UNIVERSITETET I AGDER

Integrated project delivery (IPD) in Norwegian construction projects. Sharing of risk and opportunities aiming at better cooperation and project achievement.

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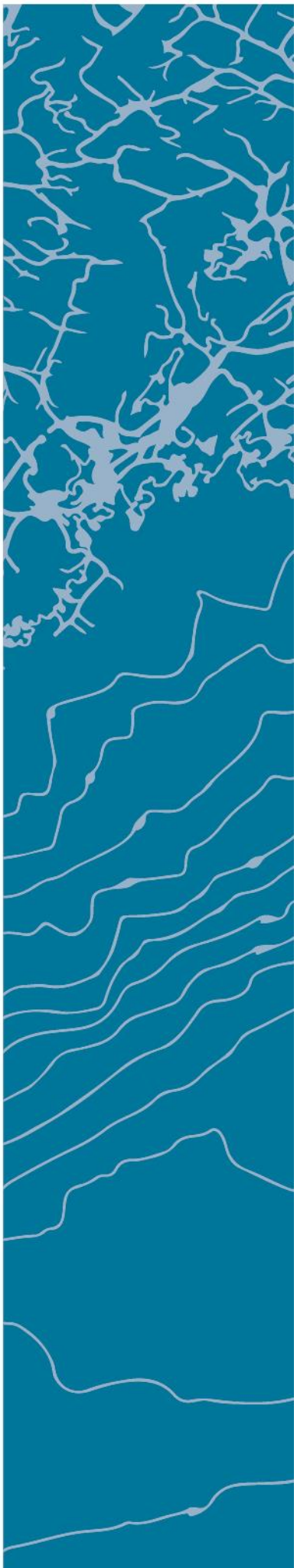

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Preface

This master thesis is part of the Master of Science master's program in industrial Economics and Technology Management at the University of Agder (UiA). This thesis is also part of a research project in project delivery models which is being conducted conducted in conjunction with the Tønsberg project and on behalf of a collaboration agreement between the University of Agder and Nye Veier AS, in order to stimulate innovation between academia and the construction industry. The research project has four master theses whereby three of these are examining best practice of procurement such as Best Value Procurement (BVP) and project delivery models like Design Build (DB) currently in use on Nye Veier's road projects. The three master theses examine the projects on the new E18 road Tvedestrand to Arendal, and through the stretch Rugtvedt to Dørdal as the new E6 project on the Arnkvern to Moelv roads in Norway.

This thesis is the fourth part of this research project which is looking at alternative project delivery models, in this case the examination of the first known case in the use of the Integrated project delivery (IPD) model at the Tønsberg project in Norway.

This project was submitted to the Norwegian Centre for Research Data (NSD) and has been approved for data collection under section 31 of the Personal Information Act. In addition the thesis was conducted under a confidentiality agreement.

Acknowledgments

Firstly, we would like to thank our supervisor at the University of Agder, Bo Terje Kalsaas, for introducing us to this subject and project, and for all the time you have spent creating the interview guides, designing the survey, guiding us, visiting the project with us, discussing and helping us with our Master thesis. Thank you for introducing us to the Tønsberg project and the AF-group. We are thankful for the opportunity given us to write this thesis on such an interesting topic. Your help and knowledge on this topic has been invaluable to us.

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Thirdly, this thesis has been conducted in collaboration with a project with Nye Veier and the University of Agder. We would like to thank Nye Veier for letting us be a part of this program. We would especially thank our contact in NV, Sebastian Kussl, for all the workshops we have had together, the feedback you have given us and the interesting debates we have had.

Fourthly, we would like to thank Magnus Hellström and Arne Isaksen for the help and support on the thesis. Thank you for setting aside time to see us and for all our long discussions. We truly value your ideas and guidance.

And last but not least, we would like to thank our family and friends for being so patient with us during this time, for all your help and support.

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Summary

In the architecture, engineering and construction (AEC) industry projects are often temporary in nature and are often characterised as PBO project-based organisations. Each project chooses a number of strategies which makes up a project development model. Traditionally models have focused on transactional contracting between actors in the value chain which opens up the way, for sub-optimisation and risk aversion as the common challenges. In such circumstances, each actor has a different perception of the aim and the success of the project, and so try to find ways to take the lowest risk and gain the most profit coupled with optimising their own interests.

Based on the highlighted problem the study aims to investigate of the research is to examine Integrated project delivery (IPD) in Norwegian construction projects. Sharing of risk and opportunities aiming at better collaboration and project achievement.

The thesis aims at testing the differences between IPD and alternative implementation models. Hence this thesis attempts to answer the following propositions:

- *Proposition one states that IPD provides less scope for sub-optimisation and opportunistic behaviour between companies in the value chain.*
- *Proposition two states that IPD provides better conditions for unified solutions (swapping) than traditional contracts.*
- *Proposition three states that IPD safeguards quality and customer value in a better way than alternative implementation models while maintaining constructability.*
- *Proposition four states that IPD, in combination with TVD, provides better framework conditions for continuous improvement and innovation compared to a Design Build model.*

Furthermore, this case study answers the propositions by collecting data composed mainly of the documents, survey and interviews which were analysed using the framework method.

Based on analysed content the findings show that IPD provides helps to alleviate the characteristic problems in the AEC industry and how this have changed using IPD. These problems come from a lack of quality, lack of collaboration, opportunism, lack of customer value and a lack of innovation. By using a critical realist perspective, one can identify the influencing mechanisms.

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1. Introduction

In the architecture, engineering and construction (AEC) industry projects are often temporary in nature and can be characterised as PBO project-based organisations. Each project chooses a number of strategies which makes up a project development model. Traditionally models have focused on transactional contracting between actors in the value chain which opens up the way, for sub-optimisation and risk aversion as the common challenges (Kalsaas, Bølviken, & Klakegg, 2017). In such circumstances, each actor has a different perception of the aim and the success of the project, and so try to find ways to take the lowest risk and gain the most profit coupled with optimising their own interests. It is this mentality that leads to sub-optimisation in projects. In addition, there is the challenge of implementing a strategy in the building arena in Norway since it is locally rooted and therefore there is decentralised decision making. This means decisions often come from a head office which has little control, and its project teams, in turn, have little contact with central leadership (Sward & Bygballe, 2017). The projects often work on their own disconnected from the main organisation.

The main problem is: Do IPD construction projects in a Norwegian context benefit from sharing risk and do they benefit from opportunities that lead to better cooperation and better safeguarding of the owner's interests?

1.1. Background

This section gives important background information about the subject, especially for those unfamiliar with the subject and incudes a review of the area being researched and relevant history on the issue.

The need for change in the construction industry

In the late twentieth century, a number of countries had concerns about inefficiency and low productivity in their respective construction industries. During the 1990s many governments published reports on building and construction in an effort to bring about change in their construction sector.

However, Japan's construction industry was improving, and this was attracting interest. Both manufacturing and construction in Japan were going through a phase of increased productivity. The Japanese Federation of Construction Contractors reported an increase in construction employment in every year from 1987 to 1993 (National Institute of Standards and Technology, 1996, p. 9). The United States set up a number of agencies to study Japanese techniques. At Massachusetts Institute of Technology, the International Motor Vehicle Program received government funding and set up an investigative research team who published a book, The Machine that Changed the World by Womack, Jones, and Roos (1990, pp. 3-4), which described motor manufacturing in Japan (described as "lean production"), especially the Toyota Production System (TPS) (pp. 4-82).

The manufacturing sector began to improve in the U.S. and in other countries under the influence of this new approach. However, construction did not benefit at first from lean techniques (construction being a more complex industry). In 1992, L. Koskela attempted to apply the new production philosophy to construction, writing

> "*leadership is needed to realize a fundamental shift of philosophy focus on actionable and measurable improvement...new organization formed with self-directed teams implementation (of lean) requires a substantial amount of learning*" (pp. 27-28).

In 1999, G. Howell gave a simplified description of the lean ethos – "meeting customer needs while using less of everything" (p. 2), and he reached the conclusion that there are incompatibility issues with lean within the traditional contract system –

> "*we expect new forms of commercial contract to emerge that gives incentive for reliable work flow and optimization at the deliverable-to-the-client level*" (p. 8).

Lean has not been adopted in construction in Japan because

> *"some of the concepts of lean construction have already been woven into the Japanese construction industry"* (Inokuma, Aoki, Shimura, Nagayama, & Koizumi, 2014, p. 25).

