To develop a theoretical background and map the existing knowledge on contract models, especially relational contracts, the work started with a literature study following the prescription of Blumberg et al. [5]. A structured search through relevant databases for a combination of both journal articles and conference papers discussing contracts models resulted in a database with more than 150 references. The literature search conducted with different combinations of the key words, namely; “relational contract,” and “project delivery.” This search resulted in many hits, with plenty of irrelevant responses. The search was narrowed down by using additional key words “collaborative” “procurement”, “Europe”, “experience”, “advantages”.

Selection phase started after stablishing the initial database by going through the abstract and screening the article. The number of articles found in the first phase of the search were reduced later by one of the following reasons:

- considered not relevant to scope of this study.
- the article is not considered to be reliable academic research (suffering from a lack of methods, strong discussion, etc.)
- published in non-refereed journals

Content of the relevant articles were reviewed and summarized in literature review chapter.

To map rationale for choosing the selected type of contract, experiences with the different models and chosen models for the future, a multiple case study after the recommendations of Yin [6] was undertaken to gather information about the use of contract models in large infrastructure case projects.

The selection of countries/case projects was partly determined based on findings from the literature study that pointed to countries/projects with some maturity in the use of relational contracts. In addition, recommendations from the NPRA concerning countries/projects believed to be relevant cases to learn from also influenced the choice of cases. The study targeted one organization in each selected country, responsible for building and operating infrastructure projects.

Data collection from the case projects was primarily undertaken through 14 semi-structured interviews with 26 respondents. The interviews took place at the premises of the respondents. Some of the interviews were case-specific. Others were about country experiences in general, but all of them followed the structure of the four overarching research questions. The respondents came from Sweden, Finland, Netherlands, United Kingdom, and Denmark.

In ***Sweden***, The Swedish Transport Administration (Trafikverket) is responsible for long-term planning of the transport system for all types of traffic. Trafikverket is responsible for the overall long-term infrastructure planning of road, rail, sea and air transport. In ***Finland***, The Finnish Transport Agency is responsible for the operation of Finland's transport system. The Agency took over from the Finnish Rail Administration. Now FTA is responsible for Finnish roads, railways, waterways and for the overall development of Finland's transport system. In ***Netherlands***, Rijkswaterstaat is responsible for design, construction, management and maintenance of the main Dutch infrastructure facilities, such as roads, waterways and water systems. In ***United Kingdom***, Network Rail owns and operates Britain's railway infrastructure. Network rail runs, maintain and develop Britain's rail tracks, signalling, bridges, tunnels, level crossings and many key stations. In **Denmark**, the Fehmarn Belt Fixed Link is a planned immersed tunnel that is proposed to connect the Danish island of Lolland with the German island of Fehmarn. The projects were selected due to similarities to the ferry free E39 project, and the agencies were selected due to similarities to the Norwegian Public Roads Administration. The respondents in each organization were chosen based on their experience with relational contracts and/or because they participated in on-going infrastructure projects that used relational contracts.

3. Literature Review

According to Haddadi et al. [7] Value creation in a construction project depends on three main stakeholders: i) the owner, ii) the suppliers iii) the users. The owner's prerequisite in order to create value is basically summarized in profitable/optimal operation of the building and fulfilling the customer's needs. The suppliers are required to minimize the waste (non-value creating activities) and to fulfil the costumer's (owner and user) needs in order to create value in their final product. The ultimate objective of the project should be to fulfil user's needs in order to increase the "customer's perceived value".

By Projects getting more complex and uncertain[1] eliminating waste-non value creating activities such as; disputes, over processing, rework, incidents, etc., is more challenging. On the other hand, delivering the customer needs in such projects might present the desire for developed contract models that can faces different challenges caused by the complexity and uncertainty.

Many authors have enlightened the range of different contract models in construction industry. Walker and Lloyd-Walker [8] introduced a project procurement taxonomy including three main subcategories; 1) segregated design and delivery- Design-Bid-Build (DBB), the most known transactional model, that separates design and construction process and teams, is included in this cluster. 2) Integrated design and delivery process by focusing on planning and

control- Design and Construction (D&C) and Public Private Partnership (PPP) are among the listed forms in this subgroup. 3) integrated design and delivery team by focusing on collaboration- Partnering, Alliance and IPD are fitted in this group. We use the term relational contracts in this article while we referring to the last cluster. Relational contract can intervene with traditional distribution of roles and risk between client and supplier. Partnering and alliancing often involves special information, communication and decision making systems.

The relational based contracts can be signed in different project phases. They frequently include untraditional distribution of roles and risk. According to Walker [9], there are several aspects in contractual relations and project execution models. Several of these aspects can be summarised on a scale from high to low. Transactional contacts typically have a high level on several of these aspects, as indicated by going to the right in Figure 1.

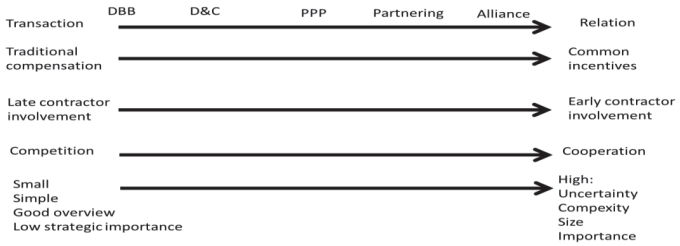

Figure 1 an illustration of aspects that vary between transactional and relational contracts

A common tool in partnering is a partnering charter [10, 11]. According to Lahdenperä [11] the practice of partnering has evolved and a new contractual practice has developed today .The Latham Report [12] discussed partnering as a broad term used to describe a collaborative management approach that encourages openness and trust between parties of a contract. According to Eriksson [13] partnering is required especially for complex construction projects, characterized by high uncertainty and time pressure. Drouin [14] also provide definitions of two categories of partnering: 'project partnering' and 'strategic partnering'. The former aims to improve performance over the life cycle of a single project. The latter focuses on obtaining a competitive advantage over the long period to foster long-term relationship.

As indicated in Figure 2, it is frequently assumed that a low level of collaboration is associated with highly transactional contracts.

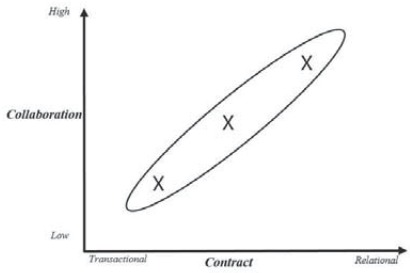

Figure 2 Relation between type of contract and degree of collaboration that is typically assumed in literature

Project alliancing is built on the notion of Partnering. Alliancing is a relational contract mechanism and typically involves an open-book accounting sharing risk setting, and initial target cost generated by the joint project team [15].

An alliance agreement defines the targets, and risk and reward mechanisms and the interrelationship of different contractors [16].

Partnering and alliancing share intentions of win-win game and sharing risk. However, the distinction between them today is not clear [11]. There is no universally agreed definition of partnering [17, 18] or alliancing. The two terms are used interchangeable, which may cause confusion [19].

In this context it is enough to note that both partnering and alliancing, can be defined as relational forms of contracts, in which the client and contractor usually collaborate through informal or formal agreements, and include the establishing of trusted-based relationships to achieve common objectives[20]. Marcus et al. [21]state that Derek et al. [22] identify that alliancing, is more "all embracing" than partnering. Consequently, we have placed alliancing further to the right than partnering in Figure 1.

In complex projects, changes can occur in the project. Changes have to be managed through the contracts in an efficient way [23].According to Ng et al. [24], the use of transactional contracting processes inhibits flexibility. Uncertainty, complexity and long duration in construction projects call for flexible contracts.

4. Findings and discussion

In this section, we present a summary of findings from each case country.

4.1. Sweden

The Swedish Transport Administration's national plan requires an annual productivity improvement of 2-3 per cent. Trafikverket and representatives of the suppliers have agreed that they are dependent on each other in the common process of change. This requires the parties to take responsibility for running the common direction and show tolerance, openness and transparency in their relationships based on their roles and responsibilities (Trafikverket, 2016).

Related to transactional project implementation models, Trafikverket have launched an initiative called «Samverkan», which can be translated to collaboration. Samverkan Basis is expected to be used on all projects, while it was previously voluntary. «Samverkan» has much in common with partnering and alliances. It requires common systems for risk management, conflict resolution, and performance measurements. Colocation of key project personnel is important for both client and suppliers, and they require attendance at the joint location at least 2 days per week. Major projects shall have a dedicated project person who is responsible for Samverkan. Interestingly, "Samverkan" is not necessary linked to relational based contracts. They consider Samverkan to be one aspect, which can be combined with different types of contracts, including transactional contracts. Samverkan is independent of contract structure and compensation format. Figure 3 illustrates the relation between collaboration and type of contract in Swedish approach. Good Samverkan is dependent of the attitude of the project management of both client and supplier.

Future plans include more Samverkan and further training. Trafikverket's goal is a 50 % proportion of design & build, which they consider to be compatible with Samverkan, and transactional contractual thinking. In the future, they have ambitions to include designers in schemes for incentives and pain/gain sharing.

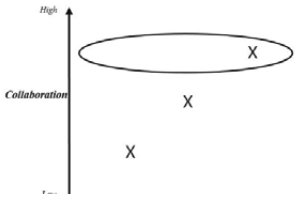

Figure 3 Swedish approach – partnering is independent of type of contract

4.2. Finland

FTA has been experimenting with new project delivery forms due to low productivity, many conflicts, poor quality and the need for innovation supported by inspiration from research from other countries that showed better solutions, better plans, better reliability and higher productivity.

After trying some PPP projects, FTA has now started to use more collaborative delivery forms including Alliancing in some projects. Project size is growing and responsibilities of contractors are broadening. Collaborative delivery method and alliance has become the most preferred road project delivery method. The response from suppliers has been varied; some fear a lower profit margin, others actively support it.

In Finland, FTA uses Alliancing, aligned with the Australian alliance model, specifically inspired by Australian experiences and some other countries, and following a deliberate decision to test it in some public projects. In Finland and other EU countries it is required to use a price component in the evaluation of contractors.

4.3. Netherlands

Dutch industry has practiced and study different type of relational base contracts [25, 26]. Scheublin [25] underlined the needs in construction industry to learn from industrial relations specially Project Alliance while construction projects are getting more complex and uncertain.

Rijkswaterstaat as a major part of the Dutch Ministry of Infrastructure and the Environment, recently introduced Best Value Procurement (BVP) as a response to problems like disputes, change orders, rework, etc. Rijkswaterstaat found the advantages in BVP when it comes to early involvement of contractors. The BVP allows the contractors tell what they can do in an early stage of the projects while in transactional approach, the client tells them what they shall do and how. After exciting couple of dozen projects, Rijkswaterstaat experienced successful outcomes including; reduced cost, shorter execution time and low level of conflict in the projects. The BVP helps a major reduction in the client's need for personnel during the execution phase, however, the client need more people compare to transactional approach in the clarification phase. By now, approximately 10 % of the projects are procured with Best Value Procurement, but the goal is to reach 50 %.

Although some projects are better suited for transactional procurement methods, the Dutch public owners and Rijkswaterstaat desire to continue this development of the contractor market toward more relational based models. They think a paradigm change is needed even the broad implementation and application might take time.

4.4. United Kingdom

Related to relational delivery models, the UK use a variety of models from, different types of PPP to partnering and alliancing. Network Rail has wide experience with relational based strategies, and has adapted a version of the Australian alliance model. The experience is that alliances are suited for large, complex, high-risk projects with interfaces to ongoing production and traffic.

Based on the experiences in UK, alliancing is a good way to get the contractor/s involved in early phase of the projects, which has been recognised as a key success factor for most projects. Authorities have started seeing the value of early contractor involvement, something that transactional contracts do not rely on.

Several different drivers have been identified for choosing alliancing in the UK; when there is a high complexity in the project, the need for technical solutions, high uncertainty, the need to set new completion targets, multiple interfaces, large number of stakeholders and projects of high value. It seems that the UK started to move towards using alliances to overcome some of the pitfalls of transactional contracting, especially those associated with the adversarial environment and the excessive claims.

In the 1990s, partnering was tried out in the UK and somehow failed because of projects relying on intrinsic motivation/incentives. The UK discovered that this does not work in the real world. You need the contract to back it up, but partnering has the problem of combining a collaborative relationship with a win-lose contract. As soon as the relationship comes under strain, the parties revert to business as usual.

4.5. Denmark

Danish experienced other types of contracts while aiming toward collaborative environment. The data from Denmark is based on one specific case project, the Fehmarn belt project, which used prequalification followed by Competitive Dialogue (CD). The selection criteria were best value for money, price plus the technical bid, including management competence. High weight was put on management aspects as part of the technical evaluation.

A challenge with CD is that you should spend more resources and money into the contracting process, both from the client and from the contractor, this is the nature of CD. Decision makers in Fehmarn decided early that they would pay money to the contractors to participate into the bidding process in order to achieve early contractor involvement benefits. Under this model, there is a need to have a competent client/project owner organization that is more involved in the process than in a traditional process.

Fehmarn has used an adapted CD procedure and seems to have been the right choice for the project; it has proven its value by giving flexibility in the process and resulting in bidders that were happy with this way of working.

5. Conclusion

While numerous researchers have gathered national experiences with relational contracts, the originality of this study comes from the comparison of experiences in several different countries in Northern Europe. We have looked at what types of contracts were applied, why these, what were the experiences, and what contract strategies will be used in the future.

Based on findings from this study, it is not easy to identify patterns in factors that influence the choice of contract. Rather, it seems that each country's selected approach is incidental, with experts advocating a certain model or practitioners who have applied a certain model. As part of the cross-country analysis, we observed that the countries could somehow be grouped in two; in Sweden and Denmark relational contracts seem to be more about attitude rather than formal contract regulations. In the UK, Finland, and the Netherlands relational contracts seem to be more dependent on formal contract regulations. We expected to find a more systematic analysis underlying the decisions.

When it comes to why the owners chose relational base contracts, two kinds of reasons seem to crystalize. The first is a need to improve the project participants' attitude, and thereby decrease the number of disputes, change orders, rework, incidents etc. The second is that projects are changing, as they are becoming more complex, longer, have higher uncertainty, more need for technical innovation and innovative solution. To meet these changes, clients look for new contract strategies, and relational contracts may represent the answer. By increasing complexity and uncertainty the likelihood of non-value creating activities like disputes and order changes increases. Relational contracts create a better environment for collaboration and addressing the challenges by establishing a common goal for involved parties in the project than traditional contracts where competition and single stakeholders´ value creation can get ahead of pursuing the common goal.

The answer to the fourth research question, about what contract strategies will be used in future projects, is related to the development of recent infrastructure projects. Public owners in targeted countries experienced the shortfall of the transactional contract models when it comes to execute a complex project with uncertain scope. We observed indications that present a trend toward increasing the use of relational base models in construction industry especially public sector. These indications include, efforts to gather the positive/negative experiences from executed and ongoing projects, increased number of pilot project and many research projects concerning the relational contract strategy paradigm.

What is required ahead is to continue the effort undertaken lately by Walker and Lloyd-Walker [8] and ourselves among other research projects to document experiences harvested through the experimentation with different contract types and accomplished effects. For the Norwegian Public Roads Administration, that aims to build the 269 Billion Norwegian kroner project Ferry free coastal highway E39, it will be equally important to find the most suitable contract strategies and document experiences from the projects they are used in.

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Selection criteria for delivery methods for infrastructure projects

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Abstract

The project delivery method (PDM) greatly influences the project outcome. Design-Build, Construction Management and Design-Bid-Build represent the three main methods. Each PDM comes up with its own advantages and disadvantages which suit different projects in different circumstances. A general literature review and a case specific document study were carried out. Firstly, this paper identifies general criteria for selecting PDM. Secondly, it comes up with specific criteria for selecting the PDM for a large infrastructure project. Due to the project characteristics, the identified specific selection criteria differ from the general selection criteria. The Norwegian Public Roads Administration (NPRA) plans a coastal highway route (E39) along the western coast of Norway covering a total of 1100 km, substituting seven ferry connections, with an estimated cost of 268 billion Norwegian kroner. This project is used as an exemplary case of a large infrastructure project. The paper contributes to the body of knowledge with a list of selection criteria for PDMs aggregated from literature, and points out that this list should be adapted to case specific characteristics before being used to select a PDM

Peer-review under responsibility of the organizing committee of IPMA WC 2015.

Keywords: Project delivery method, infrastructure, selection criteria, mega project;

1. Introduction

The choice of project delivery method (PDM) greatly influences the project outcome and is one of the most important factors that determines a project's success (Al Khalil, 2002, Chan et al., 2001, Kumaraswamy and Dissanayaka, 2001). A Project delivery method is a system for organizing and financing design, construction, operations and maintenance activities and facilitates the delivery of a good or service (Miller et al., 2000).

PDM's effect on a project's cost, schedule, efficiency and success make it a challenging issue for stakeholders and decision makers (Chan et al., 2001, Al Khalil, 2002, Kumaraswamy and Dissanayaka, 2001). The suitability of the selected PDM can improve the project performance to a great extent (Kumaraswamy and Dissanayaka, 2001, Al Khalil, 2002, Oyetunji and Anderson, 2006, Han-Kuk et al., 2008, Udechukwu et al., 2008). There are a large number of different project delivery systems available in the construction industry which aim to overcome the

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shortcomings of traditional procurement (Alhazmi and McCaffer, 2000), Figure 1 classifies some of most common PDMs based on two characteristics: the source of finance, and integration of delivery. The source of finance represents the degree of financial risk that the owner assumes while undertaking the project, while the integration of delivery is the degree to which the different project elements, such as planning, design, construction, and operation, are separated or combined during the production cycle (Miller et al., 2000).

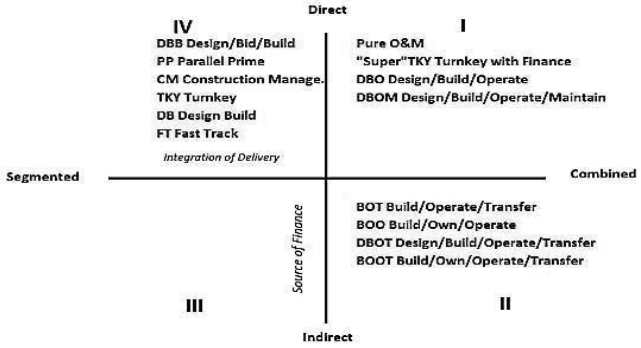

Figure 1 Operational framework for project delivery system (Miller et al., 2000)

In many cases, the PDM is chosen simply on basis of the knowledge and experiences of in-house experts and/or guidance from external consultants (Masterrman and Duff, 1994) without a deep exploration of the strengths and weaknesses of each method, or any regard to the influencing success factors and characteristics of each project.

There are many PDMs listed in literature, but Construction Industry Institute (CII) maintains that all PDMs can be placed into three fundamental PDM categories: Design-Bid-Build (DBB), Design-Build (DB) and Construction Management (CM) (Sanvido and Konchar, 1998). Although discussing the suitability of these models and other procurement arrangements in different circumstances is out of this study's scope, findings can be used to choose a suitable PDM.

With projects becoming more complex and with a large number of project success factors, there is a need to select suitable PDMs with a more systematic approach. Already much research has been done in the area of identifying the criteria that influences PDM selection, however they have focused on proposing a selection method rather than focusing on the criteria themselves. What sets this study apart is that, ***firstly, it gathers a comprehensive list of criteria from a literature study and secondly, determines a list of specific criteria to be used for selecting PDM in an infrastructure project***.

2. Method

A general literature review and a document study were carried out. The literature review was conducted according to the guidelines prescribed by Blumberg et al. (2014). The reviewed literature concentrates on PDMs and selection criteria. The tactic was to search for keywords (see Table 1) in databases as ABI/Inform, Science Direct, Scopus, Web of Science and to use search engines as Google Scholar, Compendex and Bibsys ASK.

Table 1. Keywords used in literature search

Keywords	Combination used	Narrowed by
PSC	Procurement	Infrastructure
Project delivery	Contract strategies	
Selection criteria	Contract type	

The research was carried out by using one specific case. According to Flyvbjerg (2006, p228) "one can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods". As an example of a large infrastructure project, the E39 coastal highway was selected as the case due to the complexity that the project represented in a number of different aspects, as well as the participation of the authors as members of a research group involved in the study phase and contract development of the project.

The ferry-less E39 project aims to upgrade the existing E39 that runs along the western coast of Norway between Kristiansand and Trondheim by removing the seven fjord crossings currently operated by ferries. The program covers a total of 1100 km and has an estimated cost of almost 270 billion Norwegian kroner. A program of this scale will consist of a number of projects that will vary in size and characteristics. Thus, it will be beneficial to the NPRA to have a list of selection criteria that affect the selection of a suitable PDM.

The studied documentation mainly included the reports from the Norwegian public road authority (NPRA) and other documents provided by NPRA regarding the E39 project. These documents were chosen due to the need for the understanding of the basics of the project and NPRA's objectives as the owner, in addition to the market and society/social demands[*].

3. Theoretical background

3.1. PDM

A Project delivery method is a system for organizing and financing design, construction, operation and maintenance activities and facilitates the delivery of a good or service (Miller et al. 2000). There are many PDMs listed in different literature (see for example Table 2), however the construction industry institute (CII) has maintained that all the different PDMs can be placed into three fundamental PDM categories: Design-Bid-Build (DBB), Design-Build (DB) and Construction Management (CM) (Sanvido and Konchar 1998). The three PDMs are described in the following. In ***Design-Bid-Build (DBB)***, also known as the traditional method, the owner will engage a design firm to complete the preliminary and detailed design for the project. Once completed the owner will announce a call for tenders after which a number of contractors will submit bids based on this design. The owner then selects a contractor, typically based on the lowest price, to undertake the project. In this method, the owner will sign separate contracts with designer and builder with the design contract being completed prior to awarding the construction contract. ***Construction Management (CM)*** is where an owner engages a competent firm to act as an agent who will provide and manage all necessary jobs during construction phase in addition to provide input to the designers during the design phase. In ***Design-Build (DB),*** one entity is contractually responsible to produce both the design and undertake the construction activities.

Findings show that most infrastructure projects are traditionally implemented as DBB contracts (Rizk and Fouad 2007), however there has been a trend toward using DB rather than the traditional strategy (Molenaar et al. 1999). This change of strategy is due to the complexity of the projects as well as the clients' desire to influence decisions (Herbsman 1995). It is essential to list the selection criteria for each project individually in order to address the strengths and weaknesses of each method and to choose the best-fitting implementation strategy.

[*]"Hovedrapport Ferjefri E39", 2012 and "Gjennomføringsstrategier og kontraktstyper", 2013 (Available at http://www.vegvesen.no)

3.2. PDM Selection Criteria

The selection of an appropriate PDM is the basis of success in every construction project and has never been an easy job due to the characteristics of procurement systems. Besides having several PDMs available to choose from, each one varies in several aspects. A PDM that can lead a project to success in some aspects may lead a project to failure under different circumstances, thus one PDM will not fit for all projects. The PDM selection process requires consideration and analysis of different, complex and dynamic factors which can be categorized under three groups: client objectives, project characteristics and external environment (Alhazmi and McCaffer 2000; Luu et al. 2003a).

As mentioned earlier researchers have pointed out that the suitability of the selected PDM influences the project success and is a driving force for developing several PDM selection approaches. Examples of PDM selection models are shown in Table 2:

Table 2. PDM selection model

PDM selection approach	Reference	PDM selection approach	Reference
Multivariate analysis	(Chan et al. 2001)	Decision-support system	(Kumaraswamy and Dissanayaka 2001)
Selection matrix	(Tran et al. 2013)	Fuzzy multiattribuite decision making	(Mostafavi and Karamouz 2010)
Multicriteria/multiscreening	(Alhazmi and McCaffer 2000)	Analytical hierarchy process	(Al Khalil 2002; Mahdi and Alreshaid 2005)
DEA-bound variable (BND)	(Chen et al. 2011)	Artificial neural network (ANN)	(Ling and Liu 2004)

While these approaches mostly meet their planned point of selection as a procurement selection decision, generally they suffer from a lack of consideration of the implicit interrelationships between the various procurement selection criteria (PSC).

A structured review of relevant literature reveals that the first step in PDM selection methods is to establish the procurement selection criteria (PSC) and interrelationship between them. The PSC should mirror the clients' requirements, project characteristics and external environment (M. M. Kumaraswamy and Dissanayaka 2001). As M. M. Kumaraswamy and Dissanayaka (1998) stated, PSC can be used preliminary as a guide to assist decision-makers with understanding the attributes of particular PDMs. However, it cannot be a single basis for selecting one PDM due to the intricacy of matching one PDM with the clients' requirements, project characteristics and external environment. The National Economic Development Organization (NEDO 1985) listed nine generic criteria for the public sector to priorities their projects: *time, certainty of time, certainty of cost, price competition, flexibility, complexity, quality, responsibility and risk.* In last few decades, several studies have used NEDO criteria, or modified version of that, in-order to develop a PDM selection model. However, Duc Thanh Luu et al. (2003b) believe that the use of a limited version of PSC, like those identified by NEDO (1985), may cause weaknesses for selection models to choose the most appropriate PDM for projects.

This study has aimed to address one of the main client's challenges and to fill a gap in current literature by providing a comprehensive list of criteria that can be used to develop the E39's PSC list and to assist the NPRA's decision–makers.

4. Findings

Table 6 demonstrates 22 of the most used criteria that have been identified from the literature review, and have been used by others in order to either select the most relevant PDM, use in decision making methods or to assess the performance of the selected PDM. There is the fact that projects are unique in nature and their characteristics are affected by constant change in their needs due to internal and external demands. So, would the same list be valid for all projects?

As illustrated in Table 6, some elements are repeated more than others in the literature, but the question is, are these elements more important that the others? One of the requirements for a choice of PDM for the E39 project is innovation, however innovation is only mentioned in just two articles (See Table 6). Therefore is essential to adapt Table 6 to each individual project after reviewing the project's characteristics, project objectives and client objectives. It is obvious that characteristics vary from project-to-project and depends on the project owner and

stakeholders.

To be explicit about this idea, this study points to the findings of the E39 project. After a comprehensive document study, the PSC for the E39 project are listed in Table 3 as the focus area to compare against the selection criteria obtained from the literature. Since some of the indicators have the same or similar meaning, but different expressions, a short definition is provided in the table.

5. Discussion

It can be said that each project may find one PDM that, in some sense, is more appropriate than others. Though, no PDM is likely to be better than the others for all projects. Selecting the appropriate PDM for a project may improve the probability of project success (Luu et al. 2005). Before the evaluation of PDM options, there is a need to determine the project requirements, client's needs and nature of the external environment. Decision makers may experience difficulties when deciding the suitability of different PDMs, confused as they may be by a diverse continuum of PDM options, project characteristics, client characteristics and external environments.

Table 3. Identified selection criteria for E39

Selection criteria	Defined as
Innovation	A need and demand for innovations during design and construction
Owner's available resources	Owner's capability to use their own resources in this particular project
Owner can take risk (Risk allocation)	Client's willingness to take certain risks in hope to improve project performance
Technology availability	Availability of technology to carry out certain construction techniques required
Flexibility	Potential for design changes during construction
Contractor's capability and availability	Availability of contractors/subcontractors with expertise to fulfill project requirements
Quality performance	Level of quality demanded by clients or different standards
Life cycle cost	Client's requirement for Life cycle efficiency as well as low operational and maintenance costs

Experienced clients can select a PDM which has worked for them before, or they can use a two-step process to achieve the best result (D. Luu et al. 2005; Mortledge et al. 2006). The first step is to *Identify and priorities the project/client characteristic, project/client objectives* and *environment impact*, and the second step is *Evaluating the possible options against aforementioned findings and selection of the most appropriate one*. The most important PSC based on the findings from the literature are listed in Table 4.