In the UK, a complete change from fragmentation to an integrated process was suggested by the Egan Report. Sir John Egan drew on his experience in automative manufacturing in steering the Construction Task Force in its studies and deliberations. The report identified "integrated process" as one of the keys to improving construction –

> "*The rationale behind the development of an integrated process is that the efficiency of project delivery is presently constrained by the largely separated processes through which they are largely planned, designed and constructed. These processes reflect the fragmented structure of the industry and sustain a contractual and confrontational culture*" (1998, p. 19)

Following on from the Egan Report, the National Audit Office report, entitled "Modernising Construction", said:

> "*clients, advisers, contractors, sub-contractors and suppliers of materials must be integrated to manage risk and apply value management and engineering techniques to improve buildability and drive waste out of the process....construction design should not be a separate process but be integrated with the whole construction process*" (Great Britain, 2001, pp. 4-10).

In appendix 4 of the report, the practice of partnering is praised since collaboration between organisations brings benefits in the form of savings and efficiency, and yet, on the other hand, partnering is criticised as a weak form of integration existing between organisations rather than

people, and the stronger partner tends to dominate to the disadvantage of the weaker partner (pp. 61-66).

The attempts to improve construction by means of lean techniques continued into the twenty-first century, with the publication of a research report by the U.S. Construction Industry Institute entitled Application of Lean Manufacturing Principles to Construction. The emphasis in this research report was on the elimination of waste and also striving to meet or exceed customer requirements, and finally pointing out that lean principles are more than practical steps - they are a system of thinking and behaviour (Diekmann, Krewedl, Balonick, Stewart, & Won, 2004, pp. 32-52).

Inception of Integrated Project Delivery

According to Lahdenperä (2012) Integrated Project Delivery (IPD) has been an emerging method from North America that originated from Japan, labelled as "gentlemanly principles", see Figure 1. This corroborates well with Lean and the Toyota Production Systems (TPS) where adversarial supplier relationships were transformed to cooperative relationships[1].

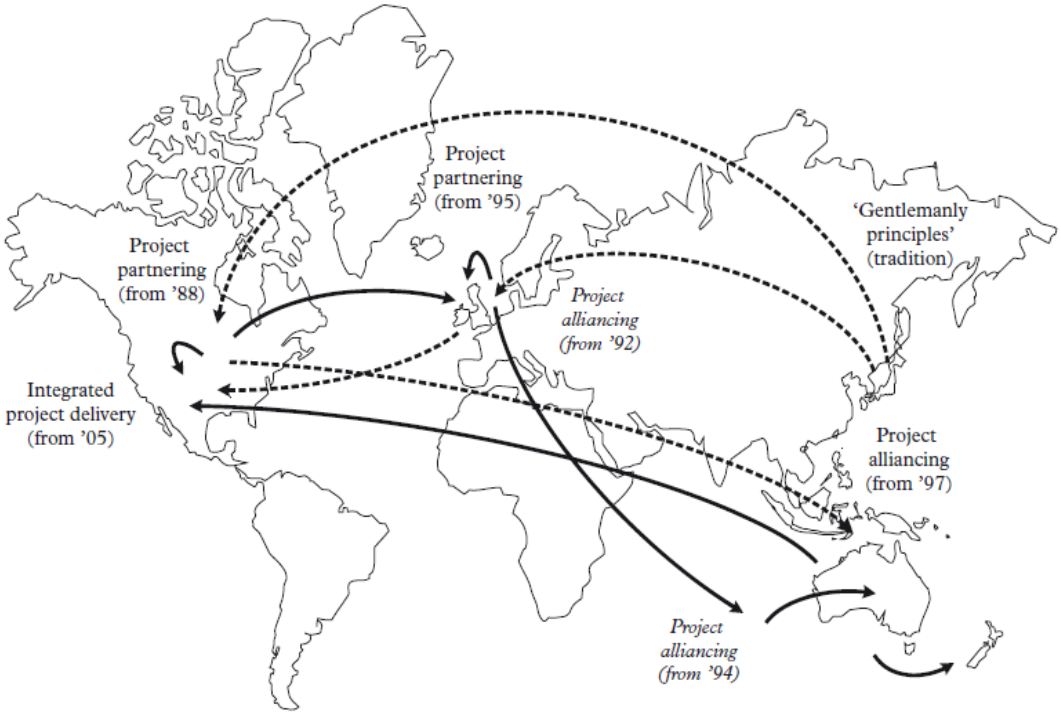


Figure 1: Integrated Project delivery (IPD) emergence, propagation and interaction with project partnering and alliancing. Source Lahdenperä (2012)

[1] Further information can be found in cases of Jaguar and Nippondenso and the Sutter Health project (Ali, Smith, & Saker, 1997; Lichtig, 2005).

A further step was taken towards a defined integrated process with the "lean summit" at Sutter Health. Sutter Health was a medical care provider wanting to commission structural seismic upgrades to its buildings after an earthquake caused significant damage to healthcare facilities in Southern California (H. Ashcraft, 2013; Lichtig, 2005) and, for this purpose, they were interested in lean construction. In 2004, Sutter Health held a summit to discuss lean construction and the organisation's five "big ideas". These could be summarized as - collaboration; relationships; networks of commitments; optimisation; and, the pairing of learning with action (Lichtig, 2005, pp. 106-108). Concurrently, a few IPD projects had started taking place, since some, who could see the advantage of integration as an idea, had decided to put it into practice, such as Westbrook in Florida. Westbrook Corporation started using IPD with relational contracting to integrate the principal parties in a collaborative contract (Matthews & Howell, 2005, pp. 46-48).

In 2007, the American Institute of Architects California Council published an IPD working definition which emphasized integration, waste reduction and optimisation of efficiency. This was supplemented by essential principles and work flow arrangements necessary for a workable IPD (2007b, pp. 1-9). The AIACC later collaborated with the national AIA to produce an IPD guide with the aim of educating interested parties in the principles of IPD and how to set one up. Also those wanting to use traditional delivery methods would be able to adopt some IPD principles within a traditional framework (2007a, pp. 1-12).

The working definition and the guide gave impetus to IPD adoption, but, in practice, there were difficulties. Ghassemi and Becerik-Gerber found there was opposition from within the industry from traditionalists and it was difficult to build trust. There was difficulty in integrating all relevant personnel from the start and there were problems with organizing training for all relevant personnel. In addition, there were financial hurdles (compensation, sharing costs, overruns, profit pooling) and legal barriers especially in the public sector (laws not allowing relational contracting, and local regulations to be complied with) (2011, pp. 32-52). In 2014, the working definition was changed. The original working definition and guide allowed for users to choose some principles and leave others out. However, in 2014, it was decided it was necessary to clarify the mandatory nature of some IPD provisions:

> *"We believe this is a necessary clarification to distinguish IPD from other delivery models that offer some of these improvements, but do not use the full system to achieve full integration"* (American Institute of Architects, 2014, pp. 4-15).

The mandatory principles covered the relationship between the owner and the key designers and the key builders. This meant continuous involvement from start to finish; shared risk; shared reward; joint project control; limited liability; and, a multi-party agreement or equal interlocking agreements. Without those principles, projects could not really be described as IPD.

Situation in Norway

Norway's construction productivity has been showing increases in percentage terms for most years but recently there have been signs of a possible downturn (OECD, 2017). Klakegg (2017) states that "investment in the building industry has accounted for 268 million kroner in 2015 and is expected to increase to 291 million in 2016 this is equal to 1.7% increase and this is an expected 0.5-2% increase for years to come. The building arena accounts for around 5th of the total value created in Norway on land mass in 2013 (without the rental industry). This has been an increase of 1.4% over 10 years from 2003-2013. The building industry is an important industry in all districts and towns. In addition, there is also an increase in employment of over 43% over the last 10 years. These statistics reveal how important the building arena is for society (p. 418).

However it can be argued that over the long term - since 1992 - its productivity has, in fact, decreased. The deep-rooted problems of the architecture, engineering and construction sector - problems that are connected, as in other countries, with the traditional way of doing things - have been further accentuated by increasing complexity and changes.

> *"The AEC industry can be said to be in a transition phase towards new shores"* (Munthe-Kaas, Hjelmbrekke, Lohne, & Laedre, 2015, p. 578).

In England and Norway public projects do not only have a tendency for being late and over budget but also that benefits do not materialise. In Norway this has led to development and the growth that we know today as external quality assurance of big public projects by the finance department. This process has established more value for money. This has led to more focus on project owner investment and benefit for users. Lean Construction (LC) focus of projects gives value creation for

the customer. This is also in line with wider development. It is generally accepted that projects are not planned and executed for their own good but for the value for society, project owners and users/customers. This can be seen as traits in the area of project development.

In public projects this has led to more focus on the early phases in projects, more definition of the right goals and the right tools. This has led to an important characteristic in the building and construction projects in the use of Building Information Modelling (BIM) and other digital models for integration of the partners in projects. In addition, more focus is on the bigger picture in terms of the project delivery model and strategy for value creation with less resources, reduced levels of conflict and without waste and minimal use of energy, time and material which will be high on the agenda in the future. In the area of project development this has caused a new dimension: How do we plan and control to create maximum value? (Kalsaas et al., 2017, p. 26)

Examples of its adoption could be seen in new practices in Statsbygg who initiated partnering in 2001 and has continued with the collaborative partnering system up to now. As a major public client, Statsbygg attempted to be a role model for the industry. Partnering is Statsbygg's way of facilitating lean with more efficiency and value and less waste in the projects where they have involvement (Haugseth, Lohne, Jensen, & Lædre, 2014, pp. 1343-1344).