Table 4. Most important PSC based on literature

Selection criteria	Count	Selection criteria	Count
Schedule delay	19	Market competitiveness	11
Quality performance	14	Owner willingness to be involved	8
Complexity	13	Project type	6
Flexibility	13	Scope definability	6
Risk allocation	12		

The literature count in Table 4 shows that the most important criteria in literature is "schedule delay" which is the most frequently used indicator for project timing and represents the project schedule. However, this has not captured much interest in an infrastructure project like E39 project. The information provided by the literature review and case document study reveals that each PSC may have a different influence in different projects and under different circumstances. In other words, Table 6 needs to be adapted to each specific project and its need, before being used as fundamental data for helping decision makers select an appropriate PDM. Therefore, the major challenges for clients are identifying the project criteria for each individual project.

Practically, a combination of PSC such as quality, innovation, flexibility, delivery speed etc. could be considered to encase the client objectives and project characteristics. Due to the diverse nature of projects, it would be

impossible to illustrate the interconnections of PSCs for every individual project and circumstance. On the other hand, these PSCs are not independent from each other, this means not only the identified criteria should be taken into consideration but those with an interrelationship with the founded PSCs also need to be included to assess and establish a priority list. Table 5 demonstrates these connections for the important PSCs for the E39.

6. Conclusion

Using an appropriate PDM is one of the key factors leading to project success. Deciding which PDM to adapt is a challenging task due to variety of available options and diversity of project/client needs and objectives. Findings expose that the selection of a suitable PDM entails two main steps: identification and formulation of the project selection criteria, and the evaluation of the different PDM strengths and weaknesses against the PSC, thus leading to the selection of the most appropriate PDM. Key selection criteria listed from the literature, categorized in three groups in this study, will assist decision-makers to come up with an adapted list to their project. Investigation of E39 Project reveals that some criteria may capture less interest in literature while being considered as main criteria in a specific projects. This highlights that there is a need to adapt the selection criteria for each individual project based on project characteristics, client characteristics and external environments. In addition, it is important to explore the interrelationship between selection criteria, since one criteria may exert on the others.

Table 5. Factors influence Procurement Selection Criteria (PSC) in E39

Selection criteria	Influenced by
Innovation	Flexibility, technology availability, risk allocation, market competitiveness
Contractor's capability	Cost and time certainty, risk allocation, quality performance
Owner willingness to take risk(Risk allocation)	Owner want to be involved
Technology availability	Cost and time certainty, risk allocation, quality
Flexibility	Contractor's capability, complexity
Owner's available resources	Owner willingness to take risk
Quality performance	Contractor's capability, technology availability, complexity, innovation
Life cycle cost	Quality performance, risk allocation, contractor's capability, innovation
Political impact	

While infrastructure projects are traditionally implemented as DBB contracts, the NPRA will be influenced by significant changes in the near future when the E39 starts the execution phase. One of the major changes will be the way in which the NPRA is going to procure roads. Based on the capacity of the NPRA, project delivery methods that guarantee smooth and appropriate project delivery by allocating more responsibilities to the contractor will be the main interest of the authority. In this direction, the implication is that the list adapted to project need, NPRA characteristics, and external environment in Norway, may assist the NPRA in the later decision-making process. The NPRA needs to choose the best procurement procedure in the early phase of the project lifecycle based on project characteristics, client objectives and the external environment. These three groups include the general selection criteria in Table 6, which should come into consideration when selecting the most suitable procurement method.

Table 6. General selection criteria

Selection criteria	References
Project characteristics	
Delivery speed	Alhazmi and McCaffer 2000; Konchar and Sanvido 1998
Schedule delay	Al Khalil 2002; Alhazmi and McCaffer 2000; Cheung et al. 2001; Gransberg et al. 1999; Konchar and Sanvido 1998; Kumaraswamy and Dissanayaka 1996; Kumaraswamy and Dissanayaka 2001; Ling and Liu 2004; Love 2002; Luu et al. 2003a; Luu et al. 2003b; Luu et al. 2005; Mafakheri et al. 2007; Mahdi and Alreshaid 2005; Molenaar and Songer 1998; Mostafavi and Karamouz 2010; NAO 2003; Ng et al. 2002; Oyetunji and Anderson 2006; Ratnasabapathy and Rameezdeen 2007

Cost growth	Alhazmi and McCaffer 2000; D. D. Gransberg, W.; Reynolds, L.; Boyd, J. 1999; Konchar and Sanvido 1998; Ling and Liu 2004; Love 2002; D. T. Luu et al. 2003a; Duc Thanh Luu et al. 2003b; D. Luu et al. 2005; Mafakheri et al. 2007; Mahdi and Alreshaid 2005; Molenaar and Songer 1998; Mostafavi and Karamouz 2010; Oyetunji and Anderson 2006; Ratnasabapathy and Rameezdeen 2007
Cost Certainty	Cheung et al. 2001; M. Kumaraswamy and Dissanayaka 1996; M. M. Kumaraswamy and Dissanayaka 2001; Mahdi and Alreshaid 2005; Ng et al. 2002
Quality performance	Alhazmi and McCaffer 2000; Ardani et al. 1999; Arditi and Lee 2003; Cheung et al. 2001; Konchar and Sanvido 1998; M. Kumaraswamy and Dissanayaka 1996; M. M. Kumaraswamy and Dissanayaka 2001; Ling and Liu 2004; Love 2002; D. Luu et al. 2005; Mahdi and Alreshaid 2005; NAO 2003; Ng et al. 2002; Ratnasabapathy and Rameezdeen 2007
Project type	Alhazmi and McCaffer 2000; Konchar and Sanvido 1998; Ling and Liu 2004; D. T. Luu et al. 2003a; Duc Thanh Luu et al. 2003b; D. Luu et al. 2005; Ratnasabapathy and Rameezdeen 2007
Project scale	Ling and Liu 2004; D. T. Luu et al. 2003a; Duc Thanh Luu et al. 2003b; D. Luu et al. 2005; Mafakheri et al. 2007; Ratnasabapathy and Rameezdeen 2007
Project cost	Ardani et al. 1999; Love 2002; NAO 2003; Ratnasabapathy and Rameezdeen 2007
Complexity	Al Khalil 2002; Alhazmi and McCaffer 2000; Cheung et al. 2001; Kumaraswamy and Dissanayaka 1996; Ling and Liu 2004; Luu et al. 2003a; Luu et al. 2003b; Mafakheri et al. 2007; Mahdi and Alreshaid 2005; Molenaar and Songer 1998; Mostafavi and Karamouz 2010; Ng et al. 2002; Oyetunji and Anderson 2006; Ratnasabapathy and Rameezdeen 2007
Scope definability	Al Khalil 2002; Ling and Liu 2004; D. Luu et al. 2005; Mahdi and Alreshaid 2005; Molenaar and Songer 1998; Oyetunji and Anderson 2006
Flexibility	Alhazmi and McCaffer 2000; Arditi and Lee 2003; Cheung et al. 2001; Gransberg et al. 1999; Kumaraswamy and Dissanayaka 1996; Ling and Liu 2004; Mafakheri et al. 2007; Mahdi and Alreshaid 2005; Molenaar and Songer 1998; Mostafavi and Karamouz 2010; Ng et al. 2002; Oyetunji and Anderson 2006; Ratnasabapathy and Rameezdeen 2007
Change orders	Ardani et al. 1999; Mostafavi and Karamouz 2010; NAO 2003
Innovation	Mostafavi and Karamouz 2010; NAO 2003
Owner characteristics	
Dispute	Gransberg et al. 1999; Kumaraswamy and Dissanayaka 2001; Ling and Liu 2004; Mahdi and Alreshaid 2005; Ng et al. 2002
Owner willingness to be involved	Al Khalil 2002; Alhazmi and McCaffer 2000; Cheung et al. 2001; Kumaraswamy and Dissanayaka 2001; Ling and Liu 2004; Luu et al. 2003a; Luu et al. 2003b; Mahdi and Alreshaid 2005; Ng et al. 2002; Oyetunji and Anderson 2006
Owner willingness to take risk (Risk allocation)	Al Khalil 2002; Alhazmi and McCaffer 2000; Cheung et al. 2001; Kumaraswamy and Dissanayaka 1996; Luu et al. 2003a; Luu et al. 2003b; Mafakheri et al. 2007; Mahdi and Alreshaid 2005; Mostafavi and Karamouz 2010; NAO 2003; Ng et al. 2002; Oyetunji and Anderson 2006; Ratnasabapathy and Rameezdeen 2007
Owners available HR	Alhazmi and McCaffer 2000; Ling and Liu 2004; Mafakheri et al. 2007; Molenaar and Songer 1998
External environment	
Contractor's capability and availability	Ling and Liu 2004; D. Luu et al. 2005; Mahdi and Alreshaid 2005
Market competitiveness	Alhazmi and McCaffer 2000; Cheung et al. 2001; Kumaraswamy and Dissanayaka 1996; Ling and Liu 2004; Luu et al. 2003a; Luu et al. 2003b; Luu et al. 2005; Mahdi and Alreshaid 2005; Molenaar and Songer 1998; NAO 2003; Ng et al. 2002; Ratnasabapathy and Rameezdeen 2007
Regulatory feasibility	Luu et al. 2003a; Luu et al. 2003b; Luu et al. 2005; Mahdi and Alreshaid 2005
Technology availability	Luu et al. 2003a; Luu et al. 2003b; Luu et al. 2005; Ratnasabapathy and Rameezdeen 2007
Political impact	Luu et al. 2003a

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Project partnering in Norwegian construction industry

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Abstract

Although partnering is one of the preferred methods of project delivery to address adversarial behavior, there is still a lack of a thorough and descriptive definition over this concept. Certain requirements must be met if we want to classify a project in the partnering cluster. Therefore, the purpose of this paper is to break down partnering into a list of tangible elements. In order to do that, we formulated the following research question: What is Partnering in construction industry?

A comprehensive literature study was carried out to identify a theoretical list of elements used in partnering projects. Data from 26 partnering projects within Norwegian construction environment was collected during face-to-face semi-structured interviews conducted with key actors in the construction industry. Collected data utilized with findings from literature to develop a definition of partnering. Partnering is defined as a collaborative procurement form, focusing on integration of the project design and delivery by weighting collaboration and coordination between involved parties. In this paper, partnering is broken down to elements such as: value based procurement, compensation form based on open books, dispute resolution method, start-up workshops, joint objectives, follow-up workshops and early involvement of contractor etc. One or preferably more of these elements should be obtained in order to tag the project with partnering. By adding more elements, the purity of partnering would increase toward full collaborative environment.

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Keywords: Partnering; contract type; construction; relational contract;

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1. Introduction

Latham [1] identifies the UK construction industry's existing industry practices as adversarial, ineffective, fragmented, and incapable of delivering for its clients. It urged for reform and advocated as well partnering as other manners of collaboration. Today, there is still a widespread acknowledgement that the UK does not get full value and has failed to exploit the potential for public construction and infrastructure projects to drive growth [2].

A report to the Norwegian parliament in 2011-2012 states that fragmentation and adversarial behavior resulting in a decline in productivity equally characterize the Norwegian construction industry. The report requests a priority on cost efficiency, smart building and improved quality, and upholds the government's role in the development of the construction industry[3].

One of the main role player in Norwegian construction industry is Statsbygg. Statsbygg is the Norwegian Government's key advisor in construction and property affairs, building commissioner, property manager and property developer. One of its five main business objectives for 2011-2015 states that it shall "deliver within budget, on time and to the agreed standard". The matching key strategy for this objective is to "guarantee results through systematic work and continuous improvement". Equally, having a long-term, innovative perspective that contributes to development of the industry. Statsbygg should be a role model for the building, construction and property management industry [4].

Statsbygg initiated their partnering effort in 2001 to contribute to a change of the culture from adversarial to cooperative, and give both faster completion and more value for money. In this way, partnering is Statsbygg's way of reducing waste and increasing the value of their construction projects.

By increasing, the popularity of partnering due to the traditionally adversarial culture and the high level of conflicts other big public clients such as Norwegian public road administration (NPRA/Statens Vegvesen) also developed their own partnering models.

This study investigates a broad range of cases, executed by different clients in Norway to find a common practical understanding over the topic and compare it with findings from literature. Furthermore, it identifies the challenges related to practical implementation of the concept.

At present time, number of partnering projects are increasing in the construction industry. This underline the need for identifying the partnering project characteristics that is essential to address the challenges related to implementation of this concept in Norwegian construction projects.

2. Method

The methodological approach is divided into two with a literature review and multiple-cases study (based on a survey, interviews and a document study). based on Yin (2011). The case study was done based on a survey, interviews and a document study on 26 selected projects. The projects were identified through the authors' network of practitioners, and chosen on basis of being partnering projects. Selected projects were executed by different organization presented in Table 5.

The literature study, following the prescription of Blumberg, Cooper and Schindler [5], was undertaken to develop the theoretical background for partnering. A combination of both journal articles and conference papers were used to get a broad perspective of the current views of the topic. A document study was performed on a number of key government and industry publications covering partnering concept. The case studies were designed based on the principles as describes in Yin [6] with both triangulation of methods and perspectives to strengthen the analysis. The methodological approach is divided into two with a literature review and a case study.

Using a combination of the literature study and document study was an effective way to gain a theoretical insight into concept of partnering. With the theoretical background in place, interviews were performed to gain practical insight. The combination of theoretical and practical insight helped to analyse how the elements of partnering help to achieve desired outcomes.

The discussion presents the authors' interpretation of the studied literature and information from case investigations.

3. Theoretical background

3.1. Partnering

An increasing interest towards the implementation of collaborative working relationships in projects has led nowadays to the development of several studies about this topic. One of the first definition of partnering has been provided by the Construction Industry Institute in 1991, where partnering is considered as;

> *"A long-term commitment by two or more organizations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organization boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost-effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services" [7].*

There are many references in the literature to partnering which Table 1 presents collection of some of the most cited definition of partnering. Many authors have developed their own contributions to the concept with aiming to mature a widely accepted definition of partnering. Some studies proved to be too broad and generic, not giving the reader a deeper insight into the case, while others have focused on the analysis of the partnering details and elements for effective implementation. Despite of all these efforts, a general and clear definition of the concept is still missing [8]. The absence of a consensus on partnering, together with an insufficient understanding of practices development, could increase the complexity for further studies and represent a challenge for effective partnering implementation[9].

Table 1. Partnering definitions

Authors	Definition
Bennett and Jayes [10]	Partnering as a management approach used to achieve business value and increase efficiency of construction industry.
Black, Akintoye and Fitzgerald [11]	Partnering for the creation of effective working relationships.
Chan, Chan and Ho [12]	Partnering as a framework for improve working relationships between project participants.
Chan, Chan and Ho [13]	Process to encourage good working relationships based upon commitment, trust, and communication.
Cheung, Ng, Wong and Suen [14]	Partnering as an attempt to enabling non-adversarial working relationships.
Cheung, Suen and Cheung [15]	Project management approach to improve performance through effective working relationships.
Eriksson [8]	Cooperative governance based on cooperative procedures in order to facilitate cooperation.
Larson [16]	Partnering as cooperative relationships that enable the creation of a project team with a single set of goals and procedures, based upon collaboration, trust openness, and respect.
Larson [17]	Formal management designed to overcome adversarial relationships in projects.
Lu and Yan [18]	Process, initiated at the outset of a project, that is based on mutual objectives and specific tools (workshops, project charter, conflict resolution techniques and continuous improvement techniques).
Naoum [19]	Partnering as a framework based on trust, cooperation, and teamwork.
Nyström [20]	Trust and mutual understanding are the most important components of partnering. Other important components are incentives, team building activities, partner selection, openness, facilitator, conflict resolution techniques, and structured meetings.
Thomas and Thomas [21]	Partnering as an integrated teamwork approach that could lead to the creation of value in projects.
Yeung, Chan and Chan [22]	Partnering is defined by soft components (trust, commitment, cooperation, and communication) and hard components (formal components, gain-share/pain-share).

Analyzing the literature on partnering reveals that while some authors presented a similar phrasing, others underlined that the creation of collaborative working relationships depends upon the presence of specific elements. For instance, Larson [23] formulated a definition of partnering that includes a list of success elements, such as collaboration, trust, openness, and mutual respect. More recently authors like Chan, Chan and Ho [13] ,Naoum [19] ,Nyström [20], Lu and Yan [18] and Yeung, Chan and Chan [22] have investigated the relevant elements for partnering. It resulted that there is a strong connection between what partnering is, and how it should be implemented, whereby, in order to fully understand this concept, partnering definition cannot be separated from the presented elements. Table 2 shows the partnering elements identified from literature.

Table 2. Partnering elements in literature

Elements	Eriksson [8]	Bennett [24]	Bygballe [9]	Nyström [25]	Kadefors [26]	Larson [23]	Naoum [19]	Ng, Rose, Mak and Chen [27]	Yeung, Chan and Chan [22]
Trust	X	X	X	X	X	X	X	X	X
Common Understanding		X	X	X	X	X		X	
Collaborative Contractual Clauses	X							X	X
Early Involvement of Suppliers	X		X					X	X
Incentives	X			X	X		X		
Common Goals	X	X			X	X	X	X	X
Team-Building Activities	X	X	X	X	X	X			
Structured Meeting/Workshop	X	X		X	X				X
Facilitator	X	X		X				X	
Committed Participants		X		X				X	X
Conflict Resolution	X	X		X	X	X	X	X	X
Open and Effective Communication		X		X		X		X	X
Open Book Economy	X								
Continuous Improvement							X		X
Continuous Joint Evaluation								X	

As it is presented in Table 2, some elements, like trust, common understanding, and conflict resolution mechanisms, are identified by the majority of the authors as important elements of partnering. Moreover, according to Eriksson [8] elements of partnering could be further classified as core and optional components as it illustrated in Table 3. Eriksson [8] believes that elements like open book economy, workshops, common goals, team building, and conflicts resolution mechanism should clustered as core component due to their position in creation of collaborative environment in projects.

Besides, Bygballe, Jahre and Swärd [28] have underlined the importance of establishing long-term relationships in partnering, in order to ensure the creation of trust, common objectives and commitment between participants. However, the effective development of long-term relationships requires the presence of both informal (relational) and formal (contractual) constituent, in a strategic perspective.

Table 3. Core and optional component of partnering [8]

Core components of partnering	Optional components of partnering
Bid evaluation based on soft parameters.	Early involvement of contractors.
Compensation form based on open books.	Limited bid invitation.
Usage of core collaborative tools. (Start-up workshops, joint objectives, follow-up workshops, team building, conflict resolution techniques)	Joint selection and involvement of subcontractors in broad partnering team.
	Collaborative contractual clauses.
	Compensation form including incentives based on group performance.
	Usage of optional collaborative tools. (Partnering questionnaires, facilitator, joint risk management, joint project office, joint IT tools).
	Increased focus on contractors' self-control coupled with limited end inspections.

According to the early definition of CII [7], the implementation of partnering could lead to major benefits in projects; *"Anticipated benefits include improve efficiency and cost effectiveness, increased opportunity for innovation and continuous improvement of quality of product and services"* [7].

In supporting CII definition, Bennett and Jayes [10] showed that adopting partnering could increase savings in project from 2% to more than 10% of the total cost. Larson [16] analysed 280 projects in his research in order to demonstrate that project partnering bring higher performance that traditional procurement methods. Moreover, partnering leads to improved quality of service and earlier completion of the project [10]. Other recognized advantages introduce with partnering practices could be the opportunity for innovation, sharing risk between parties and disputes reduction [8, 11, 13]. A list of benefits identified from literature which rationalize the use of partnering as preferred procurement method is presented in Table 4.

Table 4. Partnering benefits

	Eriksson [8]	Bennett [24]	Larson [23]	Naoum [19]	Cheung, Ng, Wong and Suen [14]	Chan, Chan and Ho [13]
Increased Efficiency	X	X	X	X	X	X
Increased Quality	X	X	X	X		X
Innovation	X	X			X	X
Reduce Litigation / Dispute Resolution	X	X	X	X	X	X
Increased Customer Satisfaction		X	X	X		X
Elimination of Adversarial Relationships	X	X		X		X
Sustainability	X					
Safety Performance	X	X		X		X
Reduce Risk / Risk Shared	X				X	
Enhanced Communication						X
Continuous Improvement						X

According to Eriksson [8], obtaining benefits from an effective cooperation in projects is not always easy, due to various barriers and challenges arising when trying to implement partnering practices. In accordance, Cowan, Gray

and Larson [29] underlined that adopting partnering in projects could be hard work, therefore the advantages might not always be achieved. Changing traditional habits and building a collaborative environment in project requires high preparation and commitment from all the participants. Furthermore, according to Ng, Rose, Mak and Chen [27] it is essential to adopt partnering in the right situations and for the right reasons in order to obtained the potential benefits.

Many authors, like Naoum [19] and Yeung, Chan and Chan [22], agreed that the absence of a standard agreement constitutes the first issue for partnering implementation. Moreover, Eriksson [8] argued that, without a consensus on partnering, confusion and ambiguity could arise between the project participants. If this happens, the cooperation between the parties, and consequently the benefits, will be more difficult to achieve.

4. Findings

According to Aarseth, Andersen, Ahola and Jergeas [30] one of the major challenge in the implementation of partnering in Norwegian construction industry is the lack of an univocal perception of what partnering is and means. In general, the partnering model, in the Norwegian environment is still under development and efforts have been spent to change from adversarial to cooperative culture. The idea that introducing partnering in projects will provide more overall value for money and a more rational building process is persuading clients that a major involvement and knowledge are needed in order to gain awareness and best practices.

Table 5. List of investigated project

Builder's name	Public/Private	Project Nr.	Project Name	Interview
Statsbygg	Public	1	The National archives	Yes
		2	Oslo Courthouse	Yes
		3	Saemien sijte	No
		4	Equestrian corps	No
		5	University in Bergen	Yes
		6	College in Sør-Trondelag	Yes
		7	Health-archive in Tynset	Yes
		8	College in Gjøvik	Yes
		9	The supreme court	No
Entra	Private	10	Konggata 51	Yes
		11	Pilestredet 30	Yes
		12	Powerhouse Kjørbo	Yes
Sektor	Private	13	Stovner Center	Yes
Studentsamskipnaden i Oslo og Akershus	Public	14	St. Hanshaugen Student House	Yes
Statens Vegvesen	Public	15	Astadkrysset Bridge	Yes
		16	Blakstad Bridge	Yes
		17	Hjelvikbruene	Yes
		18	Måndals tunnel	Yes
		19	Tresfjord Bridge	Yes
		20	Veg Vikbukt og Remmen	Yes
		21	Vågstrand tunnel	Yes
Undervisningsbygg	Public	22	Hersleb School	No
		23	Majorstuen School	Yes
		24	Nordpolen School	No
		25	Tokerud School	No
		26	Tåsen School	No

Through the analysis of case studies and interviews, it is being possible to identify the contractual elements that have more often been included in Norwegian construction projects. The results are then represented in Table 6 that gives an overview of 26 partnering projects (see Table 5) in Norway.

In the next section of the paper partnering elements identified from target projects with brief description will be presented.

Value based procurement is used in a significant number of target cases; this requires proper knowledge and experience from the project participants, in addition to a general understanding of partnering idea.

Prequalification of contractors is introduced only in few of the target cases. This depends in large part from the allocation criteria used in the tender. From the analysis, it emerged that the allocation criteria in many cases have considered both price and quality, ensuring that the contractor has sufficient knowledge and capacity to implement the project in a good way.

Introducing a **functional description,** as a basis for procurement, can lead to better solutions and cost savings. Apart from one owner, the other have often used a functional description of a project.

Most respondents identified **target price by sharing bonus/malus** as an essential interaction element as it gives the contractor a strong incentive to save costs in the project (chasing best deals with subcontractors) and increase productivity. The target cost is established after a negotiation, where both parties should be content with the pricing of the project and the incorporated risk reserve.

Open book-economy is one of the most common adopted partnering elements in projects. With an open book economy, the client can see where money is spent and this helps to create more confidence and trust between the project parties.

Start-up workshops, included in almost all the projects, are important to fix a common set of procedures and goals for the project, as well as lay the foundation for effective working relationships.

Except for one owner, all the others have adopted **early involvement of contractors** in at least one of the target case project. Involving the contractors' competence in an early stage of the project can lower the design costs and increase participation. Several respondents have indeed emphasized the importance of early involvement as a fundamental factor to achieve cooperation in projects.

Few projects have **included the subcontractors** in the partnering groups, only in one the studied projects the subcontractors participated at the bonus/malus contract. This inclusion can strengthen the partnering arrangement, but the subcontractors often choose to stay out to limit risk. The same situation is verifiable in regards to the **inclusion of consultants and architects** in the projects.

Continuous workshops, introduced in most of the projects, are important to ensure that the participants are following the procedures, and to monitor team goals and stakeholders` commitment. In case the situation must be improved with the implementation of new procedures to improve cooperation. Despite the strong importance, the **final workshop** was introduced only in one project. In most cases, even if a final meeting was planned, the participants downgraded it because of many things to focus on the completion phase of the projects.

The **measurement of performances during process** has been conducted only in one third of the studied projects. Feedback and continuous measurement is one of the key elements of partnering, and by measuring it the project manager can understand if the project is on track. The difficulty relies on the efficient measurement requiring specific measurable target, precise milestones, and available resources.

In partnering it is important that disputes are resolved at the lowest possible level, to not affect the effectiveness of the project. In these cases, a **conflict resolution mechanism** has been implemented only in five of the target projects, through the creation of a steering group or an external coordinator for governing disputes.

Furthermore, a **cooperation agreement** was issued in six project using different methods, and **target document** was rarely used in these projects.

The **contractual right to replace people and / or companies** during partnering projects have been establishes from three builders. According to the interviewees, it can be necessary to substitute a person or a firm, but this might leave a gap in the project information and knowledge.

Only in few projects, the **co-location of the partnering group** had been experienced. It is underlined the importance of face-to-face communication in order to have a successful partnering. However, according to one case, frequent workshops have replaced the need for co-location.

The matrix in Table 6 constitutes an important tool to understand how partnering is performed in Norwegian construction industry, and specifically to perceive which elements are more often implemented in projects. A further analysis has analysed which, between these elements, are most recommended to be included in partnering projects, in order to produce specific benefits, such as efficiency, cost-effectiveness, innovation, and improvement of quality.

First, the results have showed, in a priority order, the elements that have a greatest impact on the improvement of **efficiency** in projects. A (1) start-up workshop, (2) early involvement of contractors, (3) co-localization of partnering group, and the (4) inclusion of consultants and architects in the partnering group, are the elements that could strongly influenced the efficiency and the cooperation in projects.

Moreover, the element that is largely recognized to improve the **cost-effectiveness** in project is (1) target price by sharing bonus/malus. (2) Open book economy, (3,4) inclusion of architect and subcontracts in bonus/malus, and (5) value-based procurement can also influence the cost-effectiveness in project, when associated with target price.