However further developments were slow. Rodewohl carried out research into the use of lean technology in the building industry in Norway in 2014, and he found some use of lean tools (to a limited extent) and definitely an absence of an integrated approach. He concluded that the tendering system was a barrier to further progress towards a comprehensive lean process and IPD. He suggested that the ability of a contractor to carry out a project in a new way could be added to the tendering criteria[2] (Rodewohl, 2014). An attempt to circumvent this problem was attempted by Statsbygg by mandating (when they drew up contracts for a new project) that lean construction must be used for the purpose of the project. Eventually the project had some elements of lean, but the necessary collaboration was not there (Haarr & Drevland, 2016, pp. 3-11). It seems as if adopting lean and IPD fully has not taken off to the extent it has in some other countries, notably the United States.

[2] This is because the tendering process favours the lowest bidder and Rodewohl thought this added requirement would be a way of getting round the rules in order to recruit lean contractors.

1.2. Characteristics and challenges in the AEC industry

The characteristics and challenges in the AEC-industry (architecture, engineering, construction) have been paramount with past projects repeating the same problems and encountering the same challenges. Recently the AEC industry, both in Norway and Internationally, has faced a major challenge in an underperforming industry to increase productivity in order to become more efficient and increase its profits (Bråthen, 2015).

Moum (2016) points out that key actors in the AEC industry characterised it as "dysfunctional and fragmented" not just because of its competitive nature but because of the conflicts and disagreements that arise from challenges in:

> *"competitive tendering, barriers in communication, lack of trust and transparency, increased complexity, lack of implementation and adaption to new technology, short term goals focus and emphasis on lowest bid criteria and a lack of good role models who push for innovation."* (p. 377)

This poses great challenges in Norway and also internationally. Each supply chain participant tends to sub-optimise in order to maximise their own interests thus resulting in adversarial relationships (American Institute of Architects, 2007a; H. Ashcraft, 2013; Matthews & Howell, 2005; Moum, 2016). Further it is also pointed out that sub-optimising often leads to shifting of risk or blame from one party to another.

Much of this abysmal performance can be explained by the very structure of traditional project delivery.

It does not help that this is further accentuated by new challenges. Moum, talking of Norway said:

> *"societal challenges, increased globalisation and international market competition, changing markets, new legal requirements, and ever demanding user and client's needs"* (p. 377).

The dispersed nature of the AEC industry is also problematic because projects are often temporary and unique in nature. Thus, every project has a unique project delivery model for the projects lifecycle and faces unique complexities in organising, coordinating and managing a project within time, cost and quality.

Another challenge according to Moum is the "mix of uncertainty, uniqueness, interdependencies and unpredictable cause-effect relations" (p. 378) that create complex chaotic and often complex situations. These situations often have interdependencies, requiring participant output before another participant can go ahead. As a result, these problems can only be coordinated by mutual adjustment. This applies as much in the United States as in Norway.

There seems to be an agreement among both practitioners and scholars there is a need for more knowledge about ways to increase efficiency through procurement, organisation, digitalisation, execution and the maintenance of building projects. Many initiatives have started in order to test out new ways of working[3].

There are some underlying and hidden challenges that affect the construction industry of which a majority cannot be seen, but mostly felt. These will be explained further.

1.3. The concept of Wicked Problems

Designers/planners are often faced with Ill-defined problems. These problems can be either tame or wicked problems. The difference is talked about in (Rittel & Webber, 1973) who states that problems are either from the social or the natural sciences. He suggests that the problems from the natural science are "tame problems" that are "definable and separable and have solutions that are findable" and "are those associated with engineers and scientists". However, "wicked problems" are not easily defined as the definition changes every time you address it. They have "no solution" as each solution has a causal link to another and can be a symptom of another problem. Wicked problems "at best, are only resolved-over and over again" unless one terminates the problem by accepting a best fit. These problems are normally associated with planners. (pp. 136-144).

In design, we often see "tame" problems as those being for example unclear customer requirements or a poorly defined scope, ie they can be solved or there is a solution, and they are normally associated with the creation of a tangible object. They usually involve solving the problem "in a finite time period by applying standard techniques" (Camillus, 2008, p. 1). Whereas wicked problems are more objective and "usually rely on political judgement for resolution" (Rittel & Webber, 1973, p. 136).

[3] Industry workshops with Nye Veier (2018) and with the research project Meerc (More Efficient and Environmental friendly Road Construction)

1.4. Coordination problems-Coordination theory & Reciprocal Interdependency

Coordination theory is referred to as "a body of principles about how activities can be coordinated". In other words, how "actors can work together harmoniously" (Malone & Crowston, 1990, p. 3). Whereas (Crowston, Rubleske, & Howison, 2006) define in more detail Coordination theory as the "dependencies between tasks the different group members are carrying out and the coordination mechanisms the group uses to coordinate its work and then considers alternative mechanisms." (p. 120).

Malone and Crowston (1994) state that coordination and interdependency between people and resources. *Resource coordination* is based on how task and actor dependency can be coordinated, for example a task might need a required specialist whereas *resource dependency*, requires that multiple tasks need the same resources, in terms of money, storage space etc (p. 92) [4]. Thompson (1967) further adds that coordination is a problem where three interdependencies exist: "*pooled*, *sequential* and *reciprocal*". *Pooled* is not dependant on other elements to contribute to the overall puzzle as opposed to *sequential* interdependency. Whereas *reciprocal* interdependency, is the most difficult problem to manage as it contains both *pooled* and *sequential* interdependency, and each unit output can affect everyone else. As a result, these problems can only be coordinated by "mutual adjustment".

1.5. Complex problems -Cynefin framework

The Cynefin framework is a concept that is used to help managers, and others reach decisions because of the common characteristics that projects face in engineering management, complex problems. Moum explains that through a "mix of uncertainty, uniqueness, interdependencies and unpredictable cause-effect relations" that they create complex chaotic and often complex situations (p. 378). The Cynefin framework is a decision-making tool that identifies the decision-making process and categorises problems as occurring within five areas or dimensions "based on the relationship between cause and effect": *simple, complicated, complex, chaotic and disorder* (Kurtz & Snowden, 2003, p. 468).

[4] Based on the Theory of Coordination (Crowston 1994).

2. Theoretical Framework (Applicable Theories)

The purpose of this section is to give the reader an awareness of the state of theory and the relationships that were required in order to reach the research propositions. Projects often face challenges in complex and uncertain environments and therefore, it is critical to have knowledge of the theories and a good understanding of the factors that affect their performance. Therefore, the theories chosen, rely exclusively on the theories applicable to the challenges in the general theory of management. In addition, the theories were selected for their appropriateness, ease of application and explanatory power in examining and analysing the phenomenon. This study examines the theoretical framework with its central tenents being within the lean construction triangle, which will be discussed and is specifically aimed at contracts, project management and learning in organisations. The theoretical framework will, at the end of the thesis, be examined in relation to the results from the study.

The challenges in project management are many, from the background discussed above, as it seems that there are many trade-offs that are required in order achieve the optimal project.

The Lean Construction Institute states that in order to deal with the challenges in the construction industry, it is necessary to have an effective organisation covering all three sides of the lean organisational triangle, Figure 2 (Ballard, 2012, p. 7).

Figure 2: Shows the Lean Construction Triangle. Source: Ballard (2012, p. 7) adapted from (Howell, 2011)

In order to do this, it is necessary to examine the unseen drivers in effective organisational management - effective teamwork, removal of opportunism, evoking trust and enhancing coordination. The theoretical framework sets the scene for investigating integrated project delivery.

In order to examine the underlining factors for complex and uncertain projects to reach optimality, the Lean Construction Institute recommends three focus areas, shown in the lean construction triangle.

The interests of the client need to be aligned through the commercial terms and the financial interests of others in the supply chain, this can be in the form of contracts. Secondly the organisation is integrated by having "downstream players participate in upstream processes, and vice-versa", this can be through the use of project delivery models and thirdly the operating system, can be thought of as production in how teams, are structured to use the best "available methods and tools, both managerial and technological to apply" and follow the ideals and principles of lean.

Consequently, the lean construction triangle is a framework that can be applied in order to understand organizations and their structures and will be used as the basis for this thesis.

2.1. Relational coordination

There are many problems within the AEC industry, from the cross examination of the literature mentioned earlier (Ghassemi & Becerik-Gerber, 2011; Lichtig, 2005; Moum, 2016). Many authors have suggested that in order to solve these problems a cooperative way of working is required. Halldorsson, Kotzab, Mikkola, and Skjøtt-Larsen (2007, p. 287) suggests that:

"The performance of a firm depends not only on how efficiently it cooperates with its direct partners, but also on how well these partners cooperate with their own business partners".