Regarding **innovation** in projects, the research has showed that the (1) early involvement of contractors is the most recommend element. (2) Functional description, (3) continuous workshops and the (4) inclusion of advisers in the interacting group are also important partnering elements for innovation improvement.

Final, **continuous improvement of quality** is a desired effect of partnering that could result also in lower operating and maintenance costs. According to the research, having a contractor with (1) operational responsibility is the element that mostly influence quality. If a contractor assumes operational responsibility, most likely there will be a stronger focus on low production costs and improvement of quality. The (2) inclusion of subcontractors in the partnering group, (3) co-location of partnering group, (3) measurement during the project, (3) final workshop, and (4,5) inclusion of architects and consultants in the partnering group are, sequentially, the other elements that could improve quality in partnering projects.

In general, (1) early involvement of contractors is the partnering element mostly recommended in order to achieve all four desired benefits. Immediately below in the ranking, experts advised the importance of (2) target price with incentives for sharing bonus/malus, (3) co-location of partnering group, and (4) inclusion of advisers in the group. Contrariwise, elements like contractual right to exchange firms or individuals, conflict resolution mechanism, inclusion of architects, consultants or subcontractors in the contract, and prequalification of contractors are not indicated from the experts as essential elements to achieve benefits. The matrix (Table 6) presents the partnering elements that have been used in 26 projects.

Table 6. Partnering elements in Norwegian construction projects

Partnering Elements	Project Nr.																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Value Based Procurement	x	x	x	x	x	x	x						x									x	x	x	x	
Prequalification													x									x		x	x	
Functional Description	x	x	x	x	x	x	x	x		x		x	x	x									x		x	x
Intention agreement	x	x	x	x	x	x	x						x									x		x	x	x
Target price with bonus/malus	x	x	x	x	x	x	x						x	x								x	x	x	x	x
Open-book economy	x	x	x	x	x	x	x	x	x	x	x	x	x									x	x	x	x	x
Partnering based on turnkey	x	x	x	x	x	x	x	x	x	x	x	x	x	x								x	x	x	x	x
Startup workshop	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Target document		x	x	x	x	x	x					x	x									x		x		
Early involvement of contractors	x	x	x	x	x	x		x		x		x	x	x								x	x	x	x	x
Inclusion of SC in the partnering group			x	x	x	x							x	x												
Inclusion of consultant in partnering group	x	x	x	x	x	x						x	x	x												
Inclusion of architect in partnering group	x	x	x	x	x	x						x	x	x												
Inclusion of SC in bonus/malus														x												

Inclusion of consultant in bonus/malus										x																	
Inclusion of architect in bonus/malus										x																	
Inclusion of SC in the contract										x																	
Inclusion of consultant in the contract										x																	
Inclusion of architect in the contract										x																	
Continuous workshop		x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x						
Final workshop		x		x	x			x																			
Measurement during project		x	x	x	x			x	x	x												x	x				
Conflict resolution mechanism		x			x																x	x	x				
Cooperation								x		x										x		x	x	x			
Contractual right to replace people	x	x	x	x	x						x	x	x	x	x	x	x	x	x	x	x	x					
Contractual right to replace firms	x	x									x	x	x	x	x	x	x					x					
Remuneration for accepted offer																						x					
Operational responsibility of contractor									x									x	x	x	x	x	x				
Co-location of partnering group		x			x				x													x					

5. Discussions

The first purpose of this study was to identify how partnering practices have been developed in Norwegian building and construction industry and therefore increase the understanding on this matter. The building and construction industry in Norway, in fact, is to some extent still characterized by a traditional adversarial mind-set, hindering the development of partnering.

From the first step of the analysis it emerged that there is not a single partnering elements constantly used in all the Norwegian building and construction projects. In fact, it is interesting to notice that builders adopted basic partnering elements that are completely different from another builder. This highlights a great discrepancy in the way partnering arrangements are set.

The lack of constant factors in partnering makes more difficult to find a standard definition of partnering and determine partnering practices in Norwegian building and construction industry. These findings confirmed the opinion from the theory about partnering being characterized by high contingency in different situations and contexts. This aspect further increases the complexity in defining a standard means for the implementation. [27]. Some authors underlined also that the absence of a standard agreement could influence negatively the project participants, creating confusion and ambiguity towards partnering practices [8, 19, 22].

In general, the matrix (Table 6) represents a suitable tool to understand how partnering can be implemented, but it does not show which specific partnering elements must be adopted in projects. In relation to what stated before, it is not possible to recommend individual partnering elements over others, without looking at the purpose, situation, and context of the project.

Furthermore, in general, some of the builder, to cope with the uncertainty, operate with a minimum requirement for every project, assuming the idea that a partnering project is a project that includes at least one of the partnering elements. Additionally, other elements could then be implemented in the project according to the specific case and situation. According to Bresnen and Marshall [31], one of the main issues is indeed the decision of the owner to define a best practice for partnering, that apply for every case, or whether customize partnering practices for each project.

The elements identifies in the matrix could be compared with the set of mandatory partnering factors described by Eriksson [8] and reported in Table 7. Only one of the analysed projects met the requirements underlined by the author. This discrepancy between theory and empirical findings can be related to the different research context or situation.

While this study looked at the Norwegian context, Eriksson [8] developed his research on Swedish construction industry.

Table 7. Comparison of findings with theory by Eriksson [8]

Partnering elements by Eriksson [8]	**Findings**
Bid evaluation based on soft parameters. (Value-based procurement)	Early involvement of contractors
Compensation form based on open books. (Open-book economy)	Target price with sharing bonus/malus
Start-up workshops	Co-location of partnering group
Joint objectives	Inclusion of consultants in partnering group.
Follow-up workshops (Continuous workshop)	Continuous workshop
Team building	Inclusion of architects in partnering group.
Conflict resolution techniques	

The second phase of the analysis have showed, through the use of interviews and questionnaire, the recommended partnering elements that should be included in the project in order to achieve certain benefits. To improve efficiency in projects, elements like start-up workshop, early involvement of contractors, co-location of partnering group, and inclusion of consultants and architects in the partnering group are the most suitable. All these elements must be adopted in the early phase of the project and therefore provide the basis for a more efficient execution phase.

The elements recommended for the improvement of cost-effectiveness showed instead a more economical nature and are measures generally designed to keep the project cost down.

Innovation is a desired effect of partnering and elements such as early involvement of contractor, functional description, continuous workshops, and inclusion of consultants in the group are recommend to achieve benefits. Only one of the analyzed projects contained all this elements, revealed a need for innovation.

Table 8. Recommended partnering elements in priority order.

Rank	Partnering Elements	Rank	Partnering Elements
1.	Early involvement of contractors	16.	Value Based Procurement
2.	Target price with bonus/malus	17.	Inclusion of consultants in bonus/malus
3.	Inclusion of consultants in partnering group	18.	Final workshop
4.	Co-location of partnering group	19.	Target document
5.	Inclusion of sub-contractors in partnering group	20.	Cooperation
6.	Inclusion of architects in partnering group	21	Intention agreement
7.	Continuous workshop	22.	Remuneration for accepted offer
8.	Functional description	23.	Prequalification
9.	Inclusion of subcontractors in bonus/malus	24.	Inclusion of subcontractors in the contract
10.	Start-up workshop	25.	Inclusion of consultants in the contract
11.	Operational responsibility of the contractor	26.	Inclusion of architects in the contract
12.	Inclusion of architects in bonus/malus	27.	Conflict resolution mechanism
13.	Open book economy	28.	Contractual right to replace people
14.	Measurement during the project	29.	Contractual right to replace firms
15.	Partnering based on turnkey		

The most recommended elements for the continuous improvement of the quality are the operational responsibility to the contractor, the inclusion of subcontractors, architects, and consultant in the partnering group, and co-location. The involvement of all the stakeholders in the development of the project and the creation of common goals are essential to pursue a better quality. Introducing higher quality in the project will then limit the need for replacements and lower the operating and maintenance costs.

The partnering elements that have not been recommended and, therefore, not directly connected with any of the desired benefits are, for example, the contractual right to replace people/firms, and the use of tools for conflicts resolution. These can be to some extent considered as reactive partnering elements, that can be used when partnering does not work properly.

The prequalification of the contractors is also a not recommended element for partnering projects, despite this can be defined as a proactive measure to guarantee sufficient expertise from the contractor. Probably, prequalification is unnecessary when the value-based procurement is adopted.

Finally, comparing the elements that have been used in real project (see Table 6) and the recommended elements identified by the study, a discrepancy is noticeable. In fact, despite elements such as the co-location of the partnering group and the inclusion of consultants have achieved a high ranking of importance (see Table 8), these were actually implemented only in few projects. It is then important to consider that the application of the theory in practice could require experience, resources and knowledge, especially when some elements are still "new" for many of the players in the industry.

Conclusion

This paper aims to find the characteristics of Norwegian partnering projects. The characteristics we found in the 26 examined case projects are shown in Table 6. The need for identifying the partnering project characteristics is underlined by our interview respondents, who almost without exceptions stated that nearly all challenges related to implementation of partnering elements in Norwegian projects are caused by different perceptions of what partnering is. Clarification of what partnering is and its practical implications may help clients avoid some challenges.

Table 6 shows what partnering elements that appear in Norwegian building and construction projects, and we can draw at least four interesting conclusions from it. The first is that there is no partnering element considered as a must-have. As well as, there is no element that is used in all the projects. The second conclusion is that there are partnering projects that only seem to share partnering label. Except from them being labelled partnering projects, they seem to use different partnering elements. A third conclusion is that if one applies Erikson's (2010) minimum requirements to a partnering project, only one out of the 26 cases deserves the partnering label. The fourth conclusion is that partnering is practiced differently even within the same client organizations. The same client can use different partnering elements in different projects, but still use the partnering label.

Out of these four conclusions, we realize it is difficult to establish certain minimum requirements for partnering in Norwegian building and construction projects. After considerations on how to define partnering in Norway, we still think partnering is a too vague term to finally conclude. We therefore suggest to document characteristics from even more case projects with the partnering label in order to be able to come up with a definition of what partnering really is and its practical implications.

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The characteristics of Australian infrastructure alliance projects

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Abstract

The alliance contract method is a relatively new project delivery method that has started becoming popular in recent decades as an alternative to both traditional and other forms of relational contracts. The result of it being so new is that it is still unclear around the world as to when to utilise alliancing. The purpose of this research is to determine a list of project characteristics that identify when an alliance would be a suitable project delivery method. In addition, it identifies how alliancing addresses these characteristics and discusses a number of success factors and barriers.

Peer-review under responsibility of the organizing committee of the SBE16 Tallinn and Helsinki Conference.

Keywords: Alliancing; Infrastructure; Australia; Project Delivery Methods; Contract; Success Factors; Barriers

1. Introduction

The alliance contract method is a relatively new project delivery method (PDM) that has started becoming popular in recent decades as an alternative to both traditional and other forms of relational contracts. In recent years, alliancing has been receiving worldwide attention with more and more countries exploring its use. Having originated in the UK, it has become a booming success in Australia. The success in Australia has shown by example that there are alternative methods to delivering projects in order to move away from the often-adversarial, traditional project delivery methods. As projects become larger and more complicated, and the pressure from various stakeholders increases, alliancing is proving itself as being able to deal with these ambitious targets.

Jefferies, et al. [1] p466 have identified that *"there is a clear gap in Project Alliancing, particularly with regards to identifying factors for its successful implementation in the Australian construction industry"*. As countries and

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industries with no alliancing experience, and in particular, limited to no experience with relational contracting, begin adopting alliancing, they will no doubt face a number of challenges. To help overcome these challenges practitioners will need to be educated in the factors that make alliancing successful.

As the adoption of alliancing in the construction industry has started becoming more prevalent worldwide, knowledge of when alliancing is appropriate could be valuable to practitioners looking at implementing non-traditional forms of contracting. Many countries, particularly in Europe, have recently started adopting alliancing. In addition, Finland, who started using alliancing in 2007, has begun experimenting with the model by adopting lean ideology into their alliance projects [2]. A clear understanding of the current state of alliancing could potentially lead to the creation of improved project delivery models.

The body of knowledge is missing a clear summary of how a project's characteristics influence the choice to deliver the project using an alliance. The purpose of this research is firstly to determine a list of project characteristics that identify when an alliance would be a suitable project delivery method. Secondly, building on the first point, by identifying the way in which the elements of an alliance contribute to addressing the issues associated with the identified project characteristics. This combination will help to remove the ambiguity in this area and aid practitioners in determining whether an alliance could be an appropriate way to deliver their infrastructure projects. Thirdly, this research aims to determine the current success factors and barriers that exist for alliance contracting.

To supplement the body of knowledge, the following research questions have been identified:

What characteristics of a project make it suitable for alliancing?

How do alliance elements address these characteristics?

What are the key success factors and barriers when choosing alliancing?

By addressing these research questions, this study will provide a means for those less experienced with alliance to recognise projects that are suitable for the alliancing PDM. It will provide them with an understanding as to how the model addresses these projects, will give them an insight into how to ensure success, and offer some points of concern when considering whether to choose alliancing.

2. Research methods

The research questions were addressed by performing a literature and document study. The results from this study were compared with the results of a series of interviews with Australian practitioners.

A literature study, following the prescription of [3], was undertaken to develop the theoretical background for alliancing. A combination of both journal articles and conference papers was used to gain a broad perspective of the current views of the topic. A document study was performed on a number of key government and industry publications covering alliancing, for example The National Alliancing Contracting Guidelines [4] and Alliancing: A Participant's Guide [5]. This was undertaken in order to pick up the government and industry perspective on alliancing and to supplement the academic perspective. Thus, the two studies allow us to gain insight into both the theoretical and practical aspects of alliancing.

As part of a larger study on the experiences of Australian infrastructure alliances, twenty-seven semi-structured interviews were undertaken face-to-face with key industry professional in Australia. The interview questions were formulated in line with the three research questions. The interviews ran over a period of three weeks during March and April 2016. Interviewees were contacted based on their experience with alliances. Respondents were chosen among project managers and contract specialists, mostly from client side (government), as in the Australian infrastructure industry, it is the government organisations that own the projects. In addition, a number of respondents from contractors (8), consultants (3), and academia (1) were included to gain a full industry perspective on the current state of alliancing.

The selection of multiple-case design was done in order to check for replication, as described by Yin [6]. Data from thirteen alliance projects was collected during the interview series. Fourteen of the twenty-two interviews were case specific and the remaining eight were general in nature. To ensure that we were gaining reliable information, we chose projects where the practitioners had played a significant role in the alliance. In addition, a limitation of a project value of greater than $50M AUD was chosen to ensure that each project was considered a large infrastructure project. The case projects that were analysed varied in size from $52M up to $1B AUD.

Using a combination of a literature study and document study is an effective way to gain a theoretical insight into alliancing. With the theoretical background in place, interviews were performed to gain practical insight. The combination of theoretical and practical insight helped to verify that the findings from literature are representative of the current reality, and highlighted where the literature is lacking in capturing the current state of alliancing in Australia.

The results from the case projects represent the experiences of practitioners and are limited by their memories. They provided us answers to the best of their knowledge. Where possible, facts were cross-checked against project documentation. This discussion presents the authors' interpretation of the studied literature and interviews.

3. Theoretical framework

Alliancing has developed out of the need and want to improve on, and overcome, the adversarial nature and negative impacts associated with the more traditional forms of project delivery, namely design-bid-build (DBB) and design and construct (D&C) contracts [7, 8]. It often falls under the umbrella of relationship contracting [9, 10], however, now in recent years, it is beginning to be placed into its own unique category [11, 12].

Alliancing is a collaboration between the client, service providers and contractors where they share and manage the risks of the project together [11]. All parties' expectations and commercial arrangements are aligned with the project outcomes and the project is driven by a best-for-project mindset where all parties either win together, or lose together [10, 13]. The contract is designed around a non-adversarial legal and commercial framework with all disputes and conflicts resolved from within the alliance [9].

This type of project delivery can lead to improved project outcomes and value for money, in part due to the increased level of integration and cooperation between planners, design teams, contractors and operators [14].

The current most widely accept definition of alliancing comes from the Department of Finance and Treasury Victoria [15 p9] who describe alliancing as:

"… a method of procuring … [where] All parties are required to work together in good faith, acting with integrity and making best-for-project decisions. Working as an integrated, collaborative team, they make unanimous decisions on all key project delivery issues. Alliance agreements are premised on joint management of risk for project delivery. All parties jointly manage that risk within the terms of an 'alliance agreement', and share the outcomes of the project".

The majority of studied literature after 2010 has made reference to this definition when discussing alliancing and does not contribute anything of significance in addition to that mentioned above [8, 10, 12, 13].

3.1. Project characteristics

Alliancing is not a form of project delivery method that is suitable for every infrastructure project [9]. Some projects however, have key characteristics that make them highly suitable for the alliance method.

A preliminary list of the characteristics of a project identified in the literature study as being suitable for an alliance is shown in Table 1. They have been arranged in order of the number of articles that have attributed these project characteristics to the selection of an alliance.

Most often, the characteristics of a project are taking into consideration with many other factors when determining the choice of delivery method for a project. However, in some cases, the decision to use an alliance is based purely on one or two project characteristics. For example, Jefferies, et al. [1 p477] highlights that *"The Queensland State Government, in the form of both their Public Works and Main Roads departments, use Alliance and Partnering arrangements as default contracts on projects with construction periods of over 12 months and/or with a dollar value of A$10 million."*.

Each project characteristic identified in Table 1 is described briefly below. It should be noted that a number of characteristics were identified in the literature as being suitable for alliancing however, the literature lacked explanations as to why. Where possible, explanations of why alliancing suits the particular characteristic is included.

Table 1. Characteristics of a Project that Suit Alliancing Identified from the Literature

Project Characteristics	References
Tight Time Constraint/ Need for early start	[4, 9, 11, 13, 14, 16-19]
Multiple/ Complex Stakeholders	[1, 11, 13, 17-20]
High Risk	[4, 11, 13, 14, 16-19]
High Complexity	[9, 11, 13, 17-20]
Unclear/ Broad Scope/ Risk of Scope Change	[8, 13, 14, 17-20]
Complex External Threats	[11, 13, 17-19]
High Uncertainty	[4, 8, 13, 18]
Large Project/ High Cost	[1, 4, 14]
Need for Innovation	[9, 14, 21]
Tight Cost Control	[9, 13, 18]
Environmental Challenges	[1, 18]
Need for owner involvement	[17, 19]
Need for Flexibility	[21]
Special Requirements	[13]
Resource Shortages	[14]

Time pressure is a major reason for choosing alliancing [13]. Alliancing allows multiple processes to occur simultaneously, for example, investigation, design, land acquisition, approvals, materials sourcing, etc. [16], thus reducing the time to complete the project in addition to allowing the possibility for an early start. **Multiple/Complex stakeholder** issues is a project characteristic often recommended by government guidelines regarding when to use alliancing [17, 18]. **High-risk** projects are not well suited for traditional contract models as there is always the issue of who takes on the risk. The client is trying to pass the risk onto someone else and the contractors do not want to accept such high risk. Alliancing is ideal as the risk is shared amongst all participants and everyone is incentivised to work together to manage the risk [8]. Projects with **high complexity** are recommended as being suitable projects for alliances [13, 22]. **Unclear Scope/ Risk of Scope Change.** A large number of alliances have resulted from a project that has had an unclear or poorly defined scope [10, 14]. Alliancing is a suitable method to deal with such projects because all parties work together to define the scope and handle any changes that come about through the delivery of the project. **Complex external threats** has been recognised as a characteristic of a project that can be addressed by alliancing [11, 22]. The characteristic of **high uncertainty** is very similar to the characteristic of Unclear Scope because of the way an alliance addresses each characteristic. **Large Project/ High Cost.** Some government agencies, having recognised the benefits of alliancing, have made it a standard to use alliancing or partnering for large projects, for example, projects with durations over 12 months or values over A$10M [1]. **Need for Innovation.** The nature of alliancing facilitates innovation making it a top choice on projects that require high innovation to be completed successfully [9, 13]. **Tight Cost Control.** Projects that require significant cost control often see alliancing as the preferred PDM [9]. **Environmental Challenges.** Alliancing is a method recommended for projects that exhibit significant environmental challenges [1, 16, 18]. **The need for owner involvement** is another project characteristic often recommended by government guidelines regarding when to use alliancing [17]. **Need for Flexibility.** This point relates very closely to the project characteristic of Unclear Scope based on the way an alliance addresses each characteristic. **Special Requirements.** This point was only mentioned by one article and a clear description of what was meant by special requirements was not stated. **Resource Shortages.** This point was only mentioned by one article and a clear description of what was meant by resources shortages was not stated.

3.2. Alliance elements

Determining the key elements of alliancing through the literature was an involved process. Almost all of the literature on alliancing, in the introduction, involved a small definition of alliancing. These were collected and common themes were elicited. To delve deeper, the literature was carefully analysed to identify defining elements that were thought to be key to an alliance.

Lahdenperä [12] identified a number of defining elements of alliancing, which are shown in Fig. 1.

Project alliancing	
Department of Treasury and Finance (2010d)	Yeung *et al.* (2007)
Key features • Risk and opportunity sharing • Commitment to 'no disputes' • 'Best for project' unanimous decision-making processes • 'No fault—no blame' culture • 'Good faith' • Transparency expressed as open book documentation and reporting • A joint management structure	Hard/contractual elements • Formal contract • Real gain-share/pain-share Soft/relationship-based elements • Trust • Long-term commitment • Cooperation and communication *Other elements* • *Win–win philosophy* • *Equity* • *Agreed problem resolution methods* • *Common goals and objectives* • *Continuous improvements* • *Alliancing workshops* • *Early selection of contractors*

Fig. 1. Example of defining elements of alliancing from the literature.

Beginning with the elements identified by Lahdenperä [12] we concluded on a number of key elements from the literature that were of interest to this study. The elements include open book, integrated project team, pain/gain-share, aligned client and commercial participants objectives, no-disputes clause, unanimous decision making and incentivised cost reimbursement.

Open-Book Approach. A key component of alliancing, but not unique to alliancing, is the open-book approach which equates to the disclosure of financial information among all participants [11, 21]. This approach helps to reinforce the *everyone is working on the same team* mindset and helps to provide accurate and real time information on the financial performance of the project.

This approach is a major benefit for clients who, through this method, get an insight into the real cost of construction [9]. As most clients outsource the majority of their work through traditional contracts, they often lose track of the actual cost of undertaking various construction activities.

An alliance team is an **integrated project team**, which means that people from all disciplines and parent companies are working together in the one team allowing for the sharing of expertise and resources [9]. In order to make the 'perfect' team, each member is selected on a best-for-project basis, regardless of the company he or she works for.

The integrated project team is part of the concept of the virtual organisation. An alliance operates as a virtual organisation in the sense that all individuals from all parent organisations are, for all intents and purposes over the duration of the contract, employees of the alliance and it is the alliance that delivers the project [11, 16].

The co-location of the project team is a mechanism for realising the full effects of an integrated project team. Although not a strict must-have, it is an element consistent with many successful alliance projects and is often identified in literature as a key success factor [7, 23]. It is implemented as a way of developing a single alliance culture and leads to effective communication and improved innovation in that members have close and immediate contact with each other. A condition often unavailable in traditional arrangements [10].

Painshare and gainshare are essential components of an alliance and this was the most cited element in the literature study. All participants share in the profits and losses of the project and ensure that no single participant is held accountable for financial performance [7]. This helps to reinforce the mindset of *we all win, or we all lose* [11]. The pain/gain forms part of the incentive arrangements and is a measure of how the project performs against the Target Outrun Cost (TOC)[10]. If the project is delivered under the target price, the Non-Owner Participants (NOP) share in the savings, whereas if the project is delivered above the target price, the participants lose a proportional amount of their overhead and profit [16]. This is detailed further under three-limbed contract.

In recent times, alliance contracts have been structured around the three-limbed approach, where [8, 22]:

- Limb 1 consists of all the directly reimbursable costs including project-specific overheads
- Limb 2 is made up of the corporate overheads and profit for each NOP, determined by an independent auditor. This is placed 'at-risk' according to the pain/gain arrangement
- Limb 3 consists of the incentivised cost-reimbursement where all participants share in the pain/gain associated with how the alliance performs against pre-arranged targets in cost and non-cost key result areas (KRAs).

Financially, the maximum risk, or most adverse situation, for the NOPs is that they receive compensation for Limb 1 only [11, 22].

Pain/gain-share is a result of the risk sharing arrangements in alliancing. In an alliance agreement, all parties share the risk and reward, which provides a strong motivation to work collaboratively and reinforces the *we're all in this together* mindset [11, 14]. Operating hand in hand with the no-blame culture, risk sharing ensures that all participants work together to overcome any challenges that may arise during the delivery of the project [9].

Alignment of Client and Commercial Participants' Objectives. The structure of the alliance and a number of the elements mentioned previously create a situation where the client and commercial participants' objectives are aligned [1, 21]. That is, that the business goals of each party is aligned with the alliance and the outcomes of the project [9].

No Dispute Clause. The alliance agreement is structured so that everyone is working on the same team. A key component of this is the development of a no blame culture often backed up by a no dispute clause in the alliance agreement [11]. The commercial drivers and the integrity of the participants, combined with the requirement of consensus decision making, ensures that all disputes are handled internally within the alliance. This eliminates the expensive and lengthy court battles often associated with traditional contracting methods [8, 22]. With the exception of wilful default and insolvency, all issues and conflict are kept within the alliance and resolved on a unanimous basis with no recourse to litigation or arbitration [9, 11].

Unanimous Decision Making. Within an alliance, each party gets an equal say in the decision process and all decisions must be made unanimously [9, 11, 22]. Collaborative problem solving and decision-making is a key characteristic of alliancing [10]. This emphasises that all parties work together to overcome problems that arise.

Incentivized Cost-Reimbursement. In addition to pain/gain share, alliances include other forms of incentivized cost reimbursement. These can include incentives for non-cost factors such as innovation, quality, delivery time etc. and are factors that are important to the owner [10, 16].

3.3. Success factors and barriers

Success factors and barriers give insight into what factors one must consider when selecting alliancing as the PDM or when choosing to enter into an alliance agreement.

By reviewing six papers, Jefferies, et al. [1] has identified 17 success factors from literature, and by analysing a case study, they identified five additional success factors. The full list of twenty-two success factors is shown in Table 2:

Table 2. Success Factors as identified by the literature

Strong commitment by client and senior management	Trust between parties
Sound relationship	Equity
Mutual goals and objectives	Joint process evaluation
Dispute resolution process	Cooperative spirit
Flexibility and adaptability	Tight alliance outline
Alliance structure	Best people for project
Facilitation	Commercial incentives
Open communication	Shared knowledge
Stretch targets	Integrated Alliance office
Staging of project and stretch targets	Establishing project specific KPIs
Facilitating on-going workshops that include site personnel	Integration of a web-based management programme

The list by Jefferies, et al. [1] is quite extensive. Our literature search did not uncover any new unique success factors. However, the search did highlight some success factors that were emphasised the most. The selection of the right people and having a good leader seems to be a crucial success factor according to the literature [24, 25].

Rowlinson and Cheung [25], through their study of success factors (which did not form part of the work by Jefferies, et al. [1]) identified the following factors for successful alliances: creativity, trust, commitment, interdependence, cooperation, open communication, goal alignment and joint problem solving. Despite being performed independently, their results of factors necessary to ensure the success of an alliance are in alignment. The explanation behind why each success factor is important is well documented and thus will not be covered in this paper.

During the research, it became clear that alliancing is not the best-fitted PDM for all projects and a number of considerations should be taken into account when deciding whether to proceed with an alliance. These considerations can be seen as a barrier to introducing alliancing into a new country, industry or organisation. The literature study identified six factors that should be considered when selecting an alliance as the preferred PDM. The factors shown in Table 3 are sorted by the number of times they appeared in the studied literature.

Table 3. Factors to Consider when Choosing an Alliance

Factors to Consider when Choosing an Alliance	References
Cost to Establish	[4, 8, 10, 13, 14, 18, 19]
Maturity and Competence of the Industry	[7, 8, 10, 13, 18, 19, 26]
Resource Availability of Project Participants	[4, 10, 13, 19]

As an extensive study of the barriers to alliancing has not been undertaken, a brief explanation of each factors follows.

Cost to Establish. The experience in the literature is that alliances are only worthwhile for large projects [26]. This is due in part to the fact they have high establishment costs [8]. A client must be aware of this and decide whether the benefits of using an alliance outweighs the high investment cost.

Maturity and Competence of the Industry. Alliancing is an advanced form of relational contracting and thus requires competent organisations with particular knowledge, skills and attributes [8, 22]. If an industry has had little experience with relational contracting then it can create difficulties for clients to find suitable alliance partners [22].

A culture shift is required in order for the traditional mindset to transition into a mindset suitable for alliancing. This includes everything from client-contractor relationships to working methods [7, 22]. It can also be the case that organisations who are used to having all the power over a project, such as construction managers, can feel that they lose a certain level of control [26].

Resource Availability of Project Participants. As noted as a success factor, alliances require the commitment of senior staff from all involved parties [13]. This commitment needs to be supported by senior management [22]. Both clients and non-owner participants need to consider this when deciding whether to enter into an alliance agreement. This forms a barrier to the alliance method if an organisation does not have capacity to commit senior resources.

The client must consider that there is a high degree of hands-on involvement required of them due to the nature of the integrated project team [10].

4. Findings and discussion

This section will identify the findings from the interviews and discuss them in relation to the findings from the literature study and case studies.

4.1. Characteristics of a Project That Make it Suitable for Alliancing

Often, the nature of the project will dictate the choice of PDM. For example, a project may have a very tight timeframe that can only be achieved if all parties are involved from the very beginning. Such a situation lends itself to alliancing as certain aspects of planning, design and execution can happen concurrently. That being said, alliancing is not a form of project delivery method that is suitable for every infrastructure project [9]. Some projects however, have key characteristics that make them highly suitable for the alliance method.

Table 4. Project characteristics suitable for alliance as identified by thirteen Australian alliance projects

Characteristic	Number of Projects Influenced*
Tight Time Constraint/ Need for early start	9
Multiple/ Complex Stakeholders	7
High Risk	8
High Complexity	6
Unclear/ Broad Scope/ Risk of Scope Change	10
Complex External Threats	1
Large Project/ High Cost	4
Need for Innovation	4
Tight Cost Control	4
Environmental Challenges	3
Need for owner involvement	9
Multiple Interfaces	7
Market Situation	
Client Organisation	2
Other: Reputation	1
Other: Political Commitment	1

*Where a characteristic was identified by the practitioner as partly contributing to the selection we have counted it in the number of mentions.

A review of the characteristics identified by both the literature and the interviews was undertaken. Each characteristic was analysed for uniqueness; where similarities were identified between characteristics, they were

combined. In addition, the characteristics were judged by the weight placed on them in the literature and interviews, and the number of times they were cited by different sources.

A number of the characteristics can be combined based on their similarity. For example, if a project has the Need for Flexibility or has High Uncertainty, when it applies to how alliancing addresses this issue, it is very similar to the project having an under-defined scope or having a Risk of Scope Change. In all these cases, every participant works together to solve the issues as they arise and they do this by maintaining a high degree of flexibility in the process. Special Requirements and Resource Shortages were mentioned briefly by just one source each, so with limited information on each characteristic, they are not considered as being relevant to this study.

The interviews identified a number of different drivers that have influenced the selection of alliancing in Australia. Alliances have been the preferred PDM when the project has one or more characteristics from the list in Table 4. This is quite consistent with the results from the literature review in that eleven of the sixteen characteristics identified by the interviews appear in Table 1.

4.2. How do Alliance Elements Address the Identified Characteristics

The structure of alliances lends themselves very well to addressing the issues created by the identified project characteristics. The shared risk and pain/gain arrangements combined with the alignment of client and commercial participants' objectives creates an entity that is very adept to dealing with projects that are high risk or have high levels of uncertainty. When problems arise, it is in the best interest of all the parties to find the best-for-project outcome, and find it quickly. In addition, these elements work together to enable the alliance to deal effectively with complex external events.

The elements mentioned above, combined with unanimous decision-making, no dispute clause and open book help to ensure the win-win principle of alliancing necessary to deal effectively with the issues that arise.

The fact that all parties become involved in the project from the very beginning creates an environment where innovation can thrive. All options can be considered and explored for their merits. Many different perspectives all working together in the early phase can lead to very innovative solutions. This was recognised by many of the interview practitioners as being a key benefit to the alliancing method.

This arrangement of concurrent engineering creates an environment where normally successive stages can run in parallel. For example, the contractor can begin with the early works while the designers are finalising the design and the client is working on planning permissions and community consultation. This reduces the duration of the project significantly and allows for an early start. Many interviewees stated this as a reason for their project being delivered ahead of time.

In some cases, alliances were chosen for a project due to the tight cost control needed. For example, some projects were given the problem, and a budget, and told to find the best solution that addresses the problem and fits the budget. Alliances have a certain freedom to vary solutions on the go, as they are not locked into a pre-design. Combine this with the fact that it is in the best interest of all parties to find the best solution, meet the incentivised KRA's, and reduce the project cost in order for them to make money, makes alliancing well suited to dealing with tight cost control.

The integrated project team is crucial for allowing alliances to deal with complex stakeholder issues. Having the most suitable person for the job in each position means that you can manage the issues very effectively. For example, as identified by one of the practitioners, often the client has well established community consultation systems and networks. Often contractors do not have such systems and networks in place. Thus, it makes sense to have key client personal in the relevant position within the alliance. The integrated project team becomes very useful when there is a need for owner involvement, as the client is imbedded in the team for the entire duration of the project and can maintain a level of influence over the project outcomes.

4.3. Success Factors and Barriers to Alliancing

The series of interviews proved to be a great way to identify both the success factors and barriers to alliancing, and to check to ensure the literature is relevant to the current experiences.

The success factors mentioned by the majority of practitioners during the interview series were ensuring that alliance is chosen for the right reasons, and that the right people are chosen to work within the alliance. It was of the

opinion of most of the interviewees that if you have these two aspects in place, then you will achieve success. A number of times it was mentioned that one of the reasons why particular alliances were unsuccessful is that alliancing was selected for the wrong reason and that the project was not suited to an alliance.

Jefferies, et al. [1] and Rowlinson and Cheung [25] both identify a number of success factors that seem to be standard practice for the alliance model. They are essentially woven into the fabric of the Australian alliance model. Because of this, we believe that some of the success factors mentioned by Jefferies, et al. [1] and Rowlinson and Cheung [25] should no longer be identified as success factors. Yes, it is true that if they are not present then the success of the project is jeopardised, but if they are not present, then the strategy could not identify itself as an alliance, at least not by the Australia model standards. For example, every alliance project that we discussed during the interview series had mutual goals and objectives, an alliance structure, had a best for project selection process for staff, used an alliance facilitator, had commercial incentives, used an integrated project team with co-location, had established project specific KPI's, and facilitated workshops throughout the entire length of the project. That makes seven out of the twenty-two success factors identified by Jefferies, et al. [1] as being well-established norms. In fact, each of these points could be considered among the elements that make an alliance what it is today.

Another point to note is, of all the projects discussed, not one had a formal dispute resolution process. Each alliance had a no-dispute clause and the requirement that all disputes be handled internally within the alliance.

The interview series confirmed the barriers identified by the literature study and identified a number of additional barriers and points of concern. A key barrier identified by respondents is the increased pressure from Government for clients to demonstrate value for money when selecting the alliance form of procurement. It has been the case that, the majority of alliances in Australia were delivered as "pure" alliances, whereby the non-owner participants were selected on merit and not on a cost basis. This lack of a price competitive tender process, it seems, is part of the cause for concern for the Government and treasury in Australia as to whether alliances deliver value for money. Perhaps there is little cause for concern though, as another key point of the findings was the answer to the question "*Could the same level of success have been achieved if this project was delivered by another form of PDM?*". In all cases the respondents answered either "no, not at all", or "no, not to the same extent". Among the reasons why not were "*the project would have ended in dispute and we'd still be in the courts*", "*the project would have most likely been delivered one year late instead of one year early*", and "*we [the client] would have been hit with a number of large variations*". It seems the value for money is there but it is difficult to demonstrate.

To expand on the barrier of Resource Availability of Project Participants, one of the interview respondents raised the following regarding the commitment to the alliance from the client. He makes this point while referring to the success of an alliance from which he performed a number of roles including being the senior representative of the client:

"*This alliance had unqualified commitment from the highest levels of the Client. Many others received commitment in words only. When critical decisions were needed, the Client was too busy. This is a breach of faith. Alliances are really successful when they are done right – I mean REALLY successful, but they are really hard to make them run right. They cannot be run by half-hearted or incompetent clients. The things that make Alliance run well are clearly documented and well known, so there is no excuse for having an unsuccessful one.*"

5. Conclusion

This paper supplements the existing body of knowledge by answering the questions: what characteristics of a project make it suitable for alliancing? how do alliance elements address these characteristics? and finally, what are the key success factors and barriers when choosing alliancing? Due to its relatively new breakthrough into the world of large infrastructure delivery, alliancing is still finding its place amongst the more established project delivery methods. This development has been increasing rapidly since alliancing's birth in the 80's. Based on the literature studied, and the results from the interview series, we can conclude that alliancing is a very effective PDM, which is suitable for projects with particular characteristics, provided it is selected for the right reasons.

This research has identified twelve characteristics of a project that make it suitable for alliancing. Table 5 contains the final list of project characteristics based on the results of the methods contained within this report.

Table 5. Project Characteristics Suitable for Alliancing

Project Characteristics	
Tight Time Constraint/ Need for early start	Large Project/ High Cost
Multiple/ Complex Stakeholders	Need for Innovation
High Risk	Tight Cost Control
High Complexity	Environmental Challenges
Unclear/ Broad Scope/ Risk of Scope Change	Need for owner involvement
Complex External Threats	Multiple Interfaces

Where a project identifies one or more characteristics shown in Table 5, an alliance can be highly considered during the selection process for the project's delivery method. By looking closely at the elements of an alliance, we show how they address the identified project characteristics. For example, the integrated project team drives innovation and gives the owner more control within the project. The win-win culture created by the combination of a number of alliance elements enables the alliance to handle complex or high-risk projects and projects with great uncertainty.

By comparing the success factors identified in the literature with the case projects, we have concluded that a number of success factors seem to be now outdated. The bar has been raised so that these factors are now engrained into the model. However, the established research into success factors is still very important as it helps show industries new to alliancing why each element has its place in the model. It also provides a launching platform for how the model could be improved.

The research has lead us to conclude that the number one factor to having a successful alliance is choosing alliancing for the right projects and the right reasons. This makes it so crucial to have an understanding of the characteristics of projects that indicate an alliance might be the best option.

The conclusions are based largely on the Australian experience, but we believe that the lessons learned are transferable to other countries. Having an understanding of the success factors and barriers to alliancing, combined with knowing when to select alliancing, will enable practitioners to make better informed decisions regarding the adoption of alliancing into new industries and countries.

Limited work has been performed in the area of barriers to alliancing. Our preliminary research has identified a number of key barriers they may inhibit the choice of an alliance as the preferred project delivery method. The body of knowledge could benefit from further research in this area. The industry could benefit from more work within the area of success barriers to identify new "stretch" success factors that are a step above current standard practice. In addition, work should be done to identify success factors specifically for implementing alliancing in a new, immature industry.

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PROJECT ALLIANCES AND LEAN CONSTRUCTION PRINCIPLES

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ABSTRACT

There is a trend in the construction industry of adopting more and more relational type contracting methods, for example, project alliancing. In addition to this trend, there is increasing adoption of the lean construction principles. This paper explores the inherent relationship between project alliancing and lean construction in an attempt to highlight the similarities between this project delivery method and the lean methodology.

Based on the literature studied and the performed interviews, this study shows that alliancing does in fact inherently align with some key lean construction principles. Particularly in the area of customer focus, culture and people, waste elimination, and continuous improvement. An understanding of how and where alliancing aligns with lean can lead to a better insight into how the model can be improved. Such knowledge could be useful to practitioners looking at incorporating more efficiencies into the alliancing model by introducing lean concepts

KEYWORDS

Alliancing, Lean Construction, Project Delivery Method, Contract, Value.

INTRODUCTION

Project Alliancing (PA) is a relatively new project delivery method (PDM) that has started becoming popular in recent decades as an alternative to both traditional and other forms of relational contracts. In recent years, alliancing has been receiving worldwide attention with more and more countries exploring its use. Having originated in the UK (Manley 2002), it has become a booming success in Australia. The success in Australia has shown the industry that there are methods to delivering projects alternative to the often-adversarial, traditional project delivery methods.

Lean construction is a project management methodology that has adopted principles of lean that originate from the manufacturing and production industry (Ballard et al. 2007; Howell 1999; Locatelli et al. 2013). Lean construction is considered a philosophy or

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paradigm of managing construction projects and not a stand-alone contractual PDM (Ballard and Howell 2004).

Alves and Tsao (2007), through their study of IGLC papers from 2000 – 2006, identified that there has been a lack of research among the IGLC community in the area of relational contracting. They suggested that researchers *"strive to understand how to implement relational contracting, measure its outcomes, and explain project results to help provide guidance to owners that are interested in working towards lean project delivery."* (Alves and Tsao 2007, 57). Ten years later, there is still a gap in the literature comparing alliancing and lean construction. This paper addresses this issue by providing insight into the relationship between the alliancing project delivery method and lean project delivery.

As the adoption of both alliancing and lean principles in the construction industry has started becoming more prevalent, knowledge of the lean principles inherent in alliancing could be valuable to practitioners looking at adopting lean project delivery. Many countries, particularly in Europe, have started adopting alliancing. In addition, Finland, who adopted alliancing in 2007, has begun experimenting with adopting lean ideology into their alliance projects (Petäjäniemi and Lahdenperä 2012). A clear understanding of the current similarities between alliancing and lean could help improve this adoption and could potentially lead to the creation of improved project delivery models.

Integrated Project Delivery (IPD) is a method used mostly in the United States of America that has many similarities to alliancing, with one major difference being that IPD incorporates a number of lean construction elements (Lahdenperä 2012; Raisbeck et al. 2010). IPD's use is mostly concentrated in America, yet the principles of lean are more prevalent worldwide. Alliancing is often considered at the top end of collaborative and relational contracting (Ross 2003) and is more widely distributed across the globe (Chen et al. 2012; Ingirige and Sexton 2006). In addition, IPD and Alliancing have often been used for different types of projects (Lahdenperä 2012). The key differences between IPD and alliancing will not be explored further in this paper but can be found in the study by Lahdenperä (2012).

To address the identified research gap, the following research question was formulated:

Does the alliancing project delivery method inherently align with the principles of lean construction?

By addressing this, the report aims to provide a reference point going forward, for both academics and practitioners, to help understand the inherent relationship between PA and lean construction.

METHOD

The research question was addressed by performing a literature and document study. In addition, results from a series of semi-structured interviews were used. The literature study, following the prescription of Blumberg et al. (2014), was undertaken to develop the theoretical background for both lean construction and PA. This was the primary source of information on lean and was key to gaining insight into lean principles. A combination of both journal articles and conference papers was used to get a broad perspective of the current views of the topics. A document study was performed on a number of key

government and industry publications covering PA, for example, The National Alliancing Contracting Guidelines (DoIRD 2015) and Alliancing: A Participant's Guide (Morwood et al. 2008). This was performed in order to pick up the Australian government and industry perspective on alliancing. Thus, the document study allowed us to gain insight into both the theoretical and practical aspects of alliancing.

As part of a larger study on the experience of Australian infrastructure alliances, twenty-seven semi-structured interviews were undertaken face-to-face with key industry professionals in Australia. The interview questions were formulated in line with the research question, which considered if the alliancing project delivery method inherently aligns with the principles of lean construction. The interviews ran over a period of three weeks during March and April 2016. Interviewees were contacted based on their experience with alliances. Respondents were chosen among project managers and contract specialists, mostly from client side (government) as the research was exploring when and why alliances are selected. In addition, a number of respondents from contractors (8), consultants (3), and professors (1) were included to get a full industry perspective on the current state of alliancing.

Using a combination of the literature study and document study gave a theoretical insight into alliancing. This insight made it easier to infer the ways that alliancing aligns with lean principles. With the theoretical background in place, interviews were performed to gain practical insight. The combination of theoretical and practical insight helped to analyse how the elements of PA align with the identified principles of lean construction.

THEORETICAL BACKGROUND

In order to draw conclusions on the similarities and differences between PA and lean construction principles, an exploration of the current theory on each topic has been undertaken.

ALLIANCING

Alliancing has developed out of the need and want to improve on, and overcome, the adversarial nature and negative impacts associated with the more traditional forms of project delivery, namely design-bid-build (DBB) and design and construct (D&C) contracts (Laan et al. 2011; Walker et al. 2015). It often falls under the umbrella of relationship contracting (Henneveld 2006; Walker et al. 2013), however, now in recent years, it is beginning to be placed into its own unique category (Chen et al. 2010; Lahdenperä 2012). Moreover, Sakal (2005) states that "*It's important to note that Project Alliancing is more than just a contract; it's a new approach to conducting business and constructing projects that's a dramatic departure from traditional contracting practices - where trust is in short supply and antagonism runs rampant*" .

Alliancing is a collaboration between the client, service providers and contractors where they share and manage the risks of the project together (Chen et al. 2010). All parties' expectations and commercial arrangements are aligned with the project outcomes and the project is driven by a best-for-project mindset, where all parties either win together, or lose together (Chen et al. 2012; Sakal 2005; Walker et al. 2013). The contract is designed around a non-adversarial legal and commercial framework with all disputes and conflicts

resolved from within the alliance (Henneveld 2006). This type of project delivery can lead to improved project outcomes and value for money, in part due to the increased level of integration and cooperation between planners, design teams, contractors and operators (Love et al. 2010).

The current most widely accept definition of alliancing comes from the Department of Finance and Treasury Victoria (Victoria 2010, 9) who describe alliancing as:

"… a method of procuring … [where] All parties are required to work together in good faith, acting with integrity and making best-for-project decisions. Working as an integrated, collaborative team, they make unanimous decisions on all key project delivery issues. Alliance agreements are premised on joint management of risk for project delivery. All parties jointly manage that risk within the terms of an 'alliance agreement', and share the outcomes of the project".

Some of the key alliance elements noted from the literature and interviews include open book, integrated project team, aligned client and commercial participants objectives, unanimous decision making and incentivised cost reimbursement.

LEAN CONSTRUCTION

The success of lean as a management philosophy in manufacturing has inspired the adoption into other industries, and particularly into the construction industry. An exploration of the established view of lean construction was undertaken to get insight into its principles. Both lean and the development of lean construction are well described in literature [Lean: (Ballard et al. 2001; Diekmann et al. 2004; Krafcik 1988; Liker 2004) and Lean construction: (Howell and Ballard 1998; Howell 1999; Koskela 1992; Picchi 2001)]. Therefore, this will not be covered in the paper.

Lean principles have been adopted into the construction industry from the manufacturing industry. Lean construction is the management of construction using these principles. According to Howell (1999, 4) there are four points that separate lean construction from traditional practice. *"Lean construction:*

has a clear set of objectives for the delivery process,

is aimed at maximizing performance for the customer at the project level,

designs concurrently product and process, and

applies production control throughout the life of the project."

To take it one step further, we look at the definition of lean construction by Diekmann et al. (2004, iii):

"Lean construction is the continuous process of eliminating waste, meeting or exceeding all customer requirements, focusing on the entire value stream and pursuing perfection in the execution of a constructed project".

In addition to the definition, Diekmann et al., (2004) established five main principles of lean that are relevant to the construction industry:

Customer focus

Culture/people

Workplace standardization

Waste elimination

Continuous improvement/built-in quality

We note that the principles of lean construction are not as extensive as the principles of lean. For example, Liker (2004) identifies 14 principles of lean. To summarise, lean construction is based around maximising value for the customer and minimising waste (Ballard and Howell 2003; Howell 1999; Locatelli et al. 2013).

As well as being based on key principles, lean construction benefits from the use of a number of tools that facilitate these principles. Such tools are presented by Salem et al. (2005) and include Last Planner, Visualisation and Daily Huddle Meetings.

Reasons for adopting lean vary but the results speak for themselves. The work by Locatelli et al (2013) has identified shorter delivery time and higher project performance as being the most common benefits of using lean construction. Ballard and Howell (2003, 132) state that *"Even partial implementations have yielded substantial improvements in the value generated for clients, users and producers"*.

FINDINGS AND DISCUSSION

We have chosen to use the five principles identified by Diekmann et al. (2004) to represent the key principles of lean construction. This section will explore the principles of lean and look into what extent project alliancing inherently aligns with each principle. The discussion presents the authors' interpretation of the studied literature and interviews. We begin by comparing lean construction and alliances with traditional practice before focusing on the five main principles of lean relevant to the construction industry.

LEAN CONSTRUCTION AND ALLIANCES COMPARED WITH TRADITIONAL PRACTICE

By looking at each of the four points identified by Howell (1999, 4) that separate lean construction from traditional practice, we can see that alliancing aligns closely with lean construction.

Alliancing *has a clear set of objectives for the delivery process*, all of which are well documented in the alliance agreement. They are also regularly communicated to the team through various mechanisms that maintain the single alliance culture. At the project level, alliances *aim to maximise the performance for the customer*. They do this by developing a number of Key Result Areas identified by the client and incentivising them to drive performance. The commercial arrangement also drives this behaviour. All parties are aligned; what is best for project is also best for all parties. Thus, when a non-owner participant (NOP) works to maximise their outcome, this in turn should maximise the outcome for the client. A key aspect of alliances is the integrated team from the very beginning of the project. This allows alliances to *design both product and process concurrently*. Identified by many of the interview participants, as being a key benefit of alliances, is that normally sequential processes can run in parallel. The last point is where the comparison deviates. Alliancing has not been known to *apply production control* to the extent outlined in lean construction.

Lean construction is stated as being practical and beneficial to projects that are quick, uncertain and complex (Howell and Ballard 1998). One of the key findings from the Australian interviews was that the top three reasons why alliances are chosen as the project delivery method are that the project had 1. a tight timeframe and/or need for an early start, 2. had high uncertainty, and/or 3. was very complex in nature. We believe that this is an important finding because it verifies that PA and lean construction are two approaches to addressing the problems associated with quick, uncertain and complex projects.

CUSTOMER FOCUS

Alliancing, by nature, is a very customer-centric model. The inclusion of the client in the integrated team ensures that the client is imbedded in the team for the duration of the contract. This allows the client to maintain a large amount of control throughout the entire process. Combined with the open book approach, this also gives the opportunity for the Non-Owner Participants to develop a greater understanding of the customer, what they want, need and value as well as their motives, policies, constraints etc. On the other hand, the client gains valuable insights into the way consultants and contractors operate. This goes a long way to helping the alliance satisfy the customer.

Alliances aligns with this principle of lean as alliances are largely driven by value-for-money. Based on the findings from the interviews, most clients are aware that alliances can be expensive to establish, but choose them for certain projects as they often deliver better value for money than traditional contracts. Clients "pay" for it in that they must be able to commit high-level resources and senior people to achieve the best outcome and value. The Client/customer defines what they value and applies incentivised Key Results Areas (KRA) to drive behaviours to achieve the identified areas of value. Given the track record of most alliances, alliances deliver quality results the first time. They often reduce or eliminate re-work. A large part of this is due to the fact that the client is imbedded in the team.

CULTURE/PEOPLE

Alliances have particular team and personal selection processes. People are selected for roles within the alliance on a best for project basis. People are respected for the knowledge and skills that they can contribute to the project, regardless of their parent company. Locatelli et al. (2013) state that team member training is the most important investment when considering lean construction implementation. This aligns quite well with the results from the Australian interviews where the most mentioned key success factor for PAs is the team. Hence why most PAs follow strict team member selection processes.

During the start-up of the alliance a lot of work is put into developing a single alliance team culture. Alliance workshops and team building activities are performed on a regular basis and because a large emphasis is placed on team culture these activities are continued throughout the life of the project.

WORKPLACE STANDARDISATION

At this stage, our research has uncovered little evidence of workplace standardisation in alliance projects. It seems that alliancing lacks an established set of processes and

procedures that resembles that found in lean construction, for example, the 5S tool (sort, straighten, sweep, standardize and systematize) (Salem et al. 2005).

WASTE ELIMINATION

For all the types of waste identified in lean construction (Hines and Taylor 2000), we believe that PA can minimise or eliminate waiting, defects and inappropriate processing. We also believe it can reduce waste caused by variation and the disengagement of people.

Waiting is addressed by the concurrent engineering processes inherent in PAs. Defects and extra processing are often reduced due to the higher quality and performance associated with alliance projects. Variations are minimised or eliminated due to the fact that all parties, including the client, are all part of the one team and any issues that arise are dealt with right away. The results of the interview series in Australia identified that alliances address the disengagement of people. The majority of people interview favoured working on an alliancing project over any other form of contract. Provided the right people are selected to work on the alliance team moral and engagement is kept at a high. Expanding on the previous point, waste is eliminated as the right people are often being used for the right positions, regardless of parent company. This ensures efficient use of resources and eliminates doubling up of resources.

Ballard and Howell (2003,128) estimate that *"as high as 50% of design time is spent on needless (negative) iteration"*. Although no comparable statistic has been found for Alliancing, it would appear that it would be considerably lower when it comes to alliances. Alliances have everybody together, and in the same room, from day one. This means that all parties have an input into the design process. The client can immediately eliminate designs that do not comply with their wishes. In addition, the contractor can identify when designs are not practical and highlight where efficiencies in scheduling, construction methods, material etc. This immediate feedback means that needless designs are not progressed and design rework is minimised.

CONTINUOUS IMPROVEMENT AND THE STRIVE FOR PERFECTION

Alliances encourage open dialogue between all members and decisions are required to be made as best for project. This can lead to moving outside of traditional specifications and requirements associated with traditional contracts. Alliances can accommodate scope change and deal with changes and issues as they arise. In addition, alliances are always challenging the schedule to see how to improve it along the way or to mitigate delays. The commercial and legal framework of alliances facilitates this by removing issues associated with variations. The alliance mindset is to deal with challenges and setbacks as a team.

Alliances have a no blame culture. Lessons learned are distributed throughout the alliance on a regular basis. Everyone is on the same team. Guided by standards but are able to challenge them when necessary. Alliances commit to developing and sustaining an alliance culture that respects the principles of the alliance.

In the view of those interviewed, alliances often deliver "state-of-the-art" results and outcomes as they have a large focus on delivering results. Incentivised cost reimbursement is one way to facilitate this, particularly in non-cost areas as safety, quality, environment

etc. All decisions made are best for project. The client can up skill their employees by exposing them to different aspects of the industry by embedding them in the alliance.