One theory that can be used to measure this efficiency is from Mary Parker Follett relational coordination theory (Gittell, 2011, p. 401), who argues that relational coordination theory can be used to identify elements of "effective work organisations" which have high levels of coordination between "uncertainty, interdependence, and time constraints".

As a result "Effective organisation of work" involves an awareness of all participants, to others in the work process (Gittell, 2000a, p. 517).

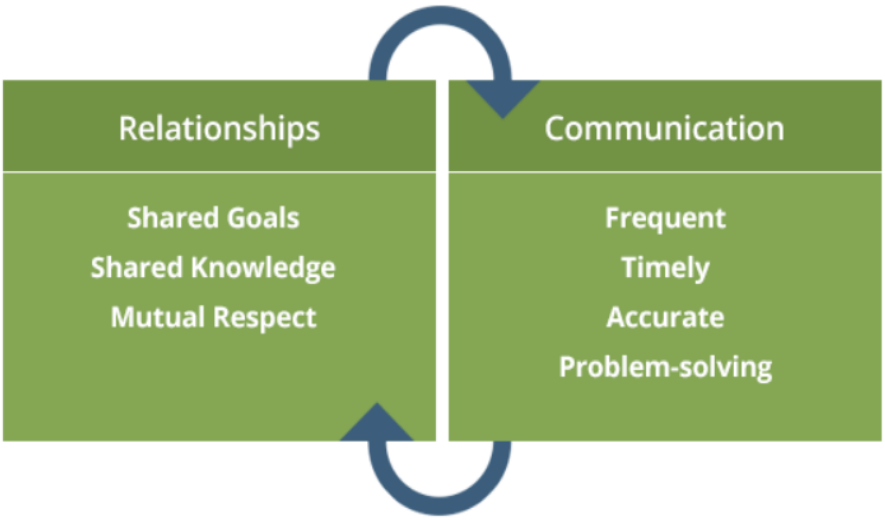


Figure 3: shows the seven areas of relational coordination theory. Retrieved March 10, 2018 from: http://rcanalytic.com/rctheory/

The seven areas of relational coordination theory, as shown in Figure 3, can be used to measure the strength and quality of a team's performance by capturing the dynamics of how work is coordinated. This is done by examining both relationships and communication. The quality of team performance is measured through shared goals, knowledge, mutual respect in relation to the communication between team members. Evidence of which has been shown in several of Jody Hoffer Gittell works, see Gittell et al. (2000) and Gittell (2000b).

2.2. Trust

Trust is an important feature of Relationship-Based Procurement (RBP). Walker and Lloyd-Walker (2014) define RBP as a concept which "refers to developing a project delivery mechanism that holds collaboration and joint problem solving as central features". In order to achieve trust in a project, participants need to have the "ability to build trust and commitment" in addition to investing time and energy (Lloyd-Walker & Walker, 2015, p. 57). Managers' perceived trustworthiness when it comes to cost, is dependent on whether they are perceived to be treating other parties ethically and reasonably when it comes to cost distribution. When used right, trust can be used to remove costs.

According to Lloyd-Walker & Walker (2015, p. 57), people make a rational decision to trust and is dependent on their willingness to be vulnerable and take a risk. They further state that trust is

affected by a sequence of events. First, a person considering trusting someone has a residual inclination which is driven by ability (the other person's motivation and capacity), benevolence (feelings they have towards that person) and integrity (matching rhetoric with actions) (p. 58). Commitment is the mediating factor, which is classified into: continuance ("need-to"), normative (obligation) and affective ("want-to") commitment (p. 58). When a situation requires trust, a person deciding whether to trust need to know the risks involved, how vulnerable it makes them and other participants' trustworthiness. The next sequence is analyzing the behavior and relationships with the people being trusted, where the person's ability to perceive the outcomes determines the value of their observations. If their observations are deemed positive, this could lead to deepening of trust and future inclination to accept greater risks. They further state that institutional trust is linked to their reputation and value, which is usually stable (pp. 59-60).

According to Lewicki, Tomlinson, & Gillespie (2006, p. 1002), define distrust as "confident negative expectation regarding another's conduct", and trust is defined in the same wording, but with a "positive expectation". They also argue that trust and distrust ranges from high to low, where trust is so complex that trust and distrust are independent of each other and can occur simultaneously. Meaning that one can both trust and distrust another person at the same time, but in different aspects. Smyth (2006, p. 102) describes calculative trust, which refers to *self-interested trust* and *socially oriented trust*. The former behavior, although having little (or no) trust, there is "mutual self-interest to trust each other". The latter behavior "is a deeper level of trust that is giving in character" and dependent on awareness of the other party's trustworthiness.

Lloyd-Walker & Walker (2015, p. 60) state that in order to have trust in a project team, they need to have shared values and assumptions that support benevolence, integrity and ability (trust attributes). Each member of a team will be a part of different sub-cultures and have different worldviews. They further state that all these sub-cultures create a system that changes and interacts. Change can happen more quickly in observable artifacts than shared values and common assumptions (p. 61). Culture influence people in different ways, which depends on their perception on fairness and justice, which determine their behavior and reactions (p. 62).

2.3. Collaboration

According to Lloyd-Walker & Walker (2015, p. 63) collaboration is defined as "together (co) working (labour), and this is implied as being directed to the same end". This is similar to

cooperation, which, however, does not necessarily imply working towards the same goal. Teams working together to deliver the same project have a relationship. They take responsibility for different aspects of the project, might have different priorities along the way, but have the same goal; to deliver the project. When goal congruity are low to medium, there is project cooperation. If this is medium to high, there is collaboration. When teams have high to very high alignment of objectives it is called coalescing. They further state that in order to solve problems together, collaboration networks are sometimes formed, where they share and create knowledge.

After comparing several different definitions of collaboration and cooperation, Schöttle, Haghsheno, & Gehbauer (2014, p. 1273) conclude that "collaboration is temporary and if the goal is achieved, the collaboration ends". They further state that trust and high transparency are important factors in collaboration. They also conclude that cooperation lie somewhere between collaboration and autonomy. In order to have either collaboration or cooperation, participants need to understand that they need each other in order to achieve their goals. Collaboration is strongly impacted by so called "soft characteristics" like trust, commitment, information exchange and communication (pp. 1273-1274). They further state that this shows that participants need to go through a development process in order to achieve collaboration. According (Schrage, 1995) as recounted by Schöttle, Haghsheno, & Gehbauer (2014, p. 1278), collaboration is not needed in "all professional situations". Which professional relationship require collaboration should be identified when establishing project teams (2014, p. 1278).

2.4. Opportunism- Principal Agent Theory, Transaction Cost theory & Game Theory

Current studies on the principal and agent problem have been diverse in various areas as economics, finance, healthcare and many more, since relationships exist in the form of contracts between actors.

Initially the principal agent problem originated from Ronald Coase on his paper "The nature of the Firm" in (1937). By the 1970' s other authors in the same period brought the work of the principal agent problem to focus however a debate exists between who was the first to create the principal and agent theory. This debate concerns (Ross, 1973) who covered incentives structures in motivating agents and Mitnick 1973 who covered behavioural problems. It was not until the late

1980's that Eisenhardt cited mostly Mitnick work (Mitnick, 2006). Other authors like Jensen and Meckling (1976), have contributed by describing the agency relationship as a contract in which to examine other variables that impact of the costs on both the principal and the agent.

The principal agent problem theory is based on Eisenhardt (1989) which states that a problem arises when an "*agent*" does work on behalf of another party the "*principal*". A relationship is created between the parties and problems arise through *risk aversion, opportunistic behaviour* and *information asymmetry* between the two parties. The relationship is a challenge because people have different and often conflicting risk preferences, desires and goals, more focused on *self-interest* and are limited by *bounded rationality*. *Information asymmetry* can be challenging to the principal when the agent can be deceptive by hold back, lie or even shift blame in order to enter into or while in a contract.

However, when examining recent works on the principal agent theory in construction it is wide-ranging. An example of these works is Schieg (2008) who discusses information asymmetry in construction project management as having three problems: *adverse selection, moral hazard and holdups*. In *adverse selection* whereby, contractors conceal qualities or qualifications which could lead to an undesired partner. An almost different problem is *moral hazard* where information asymmetry or an imbalance of information occurs in favour of the contractor, who indulges in risk taking on behalf of the principal, because the client cannot supervise or deduce stringent quality in the work. While *Holdups* problems occur when a client invests heavily in a future transaction with a contractor who can act uncooperatively, and a one-sided relationship occurs whereby the client is held up to excessive demands.