CONCLUSION

Based on the literature studied and the performed interviews, this study shows that alliancing does in fact inherently align with some key lean construction principles, particularly in the four areas of customer focus, culture and people, waste elimination, and continuous improvement. The research lacked sufficient evidence of alignment in the fifth area of workplace standardisation. To give a visual representation of the alignment between PA and lean construction we refer to the lean construction triangle in **Error! Reference source not found.**. There is sufficient evidence for PA alignment with the organisation and commercial sides of the triangle. Alliancing aligns with the principle of customer focus, a key element of the commercial side of the triangle. On the organisational side, we have shown the alignment in the areas of culture/people, waste elimination and continuous improvement.

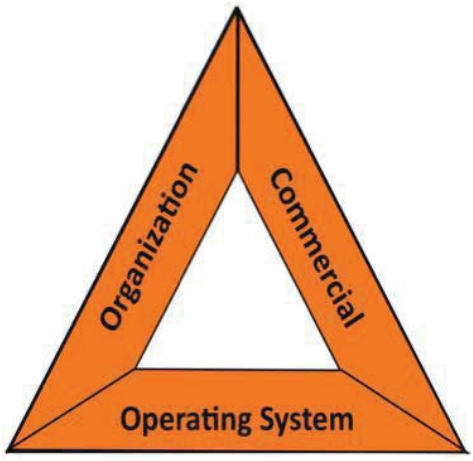

Figure 3: The Lean Construction Triangle (Lean Construction Institute)

A key difference between PA and lean construction appears in the operating system. Alliancing lacks the workplace standardisation and the use of lean construction tools identified with lean construction. Further research into this area could determine whether alliancing would benefit from directly incorporating the principle of workplace standardisation and/or the lean construction tools.

An understanding of how and where alliancing aligns with lean construction can lead to a better insight into how the model can be improved. Such knowledge could be useful to practitioners looking at incorporating lean principles and tools into the alliancing model; such is the case in Finland. It could also prove useful to those looking at developing improved collaborative contracting models. This study does not claim that alliancing is a lean project delivery method, but rather that it inherently contains qualities of lean. To sum up; alliancing can be the starting point for an owner interested in the lean project delivery system, as it aligns with many of the lean construction principles.

This paper aims to generate future research and discussion around the relationship between lean construction and alliancing. For example, an in depth look into comparable cases of lean construction and alliance projects could lead to a better understanding of the similarities between the structure, process and performance of both methods. In addition, as the clients continue demanding projects with improved outcomes, higher efficiencies,

less cost and less waste, the development on new project delivery methods incorporating lean principles could be an answer.

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A COMPARISON OF PROJECT ALLIANCING AND LEAN CONSTRUCTION

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Abstract: As the adoption of both alliancing and lean in the construction industry has started becoming more prevalent, knowledge of the alignment of Lean Construction with alliancing could be valuable to practitioners looking at adopting lean project delivery. This paper contributes to addressing this issue by providing insight into the relationship between the alliancing project delivery method and Lean Construction project delivery through the review of a literature review, interviews and a document study. A major driver of alliancing is to deliver value for money to the client, so it comes as a surprise that, to this date, alliancing has yet to fully capitalize on the Lean Construction operating system to drive the pursuit of maximum value. The inclusion of a lean operating system would require only minor changes to the existing structure of a standard project alliancing agreement. Alliancing could essentially remain the same, both structurally and commercially, while incorporating Lean Construction methods and tools into its operating system. In the right circumstances, this combination could be used to deliver greater value to the client.

Keywords: Alliancing, Lean Construction, Operating System, Organisation, Commercial.

1 INTRODUCTION

Alves and Tsao (2007), through their study of IGLC papers from 2000 – 2006, identified that there has been a lack of research among the IGLC community in the area of relational contracting. They suggested that researchers "*strive to understand how to implement relational contracting, measure its outcomes, and explain project results to help provide guidance to owners that are interested in working towards lean project delivery.*" (Alves and Tsao 2007, 57). Ten years later, there is still a gap in the literature comparing project alliancing (PA) and Lean Construction (LC). This paper contributes to addressing this issue by providing insight into the relationship between the PA and LC project delivery methods.

Previous work by the authors shows that alliancing does in fact inherently align with some key LC principles, particularly in four of the five LC principles identified by Diekmann et al. (2004), namely customer focus, culture and people, waste elimination, and

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continuous improvement. The research at that time lacked sufficient findings to show an alignment in the fifth principle of workplace standardization. To give a visual representation of the alignment between PA and LC we refer to the Lean Construction triangle in Figure 1.

Figure 1: The Lean Construction Institute Triangle (Lean Construction Institute and Thomsen et al. (2009))

There is sufficient evidence for PA and LC alignment concerning the organization and commercial sides of the triangle. Alliancing is associated with the principle of customer focus, a key element of the commercial side of the triangle. On the organizational side, we have shown alignment in the areas of culture/people, waste elimination and continuous improvement. The research uncovered insufficient evidence to comment on the alignment between the operating system side of the triangle and is therefore the departure point for this paper.

There is a view that despite a lack of direct influence from alliancing, Integrated Project Delivery (IPD) can be seen as a combination of an alliance contract and governance system with a LC operating system (Raisbeck et al. 2010). Since IPD developed independently from alliancing yet resembles a combination of PA and LC, what would the potential outcomes be if PA and LC were combined intentionally? The fact that there is an inherent alignment between the organizational and commercial domains shows that such a combination is plausible, while the existence of IPD shows that it is possible.

The initial findings identified that a possible key difference between PA and LC appears in the operating system. Alliancing seems to lack the workplace standardization and the use of tools associated with LC. This paper will expand on this point by focusing in on the operating system side of the triangle. To provide a clear focus, the following research questions were identified:

- What are the similarities and differences between the two project delivery methods?
- Is there potential for the two systems to learn from each other?

Thomsen et al. (2009) uses the above triangle to represent the three domains of all project delivery systems. Domains must be in alignment and balanced to ensure that the delivery system is coherent and optimal. Using this model as a departure point, the paper begins by exploring the balance and alignment between these three domains for both PA and LC. Once a high-level understanding of each of these methods is established, a deeper exploration is made into their operating systems. This exploration forms the basis for a comparison between the PA and LC operating systems, noting any key differences and similarities between the two. Finally, conclusions are drawn and recommendations made for further research.

2 Method

A literature search was undertaken following the five steps prescribed by Blumberg et al. (2014). Step 1 was to define the questions to be answered after the literature search. Step 2 and 3 was to identify and apply key search terms in primary sources (for example

databases and search engines). In step 4, secondary sources were located and reviewed (for example by scanning references). Step 5 was to evaluate the sources and the content. After this search, a review of the literature formed the basis for the theoretical background. To gain insight into both the academic and practical aspects of the operating systems, findings from both journal articles and conference papers (mostly primary sources) are used in combination with findings from government and industry publications (mostly secondary sources).

After the literature review, two of the authors undertook a series of 27 semi-structured in-depth interviews – following the descriptions of (Yin 2013) – in Australia in early 2016. The interview questions were formulated after the literature review was almost finished, and each interviewee received a transcript afterwards to avoid misunderstandings.

A document study was carried out after the literature search and interviews, where the documents were what (Weber 1990) denotes as sampling population. The purpose of this document study was to supplement the secondary sources found during the literature search. The main source for identifying relevant documentation were the interviewees, who both recommended and provided documents.

3 Theoretical Background

In order to draw conclusions on the similarities and differences between PA and LC, an exploration of the current theory on each topic was undertaken. As the adoption of both alliancing and lean in the construction industry has become more prevalent, an understanding of the lean principles inherent in alliancing could be valuable to practitioners looking at adopting lean project delivery. Many countries, particularly in Europe, have started adopting alliancing in recent years. In addition, Finland, who adopted alliancing in 2007, has begun experimenting with adopting lean ideology into their alliance projects (Petäjäniemi and Lahdenperä 2012). The authors will explore the practical findings based on the outcome of this combination of lean and alliancing in Finland in later publications once enough completed projects are available to provide significant findings. A clear understanding of the current similarities between PA and LC from a theoretical view could help improve this adoption and could potentially lead to the creation of improved project delivery models.

IPD is a method used mostly in the USA that has many similarities to alliancing, with the one major difference that IPD incorporates a number of LC elements (Lahdenperä 2012; Raisbeck et al. 2010). IPD's use is mostly concentrated in America, yet the principles of lean are more prevalent worldwide. Alliancing is often considered at the top end of collaborative and relational contracting (Ross 2003) and is more widely distributed across the globe (Chen et al. 2012; Ingirige and Sexton 2006). In addition, IPD and Alliancing have often been used for different types of projects (Lahdenperä 2012). The authors believe that there is sufficient difference between alliancing and IPD to warrant such a study, and as such, a full exploration into the differences between IPD and alliancing will not be explored further in this paper but can be found in the studies by Lahdenperä (2012) and Raisbeck et al. (2010).

3.1 Project Alliancing

PA is a collaboration between a client, service providers and contractors where they share and manage the risks of the project together (Chen et al. 2010). All parties' expectations and commercial arrangements are aligned with the project outcomes and the project is driven by a best-for-project mindset, where all parties either win together, or lose together

(Chen et al. 2012; Walker et al. 2013). The contract is designed around a non-adversarial legal and commercial framework with all disputes and conflicts resolved from within the alliance (Henneveld 2006). This type of project delivery can lead to improved project outcomes and value for money, in part due to the increased level of integration and cooperation between planners, design teams, contractors and operators (Love et al. 2010).

Alliancing as a model is well addressed in the literature and thus will not be discussed in great detail here. Previous research determined the most common characteristics of a project that may influence the decision to proceed with an alliance as the preferred PDM and provides an up-to-date look at the critical success factors and barriers to alliancing (Young et al. 2016a). *Alliancing: A Participant's Guide* is a detailed industry publication that addresses alliancing from the perspectives of both the owner and non-owner participants (NOP) (Morwood et al. 2008), and *Introduction to Project Alliancing* is a valuable piece of the alliancing body of knowledge (Ross 2003).

Project alliances are suitable – and most often used – for projects that have tight timeframes, multiple or complex stakeholder issues, are uncertain, complex and/or high risk (Young et al. 2016a). The organization domain of PA focuses on the high level of team integration necessary to deal with such projects. Alliancing uses a fully integrated project team that is co-located (in most cases) for the entire duration of the project. A board made up of equal representation of senior leaders from each party, known as the alliance leadership team (ALT), governs the alliance. The ALT makes decisions unanimously and handles all disputes (that cannot be handled at the management level) in house (with the exception of willful default), reinforcing the high level of team integration. The level of integration experienced in alliancing is at such a level where an alliance essentially becomes a 'virtual' organization.

The commercial domain of alliancing is made up of, in large part, the three-limbed compensation model. In recent times, alliance contracts have been structured around the three-limbed approach: (Ross 2003; Walker et al. 2015):

- Limb 1: all the directly reimbursable costs including project-specific overheads.
- Limb 2: corporate overheads and profit for each NOP, determined by an independent auditor and is placed 'at-risk' according to the pain/gain arrangement.
- Limb 3: incentivized cost-reimbursement where all participants share in the pain/gain associated with how the alliance performs against pre-arranged targets in cost (e.g. the target outturn cost and non-cost key result areas).

This three-limbed model creates a contractual alignment between all parties and provides the financial mechanisms that align the client and NOPs' interests and objectives.

The operating system of alliancing isn't known to be associated with a specific set of tools in the way that LC is. In a general sense, alliancing can be seen to behave in a similar way that a design and construct (D&C) project would (Marosszeky and Ward 2010) by using common project management (PM) methods and tools. On a day-to-day level the alliance is run by an alliance management team (AMT), whose responsibility is to work with the alliance manager to drive the operational project delivery (Morwood et al. 2008). The authors are yet to see any prescriptions in the literature explicitly dictating how to operate an alliance. The literature often deals with *what* to achieve, i.e., the clients value for money statement, delivery of project objectives etc., but not *how* to achieve it. It seems that alliances do in fact rely on common PM methods and tools unspecific to any particular PDM. Given the extent to which common PM methods and tools are prevalent in the construction industry, they will not be covered in detail here.

3.2 Lean Construction

Lean Construction was born out of the success of the lean philosophy that developed in the manufacturing industry. Both lean and the development of LC are well described in literature [Lean: (Ballard et al. 2001; Diekmann et al. 2004; Krafcik 1988; Liker 2004) and LC: (Howell and Ballard 1998; Howell 1999; Koskela 1992; Picchi 2001)]. Therefore, this information will not be covered. This paper will instead focus on the way LC addresses and balances the three domains of the LC triangle.

LC addresses the domain of project organization through the promotion of an integrated organization, the creation of cross-functional teams and the alignment of participants' interests. LC aims to break down the barriers between different organizations, and between the different functional silos that are present within most organizations. The organizations can reduce waste by avoiding the separation of design and construction and the sequential nature of processes often found in traditional project delivery. The alignment of interests is achieved by combining the promotion of collaboration with a major focus on the achievement of value as defined by the customers (both internal and external). This alignment extends not only to the alignment of different organizational objectives but also to the alignment of employees to each other and their own organizations (Azari-Najafabadi et al. 2011).

A key element of the LC operating system is characterized by the use of tools. While a tool in and of itself cannot be described as LC, the application and use of tools in a project embodies LC if it eliminates waste and/or maximizes value in the project. The same tools applied poorly could lead to the opposite effect by creating waste and not value (Thomsen et al. 2009). A number of tools have developed out of the lean community that have been employed in construction projects. These include, but are not limited to: Last Planner System™, Increased Visualization, 5S Process, First Run Studies, Daily Huddle Meetings, Fail Safe for Quality and Safety, Plan-Do-Check-Act, A3 Reports, Value Stream Mapping and Target Value Design (Salem et al. 2005; Thomsen et al. 2009).

Addressing the commercial domain is not so straight forward since LC itself is not considered to be a typical project delivery contract strategy. The commercial domain has do to with the "*compensation method, contractual assignment of roles and responsibilities, and financial mechanisms which can result in alignment of interests within a project organization, if properly designed, etc.*" (Azari-Najafabadi et al. 2011, 428). The research has uncovered many ways that LC can lead to alignment of interests within a project, but not in the specific commercial aspects of a compensation model or financial mechanism. This gap is often where, in the LC community, IPD steps in to handle the commercial contractual arrangements.

4 Findings and Discussion

This discussion presents the authors' interpretation of the findings that have resulted from this research. This discussion explores the three project delivery domains of both PA and LC in order to determine the similarities and differences between the two and to identify the potential for lessons learned to be passed from one to the other and vice versa.

Alliancing is structured in a way that creates full alignment of the three domains. The shared risk and pain/gain arrangements combined with the alignment of client and commercial participants' objectives creates an entity that is adept at dealing with projects that are high risk or have high levels of uncertainty. When combined with unanimous decision-making, no dispute clause and open book, it helps to promote the win-win

principle of PA necessary to deal effectively with issues that arise. When problems arise, it is in the best interest of all parties to find the best-for-project outcome, and find it quickly. The full integration of the organizational domain combined the commercial aspects creates a situation where the emphasis of contract management in the typical sense is removed and full focus can be placed on the operation of the alliance.

It seems that, even with a good balance between the domains, alliancing hasn't made any leaps forward in terms of revolutionizing its operating system when compared to traditional PDMs. The success of alliancing seems to be due to the innovations made in the organizational and commercial domains. Such a finding leads the authors to believe that alliancing could be greatly improved by focusing on its operating system.

LC as a method of management seems to operate mostly in the organizational and operating system domains. Despite deficiencies in what is commonly understood to be the commercial domain, LC maintains a high-level alignment between the other two domains. This alignment makes it particularly adaptable to being incorporated into a wide range of commercial models.

Considering both PA and LC from this perspective, we can see that they are highly compatible. They share many similarities in the organization domain in that they both strive to achieve full integration to the effect that value is maximized for the client. PA has a fully functioning commercial domain that is inherently aligned with the principles of LC (Young et al. 2016b), thus making PA and LC highly compatible in this area. In the operating system domain, PA relies on traditional approaches to project management and does not have a specific set of prescribed methods and tools of its own. This void creates a situation where a full LC operating system, i.e., tools and methods such as LPS, Increased Visualization, 5S etc., could be seamlessly introduced into an alliance without fundamentally changing the alliance itself.

The findings show that there is great potential for PA and LC to learn from each other. This possibility has been demonstrated practically via the adoption of alliance-like governance and commercial aspects into LC, creating the IPD model. On the other hand, the alliancing model could benefit from LC, particularly from its operating system, while still staying true to the structure and principles that make alliancing what it is today.

5 Conclusions

A major driver of alliancing is to deliver value for money to the client, so it comes as a surprise that, to this date, alliancing it yet to fully capitalize on the LC operating system to drive the pursuit towards maximum value. Despite the presence of PDMs that resemble a combination of PA and LC, namely IPD, alliancing, in its own right, has solidified its place alongside such PDMs in the project delivery toolkit available to clients. The presence of IPD does not make alliancing obsolete and the inclusion of a LC operating system into standard PA would not necessarily become IPD either.

Regarding the similarities and differences between the two project delivery methods, the similarities are in the organizational domain while differences exist on the commercial and operating system domains. Despite the differences in the commercial domains, PA does inherently align with LC principles, making the two compatible in this area. The major difference in the operating system domain is that LC relies on a specific set of tools to handle daily operations while PA uses non-specific tools from the common PM toolkit.

There is potential for the two systems to learn from each other. Particularly, alliancing could learn from the LC operating system. The inclusion of a lean operating system would not require any major changes to the existing structure of a standard PA agreement.

Alliancing could essentially remain the same, structurally and commercially, while incorporating LC methods and tools into its operating system. This integration is made possible due to the inherent alignment between alliancing and the lean construction principles in the organizational and commercial domains.

The authors aim to study the practical implications of this concept by reviewing the outcomes of a number of Finnish alliances that are in the process of experimenting with the inclusion of the lean construction philosophy, tools and methods. Based on these theoretical findings, the expectation is that this implementation will deliver positive results and key lessons learned.

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Partnering elements' importance for success in the Norwegian Construction Industry

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Abstract

As construction projects are becoming more complex and uncertain, and there is an increased focus on sustainability and green building, partnering is a way of enabling a non-adversarial environment. This creates a flexible process that helps e.g. retrofit projects achieving their goals. The purpose of this paper is to identify key elements that ensure the success of partnering projects for the different stakeholders. This paper will seek to answer the following questions: What elements are used in partnering projects? Is there a link between the use of the different partnering elements and the project's success seen from the client, contractor and user perspective? The research is carried out as a review of partnering literature, as well as an investigation of 10 partnering projects within the Norwegian context, using a case study approach. The investigated projects were both new buildings and retrofittings. A preliminary survey with additional in-depth, semi-structured interviews of clients and contractors was conducted. A document study was also carried out as a supplement to the survey and interviews. Key partnering elements such as early involvement, value-based procurement and start-up workshop were identified through this study. Further analysis revealed that these partnering elements, in combination with soft elements such as trust, commitment and competence, help facilitate success for stakeholders. The identified key partnering elements gives practitioners an implication of which partnering elements should be implemented to achieve project success and more sustainable buildings.

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Keywords: Partnering; Hard partnering elements; Soft partnering elements; Success for stakeholders

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1. Introduction

The use of partnering as a project delivery model emerge as an important trend in the Norwegian construction industry. Public clients such as the Norwegian Directorate of Public Construction and Property (*Statsbygg*) have developed their own models for executing partnering projects, but also municipalities are implementing partnering at an increasing scale. The popularity appears to be due to the traditionally adversarial culture and the high level of conflicts typically associated with the construction industry [1]. A driving force for partnering being more in demand seems, partly, to be that projects are getting more uncertain and complex than before [2], and partly due to the increased focus on sustainability. As stated in the report State of the Nation 2015 [3], municipal buildings are in particular characterized by a lag in maintenance and are in need of retrofitting and refurbishment in order to be as effective as possible. As these types of projects often experience scope creep, partnering is found to be a well suited project delivery model.

Construction projects are often associated with low efficiency, mainly due to the large focus on transactions [4]. The aim of introducing measures such as partnering is to increase productivity, avoid conflicts and shorten execution time by focusing on relations rather than transactions. The use of such measures may also lead to an increase in innovation and thus better products [5].

Different partnering models are in use within the Norwegian context. Haugseth et.al [6] investigated how partnering projects are executed in Norway, and examined elements that are used in partnering projects. However, the list of elements identified by Haugseth et al. [6] is not complete, and needs to be supplemented. At the same time, since implementation of partnering elements demands resources and dedication, it will be useful to establish a link between what partnering elements that are used and the projects' success. In order to do so, the paper addresses the following two questions:

1. What elements are used in partnering projects?
2. Is there a link between the use of the different partnering elements and the projects' success seen from the client, contractor and user perspective?

When assessing project success, the focus is on the client, contractor and user perspective. The perspectives of the consultants and architect are thus not evaluated. The practitioners from the clients and contractors were asked about the users' satisfaction with the end product. Based on the limited number of cases in this study, the conclusions are narrowed to address management and collaboration aspects of partnering projects in Norway, but they should partly be applicable in an international setting.

The following theory part presents the definitions of partnering and success. In part three, the research method is elaborated upon. The results from the case studies will be presented in part 4, and further discussed in part 5. The paper will conclude with a set of recommended partnering elements that are important for a successful outcome for both clients and contractors.

2. Theory

2.1. Background

Relational contracting has been a growing trend in the construction industry since its humble beginning in the late 1980s and early 90s. Largely based on insights from the Latham [7] and Egan [8] reports, public clients have started the shift from a practice based on transactions towards establishing relations.

One main ambition of relational contracting is to avoid adverse objectives and conflicts, which have characterized the industry for too long [9]. In order to achieve this, a relationship based on trust between the actors should be established. The literature argues that this can be achieved through relational contracting concepts such as alliancing, joint venture, public private partnership, partnering and integrated project delivery (IPD) [10]. Partnering, focusing essentially on improving cooperation within existing frameworks, separates itself from alliancing and IPD by being a more conservative approach than the latter[11, 12]. Alliancing and IPD are typically more explicitly incorporated in the contractual structure, and can thus be seen as independent project delivery models.

2.2. Definition

Despite having been studied thoroughly for the last 25 years, the literature still presents no commonly shared definition of partnering. Many researchers have tried to establish a common definition of the concept, but it has proven to be difficult due to its ambiguous characteristics [13-15] . The Construction Industry Institute has presented the most widely accepted definition of partnering, notably as "*[a] long-term commitment between two or more organizations for the purpose of achieving objectives by maximizing the effectiveness of each participant's resources.(…) The relationship is based upon trust, dedication to common goals and an understanding of each other's individual expectations and values." [16]*. This definition explains what partnering is in its purest form, but it does not acknowledge the challenges of public clients who have to execute tender competitions due to public procurement regulations. Bennett and Jayes [17] introduce the concept of project-partnering, where partnering effects can be achieved over a single-project [17]. This definition has been used during this research, as it is more applicable for public clients who have difficulty establishing long-term cooperation over multiple projects due to legislation.

2.3. Purpose of partnering

By establishing relations and a "pain and gain sharing"-mentality, partnering aims to accomplish a positive environment in the project and achieving success for all participants [18]. The effect of this can be difficult to measure due to interrelated processes and different goals, in addition to perspectives making it difficult to assess project success [19]. Still; literature points to several benefits that can be obtained by using a partnering approach, such as less conflict, increased productivity, shorter execution time, more innovation, better cost efficiency, increased flexibility, improved work environment and continuous improvement of quality in results and services [6, 20-22]. Even though these benefits may be greater in long-term partnerships, project partnering in public sector is claimed to be able to achieve a 10,5% schedule reduction and 16,3% cost reduction [23]. As public construction contracts steadily increase in size, these potential savings will be a great asset in order to make a more viable industry.

2.4. Partnering elements

There are numerous ways of implementing partnering, and thereby achieving the intended effects [14, 24]. The list of elements in Table 1 was identified through a study of literature [1, 6, 14, 18, 25]. The different categories were chosen by the authors, and represents areas in the contract where the element is applicable. The elements can be combined in different ways, and some elements are interconnected. For instance, when target cost with bonus-malus is presented in the project, it is typically convenient to combine it with open books and work based on cost-plus.

2.5. Success

The aim of this article is to establish a connection between use of partnering elements and project success. Success is a term with many different definitions in project management literature. In order to assess success for different stakeholders, success is defined as "The accomplishment of an aim or purpose" as stated in Oxford dictionary of English. This means that success in partnering projects simply means the accomplishment of an objective [26].

This definition of success is also applicable for the different perspectives investigated in this paper. During the interviews, the interviewees were asked about their objectives with the project. The outcome was then dependent on whether their objective was met during or after the project was finished. The stakeholders' objectives were most often linked to the so-called Iron Triangle of cost, quality and time. Success as to the long-term effects of the product was not investigated.

Table 1 Summary of partnering elements, sorted after categories by the authors

Partnering elements	
Procurement	**Conflict resolution**
Pre-qualification	Predetermined strategy for disputes
Value-based procurement	Contractual right to replace people
Functional description	Contractual right to replace firms
Client possibility to terminate agreement	**Workshops**
Distribution of responsibility	Facilitator
Partnering charter	Start-up workshop
Client administrated design	Workshops during project
Design and build contract	Sum-up workshops
Transferred operational responsibility to contractor	Co-localisation of partnering group
Work based on cost-plus	**Involvement in partnering group and target cost**
Process	Including architect in partnering group
Intention agreement before establishing target cost	Including architect in target cost and bonus/malus
Target cost with bonus/malus	Including consultants in partnering group
Allocation in target cost due to unfortunate design	Including consultants in target cost and bonus/malus
Open book	Including technical- and/or sub-contractors in partnering group
Early involvement of contractor	
Incentive agreement	Including technical- and/or sub-contractors in target cost and bonus/malus
Mutual objectives	

2.6. Hard elements vs. soft elements

The literature distinguishes between hard and soft elements in managing projects [24, 27]. Hard elements include elements that either are directly regulated in the contract or has its root in the procurement process. Soft elements, on the other hand, are related to the relationship between the people in the project [24]. The literature generally identifies the most important soft elements as trust, communication, long-term commitment and cooperation, whilst the most important hard elements are having real pain/gain sharing mechanism and a use of a legally binding partnering charter [13]. In some cases, hard contractual elements and soft coincide, such as start-up workshop and mutual objectives [24].

3. Research Method

This article is based on a literature review and case studies of 10 partnering projects in the Norwegian construction industry. The reason for choosing a case study approach was to investigate if hard partnering elements actually leads to success in projects. The 10 projects were identified through the authors' network of practitioners, and chosen on basis of (1) being partnering projects, and (2) having been executed in recent years.

The research design is based on the principles as described in Yin [28] with both triangulation of methods and perspectives to strengthen the analysis.

3.1. Literature review

In order to map existing research and reveal knowledge gaps, a literature review was conducted. The review was carried out through structured searches in the well-known databases Scopus and Science Direct. The first searches was conducted with the words "partnering" and "concept". This resulted in many hits, where most were irrelevant to the subject. As a result, the search was narrowed by the additional search words "success", "experience" and "advantages". The literature study revealed a gap in research about what hard partnering elements that lead to success.

3.2. Case studies

The case studies were carried out as what Yin [28] calls explanatory case studies. Explanatory case studies prove best adapted to situations where the problem at hand is previously investigated and there is an existing theoretical framework. This fits the situation of partnering within the Norwegian context, and is well-suited for multiple case studies. Three of the investigated projects were retrofitting and refurbishment projects, whilst the other seven were new buildings. All of the examined projects were executed and finished during the last six years.

3.2.1. Survey

A preliminary survey was conducted in order to gather and organize a large quantity of information most effectively. The survey was distributed by e-mail, and as all the 16 respondents of the survey were to be interviewed after submission, the return rate was 100 %. The survey consisted of three parts; (1) project characteristics, (2) use of partnering elements and (3) the partnering elements' impact on success. During the information retrieval phase, it became evident that part 3 was the most challenging to answer. The challenges seemed to stem from a difficulty of saying if one partnering element was more important for success than the others, as they are more or less interconnected. This problem was mainly sorted out during the interviews, where interviewees were given the opportunity to elaborate their initial survey answers.

3.2.2. Interviews

16 in-depth interviews concerning the ten cases were executed, and the client was interviewed in all the cases. It proved difficult to make arrangements with the contractors, and as the answers from the interviewed contractors corresponded well with those from the clients, it was considered as sufficient to interview six of the contractors. All interviews were conducted as semi-structured following the principles described by Corbin and Strauss [29]. The interview procedure was to allow the interviewees to talk as freely as possible, and ask follow-up questions when needed. Because the projects originate from different locations in Norway, 12 of the interviews were conducted by phone or video conference tools such as Skype. Four interviews were conducted face-to-face.

3.2.3. Document study

In some cases, interviewees sent documents describing their project, project delivery model or organization. These documents were studied, and they served as a supplement to the survey and interviews. The documents made it easier to ask the right questions and understand the given answers.

4. Findings

4.1. Elements used in partnering projects

The use of different partnering elements in the investigated cases was mapped through the preliminary survey. The interviewees were asked to mark what partnering elements were used in their projects, and got a chance to elaborate their answers during the interview. From the list of totally 30 pre-defined elements, seven were found to be implemented in all ten projects. The appearance of the other elements varied in different cases. An additional three partnering elements were used in the projects characterized as successful. Table 2 presents a summary of the given answers, sorted in the categories introduced in Table 1. The categorization was carried out to see what categories had the most implemented elements, and to make it clear what elements in the table that are new.

Table 2 Use of partnering elements in the 10 investigated projects, sorted in the categories from Table 1

Project number	1	2	3	4	5	6	7	8	9	10
Procurement										
Pre-qualification	X	X		X	X		X	X	X	X
Value-based procurement	X	X	X	X	X	X	X	X	X	X
Functional description	X	X	X	X	X	X	X	X	X	X
Client possibility to terminate agreement	X	X	X	X	X	X	X	X	X	X
Distribution of responsibility										
Partnering charter	X	X	X	X	X	X	X	X	X	X
Client administrated design										
Design and build contract	X	X	X	X	X	X	X	X	X	X
Transferred operational responsibility to contractor		X								X
Work based on cost-plus	X	X	X							X
Process										
Intention agreement before establishing target cost	X	X								X
Target cost with bonus/malus	X	X	X							X
Allocation in target cost due to unfortunate design	X	X								X
Open book	X	X	X							X
Early involvement of contractor	X	X	(X)	X	X	X	X	X	(X)	X
Incentive agreement										
Mutual objectives	X	X		X	X	X				X
Conflict resolution										
Predetermined strategy for disputes	X	X	X	X						X
Contractual right to replace people		X	X	X	X		X	X	X	X
Contractual right to replace firms		X		X	X		X	X	X	
Workshops										
Facilitator	X		X		X	X	X	X		
Start-up workshop	X	X	X	X	X	X	X	X	X	X
Workshops during project	X			X	X		X	X		X
Sum-up workshops	X		X			X			X	X
Co-localization of partnering group		X								X
Involvement in partnering group and target cost										
Including architect in partnering group	X	X		X	X	X	X	X	X	X
Including architect in target cost and bonus/malus	X									X
Including consultants in partnering group	X	X		X	X	X	X	X	X	X
Including consultants in target cost and bonus/malus	X									X
Including technical- and/or sub-contractors in partnering group	X	X		X	X	X	X	X	X	X
Including technical- and/or sub-contractors in target cost and bonus/malus	X									X
New elements										
Building information model		X		X	X	X				X
Meeting to ensure alignment between design phase and design and build contract			X			X				X
Volunteer group composition				X	X		X	X		X

All of the projects were conducted with a "partnering phase" of 2-12 months before entering a design and build contract. During the partnering phase, the client, contractor, consultants and architect cooperated to develop a pre-project. The use of design and build contracts in partnering projects is due to the lack of standardized contract regulations for Norwegian partnering projects. For the projects where "Early involvement of contractor" is marked with (X), the contractor was acquired right before signing the design and build contract, whilst the projects with X had a partnering phase of 6-12 months before signing the contract.

Two elements; client administrated design and incentive agreement, were not used in any of the projects. This is due to the use of design and build contracts, and target price with bonus-malus. Projects that were conducted with a fixed price contract did not have incentive agreements in terms of bonuses.

As shown in Table 2, three new elements were discovered in addition to the 30 pre-defined elements:

- Use of building information models (BIM) when dealing with the users. BIM makes it easier to understand what the actual building plan is, and is therefore said, by the interviewees, to be an important communication tool for the clients' user coordinator. It is also an effective design tool.
- Meeting to ensure alignment of the plans from the preliminary design phase and the design and build contract. Respondents maintain that this is best done by one or more meetings at the end of the preliminary design phase. This point in the project also represent the time for transfer of risk from client to contractor. Whether the entire risk is transferred to the contractor, or shared between the partners in the group varies in the different projects.
- Volunteer group composition is used in five of the projects. It encourages the contractors, consultants and architects to compose teams that most likely work well together. Volunteer group composition makes it possible to construct good teams that can have a long-term commitment to each other.

4.2. The link between partnering elements and projects' success from the client, contractor and user perspective

When the interviewees were asked about the project's success, both contractor and client agreed on the outcome. Therefore, in the seven projects characterized as successes, both parties were satisfied. In addition, in the three projects characterized as failures for both parties the users were satisfied according to the clients and contractors. This means that the outcome for the users seems independent from the outcome of the client and contractor.

All the interviewees were asked to prioritize the implemented elements from Table 2 according to their importance for success. This proved difficult due to the interdependency between the different elements. This was sorted out during the interviews, where the interviewees were challenged to elaborate on their views, and talk freely about their own experiences. In order to make the results comparable, the 10 most important elements for the clients and contractors are presented in Table 3. Some of the elements were given the same priority by the interviewees, something which make them equally important to success.

Client		**Contractor**	
Priority	Element	Priority	Element
1	Early involvement of contractor	1	Early involvement of contractor
2	Value-based procurement	2	Mutual objectives
3	Design and build contract	3	Design and build contract
4	Start-up workshop	4	Including architect in partnering group
5	Client possibility to terminate agreement	5	Including consultants in partnering group
5	Including architect in partnering group	5	Including technical contractors in partnering group
6	Including consultants in partnering group	6	Target cost with bonus/malus
7	Partnering charter	7	Start-up workshop
8	Including technical contractors in partnering group	8	Partnering charter
9	Mutual objectives	8	Value-based procurement

Table 3 The partnering elements that are most important for project success according to interviewees from ten clients and six contractors, respectively

Surprisingly, the interviewees from the clients and the contractors agree on 9 out of the 11 most important partnering elements presented in Table 3. *Early involvement of contractor* and *design and build* is given the same priority, but partnering charter is also given high priority.

5. Discussion

A total of seven elements are common to all the investigated projects. When looking at the seven projects characterized as a success for both client and contractor, ten common elements emerge; value-based procurement, functional description, client possibility to terminate agreement, partnering charter, including architect, consultants and technical contractors in the partnering group, design and build contracts, early involvement of contractor and start-up workshop. None of the categories from Table 1 and 2 are significantly more used than the others.

Out of the ten projects, seven was said to be a success for both the client and contractor. At the same time, the three failed projects were characterized as a failure by both. This is because the clients and contractors shared perspectives in the projects, meaning that they both succeeded or failed together. The interviewees claimed, regardless of whether they represented the clients or the contractors, that the users were satisfied in all the 10 projects. However, the client representatives admitted that the users were interested in moving to a building that was better than the former one. In this assessment of success, no long-term effects of the buildings have been studied. This means that by looking at the long-term effects, the users' assessment of success may change.

This study reveal that nine out of the eleven different elements prioritized as important for success by the clients and contractors were implemented in all the successful projects. This motivated the authors to further investigate how well the recommendations actually corresponded with what partnering elements that were implemented. Figure 1 illustrates the recommended priority of elements against the number of projects that used them. The recommended priority of the elements is the average of the results given from both client and contractor. The most important element for success is given the score 11 (as there were a total of eleven different recommended elements), lower numbers mean lower priority. The use of these elements were then counted in the investigated projects.

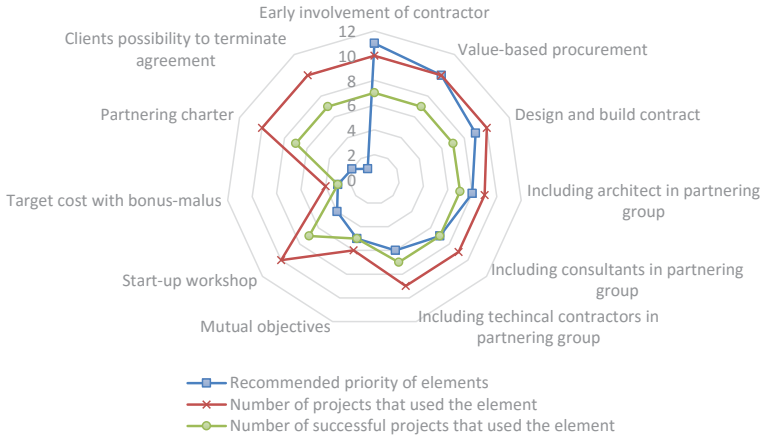

Figure 1 Recommended elements against executed in the investigated projects

The results show that most of the projects actually implemented the recommended elements except "mutual objectives" and "target cost with bonus malus". Mutual objectives is a recommended element from both client and contractor (Table 3), and should therefore be expected to be more widespread in usage. As a reduced number of conflicts is one of the desired effects of partnering [20], mutual objectives is a key element that helps contribute to this benefit.

Although target cost is stated as a core partnering element by e.g. Eriksson [13], Cook and Hancher [30] and Black et.al. [20], it is understandable that it is not used in all the projects. This is because the target cost presupposes a certain level of complexity and uncertainty in order to be advantageous. The research also shows that target cost requires a client willing to share risk during execution with the contractor, as well as facilitating trust and commitment between the parties. In projects where the uncertainty is low after initial design, and/or the client is not willing to share the risk during execution with the contractor, a fixed price contract will suit better than target cost.

The elements that are mutually recommended by client and contractor, and implemented in the successful projects, namely; early involvement of contractor, inclusion of technical contractor in partnering group, value-based procurement and start-up workshop all coincide with what Eriksson [13] states as either core or optional partnering elements. In addition, functional descriptions can be seen as a prerequisite of partnering and therefore also a "given" element.

All of the projects had a termination possibility for the client. Eriksson [13] does not mention the need for such a termination possibility, but it was encouraged by the interviewees on the basis of the characteristics of the industry. One of the three projects characterized as a failure used the possibility to terminate the agreement in order to prevent the project from becoming an even bigger failure. The other two projects failed mainly due to a misaligned understanding of the contract. Terminating the agreement after initial design could potentially have saved the projects from becoming failures. As a result, a possibility for the client to terminate agreement, or not offer the contractor the design and build contract, is an element needed as a lifeline in saving the projects from becoming massive failures for the clients.

Even though there were 10 common elements in the successful projects, the same 10 elements were used in two of the failed projects. When the interviewees were asked about what made the project a success, they all pointed to relationship-based elements such as building trust and commitment. In-depth questions about the soft elements impact on success revealed that the interviewed practitioners see them as equally important to success as the hard elements.

Table 4 Soft partnering elements that facilitate success in the project

Soft partnering elements	**Comment**
Mutual objectives	Includes mutual success criteria and respect for individual objectives.
Clients ability to make decisions	Decisions should be made at lowest operational level for fast clarification and decision-making.
Workshops	Especially in start-up phase. Workshops should be combined with team building activities and "get-to-know-each other" activities.
Trust	Includes openness. It is important that project managers do not have hidden agendas and start litigation processes. Trust must be given unconditionally by client and lived up to by contractor.
Commitment	Both project participants and top management must show commitment to the project and the established goals. Long-term commitment between client and contractor is desired [24], but not possible for public clients.
Competence	Partnering competence is vital in order to establish trust in the project. Success depends on the understanding of the concept of partnering. Construction competence is also important in order to make the right decisions and choosing the right design.
Communication	Good communication skills and open communication channels. Disputes and conflicts should be solved at the lowest possible organizational level, and handled when they occur.
Choosing the right people	Contracting should be based on volunteer group composition. Important to choose the right people in the organization from client as well.

Some stated that the soft elements are what makes it possible to turn the hard, contractual elements into success for the stakeholders. As an example, two of the investigated projects were executed using almost the same partnering elements and project delivery model. However, one of the projects was a huge success, whilst the other was characterized as a failure. What separated the two projects was the bonus/malus distribution where the client would always "win" in the failed project, and the lack of understanding of the partnering concept. It also became evident during the interviews that there was a big difference in the participants' attitude in the two projects, which may have influenced the outcome.

The soft partnering elements listed in Table 4 is to a large extent present in all successful construction projects, and are not limited only to partnering projects. Some of the elements could be both soft and hard, such as workshops, volunteer group composition, and mutual objectives [24]. In these cases, the hard elements force participants to implement the soft elements, and thereby achieve greater effects. At the same time, the soft elements are important for achieving full benefit with the hard elements. This means that the hard and soft elements are interdependent, and that success in partnering can be a result of both.

As construction projects are getting more uncertain and complex, and the scope is getting more ambitious, it becomes increasingly difficult to meet the objectives. This is the situation with for example retrofit and green building projects, which have become more in demand in recent years. According to literature, partnering can help uncertain and complex projects where innovation is needed to meet their objectives [1]. As there is also an increased focus on cost efficiency and productivity, partnering may contribute to making a more viable industry, and also making ambitious projects more successful. Many of the investigated projects were both ambitious in scope, had multiple user groups and a tight budget. Although not all the projects were a success for the client and contractor, most of them met their objectives. In addition, the users where satisfied in all the projects.

When asked about achievement of desired effects of partnering, most interviewees mentioned less conflict, better work environment and shorter execution time as main effects. Although stated in literature, none of the interviewees mentioned increased innovation as an effect of partnering. This may be due to: 1) partnering did not increase innovation in the design process, or 2) practitioners do not recognize innovation in the design phase. Further investigations must be conducted in order to find the real reason for the alleged lack of innovation.

6. Conclusion

6.1. Partnering elements used in the projects

From the 30 pre-defined elements, seven were found to be implemented in all the investigated projects; design and build, value-based procurement, functional description, client possibility to terminate agreement, partnering charter, start-up workshop and early involvement of contractor. Three additional elements were common for all the successful projects; inclusion of architect, consultants and technical contractors in the partnering charter.

Three new partnering elements were uncovered, namely: BIM, meeting to ensure alignment of the plans from the preliminary design phase with the design and build contract and volunteer group composition. BIM is useful both as a design tool in retrofit projects, and as a tool to improve communication with large groups of users. In order to ensure that the pre-project is anchored in the partnering group, meetings between the participants in the pre-project partnering phase and participants in the design and build contract is recommended. This will also help ensure alignment of the client's and contractor's understanding of the contract. Procurement of the whole group, in combination with volunteer group composition, was also used in five of the projects. This means that the client signs one single contract with the group composed by the contractor, the consultants and the architect.

6.2. The link between partnering elements and projects' success from the client, contractor and user perspective

Although there is a link between 10 common elements and the seven successful projects, the same ten elements were also implemented in two of the failed projects. As a result, we conclude that the hard elements alone will not necessarily lead to success. Table 5 contains elements that are common in all successful projects, recommended by the clients, contractors and authors, and soft elements that helps facilitate the hard elements. The common elements

are the ten common elements from the successful projects. The recommended hard elements are based on the ranking of elements in Table 3. In addition, volunteer group composition, open book economy and inclusion of the entire partnering group in the target cost is added by the authors to the recommended hard elements. This is because the contractors' recommendation of target cost implies full openness and involvement by all stakeholders to achieve the desired effects of the element. Soft elements that help build relations are listed together with the common and recommended hard elements in Table 5. This is because the soft elements are actually what facilitates success, and that the hard elements alone will not lead to success without the presence of the soft ones.

Table 2 Important elements in achieving success in partnering projects

Common hard elements	Recommended hard elements	Soft elements
Value-based procurement	Pre-qualification	Mutual objectives
Functional description	Volunteer group composition	Client representative ability and mandate to make decisions
Partnering charter	Mutual objectives	Workshop in start-up and during project, as well as teambuilding activities.
Design and build contract	Target cost with bonus/malus	Trust needs to start at the top, and work its way down.
Early involvement of contractor	Open book economy	Commitment to the project and established objectives.
Start-up workshop	Inclusion of the whole partnering group in the target cost	Partnering competence in order to put the principals into life.
Including architect, consultants and technical contractors in the partnering group.		Common, open communication channels in the project. BIM is recommended as a tool to improve communication with users.
Client possibility to terminate agreement		Choose the right people that make out an effective team. This means procurement based on interviews and competence among others.

Although the investigated cases used different partnering models, seven of the ten projects were characterized as a success for both client and contractor. In the three failed projects, both contractor and client agreed that the project was a failure. For all of the ten projects, the users seem to be satisfied with the product. This leads to the conclusion that in the studied projects, the challenge was to govern the process and facilitate true partnership between the involved parties. As the focus on green building increases and project characteristics are becoming more complex and uncertain, soft elements such as commitment, communication and trust will become even more important in order to succeed.

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PUBLICATION 11

“Next Step”: A New Systematic Approach to Plan and Execute AEC Projects

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Abstract

Planning and control of project execution is the core of project management. One key success factor is an adequate implementation strategy. The Architecture, Engineering and Construction industry (AEC) is portrayed as an industry with serious challenges ahead. Among observed problems that often happen in AEC project are the decisions, which are made in wrong time or at the wrong level of organization, as well as solutions executed in the project without being aligned with corporate strategies. This conceptual paper presents a new systematic approach introduced in Norway to fight the many difficult challenges in the AEC industry. The systematic approach is called “Next Step” and is a framework inspired by the RIBA plan of Work. The new framework presented in this paper identifies the key steps and tasks in a project lifecycle from the definition to the termination of the building. The framework focuses on project execution as well on the critical decisions on a corporate level, involvement of the proper stakeholder perspective, and a sustainable development of the AEC industry. The main purpose is to help the actors of the AEC industry. The intention is not to define a constraining recipe, but to give the industry a common language and collective reference for AEC projects. The framework also highlights important issues in the front end of projects concerning strategic alignment and project planning. This paper also reports on the adaptability of the new framework with different procurement forms. The new framework suggests examining the different phases in this systematic approach through different perspectives: by introducing the perspective of the owner, user, supplier and public, the project is driven to achieve strategic goals and leads to a more efficient process and sustainable outcome.

Keywords: Project execution framework, perspectives, stage gates, project delivery methods, contracts

1. Introduction

Planning and control of project execution is the core of project management. One key success factor is an adequate implementation strategy. This is specifically true in the architecture, engineering and construction (AEC) industry. Implementation strategies refer to the systematic approach to planning and execution of a specific project within a corporation. Reasons for wanting systematic approaches are obviously the constant need for continuous improvement and learning from past experiences. These are difficult challenges, and given the wide array of different contexts (national-, financial-, industry etc.) and individual strategies of corporations (business models, markets, growth etc.) and technical solutions (elements, products, materials etc.) it is no surprise the approaches vary a lot. Focusing the AEC industry, the specific challenges are often identified as being increasingly fragmented and complex on one side (Pennanen et al., 2010) and reluctant to change and innovate on the other (Dale, 2007). These characteristics combined portray an industry with serious challenges ahead.

To summarize some observed problems that frequently occur in construction projects: strategic decision-making often rely on documents (Business Case, Project Plans etc.) that are incomplete, inconsistent and in some cases simply wrong by purpose or incident (Flyvbjerg et al., 2002). Decisions are not made in time, sometimes made on the wrong level of the organization (Berg, 1999) or by the wrong individuals. This may be indication of unclear roles in connection to the decision-making process, or ineffective organizations. It may also indicate errors and flaws in decision making on individual or group level as pointed out by many authors (e.g. (Kahneman, 2011; Lovallo & Kahneman, 2003; Raiffa et al., 2006). Another recurring problem is solutions planned and executed in projects, without being aligned with corporate strategies. Projects are often viewed as pure execution without responsibility for delivering the right product, the right result for users and owners. This is evident in the traditional definition of a project as a unique task (PMBOK, 2004). It is also well known that construction projects are tormented with errors and mistakes in planning, design and execution, costing unnecessary money and reputation (Love et al., 2003).

In sum all these challenges form a problem-complex that is too much to handle for each individual project owner, project sponsor or project manager. Allowing completely individual implementation strategies to be developed for each single project will not only be costly in terms of making the same development many times, but will also miss out the opportunity to improve and learn. This conceptual paper presents a new systematic approach introduced in Norway to fight the many difficult challenges identified above. The framework is presented in chapter 3. The main issues in this paper are addressed through three axes, each represented in a research question:

- How can the framework help to achieve the right result for owners and users?
- How can the framework help to secure that the right perspectives are considered?
- How can the framework deal with different procurement forms?

2. Theoretical Framework

2.1 Success and stakeholders

In project management literature there are many definitions of success, yet Oxford dictionary of English simply states, “Success is the accomplishment of an aim or purpose” and failure as “lack of success”. Samset (2010) states “Projects are initiated to solve problems or satisfy needs”. Thus, we can assume that a project success is actually connected to its ability to solve those problems or needs.

The identification of problems and needs and the process of solving them is an important step to be able to define the project, and to define the aim or purposes in order to achieve success. Samset (2010) also argues to look at AEC projects in a larger context than only to solve the immediate problem. He claims that monitoring of a project should be both on tactical and strategic level. The tactical level deal with what most regards as the important success indicators in a project; cost, time and quality. Tactical success in projects is associated with the term “project management success” (Cooke-Davies, 2002). The strategic level looks at indicators as effect, relevance and sustainability. Strategic success is associated with “project success” (Cooke-Davies, 2002).

The AEC industry is a fragmented industry and relies on many different stakeholders to complete a project (Kerosuo, 2015). Each stakeholder have a different perception of the aim and the success of the project and these stakeholders will most certainly try to optimize their own operation (Aapaoja et al., 2012). This leads to sub-optimization of projects (Zidane et al., 2015). The right stakeholder involvement is important to create value in projects. By displaying key stakeholders and together aligning their aims, can help to conquer some of the differences (Yang et al., 2009). Keeping the most important stakeholders in mind, it is important to look at the three major groups of stakeholders and their views. Samset (2010) refers to this as perspectives and list them as the owner perspective, the user perspective and the executing perspective.

The owner is the initiating and financing party, the one who normally has a long-term interest in the investment that the project represents. The user is the party who is going to utilize the result of the project for operating their business. The executing party (-parties) is the architects, engineers and contractors who are executing the project on behalf of the owner – the project organization. The owner typically has, or at least should have, interest in the strategically performance of the project, while the executing parties typically limit their interest to the tactical performance (Slevin & Pinto, 1987). Bertelsen and Emmitt (2005) identify the owner, user and society as important groups that a “client” should represent: “These three groups of interest each value different things at different times in the life of the building.” Identifying the perspectives early might help to change and understand the focus of the stakeholders.

2.2 Project delivery methods

Project Delivery Method (PDM) - a system for organizing and financing design, construction, operations and maintenance activities that facilitates the delivery of a goods or service (Miller et al., 2000). Choosing different PDM will affect the project cost, schedule, success and influence the efficiency of running the project. This makes it a challenging issue for stakeholders and decision makers (Al Khalil, 2002; Chan et al., 2001; Kumaraswamy & Dissanayaka, 2001). The suitability of the selected PDM can improve the project performance to a great extent (Al Khalil, 2002; Han□Kuk et al., 2008; Kumaraswamy & Dissanayaka, 2001; Oyetunji & Anderson, 2006; Udechukwu et al., 2008).

There are large numbers of different PDMs available in AEC industry to overcome the shortcomings of traditional procurement (Alhazmi & McCaffer, 2000). Numerous authors have categorized the range of procurements forms in the literature. However, in this paper we try a new classification of procurement forms, to make it more practical for alignment with the framework. This classification is inspired by a very recent PMI book (Walker & Lloyd-Walker, 2015).The procurement forms could be fitted in three groups:

Segregated procurement forms: A key feature of procurement forms in this group is a trend to separate design and construction/delivery. Segregated forms include well-known traditional approaches. The dominant segregated form of procurement, which is operating in most countries, is Design Bid Build (DBB). In DBB the owner will receive the bid and award construction contract based on the finished designer's construction document. In this procurement approach, it is assumed that the project design is complete enough to enable a bidding process to establish the cheapest and/or the quickest tender cost. It also assumes that the price of design variations encountered throughout the delivery process will not be excessive (Masterman, 1992; T. Rizk & Fouad, 2007; Sanvido & Konchar, 1998).

The advantage of segregated forms, which is the key cause to select this procurement form in many organizations, theoretically lies with market contestability for the lowest cost (bid) in combination with shortest time. Other example of forms in this group is Cost reimbursement (Cost-Plus).

Integrated procurement forms: Integrated procurement forms are to some extent either physically or contractually integrated design and delivery process. A key character of this collection of procurement forms is that there is a planning and control logic driving the project and a confidence that integration is mainly accomplished through planning and control systems. Some of the procurement forms in this group are: Design and Construct (D&C), Management contracting (MC/CM), Joint venture consortia, and BOOT family procurement approaches (PFI, PPP). The most recognized procurement form in this cluster is Design and Construct (D&C) where one entity is contractually responsible to produce design and perform the construction service, typically called design-builder. It integrates the design and delivery functions either through an integrated firm mechanism, which has an in-house design team, as well as a delivery team or by the delivery organization outsourcing the design to another team that becomes its design services provider (Molenaar & Songer, 1998; Molenaar et al., 1999; T. F. Rizk, Nancy, 2007).

In all integrated procurement forms the main focus is on integrating design and delivery processes by emphasizing on planning and control, however, this does not eradicate the importance of collaboration aspect and the people management but it indicates the weight on systems integration through planning and control.

Collective procurement forms: In this cluster the focus is on integrating the project design and delivery teams rather than the process by highlighting collaboration and coordination. Some might claim that this group of procurement forms could be the most mature forms for best outcome and value for money. Collaborative procurement forms like *Partnering*, *Integrated Project Delivery (IPD)*, *Delivery Consortia/Partner (DC/P), Competitive Dialogue (CD)* and *Alliancing* are fitted in this collection. However, the authors believe that some of the forms in this cluster (partnering, competitive dialog, etc.) are naturally represented as a cultural state or formal/informal contract arrangements rather than procurement choice. They have characteristics, features, and cultural elements that can be applied to other forms.