Examples of these issues can be seen in recent empirical studies like Steinle, Schiele, and Ernst (2014) who tested the principal agent theory, in buyer supplier relationships by examining information asymmetry as an issue that explains moral hazard: why suppliers behave differently than expected. The conclusions gave strong indications, adding to theory, that regardless of the length of the relationship or the number of meeting involved "both hidden action and hidden intention can lead to moral hazard" (p. 136) .

Another theory that examines opportunism is Transaction Cost Theory which examines the transaction costs in contracting. Transaction theory also originated from Ronald Coase work in

(1937) and it was not until 1970's that interest arose and influenced Williamson who took the focus from activities of the firm to the level of the transaction (Klaes, 2000).

Williamson (1979) examined the cost associated with the exchange of goods and services when dealing with an external party and found that people's *opportunistic behaviour* and their *bounded rationality* increase the transaction costs. Rationality in people minds is limited based on their capacity to understand and encompass everything. Dahlman (1979) adds that transaction costs can be further categorised into three categories; the *cost of searching and finding information*, the *cost of bargaining and decision making* and the *cost of policing and informing* as these are also a part of the optimisation issue. (Dahlman, 1979, p. 148)

Another aspect Williamson adds is the further impact on the costs by the *frequency* of the transaction, the *uniqueness* of the asset and the *uncertainty* of the relationship (p. 254).

Transaction Cost theory has often been used in empirical studies, examples can be in Li, Arditi, and Wang (2012) who identified and categorized the factors that affect transaction costs in construction project management in public companies. It was shown that that owners transaction cost was a factor that could also contribute to the transaction costs.

Other similar studies like Unsal and Taylor (2011) tested opportunistic behaviour over time and its impact in an artificial procurement market which showed that participants opportunistic behaviour was the driving force in minimising costs and maximising profit.

Another theory when examining opportunism, is game theory, as it closely resembles an exchange relationship. The theory shows how through the prisoner dilemma, that even the most rational of decision makers, when rewarded for cooperative and non-cooperative actions, still choses to take a payoff that maximises their interests, even though the cooperative payoff is a better choice as it lowers the reward but results in a win, win situation for both parties. However these actions are continually taken (Hill, 1990).

While on the other hand some empirical studies like Huang, Yin, and Tserng (2012) describe control mechanisms, such as incentives as an important aspect in minimising opportunism in contracting within projects. Other authors such as Schieg (2008) suggest that the problems of opportunism, may be solved using six mechanisms (p. 49) whereby incentives is just one method:

- bureaucratic control;
- information systems;
- incentives, bonuses;
- corporate culture;
- reputation;
- trust.

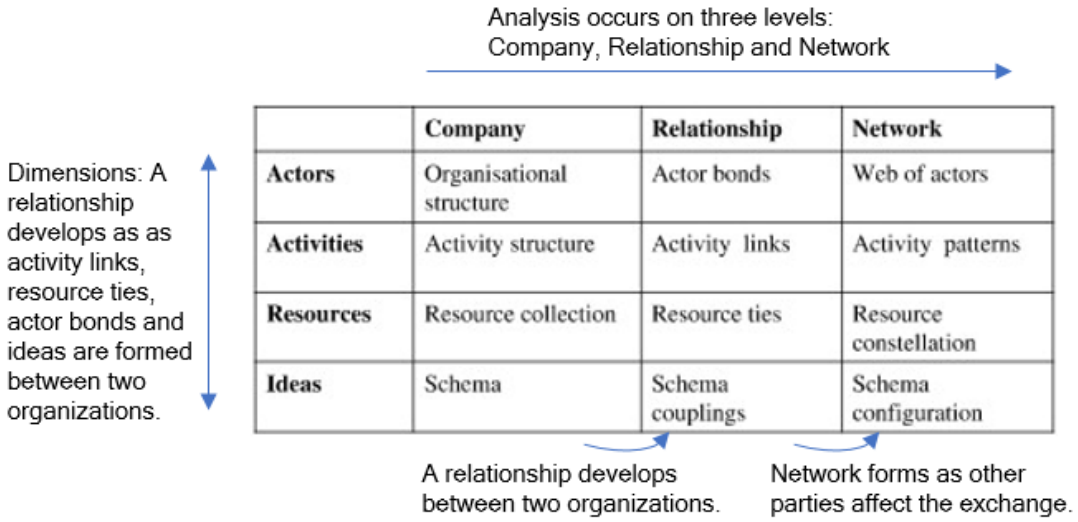
Whereas a literature review on the complementary theories in supply chain management suggest several mechanisms that would mitigate the risks of opportunism such as long-term contracts, penalty clauses, equity sharing, and joint investments (2007).

While we understand opportunistic behaviour as being interconnected with the cost associated with the exchange of goods and services when dealing with an external party, it can be argued that these theories are most useful in explaining both the contracting structure, project management issues and irrational behavioural in supply chains.

Other supplementary theories include aspects that are apparent in supply chain relations, like branches of game theory, Contract theory, Stewardship theory however, these studies are beyond the scope of this paper.

2.5. Understanding Interaction and Networks- AARI Schedule of Analysis

A way of understanding network development and the analysis of business relationships in organisations is to examine the AARI Schedule of Analysis, see Figure 4. Originally the dimensions of the relationships and networks in organisations was proposed by Snehota and Hakansson (1995) based on three levels of analysis: Actors, Activities, Resources (AAR) yet it was not until 2002 that Welch and Wilkinson suggested mental models (ideas) also occur within the interactions between organisations and networks (Holmlund, 2012).



	Company	Relationship	Network
Actors	Organisational structure	Actor bonds	Web of actors
Activities	Activity structure	Activity links	Activity patterns
Resources	Resource collection	Resource ties	Resource constellation
Ideas	Schema	Schema couplings	Schema configuration

Figure 4: The AARI scheme of analysis. Adapted from Welch and Wilkinson, (2002) based on Snehota and Hakansson (1995).

The AARI Schedule of Analysis shown, in Figure 4, that at the company level activities link as the connection among operations between firms transpires, as a result mutual adjustment occurs between parties. Resource ties develop as companies exchange and access each other's resources. Actors bond individually and collectively and respond to each other professionally and socially. In addition, ideas are formed, within a schema, from perceptions from individuals and organizations. A relationship is formed, and ideas are shared and shaped through interaction, which are adapted over time. As other parties affect the exchange a network is created, and a pattern of co adapted ideas occurs(Holmlund, 2012; Welch & Wilkinson, 2002). "*A network provides favourable settings for learning"* (Welch & Wilkinson, 2002, p. 29).

2.6. Conceptual analysis of human behaviour in organisations: Illeris Learning theory

Learning is often discussed in most textbooks at an individual level (Illeris, 2018; Malloch, Cairns, Evans, & O'Connor, 2010). One of the most well-known is Illeris, who discusses human learning, yet it was not until early 2000 that he expanded on the works of Jørgensen and Warring and Bottrup on learning in the workplace (Kalsaas, 2012, p. 91). In his book "Learning in working life", he uses a double perspective, to create an understanding of learning in the working place.

Organisational learning according to Illeris is a combination of both internal and external interaction processes which all play a role in determining how systematic learning occurs in the workplace (Malloch et al., 2010), see Figure 5.

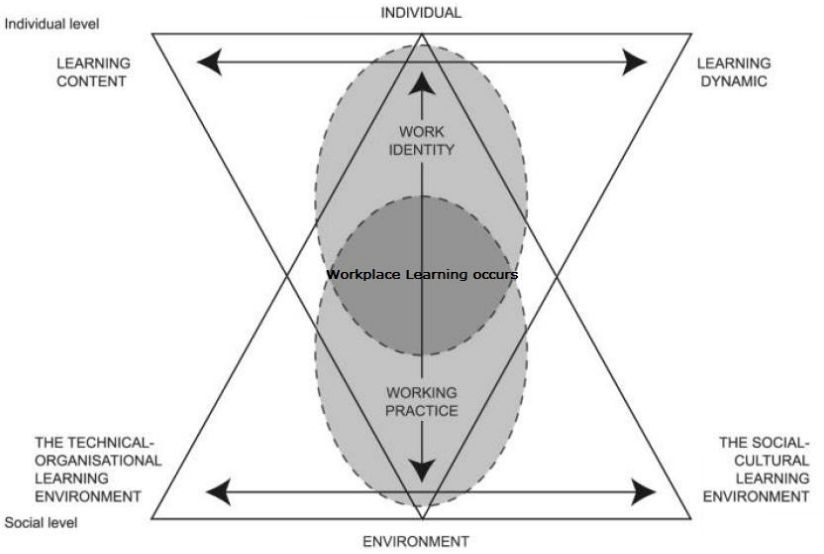


Figure 5: Illeris's learning in the workplace. Adapted from (Illeris, 2004, p. 438)

The model of workplace learning consists of two triangles, whereby the first triangle depicts the basic process and dimensions of individual learning. On an individual level, a specific learner learns from three dimensions simultaneously, that are always involved and integrated: capacity of the learner to manage the learning *content*, the *incentive* to learn and their interaction with the *workplace*. In the *content* dimension the capacity of the learner to manage the content, will depend on their: knowledge, understanding and skills level. The *learning dynamic* is where the learner has to manage their motivations and emotions. Learning is always composed based on the interaction on the individual level between social, the content and dynamic dimensions.

Illeris points out that a learner builds on his/her knowledge through four types of learning in an individual's learning process. These are: *cumulative* learning which is a "type of automation" involving recall; *assimilative* learning occurs by adding new information onto what one already knows; *accommodative* learning ensues when the learner has to adapt their current understanding to accommodate new information, which can often be "demanding and painful" but results in a renewed understanding whereas *transcendent* learning emerges when the learner is required to

transform their behaviour or personality, through a crisis situation, in order to get further (Illeris, 2018, pp. 12-14).

The second triangle is based on three simultaneous dimensions a learner interacts within the workplace. The first dimension concerns the *technical-organisational learning environment* whereby learning depends on six characteristics: division of work tasks, diversity in the work content, opportunity for self-governance, opportunity to use one's qualifications, possibility for social interaction and the stress and workload on the employee.

The second dimension, the *social learning environment* is based on how social grouping and processes, in the work community, cultural community and the political communities in the workplace and society affect the learner. The third dimension is again based on the individuals learning process in relation to the workplace, mentioned earlier (Malloch et al., 2010, pp. 36-37).

In addition to the learning dimensions of the two triangles there also includes two areas, where the two triangles meet, these according to Illeris, are called *working practice* and *work identity*. In the learning triangle a learner's individual experience is summed up by who I am and how I am experienced by others that their work identity become apparent (Kalsaas, 2012, p. 92). In the workplace environment triangle, workplace practice occurs in how much the learner practises the tools and artefacts, personal and social relations, positions, power conditions etc.

The central overlap between *working practice* and *working identity*, shading in the figure, is where *workplace learning* occurs, and it is here that competence development arises(Malloch et al., 2010, pp. 36-37). It is important to note that the combination of both separate triangles are logically separate but inter-related, meaning that the workers identity influences the workplace and the *workplace practice* forms the individual *working identity* (Illeris, 2004, p. 439; Malloch et al., 2010, pp. 36-37). However if this overlap does not occur a learner might first try to modify their work practice or their work identity by trying to do things better or differently before deciding to work for a different employer (Kalsaas, 2012, p. 92).

3. Theoretical Framework (Appliciable literature)

This section aims at giving the reader awareness of the applicable literature, which covers anything previously reported that was deemed relevant to the subject studied. This literature aims at explaining the context surrounding the case study and the relationships that are required in order to examine the proposed case study. In addition the literature helps to understand what research has been conducted and what has influenced the thesis.

3.1. Choice of Project delivery models in AEC

Every construction project needs to set up a delivery model for how the project will be conducted. According to Klakegg (2017), every project manager needs to consider their business model, situation and goals in order to find the delivery model that will give the best results based on low costs and resource efforts. He further states that there is no fitting description of the term project delivery model, thus mentioning the elements he thinks should be included to encompass this term; organizational structure, specification form, structure (task structure and project delivery process), contracting strategy (form of contract, risk distribution and resolution mechanisms), form of agreement and form of settlement (pp. 442-444).

Project delivery process

According to Lædre (2006, p. 52), when choosing project delivery process the owner chooses how involved they want to be during the duration of the project. Their ability to influence the project depends on how long they choose to participate in the project. The longer they patriciate the more influence they have on project details. Project delivery method states whom the participating parties are contractually bound to, how responsibility is distributed between parties and how the project is organized.

Lloyd-Walker & Walker (2015, pp. 17-24) divide project delivery process/method, within construction, into three wide categories; *traditional* (where design and construction is segregated), *integrated design and delivery procurement arrangements* (where planning and control is emphasized) and *Integrated project teams* (where collaboration and coordination is emphasized). The traditional approach has divided design and construction processes, while the other two categories integrate them into the project (p. 17).

In the traditional approach, this thesis will focus on the project delivery method *Design Bid Build*. From the second category this thesis will focus on *Design Build*, (Lloyd-Walker & Walker, 2015, p. 17). While, *Integrated Project delivery*, *(Project) Partnering, Project Alliances* fall into the third category.

Design Bid Build

In a Design Bid Build (DBB) the owner coordinates design and construction (anskaffelser.no). On behalf of the owner, the architect and contractor develop the project through drawings, descriptions and competition rules. Lloyd-Walker & Walker (2015, p. 17) state that projects using this type of method should have a design "complete enough to enable a bidding process to establish the cheapest and/or the quickest tender cost". Additionally, it assumes that the delivery process will not excessively alter the cost of design variations. According to Mahdi & Alreshaid (2005, p. 565), a DBB is often referred to as the "traditional" option because of its popularity among project delivery options. In this delivery method, there are three main parties: owner, general contractor/builder and designer.

According to Lloyd-Walker & Walker (2015, p. 17), generally, there is a high level of detailed design specification when project delivery organizations are called in for bids. Tenders usually have fixed price and time, because of rigid contracts terms. Mahdi & Alreshaid (2005, p. 565) state that the contractor is chosen through a competitive bid, followed by quality assurance/inspection or "even complete construction management services". The designer is chosen from a quality-based selection. The architect acts as the owner's representative through administration of construction contract in addition to being responsible (to the owner) for the project design. Contractor is responsible for properly constructing the design (given by architect) and procedures and methods of the construction. Both parties are responsible directly to the owner, which gives an independent relationship between contractor and architect, as shown Figure 6. Whenever any of those two parties discover errors made by the other party, they report them directly to the owner.

Lloyd-Walker & Walker (2015, p. 17) state that contract variations lead to a lot of negotiation and settling these ties up resources and energy.

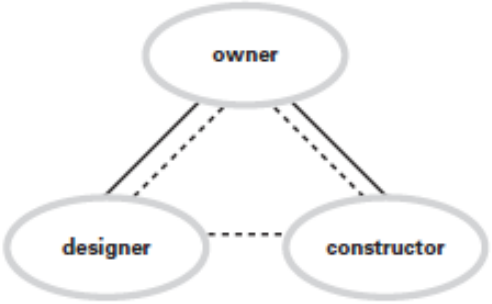


Figure 6: Design Bid Build relationships (American Institute of Architects, 2007a, p. 49)

The owner's responsibilities are defining project requirements, providing standards and contractual terms, which are to be followed, and financing (Mahdi & Alreshaid, 2005, p. 565). A designer might be hired for planning, conceptual design and design services if the owners do not wish to do these themselves. The American Institute of Architects (2007a, p. 49) states that many issues are not discovered until the project is in the construction phase, as a result of little input from contractors during the design phase.

Mahdi & Alreshaid (2005, p. 565) state that this method is quite time consuming during the design and construction phases. In addition to the "somewhat adversarial nature of the relationship between the architect and contractor", this has led to the development of many variations of this method. The architect estimates construction costs for the project during the design phase, while the formal pricing takes place after the completion of documents, and the project tender has been issued. Whenever bids come in over the cost estimate this could lead to consideration of cost savings or other methods. However, if the tender process shows that cost estimates are far lower than tenders (bids), then the owner needs to make sure the architect redesigns and re-price before value engineering and contract awarding take place.

According to Lloyd-Walker & Walker (2015, p. 17), this method's success is dependent on:

> *"High levels of design specificity at the time of tender, low uncertainty about events requiring substantive subsequent design change, contractors that are highly effective in carrying out the work as planned and contractors having a sound relationship with the project owner representative to be able to foster mutual adjustment on side-issues."*

However, according to Kalsaas, Hannås, Frislie, and Skaar (2018, p. 4), delivering high levels of design specificity at the time of tender might be challenging because contractors are "different enough with respect to equipment and working methods that it is impossible to design solutions that are equally constructible for everyone". Therefore, consultants often want to deliver as low levels of design specificity as possible before the tender.

Criticisms of this method includes the design not being defined sufficiently when the bid phase starts, which results in "poor value for money", contractor and project owner representative waste their time, and poor basis for choosing contractors (Lloyd-Walker & Walker, 2015, p. 17). In addition, they often use open tender systems where they are unable to check contractors' records of accomplishment. It is often said that the bidder who wins the tender is the one who has "forgotten or left out the most" (pp. 17-18).

DBB and IPD

DBB and IPD are difficult to merge because the contractor's involvement in the project comes at a much later stage than an IPD requires. This delivery system is therefore thought to be the least suited delivery system to integrate with IPD. In order to achieve an IPD the owner and architect would have to bid the project at the earliest stage possible and make their intent to work toward an IPD known when accepting bids (American Institute of Architects, 2007a, p. 49).