Collective procurement forms provide a framework for establishing mutual objectives among all parties involved. This normally also lead to developing an agreed dispute resolution system. Collective forms need strong team building skills among participant. Compared to other traditional forms it also needs a different paradigm from highly commercial winner-gets-all and adversarial relation between parties involved. In collective forms, the project owner does not only engage/collaborate with the designers but also collaborate from the very initiate stage of the project with contractors and possibly with significant subcontractors. Collective forms mainly characterized by covering collaboration, transparency, innovation and accountability.

2.3 Phases and decision gates

The governing of projects is a major challenge for project management. With the increased focus on governance over the last decade, phases and decision gates became more in focus and hence have received increasing attention (O.J. Klakegg et al., 2009; Müller, 2009). A fundamental logic in this perspective is that for each step of the development, one should stop and check the status before moving on, that is; one should proceed only if everything is in order. This approach is maybe best summarized in the concept of gateways: a formal control of documents and assumptions before making a decision to accept a project, or to close one phase and enter into the next. The source of this thinking seems to stem back to the term “stage gate” introduced by Cooper (1993). We choose to use the term “decision gate” as a reminder that in a governance perspective, we hold the decision to be the main issue connected with these gates.

The gateway is a key element in an adequate implementation strategy: Seen from an owner’s perspective a decision point (a point for looking forward), whereas seen from the constructor´s perspective it may be a milestone (a point for celebration, following accumulated results), as pointed out by Lereim (2009). The purpose of a decision gate, as seen from a project owner’s perspective, is to make sure the formal decision-making is successful in supporting the success of the organization, business-corporation or public entity. Broadly speaking, this depends on making the right decisions. The logical way of making sure the right decisions may be achieved

is to choose the right people to make the decisions, and make sure they have the best possible basis for making the decisions.

Having the best possible basis for making key decisions is a question of extracting the right information. The right information is a question of what is available (known at the time of decision) balanced against the cost of obtaining more/better information and the risk associated with making the decision on less than perfect basis. Decision gates are often characterized by having defined procedures for assessments/control and decision making, defined roles and responsibilities, criteria for acceptance, and a gatekeeper (owner of the gateway process) who decides whether the project is allowed to enter the gateway or not.

The cost of attaining perfect information means it is rational to divide the development in steps and not produce more than needed at each step. Making sure the relevant information is available at the right time and in adequate detail is paramount. Consequently, phases and decision gates are key elements of an information flow framework. Examples from phases given below are meant to illustrate some selected decisive moments in this development:

The first phase is the initial process where the problem or need is acknowledged. This could be due to an owner having a site he wants to realize, or a company looking for other facilities to do their business. This indicates a reason to invest and is often referred to as the business case. Acknowledging that a reason to invest exists is a decisive moment because it drives the decision-making and planning process forward and raises expectations among users.

The next logic step is to view the feasibility of the business case; can it be developed, what are the best alternative concepts, what should the project include. This should now end up in a brief, specifying the contents of a project. Particularly the brief is viewed as a crucial document to achieve a successful project (El. Reifi et al., 2013). The brief is the foundation for a good design and production process. Approving the brief is another decisive moment because this is the point in time where you decide what the users are going to get in the end.

Another key milestone is the handover from the contractors to the owner. This decisive moment represents responsibility shifting from executing party to owner. At this point it is crucial to compare the actual delivery against what was decided in the final brief. For some projects this is when the owners and users for the first time are able to consider to what degree the project fits his or her needs. Traditionally this was where the focus of the project organization ended, but today there is strong focus in the use of the project, looking at how the users of the project succeed in their business and in the management of the facility.

Having a long-term perspective that includes sustainability of the investment is today required, even expected for all parties, despite traditional short-sighted execution perspective. Sustainability has to be considered in in terms of the investment's economical-, social- and environmental consequences. Only when the truth is known about the investment's long-term consequences can its true value be assessed. This makes the decision to terminate,

decommission or sell the facility into another decisive moment. This is where the initial intention meets the hard reality of the end and the circle is completed.

3. Result

In January 2015 Bygg21 and The Norwegian Property Federation took an initiative to make a common phase model for the Norwegian AEC industry. The project was undertaken by a research group from the Norwegian University of Technology and Science (Ole Jonny Klakegg et al., 2015). Figure 1 presents an outline of the resulting framework, which was released in December 2015 (www.bygg21.no).

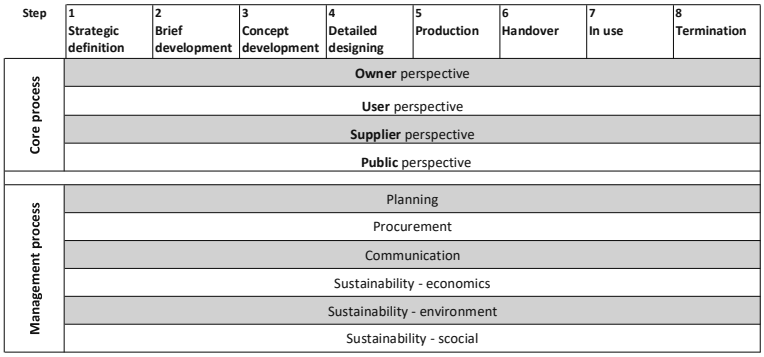

Figure 1: Outline of the framework called "Neste Steg" (Next Step)

The framework “Next Step” is generic and based on a similar set-up as the RIBA Plan of Work (RIBA, 2013). The AEC industry can use the framework with any form of contracts and is open for future development of new PDMs as well. The main purpose is to help the actors of the AEC industry with defining key tasks that need to be fulfilled in the different stages of a project, and to help coordinate their involvement. The intention with this framework is not to define a recipe that needs to be followed to the letter, but to give the industry a common language and collective reference to execute projects.

The different steps of the project are indicated on the top of Figure 1. Each step has a clear purpose and together they all the different phases of a project. In this framework there are 8 steps, including the last important step of termination. Termination can refer to the termination of ownership; i.e. the owner sells the property or the demolishment of the building in order to utilize the site in a different way. The logic of the steps is based on a systems thinking approach with input, process, and output logic, creating decisions gates after each step. The output can be input to the next step or leading to a termination of the project. The process is the actual tasks that need to be completed in order advance the project (Ole Jonny Klakegg et al., 2010).

Inspired by Eikeland (2001) the framework divides the processes into two major categories: Core processes and Management processes. Core processes are main tasks and supporting tasks that develop the professional contents of the project. Management processes are planning, coordination and control tasks that need to be performed professionally to make the core processes work well.

In the core processes, the activities are separated into four different perspectives, allowing the stakeholders to easier identify their major activities and tasks and understand the purpose of the tasks at hand. The fundamental perspectives are described by Samset (2010), consisting of owner- user- and executing perspectives. In addition, the new framework includes a public perspective to put focus on how projects need to work actively with their context. The core processes are described with recommended activities that needs to be addressed, in what perspective they need to be performed, and summarizes necessary start-up conditions (input) and deliveries (output) from each step. The idea is that all parties in the project need to know that these are the main activities and issues to be addressed. The framework does not prescribe who should address each task – it is up to the project management to organize the project. The framework prescribes what perspective, or mindset, each task should be performed in.

The management processes includes several categories of tasks that are of the utmost importance for the project process. Planning, procurement and communication are three vital examples. These processes run continuously over time across all steps, but also include separate tasks for each step. Another category of management processes deals with the sustainability of the projects. To secure a wide perspective all three dimensions of the triple bottom line is explicitly addressed. To secure a long time perspective the 8th step focus termination of the project result (the infrastructure, building etc.). There shall be no excuse for not making sustainability considerations in construction projects.

The planning tasks are linked to making plans for the execution of the tasks, adding details to the plan through each step. Examples of important planning tasks include planning the handover strategies from the contractor to the owner and for the user. The procurement tasks will vary along the steps and have to be adjusted to the execution strategies of the project. A typical question is at what step you procure consultants and contractors: This can vary from step three to step five depending on how early involvement is optimal for the development of the project. Some execution strategies require involvement of all parties on an early stage; other strategies develop a detailed design before procuring the construction companies and suppliers. The framework holds that it is important not only to plan but also to control that the plans are followed. The framework is a powerful tool for project management.

Communication in a project is important and challenging; given that the construction industry tends to be fragmented with many different parties specialized in different areas. The framework explicitly addresses the digitalization of the project process, especially the use of integrated communication tools, such as building information models (BIM) as a communication platform. Developing digital project execution strategies early in the project is important to make sure the parties are all “on the same page”.

Sustainability is necessary for future projects – both in execution and with regards to the result. The AEC industry will not be allowed to continue using energy and producing waste like they used to. The framework differentiates the sustainability in three dimensions: economic, environmental and social. The economic sustainability includes securing the right choices in investment and for the full lifecycle cost of the project result. The environmental sustainability is regarding the use of materials, emission, heating, cooling etc. – both the climate effect and the energy use. The social sustainability is how the project affects the life of the team members, users of the result and people around the project, including ethical dimensions and fairness in distribution of effects.

4. Discussion

Planning and control of project activities is still a challenge in the AEC-industry. As seen in the introduction, this is a serious threat to tactical or project management success (doing it right). However, as argued in the introduction, there is a bigger issue – the strategic or project success (doing the right thing). More systematic planning and execution in every step of the development, from problem to solution to effect to termination, can improve both. Doing this one by one (each company by themselves) will necessarily create non-conformance and miscommunication. It will also require a lot of unnecessary effort in repeatedly inventing the wheel. It will waste time and resources and at the same time create limited results.

Trying to change this situation require major steps. Designing a new framework like described above is only a first step. Whether it is good or bad, suggesting it as a general standard will inevitably spark resistance in a traditional industry. To have effect many actors will have to adapt their systems and management practice to the new framework.

First of all, the time is right. There is a growing attention to the importance of good governance in solving major challenges in the industry, companies and projects. All leading actors in the industry accept sustainability as the standard – at least on paper and in speeches. There is a highly developed understanding that projects are about value creation and that everything that represents wasting time and money or “gold plating” is improper. This is helped by the current slow-down in the economy due to reduced activity in the oil and gas sector. Finally there is a wide range of different new standards being developed for PDMs and information exchange that paves the way for integrated delivery strategies. These strategies obviously need some sort of common framework.

The new framework itself is made as flexible and future oriented as possible. The generic framework is valid for different projects delivery methods (PDM) including future innovations. The framework is scalable in the sense that roles and activities can be adapted to small and big, simple and complex projects. Finally the framework is not a strait jacket that requires everyone to become the same or use the same words. On the contrary, it is designed acknowledging the need for companies to be able to develop their profile and competitive edge. The framework is supposed to be a common reference and “language” that all parties refer to in order to clarify concepts and better coordination. In order to achieve this, the framework should highlight the

most important issues in each step, and help to create a platform for timing the right decisions and securing relevant basis for these decisions.

The framework is constructed from well-known principles and international best practice. It has a solid basis. For most actors the changes needed to implement it will be small to moderate. A comparison between the project-models of major companies in the industry reveals that most of the major decision making points are identified in most models(Ole Jonny Klakegg et al., 2015). The level of detail in models varies and the choice of words and graphic presentation is different, but the fundamental structures are remarkably compatible.

Leading organizations in the Norwegian AEC-industry are behind the new framework, including major public clients. The response from the industry has been positive. Other major actors are ready to start using it, and this is the main force that will be able to influence the industry. By January 2016 it is already clear that three different committees in Standards Norway are using Next step as a part of their working basis in developing new standards for the AEC industry. When major clients require it used as a reference, and major executing parties also say they will comply, this has the potential to grow into a strong wave with the force to change a conservative industry. In the long run, the observed improvements will be the best selling points for the model. This of course still remains to be seen.

5. Conclusions

This paper presents a new Norwegian framework for the AEC industry. The framework is not a detailed recipe for project execution, but tries to define the key tasks and steps in a project from the definition to the termination of a building. To sum up we conclude the proposed research questions:

How can the framework help to achieve the right result for owners and users? By defining the decisive moments and the necessary steps on the way from problem to solution until the investment is terminated. By forcing the parties to consider the long-term issues, and assess holistically the relevance and sustainability of alternative concepts, the right choice comes forward and becomes the natural decision.

How can the framework help to secure that the right perspectives are considered? A key feature of this framework is the focus on the key stakeholders and their perspectives. To help the owner make good business decisions, the actors need to think like an owner when they perform their tasks in planning and execution. To create the right solution for the users, the actors need to think like a user and consider how the project can best support the user's business and facility management. To perform an efficient execution process the actors need to think about project delivery models early and make conscious choices about constructability. To secure that society's perspective is considered, the model puts emphasis on requirements, approvals and other aspects of context that the project has to work with.

How can the framework deal with different procurement forms? One challenge in delivering a project is at what stage you procure consultants and contractors. The framework helps to deal with this challenge by explicitly state on what stages different procurement strategies has to be considered to be valid alternatives. Collective and integrated procurement forms needs to be considered early – from step three to five – depending on how early involvement of parties is optimal for the development of the project. Segregated procurement forms could be fitted in step five. A typical problem today is that some strategies are constantly considered too late in the process and thus remain unexploited. Other actors choose strategy from tradition and lack of awareness more than a conscious choice. If they are confronted with the new framework there will be no room for such neglect anymore.

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EARLY CONTRACTOR INVOLVEMENT IN PUBLIC INFRASTRUCTURE PROJECTS

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ABSTRACT

Advocates of lean construction recommend early contractor involvement (ECI) to further reduce waste. Waste reduction and flow, value generation and sustainability can be improved if some of the companies on a project use lean principles and methods. However, if the contractor is organizationally integrated in the early phases, there is a better chance that the product and process designs are consistent with one another. ECI can ensure better value for money by organizationally integrating contractors` knowledge to early phases of projects. This paper contributes to the knowledge about how to implement ECI in public projects. In addition to a literature study, a document study as well as fourteen semi-structured in-depth interviews with key informants from eleven Norwegian public bridge projects were carried out. The EU public procurement directive represents a challenge for public owners when they consider ECI in their projects. However, the studied bridge projects have used various approaches to implement ECI without violating the EU directive. Thirteen approaches are identified in this study. The conclusion is that there are several approaches to implement ECI in public projects, though the contractors' contribution varies a lot depending on which approaches that are implemented.

KEYWORDS

Lean construction, ECI, Project alliancing, Public procurement, Knowledge integration.

INTRODUCTION

It is widely accepted that contractors have better experience than the owner and the designer when it comes to construction knowledge and experience (Song et al. 2009; Walker and Lloyd-Walker 2012). The traditional project delivery methods with open bidding, unit price contracting and owners' quality control provide transparent checks

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and balances, especially when the award criterion is lowest bid. However, the evolving projects demand alternative (evolving) project delivery methods to ensure appropriate project delivery, contract compliance and quality assurance (Molenaar et al. 2007). When the contractors are more experienced with choosing materials and methods, the traditional project delivery methods should be adjusted to promote early contractor involvement (ECI) in order to eliminate waste (Song and Liang 2011).

Lean is about reducing waste and increasing flow and value generation by optimizing design, supply and assembly with an aim of to improve the whole process and to exceed owners` expectations (Furst 2010; Song and Liang 2011). Construction knowledge and experience is one of the important elements in the lean construction concept (Song et al. 2009). In principle, lean construction requires ECI in the front-end phase of projects (Forbes and Ahmed 2010). Therefore, the contractors should first help the owners to decide in what they want before delivering the project (Ballard 2008).

One of the evolving parts of project delivery methods is ECI (Molenaar et al. 2007). Even if ECI has several advantages, also for the design team(Sødal et al. 2014), it faces many barriers during the implementation (Song et al. 2009). The barriers that hinder ECI are even higher for public owners, since they should treat all tenderers equally, be non-discriminatory and act in a transparent way. Furthermore, public owners should take in to account both price and quality during the early team selection in order to comply with EU public procurement directives (European Parliament 2004; European Parliament 2014; Lahdenperä 2013).

During literature study, the authors of this paper did not find much literature that document what public owners do to implement ECI without violating the EU public procurement directive. This paper addresses this knowledge gap by answering the following research questions:

- How can public owners implement early contractor involvement?
- What do public owners do to implement early contractor involvement?

The first question has been addressed on basis of the literature review, whilst the second one using case studies.

RESEARCH METHOD

An initial literature study concentrated on research databases (Google Scholar, Oria and Emerald), library databases and references in relevant articles was carried out. The objective was to identify relevant research and thereafter describe theoretical background.

The literature study was followed by case studies with an objective of investigating the contemporary phenomenon to answer the second research question. To find appropriate cases to study, 20 key professionals that have several years of work experiences in Norwegian Public Roads Administration (NPRA) were contacted. In addition, NPRA's yearly internal projects reports from 2001 to 2013 were studied. In this way, eleven bridge projects that have used/will use different approaches to involve contractors in the early phase were identified.

These projects are:
1) Lepsøybrua,
2) Straumsbrua,

3) Sykkylvsbrua,
4) Tresfjordbrua,
5) Paradisbrua,
6) Linesøybrua,
7) Gullibrua,
8) E6*E16 Flyplasskryssetbrua,
9) Smålenenebrua,
10) E39 Godsterminalenbrua and
11) Tjønnøybrua

Fourteen semi-structured in-depth interviews on the eleven identified cases were conducted according to the methodological approach described by Yin (2013). All interviewees, except one, are from owner side of the projects. The interviewees were selected from different management levels in the examined projects. The interviews were recorded and transcribed to increase data collection reliability. The research ended by a study of documents retrieved from the informants and from NPRA's internal database.

This study involves some limitations. The cases range from Norwegian bridge projects completed after 2001, as well as some that are in the design phase in the course of the study. The other limitation of the study is that all interviewees, except one, are from the owner side of the projects.

THEORETICAL BACKGROUND

The main objective of the client when involving the contractor in the early phase of project development is to get assistance from the contractor by working together as a team with owner and consultant (Mosey 2009; Rahman and Alhassan 2012; Scheepbouwer and Humphries 2011). In order to benefit fully from the ECI both direct and early involvement of the contractor in the early stage is necessary. Direct involvement facilitate for better cooperation while early involvement facilitate for better contribution (Song et al. 2009). This shows that ECI goes hand in hand with lean construction concept.

The phenomena here denominated ECI is covered by different terms in different countries. In addition, there are various means that can be used to implement it such as; target pricing and integrated project delivery, early supplier involvement and interweaving (Gokhale 2011). Recently, Walker and Lloyd-Walker (2012) came up with a comprehensive definition of ECI. According to them, ECI can take place in the internal phase, the project definition and design phase and in the project execution phase. Literally, ECI can happen in all these 3 phases. They further divide ECI into five different approaches depending on in which phase of the project the contractors are involved. "ECI 1" can take place in the three phases. "ECI 2, 3 and 4" can be applied in the project definition and design phase. "ECI 5" can be applied both in the project definition and design phase and in the project execution phase.

Previously, public owners thought that the EU procurement directive rules out project alliancing. Nowadays, that attitude is under change and project alliances, similar in forms to those delivered in Australia, are being undertaken in Europe (Laan et al. 2011). Moreover, the emergence of competitive dialog has facilitated the use of project alliances in Europe (Walker and Lloyd-Walker 2015).

The Finnish Transport Agency experience is that pure alliancing without price component as a selection criteria and single target outturn cost (TOC) could be the best alternative to implement ECI. However, it might lead to difficulties with the EU public procurement directive. Two alternatives are alliancing based on the most economically advantageous tender with capability and fee percentage as a price component (capability-and-fee competition based target-cost (TC)) and dual TOC, respectively (Lahdenperä 2013; Lahdenperä 2015; Lahdenperä 2016). The procurement procedure of alliancing is significantly different from other procurement procedures. Recently, the procurement procedures process of alliancing in Australia has evolved from single Target Outturn Cost (TOC) basis to dual TOC, as depicted in figure 1. The dual TOC approach resembles the competitive dialog approach in Europe (Walker and Lloyd-Walker 2015).

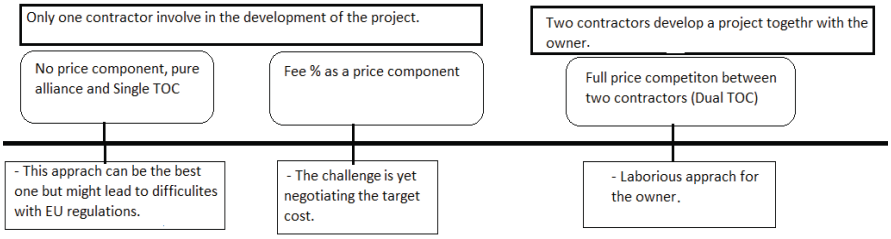

Figure 1. Contractor selection approaches in project alliancing (developed from (Lahdenperä 2013)).

In ECI, the procurement procedure is decisive to achieve integration. The procurement procedure should create a room for creative solutions and for exchange of ideas. Competitive dialogue (CD) and negotiated procedures are the two alternatives owners can use to achieve ECI. By using these procurement procedures, it is possible to use functional specification, conduct a (confidential) dialogue, divide the procurement procedure and perform competition throughout several phases (Lenferink et al. 2012; Van Valkenburg et al. 2008). For simple projects, it is possible to apply negotiated procedure (Lenferink et al. 2012; Lædre 2006; Van Valkenburg et al. 2008), whereas for more complex projects, CD can be suitable. In CD, functional specification and technical requirements, staged process bids and competition over several stages, with most economically advantageous tender can be used to develop a project (Lenferink et al. 2012; Van Valkenburg et al. 2008). To summarize the answers to the first research question, there are several models of ECI. Public owners can choose among these ECI approaches based on their needs through the various contract forms and procurement procedures.

FINDINGS AND DISCUSSIONS

In the following, findings for the eleven first ECI approaches are presented and discussed. The findings are based on the interviewees' perceptions and the document studies. The approaches 1 to 9 have been used in the studied projects to a varying degree. Approach 10 and 11 have not been implemented in the studied projects. Instead, interviewees proposed them as potential approaches for the future use. Due to the limitation in number of pages, not all the approaches are discussed extensively in this paper.

1. Indirect approaches

The interviewees have discussed the use of consultant and in-house construction experience as an approach to integrate the construction knowledge in the front-end of a project. Furthermore, inclusion of contractors in the preparation of handbooks, standards and standardizing of bridge parts are also discussed. It can be realised that, even if this is not a direct project activity, the project benefits from involving contractor knowledge in the early phases.

2. Information meetings

In relation to contractor's involvement, the respondents mention that information meetings with the contractors` branch are used in diverse degrees in the studied projects.

It can be realised that the influence of the information meetings depends significantly on in which phase of the project it is held. If it is held in the early phase of the project, then it is easier for the owner to include inputs form the meeting to the front-end phase of a project. However, if it is held in the later phases of the project, like in projects with a tender conference, it is difficult to implement the inputs in the project. This is because most of the works are already done and the important decisions are already taken.

3. A front-end partnering process

According to the interviewees and documents, the main aim of this process is to create an opportunity for the contractor, the owner and the consultant to get to know each other and to set a common goal. A partnering process will start after the contract signing and ends before the contractors commence construction.

In this approach, it is still possible for the contractor to come up with optimization ideas since the execution phase has not started yet. The success of this approach depends on how much the contractor can be prepared to come up with optimization ideas. Furthermore, it depends on how flexible the owner is to accept new ideas at this stage. This approach should be combined with contracts that accommodate flexibility.

4. Announcing the project with alternative technical solutions

As discussed by interviewees, the Norwegian Public Roads Administration (NPRA) tries from time to time to prepare contract documents that have more than one technical alternative. The aim of the announcement with alternative technical solutions is that the contractor can get the possibility to influence the production method and material selection during the project delivery. The alternatives include all necessary detailed designs and respective procurement documents. The primary motive of NPRA when using this approach is to reach a wider supplier market in order to get several bidders for a project and get the cheapest prices. Consequently, it increases competition.

In order to use this approach, it should be technically possible to use alternative technical solutions without compromising with quality. The limitation of this approach is the contractors options are restricted by the owner`s options and their involvement is not direct and not early enough.

5. Design build contract (DB) or functional description

DB contract based on open procurement procedure was used as an approach to involve contractors from the design phase of a project. In this approach, the contractor gets the responsibility and the flexibility to design the project. The design must be approved after a quality assurance by NPRA. As discussed by the interviewees, even if a DB

contract is a suitable approach to implement ECI, the downside is that the owner misses control and the possibility to contribute in the design phase of the project.

While using a DB contract the project should not have very high uncertainty and not be very complex in order to get enough bidders as well as to avoid conflicts afterwards. Therefore, the owner should be able to design the project to an optimal level to minimize the uncertainty and clarify the owner's expectations to the contractors. The findings indicate a lack of integration when DB contracts are combined with open procurement where the owners have less influence on the project.

6. Direct contact with specialist contractors in the front-end phase of projects

The interviewees explained that to implement ECI, the focus should not only be on the main contractors but also on specialist contractors. Specialist contractors have special competence and equipment that both owners and major contractors are dependent on to execute a project. The approach is described as effective since it is based on direct contact with the specialist contractors, and not communicating through main contractors.

It can be perceived that the direct involvement may facilitate for the concepts of lean construction, and thereby reduce waste and add effectiveness to the project. Through that, the project participant may achieve a feeling of partnering and working together.

7. Idea competition

Idea competition is one of the ECI approaches used by public owners in the planning phase of projects. The respondents claim that the dilemma of public owners in using this approach is, whether contractors that participate in the idea competition should be excluded from the bid for construction of the project or not. The cause of the dilemma is to be in line with the EU procurement directive.

It can be seen that the primary disadvantage of this approach is that it lacks continuity and involvement integration throughout the whole project life cycle. In order to decrease the probability of occurrence of the above-described dilemma, proper documentation and well-prepared contract document can be used as protective measures. Furthermore, owners should be proactive to evaluate all ideas identified in the competition before selecting one.

8. Contractors sell their idea to the owner in the early phase

In one of the studied case, one contractor took the initiative to promote the idea to NPRA in the front-end phase. The contractor strongly believed that the company had the appropriate knowledge and equipment to solve the project in an optimal way. Then, NPRA has used the idea after detail designing as an alternative technical solution. It is not common that contractors take such initiatives.

9. Negotiated bidding procedure

NPRA is planning to use a negotiated bidding procedure by combining with turnkey contract in one of the studied project. The reason why the project owner is planning to use this approach is due to lack of internal competence about the subject matter from owner side regarding this specific project. Then, NPRA wants to use the contractors' experience in the front-end phase of the project to get help for the decision process. NPRA's challenge in using this approach is lack of experience with this procedure.

10. Opening for alternative tenders

Opening the project for alternative tender, with other technical solutions than those specified by the owner, has been discussed by the interviewees. With this approach, the contractors can submit one or more alternative solutions to the project. However, this approach is not used in the studied eleven bridge projects.

In most cases, the contractors are not allowed by NPRA to submit alternative tenders because of three major reasons. The first reason is that it is difficult to control the quality of the alternative offers in the short period between bid opening and contract awarding. The other one is that it is difficult to compare bidders based on different competition grounds since lowest price is the most used competition base. The last reason is that bridge projects have quite long-lasting control and approval procedures. If the contractor comes up with alternative offers, it will most probably delay the whole project delivery. The finding illustrates the owner may need to be cautious of this approach as the duration and thereby the cost can be influenced by the variety of alternative tenders.

11. Other approaches

The interviewees proposed competitive dialogue and project partnering as potential approaches for implementing ECI. However, none of these approaches was implemented in the studied projects. In addition, project alliancing was identified as an approach through the literature study.

CONCLUSION

The overall conclusion is there are several approaches to implement ECI in public projects. Twelve of the approaches (1-12) have been identified from the case studies. Approach 13 is identified from literature based on the Finnish Transport Agency`s experience. Table 1 shows the thirteen possible approaches identified by this study, and which of the eleven projects that have applied them. The table implicitly illustrates to what extent each approaches have been/will be implemented in the target projects. The thirteen approaches are numbered after how often they appear in the eleven target projects.

Table 1: Frequency of the ECI approaches (1-13) in the investigated projects (1-11)

Approaches vs Projects	1	2	3	4	5	6	7	8	9	10	11	Total
1.Indirect approaches	X	X	X	X	X	X	X	X	X	X	X	11
2. Information meetings	X			X	X		X	X	X	X	X	8
3. A front-end partnering process	X			X	X	X	X	X	X	X		8
4. Announcing the project with alternative technical solution	X	X	X	X			X		X	X		7
5. Design build contract (DB) or function description					X	X	X	X			X	5
6. Direct contact with specialist contractor in the front-end phase of projects	X			X								2
7. Idea competition				X								1
8. Contractors sell their idea to the owner in the early phase							X					1
9. Negotiated bidding procedure					X							1
10. Opening for alternative tender												0
11.Competative dialogue												0
12.Project partnering												0
13.Project alliancing												0

It does not seem to be many studies that have documented what public owners do to implement ECI without violating EU public procurement directive. This research is an initial study with a purpose to fill this knowledge gap by using cases study approach. Even though this study is based on NPRA's experience from bridge projects, most of the research findings can be useful for the majority of public owners governed by EU public procurement directive. The logic behind to come to this conclusion is, since they have similar operating framework and NPRA`s affirmative experiences throughout implementing the approaches. The findings can also be helpful for project owners that want to know the range of possibilities for ECI. However, the contractors' contribution into the projects varies a lot and depends on which approach that is used.

In the future, experiences from ECI in other project types may need to be collected to reveal new approaches as well as to validate the findings. Furthermore, in future research ECI success factors as well as each of the approaches, which are identified in this study, can be studied in-depth in order to compare them with international experiences. In this way, it will be possible to identify and recommend suitable approaches to implement ECI in future projects. These findings, in combination with future findings, would also be valuable for researchers who want to develop a set of best practice guidelines for ECI.

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Effective knowledge transfer in successful partnering projects

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Abstract

The purpose of this study is to determine whether there is a link between partnering and effective knowledge transfer. Analyzing the key factors that enable partnering, there are reasons to believe that partnering may help to promote effective knowledge transfer in projects. Collaboration, open communication, and trust are some partnering elements that imply effective knowledge transfer and, consequently, lead to successful outcome. The findings will drive practitioners to a greater awareness of partnering practices and assist in promoting effective knowledge transfer in partnering projects.

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Keywords: Partnering; knowledge transfer; relational; benefits realization; collaboration

1. Introduction

Partnering, as a collaborative managerial approach [25], is considered as a potential tool for enhancing the efficiency of the construction industry, introducing collaboration and, consequently, tangible benefits in projects [17]. At the same time, other authors claimed for the adoption of a knowledge-based project management approach that could support the achievement of higher project performance [30].

Naturally, the awareness towards these topics has become increasingly important, especially within the construction sector that is generally characterized by adversarial relationships and conflicting goals between the project participants [25]. The adoption of collaborative relationships between the project participants along with the implementation of an effective knowledge transfer process could be the formula for the achievement of successful

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projects outcomes. In addition to this, an inducement for improvement could emerge when the link between effective knowledge transfer and successful partnering projects is understood.

Despite the presence of several studies concerning both the topic of partnering and knowledge transfer separately, there is a limited number of academic contributions that actually investigate the link between the two. Considering the practical relevance of these research areas, this study represents an attempt to narrow the knowledge gap, analyzing how knowledge transfer and partnering influence each other.

The broadest research question of the study was "does a link exist between knowledge transfer and partnering?" (RQ1). Additionally, in order to narrow the focus of the research, two sub-questions were formulated, specifically: "which partnering key elements enhance effective knowledge transfer?" (RQ2) and "how knowledge transfer and partnering in projects influence each other?" (RQ3).

In order to answer these research questions a comprehensive analysis of the literature and a set of expert interviews was conducted. First, the literature review will provide a brief insight into the topics, highlighting the key elements respectively of partnering and knowledge transfer. If similarities of the key elements appear, a connection between the two topics can be assumed. Afterwards, the findings from a set of ten qualitative interviews will show how the experts (from the academic and construction context) perceive the link between partnering and knowledge transfer in projects. Finally, the results were compared and discussed in order to answer the research questions and clarify how an effective knowledge transfer process could bring success in partnering projects and vice versa.

2. Theory

The concept of knowledge is considered as a driver of innovation and competitive advantage within the construction industry [35]. Authors, like Carrillo and Chinowsky [12], attempted to define the concept of knowledge, starting from the distinction between tacit and explicit knowledge, that was introduced by Polanyi [30]. Tacit knowledge, defined as intangible and subjective, is embedded in individuals' experiences, beliefs and know-how, and is therefore hard to formalize and express in words [12,15,23,24]. On the other side, explicit knowledge is systematic and formal and can be transferred through standardized procedures [23,36].

As knowledge constitutes the "mind" of an organization [18], an effective knowledge transfer process becomes essential for the creation of successful outcomes in projects [4]. Specifically, knowledge can be transferred among individuals, teams, or organizations [19,22] and is defined as the process of learning from previous projects through an interactive exchange of experiences [3,23]. According to Ayas [4], the capability of accessing experience can indeed guarantee continuous improvement over time and the creation of business benefits [12]. Some definitions of knowledge transfer are reported in table 1.

The temporary and fragmented nature of each project, especially within the construction industry, makes effective knowledge transfer more challenging [6,12,16]. In this scenario, an innovative attitude is required that considers a project as an occasion for learning [4]. Furthermore, a greater awareness towards the key elements could help in achieving an effective knowledge transfer in projects [36].

The expression "key elements" refers to specific factors that are necessary in a project in order to reach a goal [2]. In this case, several authors, like Hajidimitriou et al. [23] and Chen et al. [14], considered trust as an important key element for effective knowledge transfer. According to Yew Wong [35], mutual trust between the project participants fosters the creation of an open knowledge-sharing environment. In addition, the level of trust directly affects the collaborative culture and the cooperation between the parties [23], which in turn are considered prerequisites for effective knowledge transfer. Moreover, team work [35], meeting and workshops [16], open communication [14], a supportive organizational culture [36], and co-location of project participants [35,4] are necessary key elements that enable effective knowledge transfer.

As projects becomes more complex and uncertain [5], the adoption of collaborative forms of project delivery, (e.g. *partnering*), increases. This is particularly true in the construction industry [25]. Consequently, several studies have been conducted concerning the definition of partnering (table 2) and its implementation in practice. Despite this, many authors affirmed that there is still no univocal consensus on partnering definition [9,11,20,26,28]. For example,

partnering is defined by Black et al. [8] as a procurement method that aims to eliminate adversarial relationships, encouraging the project participants to share common objectives. Similarly, Chan et al. [13] considered partnering as a process of establishing good working relationships. Moreover, Barlow and Jashapara [6] referred to partnering as a variety of managerial practices for the creation of collaboration in projects. According to Bygballe et al. [11], the lack of understanding about the concept of partnering in the construction industry represents a challenge for an effective project implementation. However, the majority of the authors have recognized that partnering provides different advantages in projects, including improvement of performance in terms of cost, time, and quality [7,8,13,17].

Table 1. Definitions of *knowledge transfer*.

Easterby-Smith et al. (2008) in Hajidimitriou et al. [23]	Process during which one organization learns from the experience of the other (page 41).
Argote and Ingram [3]	Process through which one unit is affected by the experience of another (page 152).
Wong (2003) in Duan et al. [19]	Systematically organized information and skills are exchanged between entities (page 357).
Duan et al. [19]	Knowledge is exchanged between or among individuals, teams, groups, or organizations (page 357).

Table 2. Definitions of *partnering*.

Barlow and Jashapara [6]	Partnering refers to a variety of managerial practices and organizational design that enhance and maintain collaboration (page 88).
Black et al. [8]	Partnering procurement method aims to eliminate adversarial relationships between client and contractor by encouraging the parties to work together towards shared objectives and achieve a win-win outcome (page 423).
Chan et al. [13]	Partnering is the simple process of establishing good working relationships between project parties (page 524).
Cheung et al. [17]	(…) an important management tool to improve quality and programme, to reduce confrontations between parties, thus enabling an open and non-adversarial contracting environment (page 333).
Eriksson [20]	Cooperative governance form that is based on core and optional cooperative procurement procedures to such an extent that cooperation-based coopetition is facilitated (page 905).
Lahdenperä [25]	Collaborative building project practice (page 58).
Larson [26]	(…) method of transforming contractual relationships into a cohesive, project team with a single set of goals and established procedures for resolving disputes in a timely and effective manner (page 30).
Naoum [28]	Partnering (…) provides a framework for the establishment of mutual objectives among the building team (page 71).

Recently, several authors like Eriksson [20] and Yeung et al. [34] investigated the relevant key elements for partnering. Specifically, the success of partnering projects strongly depends on the creation of a shared collaborative culture [7], and on the presence of factors like trust, cooperation, and common objectives [9]. As opposed to traditional procurement methods, partnering encourages non-adversarial working relationships [1], commitment and open communication [17]. Other key elements, like value based procurement, early involvement of contractors, and joint selection of subcontractors may foster the involvement of the various actors into the partnering process [20,25].

The presence of a solid network between the project participants, based on strong collaboration between suppliers, architects, and consultants can also reinforce the learning process [11]. Moreover, mutual trust, that is essential for the creation of collaboration between the project participants [14], enables a proactive knowledge sharing process [34].

In general, limited contributions from the literature analyzed the link between effective knowledge transfer and success project partnering directly. Barlow and Jashapara [6] examined the factors that can influence knowledge transfer between construction firms, considering the UK context. Similarly, Fong [21] and Cheng [16] focused on the knowledge transfer process in construction projects, while other authors like Mowery et al. [27] and Inkpen [24] investigated how “alliances” between manufacturing firms can enhance effective knowledge transfer. Project partnering is closely linked to the concept of project alliances, and these two concepts can present many of the same key elements. Some common factors are, for example, the presence of a formal contract and sharing risk and

opportunities (contractual elements), as well as trust, long-term commitment, cooperation, open communication, and management support [34,29,33]. However, this paper does not study project alliances any further. In fact, according to the comprehensive literature review performed by Yeung et al. [34], the goal of project alliances is sustainable development, which differs from the main purpose of this research.

3. Research Method

This research is based on the findings from a theoretical review and a set of qualitative interviews. First, the literature provided a general framework about the concepts of knowledge transfer and partnering, respectively. Then, in order to answer the research question fully, qualitative interviews consisting of experts and practitioners were conducted to investigate the perceived link between partnering and knowledge transfer. In particular, the methodology used in this research followed the recommendation by Bryman and Bell [10]. As first, it was important to select the research strategy, considering the specific nature of the topic. Since the purpose of the research depended on experts' contributions, a *qualitative* research strategy was chosen.

The literature review started with the selection of the relevant contributions. Specifically, the majority of articles were searched on scientific databases, like Scopus, Emerald, and Wiley Online Library, using specific key words, like *partnering*, *knowledge, knowledge transfer*, *collaboration*. At the end of the selection and the screening phase, 35 articles were accepted from internationally refereed journals (table 3). Afterwards, the main contents from the articles were analyzed and coded, according to the scope of the research. The results from the literature review constituted the basis for the formulation of the interview-guidelines.

Table 3. Main international journals.

International Journals	N. of Articles
International Journal of Project Management	8
Construction Management and Economics	4
Journal of Management in Engineering	3
The learning organization	2
International Journal of Managing Projects in Business	1
Journal of Construction Engineering and Management	1
Project Management Journal	1
Journal of Purchasing and Supply Management	1
Organizational Behavior and Human Decision Processes	1
Journal of Business Research	1
Strategic Management Journal	1

As stated, the main purpose of the interviews was to understand how researchers and practitioners perceive the link between partnering and knowledge transfer. In order to obtain valuable and unbiased results, the selection of the sample of interviewees has followed specific criteria. The interview-objects were chosen based on their previous experience with partnering (or collaborative procurement methods) and their ability to contribute to the research with relevant data. Specifically, the interviewees' sample included two PhD candidates at NTNU (Norwegian University of Science and Technology), two professors at the same university, one assistant professor at Tampere University of Technology, and two researchers working at SINTEF (the largest independent research organization in Scandinavia). All these experts work in the field of project management, with the majority having worked with the concept of partnering for more than ten years. The same criterion was used to select the interview-objects from the industry. Three experts project managers, two from a large Norwegian construction company and one from an international

engineering company (with office in Norway), were chosen, based on their long-term experience working with partnering contract.

The interviews were conducted by a single interviewer using a *semi-structured* approach [10]. This type of approach requires high flexibility and preparation from the interviewer in order to have a clear and objective understanding about what the interview-objects consider as important and, consequently, obtain valuable findings for the research [10].

Moreover, in order to collect meaningful answers from the experts, the interview-guideline included seven *open-ended* questions [10]. With a qualitative research strategy, this type of questioning is ideal because it does not suggest any possible answer to the interview-objects [10], who can express their opinion and ideas freely. In particular, the interviews started with more general questions, like "*how do you define partnering/knowledge transfer*?", that served to test the familiarity of the interview-objects with the topics and, at the same time, create a common basis for the comparison of the findings. Further questions, for example "*how knowledge transfer process influences the success of partnering project?*", were more relevant for the analysis and required an attentive answer from the interviewees.

The use of specific expedients during the interview process has guaranteed unbiased results. First, (1) a single interviewer carried out all the interviews and coded the findings. In fact, introducing a different approach when addressing the interview-objects' answers or assessing the findings would have strongly influenced the results of the research. Second, (2) the interviewees did not have access to the interview guideline in advance. Therefore, the interview-objects could provide their own opinions to the questions during the interviews, without being influenced by external factors. Finally, (3) the coding process were done in parallel with the interview process. This helped to optimize the interview guideline and obtain meaningful results.

At the end of the interviews, when all the data were available, it was important to interpret the findings, always taking into account the research questions and the scope of the analysis.

Table 4. Respondents from the interview.

	Role/work position	Experience with partnering	Experience with knowledge transfer
1	PhD candidate	10 years	Collaborated in researches/discussions.
2	PhD candidate	1 year (more experience with contracts)	Collaborated in researches/discussions.
3	Senior Scientist	1 year	Long previous experience
4	Professor	15 years	Some researches in the area
5	Senior Researcher	Experience with contracts in construction projects	Collaborated in researches/discussions.
6	Professor	20 years	15 years
7	Assistant Professor	12 years	Collaborated in researches/discussions.
8	Project Management Consultant	10 years	Collaborated in researches/discussions.
9	Project Manager	14 years	Collaborated in researches/discussions.
10	Project Leader	12 years	Collaborated in researches/discussions.

This study combines two area of research that are well-established and significant to the construction projects' success. In particular, the analysis assesses the opinion of experts in the field in an objective and systematic way and

the literature review is based on well-recognized scientific articles (published within international referred journal). However, some limitations are still present in the research process. First, (1) the interviews were conducted towards two different targets (researchers and professors within the academic context and project managers from the construction industry). A diversified sample of interviews could enhance the value of the research but, on the other side, it could increase the complexity of the overall research process. In this situation, it is especially important to consider the various nature and perspective of each interview-objects during the analysis of the findings. Similarly, (2) the research mostly took place within the Norwegian academic and industrial context. Expanding the analysis to other contexts will introduce new points of view and improve the findings. Moreover, (3) only one interviewee has direct experience with knowledge transfer, although all the experts have collaborated in researches or discussions about the topic. Despite these aspects, it is believable that the limitations can be optimized in further researches.

4. Findings

The purpose of this research was to understand whether a link exists between knowledge transfer and partnering, and, furthermore, clarify how the experts perceive this link. In particular, the findings answered to the following research questions:

- "does a link exist between knowledge transfer and partnering in projects?" (RQ1),
- "which partnering key elements enhance effective knowledge transfer?" (RQ2),
- "how knowledge transfer and partnering in projects influence each other's?" (RQ3).

The findings from the interviews are summarized in the following table.

Table 5. Findings from the interviews.

	Findings	Interview-objects	
Finding 1.	a link exists between knowledge transfer and partnering projects	9/10	RQ1
Finding 2.	cooperation, open communication, trust, and co-location are some of the partnering key elements that can influence knowledge transfer	8/10	RQ2
Finding 3.	the link is a loop	4/10	RQ3

4.1. A link exists between knowledge transfer and partnering projects

As response to the first research question, nine out of ten interview-objects perceived that a link exists between effective knowledge transfer and successful partnering projects. More specifically, the interview-objects who believe in the presence of a connection between knowledge transfer and partnering, noticed that some of the key elements are common for both partnering and knowledge transfer process (table 6). In their opinion, this aspect could be the evidence of the link between knowledge transfer and partnering in projects.

4.2. Cooperation, open communication, trust, and co-location are some of the partnering key elements that can influence knowledge transfer

Eight out of ten interview-objects agreed that several partnering key elements, like cooperation, open communication, workshops, common goals, trust, and co-location, could affect the knowledge transfer process within a project. In particular, the element of trust is considered fundamental in the definition of the link between effective knowledge transfer and successful partnering projects. Trust is a critical success factors for partnering in projects and, coincidentally, building trust between the project participants is essential for the improvement of knowledge transfer.

Table 6. Common success factors in partnering and knowledge transfer.

01. trust
02. communication
03. cooperation
04. incentives – rewards system
05. commitment / willingness to share
06. leadership support
07. team building activities
08. workshops and meetings
09. co-location
10. common understanding
11. involvement of project owner
12. common goals
13. learning from mistakes (lesson learned)

4.3. The link is a loop

Regarding the nature of the link between partnering and knowledge transfer, four out of ten interviewees presumed the link between partnering and knowledge transfer as a loop. The presence of a loop implies that partnering and knowledge transfer influence each other's reciprocally. However, between the number of interview-objects that confirmed the presence of a connection, five out of ten claimed that the link is valid only in one way, that is partnering promotes effective knowledge transfer. Therefore, in total, nine out of ten experts believe that the collaborative partnering environment enhances the development of knowledge transfer.

The partnering culture, based upon openness, trust, and cooperation, provides the perfect conditions for the exchange of knowledge and expertise between the project participants (related to finding 2). According to one expert, the reasons why knowledge transfer could be more effective in partnering projects than in traditional procurement projects, relies in the easier access to the know-how, the higher commitment to the project, and the common goals among project participants. The co-location of the project participants is also considered as an important factor by the interview-objects. In fact, when project participants operate in the same site, the communication-lines are shortened and this lead to a more efficient transfer of knowledge. Moreover, workshops, seminars, and meetings (formal and informal) are considered as a way to allow project participants to share information. As one of the interview-objects stated, these elements must be accompanied by an open culture and willingness to share information and expertise by the project participants.

Considering the other side of the link, four out of ten experts stated that if two or more organizations developed effective knowledge transfer practices, then it would be more likely for them to be engaged in a positive partnering collaboration. Therefore, effective knowledge transfer is essential for a successful partnering. Interestingly, one interviewee considered knowledge transfer as a key element of partnering itself, affirming that a partnering project is not complete if it does not involve effective knowledge transfer to a certain level.

4.4. Other findings.

From the conducted interviews it emerged that a univocal definition of partnering is still missing. Two of the project managers found it challenging to define partnering in a specific way, and it resulted easier for the practitioners to describe how partnering can be implemented in a practical way. Likewise, another interviewee underlined that the presence of more than one definition of partnering could probably lead to more than one understanding and, consequently, increase the complexity when implementing partnering in projects. However, despite the lack of a common definition, all the experts believe that partnering can bring benefits in projects.

5. Discussion

The general purpose of this study was to investigate the nature of the link between knowledge transfer and partnering in construction projects. Interestingly, the presence of a relationship between these topics is strongly confirmed through the interviews and, additionally underlined by some assertions in the literature. The adoption of collaborative forms of project delivery, such as partnering, is recommended by several authors as a way of introducing collaborative relationships and, consequently, tangible benefits in projects [7,8,13,17]. Similarly, a knowledge-based approach to project management can be the formula for achieving successful projects outcomes [4]. Therefore, it is possible to argue that the adoption of partnering and the implementation of an effective knowledge transfer process can be the solution to deal with the increasing complexity of the construction industry [5]. Furthermore, the link can also be validated by the presence of several common success factors. In fact, this was affirmed not only through the literature review but also after the analysis of the interviews (table 7).

A collaborative environment, an open communication between the project participants, and mutual trust are identified as some partnering attitudinal factors that imply effective knowledge transfer in projects and coincidentally lead to successful outcomes. In particular, the presence of a shared collaborative culture contributes to the achievement of partnering success [7] and, at the same time, favors the development of effective knowledge transfer [24] through the creation of a positive and open context. Similarly, trust proved to be one of the most important key element for successful partnering and effective knowledge transfer [20,23]. According to the interview-objects, building trust between the project participants is essential for partnering success and it enhances knowledge transfer. However, despite its strong relevance, trust can be difficult to define, measure, and implement in practice because of its subjective and abstract nature.

These success factors, like collaboration, trust, and open communication, are defined as behavioral and attitudinal [17]. According to the interview-objects, other contractual factors, such as the early involvement of the suppliers, a value based procurement, and co-location, could support the creation of collaboration and trust in project in a more practical way. Therefore, the link between knowledge transfer and partnering depends on the presence of both relational and contractual elements. When these critical success factors are implemented in partnering projects, then theoretically, it will be feasible to develop an effective knowledge transfer process.

Once the presence of a link between knowledge transfer and partnering has been proved, the focus shifted towards a deeper analysis of the nature of this relationship. In particular, reason being the limited amount of studies on this relation, the literature review does not completely address this issue. The contributions of Barlow and Jashapara [6] proved to be the more relevant on this topic. In their research, the authors underlined a growing awareness about the role that partnering can play in promoting *learning* in projects, providing the conditions for the development of cooperation and open communication [6].

The nature of the link between knowledge transfer and partnering in projects can be well understood from the interviews. As previously stated, specific partnering elements indirectly enhance knowledge transfer. The partnering culture promotes sharing and transfer of tacit knowledge, in form of expertise, and know-how and this happens especially when the project participants are willing to commit themselves and promote a sharing attitude [9]. On the other side, the presence of an effective knowledge transfer in project could facilitate the development of partnering. In fact, when two or more organizations have developed optimal practices for the transfer of knowledge, it would be more likely for them to be engaged in a successful collaboration. Therefore, the link between knowledge transfer and partnering develops in two possible ways, forming a loop.

More in depth, as one interview-object mentioned, it is also possible to consider knowledge transfer as a critical success factor for partnering projects. However, since effective knowledge transfer is desirable within every construction projects, this opinion remains difficult to discuss [22]. On the other hand, according to Barlow and Jashapara [6], under specific circumstances, partnering can be adopted with the purpose of improving the knowledge transfer process. In fact, partnering theoretically provides access to a broader spectrum of knowledge, skills, and competences (from designers, suppliers, constructors, and so on). In this environment, knowledge transfer can be improved, providing mutual benefits to the involved parties.

As last, while the temporary and interdisciplinary nature of a construction project calls for improved learning and knowledge sharing, the discontinuities and fragmentation of the projects could limit the assimilation of knowledge. For this reason, this study aimed to increase the awareness towards the link between effective knowledge transfer and partnering within the construction industry because the adoption of partnering in a construction project is a way of overcoming the limitations of traditional projects, introducing collaborative relationships between project participants [7,8,13,17].

Table 7. Common key elements in partnering and knowledge transfer; comparison of the findings from the literature review and from the interviews.

LITERATURE REVIEW		INTERVIEWS
Knowledge transfer	Partnering	Common elements
Trust	Trust (mutual trust)	Trust
Cooperation Collaboration	Collaboration and cooperation (cooperative culture – collaborative tools – cooperative attitude)	Cooperation
Reward System	Incentives (compensation)	Incentives - rewards system
Clear Definition of Objectives and Rules	Common goals (mutual- beneficial goals – shared objectives – joint objectives)	Common goals
Attitude Motivation Commitment	Commitment and attitude of project participants (mutual commitment)	Commitment / willingness to share
Communication / Continuous Dialogue / Openness	Open and effective communication (openness) – informal communication – open sharing of information	Communication
Technology Support System and IT Infrastructure	ICT (IT tools)	
Teamwork	Team building activities (teamwork) – trainings – project team	Team building activities
	Workshops (continuous workshops – initial workshops – follow up workshops – monthly review meetings – joint workshop – meetings – start up workshops)	Workshops and meetings
Pilot Implementation / Feedback	Continuous improvement process (continuous feedback)	
Social Interactions / Social Network	Social functions (informal gathering)	
Leadership Commitment / Top Management Support	Top management commitment to partnering spirit (leadership) – participative leadership	Leadership support
Effective and Systematic Processes and Measures / Performance Measurement	Measurement (key performance indicators and reports) – periodic assessment – joint evaluation – evaluation methodology – partnership monitoring – periodic performance evaluation	
	Willingness to accept mistakes	Learning from mistakes (lesson learned)
Proximity / Co-location		Co-location
Common Language / Understanding of the benefits		Common understanding
Training program		Training

6. Conclusion

This research intended to clarify the nature of the relationship between effective knowledge transfer and successful partnering projects in the context of the construction industry. From the literature review and especially from the performed interviews, it emerged that a strong link exists (RQ1). In particular, the literature review and the interviews showed that some partnering success factors, like collaboration, mutual trust, and open communication, are directly

related to effective knowledge transfer. These common factors validated the presence of a strong relationship between partnering and knowledge transfer (RQ2).

According to what have been discussed in the previous chapters, the link between knowledge transfer and partnering theoretically develops in two ways, formed as a loop (RQ3). In one way, the partnering collaborative context promotes the sharing of knowledge between project participants, offering a wider access to expertise and know-how (tacit knowledge) and creating a learning culture [6]. On the other way, an effective knowledge transfer process, within a construction project, could contribute to the implementation of a successful partnering. In brief, knowledge transfer and partnering influence each other's, mutually.

Interestingly, these findings are consistent with the contribution of Barlow and Jashapara (1998), one of the first researches in the literature that have focused on the analysis of link between partnering and knowledge transfer. However, the interviews revealed a need for more practical contributions about partnering and knowledge transfer.

In general, this research stands to offer a possible solution to deal with the increasing complexity and uncertainty of the construction industry [5]. In fact, the adoption of collaborative working relationships (e.g. partnering), along with the implementation of an effective knowledge transfer process, have been suggested as methods for achieving higher benefits in projects. In fact, since both partnering and knowledge transfer could bring benefits in projects, a combination of these approaches could, hypothetically, represent the winning strategy for projects success. Therefore, the link between knowledge transfer and partnering should now be read in a new perspective, that is the connection between *effective* knowledge transfer and *successful* partnering projects.

Finally, this research represents a first step towards a complete understanding of the link between knowledge transfer and partnering and it opens to new possible research development. In particular, further studies should exceed the limitations of this research; for example, a larger sample of interview-objects should be involved in the interview-process and the analysis should also be expanded outside the Norwegian context.

7. References

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