Design build/Design and construct

In a Design build (DB), the owner provides a functional description of the project and hands over the project responsibility to another party, the main contractor (anskaffelser.no). This means that the owner only has to sign one contract (with the main contractor/design-build entity), while the contractor has to contract designers/consultants and sub-contractors/constructor. The project requires a main contractor who can manage the project execution well. The owner has little impact on the project after it has been handed over to the contractor, therefore, qualification and awarding

criteria for the competition basis is crucial. Figure 7 shows the contractual and functional relationship between owner and the Design Build.

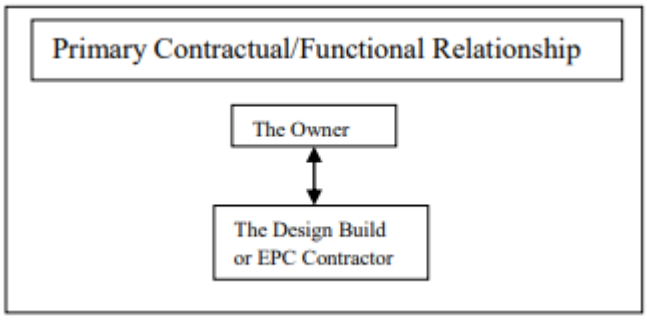


Figure 7: Design Build relationships (Construction Industry Institute, 2003)

American Institute of Architects (2007a) suggest that the reason owners choose this form of project delivery system is to transfer coordination and responsibility over to one actor, thus achieving a high level of coordination and reduction of project based risk. According to Lædre (2006, p. 53), whenever a design-build is chosen, the main contractor comes in at an earlier stage compared to other project delivery methods. Owner might consider somewhat compensating contractors who does not win the bid, if the project requires them to spend many resources on the tender.

There are three varieties of Design-build (in a Norwegian context); functionally described, owner developed project and a reversed Design build. For the first variety, the owner only describes functions and standard (and potentially special) requirements, which is planned after the contractor has been assigned to the project. The second variety has an additional preliminary or draft project, which is a part of the competition basis. Here, the owner clarifies how much may be altered or waived. The functionally described DB makes up the base for the reversed DB, with an additional upper limit for construction costs (anskaffelser.no).

According to Lloyd-Walker & Walker (2015, p. 19), the advantages of this method is ”closer cooperation and (hopefully) collaboration between” contractors and design team, through possible dispute cost reduction. This project delivery method requires less from the owner than a Design-bid-build and provides an earlier overview of costs (anskaffelser.no). One of the disadvantages of DB (for the owner) is that any changes the owner wants to implement after the contractor has taken over responsibility of the project will come at an additional cost. Then, the owner themselves, has to validate the basis for the contractor’s alteration prices. Getting the early stages of the project

correct is crucial for the owner. This is the time where they have the most impact on the project, which means they have to avoid ambiguous descriptions of functions, form and quality of the desired outcome of the project. As a result, the owner may limit the need for change after the project has been signed over to the contractor, which is crucial to keep project costs down (anskaffelser.no). In Norway, Norwegian Standard (NS) 8407 describes general design build contractual terms.

Design-build and IPD

IPD principles can be implemented easily in a design-build because the contractor and designer are contracted at the same stage, which increases the chances for project collaboration between these actors. The owner may also choose their level of involvement in the project, and is a part of the Design-Build team. However, owners usually choose this form of delivery system to decrease their level of involvement, which is in contrast to IPD principles. This can lead to minimized innovation and improvement opportunities for the project. In order to integrate IPD, the owner should shift their focus from cost reduction to project improvements (American Institute of Architects, 2007a, pp. 47-48).

Construction management at risk

American Institute of Architects (2007a, p. 46) refer to the term "construction management" as "a generic phrase applied to a variety of project delivery scenarios in which specific Construction Management services are called for in addition to the general services a constructor traditionally provides". They further state that this delivery system is referred to as Construction Manager at Risk when Construction manager–Constructor (CMc) and Construction manager-Adviser (CMa) roles, which differs in responsibilities, are conducted by the same person. This person will then take on responsibility and liability of a general contractor. If these roles are not assumed by one person, Lædre (2006, p. 54) states that the owner is still responsible for cost, time and quality.

According to Mahdi & Alreshaid (2005, p. 566), Construction management at risk (CMR) is a project delivery method which is characterized by an owner selecting a construction manager (CM) at an early stage in the design phase, to fill the role as a general contractor, while an architect (or engineer) will be assigned to design the project. Konchar & Sanvido (1998, p. 2) states that in addition to performing construction management services, the contractor manages construction

work for a guaranteed price. He also has significant input on the design phase where his responsibility includes "evaluating cost, schedule, implications of alternative designs and systems and materials during and after the design of the facility" (Mahdi & Alreshaid, 2005, p. 566). Figure 8 shows the relationship between owner, designer and construction manager.

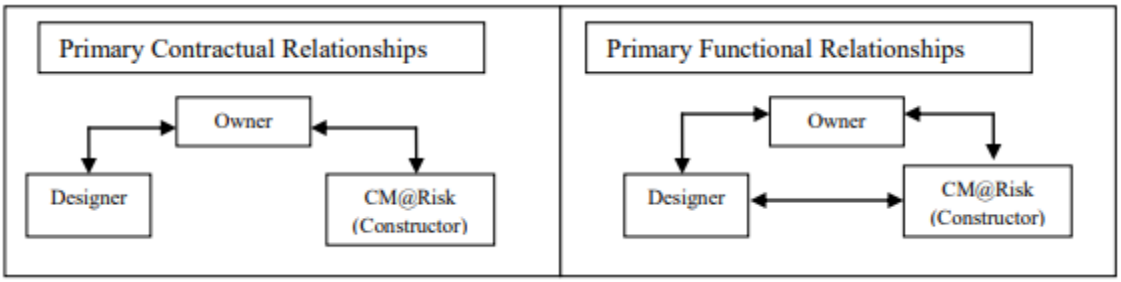


Figure 8: Construction Manager at Risk contractual and functional relationships (Construction Industry Institute, 2003)

This project delivery system and design-bid-build are very similar because they both have an assigned general contractor in charge of the project and the same contractual relationship between architect and owner, and contractor and owner (American Institute of Architects, 2007a, p. 46). Mahdi & Alreshaid (2005, p. 566) state that when the design is finished, the CM holds the risk for finishing the project at a negotiated or fixed price (by hiring trade sub-contractors to do the construction work). The difference between design-bid-build and CMR is that in the latter system the owner hires a construction manager to manage the construction phase. Here, the delivery process may be expedited by overlapping design and construction phases through architect and construction manager coordination. In addition, the construction manager can guarantee a maximum project price. According to American Institute of Architects (2007a, p. 46), CMc and Design-build both have early cost commitment, while they differ in that the owner contracts the architect who is responsible for design.

CM and IPD

According to American Institute of Architects (2007a, p. 46), this delivery system works well with an IPD. An important aspect of an IPD is to "bring all relevant parties into the delivery process early" to influence performance through decisions, which a construction manager fulfills by coming into the project at an early stage (p. 46). They further claim that where a bid-delivery method is required in a project, the CMc delivery model is the best fit for an IPD. One of the challenges of implementing IPD is the separate contracts in the CMc delivery model, which lead

to different goals and processes to achieve these goals. In order to fully integrate an IPD in the CM delivery model, the owner has to either require the actors to adapt certain conditions or agreement to make them a joint team or negotiate with them.

3.2. What is a IPD

Integrated Project Delivery (IPD), is also known as "Gjennomføringsmodell" in Norwegian and is according to the American Institute of Architects (2014) defined as:

> *"a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste and maximize efficiency through all phases of design, fabrication and construction"* (American Institute of Architects, 2007a, 2014)[5]

Integration, stated in the definition above, according to the American Institute of Architects (2014) is based on the development of a virtual project organization whereby it is committed to "best for project" decision making, and this commitment is supported by alignment of the firm's business interests through shared risk and reward (p. 4). This definition was the only one given or stated throughout the literature.

It should contain at a minimum, all of the following elements:

> *"• Continuous involvement of owner and key designers and builders from early design through project completion*
>
> *• Business interests aligned through shared risk/reward, including financial gain at risk that is dependent upon project outcomes*
>
> *• Joint project control by owner and key designers and builders*
>
> *• A multi-party agreement or equal interlocking agreements*

[5] More information and a further explanation can be found in Appendix 12.

• *Limited liability among owner and key designers and builders"*

3.3. IPD key players

A IPD project team consists of Primary and Key supporting members. The primary members, shown in Figure 9, are those with substantial involvement and responsibilities in the project, such as the owner, architect and contractor, whereas the key supporting participants have distinct responsibilities that play a vital role, such as subcontractors.

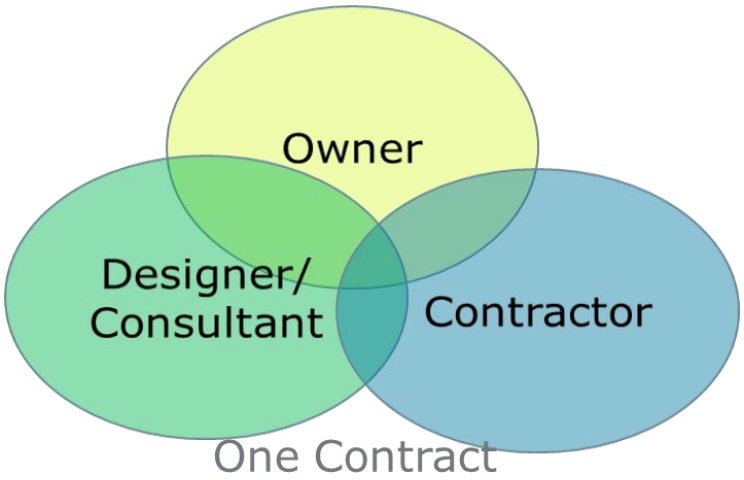


Figure 9 shows the Integrated project delivery and its primary participants.

The choice of primary and key supporting members will depend on the type of project and not all subcontractors are key supporting members for example a structural engineer on a bridge building project would have substantial responsibilities and would be considered a Primary member however on a road building project with perhaps one small tunnel the structural engineer might be considered a supporting member(American Institute of Architects, 2007a, p. 12). Rather, the key participants are those "whose work affects the schedule and performance of others" by releases work to others, prime examples are "mechanical, electrical, and plumbing contractors" who benefit by having tighter integration in the project. (Cleves & DalGallo, 2012, p. 32). In an IPD the key supporting members might have a contract with one of the primary team members or to a primary entity, whatever the case, he/she must agree to be bound to the contracted conditions among the primary participants member (American Institute of Architects, 2007a).

Many authors have stated that it is important to choose team members that have integrity, character and competency and are trustworthy (American Institute of Architects, 2007a; Cleves & DalGallo, 2012; Matthews & Howell, 2005).

(H. Ashcraft, 2013) states that IPD projects require champions who measure project processes and behaviours against IPD ideals. In part, these people are those within the team who are willing to call out when the process is not occurring properly(p. 6)

3.4. Principles of Integrated Project Delivery (IPD)

The principles of Integrated Project Delivery (IPD) have been widely known in recent years throughout the AEC industry as those stated in the American Institute of Architects guide book (2007a)

What factors or elements constitute a IPD is not clear, see Table 2. Much confusion has come from "proliferation of projects using IPD principles" using "incomplete models of integration, often called "IPD-ish," that prompted a updated definition from the American Institute of Architects (2014). This confusion can also be seen in Ghassemi and Becerik-Gerber (2011) empirical paper "Transitioning to IPD: Potential Barriers & Lessons Learned" whereby a table shows the differences between nine IPD projects. However, this table is not really explained further in the text and there is no explanation as to why all nine organisations listed in the table are IPD projects.

Further H. Ashcraft (2013) states that IPD is simple in concept, but it becomes complex when applied to specific organisations (p. 8) and it is this complexity that has caused some confusion as to what constitutes a IPD. For example respondents in H. Ashcraft (2013) noted that

> *"Even now, there are pretenders" There are many in our industry who raise their hand and want to do IPD, but who have not spent any time or effort to understand what IPD really is." "It is interesting how many people say they are doing an IPD and when you dig into their experience, it is not even close." "Vendors that claimed to have "always been doing IPD were seen as lacking understanding or being disingenuous." (p. 9)*

This section focuses on the differences between, and similarities of, IPD. For the sake of clarity, an examination of the key characteristics of IPD projects is presented in Table 2 based on the initial review of the primary sources. From table 1 two fundamental principles are often reiterated:

- *Shared risk and reward*
- *Liability waivers among key participants*

Though, Ghassemi and Becerik-Gerber (2011) empirical findings show that only five out of the nine projects had "shared risk/reward" while only one project had used a "liability waiver" (p. 36).

Other characteristics like *multiparty contract* is defined as a key characteristic by almost all references. It is the National Association of State Facilities (2010) taken from (Lahdenperä, 2012) that states that "*Key participants bound together as equals*" as the closest factor.

Nevertheless when examining empirical studies by Ghassemi and Becerik-Gerber (2011) it is deemed important for the successful implementation of an integrated project delivery (p. 36) however these traits are shown in only five out of the nine projects examined. Yet this is further defined as a definite in American Institute of Architects (2014) paper who see a multiparty contract as a core principle however they add "or *equal interlocking agreements*". This vague terminology can also be seen in Matthews and Howell (2005) paper which describes multiparty contracts as a team member agreement that involves a "pact" whereby a single contract binds the IPD team to the client (p. 49).
The definition of a pact is often referred to "a formal agreement between two people or groups of people".
This is again further shown in Ghassemi and Becerik-Gerber (2011) examination wherby one IPD project has all the necessary plan, design and construction services in house which is why no sharing of risk or reward or multiparty contracts were signed. The implication of these arguments is that *multiparty contract* is an important characteristic however there is some confusion, as to whether it can involve just two parties or many contracts that interlock.
Another key characteristic that is a core principle of IPD is:

"Continuous involvement of owner and key designers and builders from early design through to project completion" (American Institute of Architects, 2014).

However this is an updated definition from an older version of the American Institute of Architects (2007a), whereby it states that a project requires "*Early involvement of key participants*". This is also reiterated as a recurring theme in the literature (H. W. Ashcraft, 2014; Ghassemi & Becerik-

Gerber, 2011; Lahdenperä, 2012; Matthews & Howell, 2005). This characteristic is mentioned in latest version of the American Institute of Architects (2014) but it is defined as a "key construct" that enables parties to contribute and optimize a IPD project by increasing buildability and thus reducing costs (p. 11).

However, Ghassemi and Becerik-Gerber (2011) empirical findings recommend that at a minimum there is owner involvement and tight collaboration between the core players, from early collaboration to final delivery. Nevertheless, this was shown only seven of the nine projects had "early involvement and collaborative decision"

The last key characteristic stated by American Institute of Architects (2014) is *Joint project control by owner and key designers and builders.*

Here the definition is slightly unclear as others have stated that it requires; "*Jointly developed and validated project goals*" (H. W. Ashcraft, 2014) & Cohen (2010) from Lahdenperä (2012), "*developed project target criteria*" National Association of State Facilities (2010) from Lahdenperä (2012) or "*Jointly developed project goals*" (American Institute of Architects, 2007a; Ghassemi & Becerik-Gerber, 2011).

It is important to mention other characteristics that have not been mentioned, such as; "*Fiscal transparency between key participants"*, *"Intensified design"*, and "*Collaborative decision-making"* from National Association State Facilities (2010) taken from Lahdenperä (2012) and "*Collaborative innovation and decision making", Mutual respect and trust, Early goal definition, Open communication, Appropriate technology* and *Organisation and leadership (American Institute of Architects, 2007a).*

Table 2 shows that the defining principles of IPD are to create a climate of trust and collaboration for implementing the projects goals. Such a relationship requires honest and open communication and only then can the parties respect each other and establish a trustful relationship. Other key elements include sharing, commitment, predictability, ownership, reliability and empowerment. It is important that all parties are meeting their obligations, looking out for other party's interests as well as their own and acting honestly and with integrity without hidden agenda this behaviour

empowers the team to trust and collaborate towards continuous improvement. Basically team members who are trustworthy (Matthews & Howell, 2005, p. 50).

This table is shows the fundamental characteristics from the latest version of the AiA guide (2014) and the primary behaviour are derived from the literature. Trust and collaboration is the basis for all five principles. It also further suggested that principles should be used in order to reduce waste and optimise efficiency

Table 1: Summary of the most recent principles from the AiA organisation (2014). Deciphered for the underlining primary behaviours.

IPD principles	Primary desired behaviour
1. Continuous involvement of owner and key participants from early design to project handover	Re-enforces trust, joint ownership, joint collaboration and integration. Allows for mutual respect and continued mutual adjustment by all parties.
2. A multi-party agreement or equal interlocking agreements.	Basis for creating a relationship of trust between the parties. It creates a binding agreement for joint collaboration and integration. Bonds participants and re-enforces equality between the key participants.
3. Shared risk and reward that are dependent on project outcomes.	Obligated shared pains and gains. Important in creating trust and aligning individual and or team's interests with the projects goals. Gives participants a sense of joint ownership Bonds participants by having a common goal and Incentives teamwork and focus on the projects goals
4. Joint project control and decision making (key participants)	Empowers the team to jointly manage the project. Important in creating trust
5. Limited liability among key participants	Important incentive that creates trust. Removes accountability and creates a safe environment in which participants can be innovate and flexible to accommodate to change.

Table 2: This is an overview of all the literature that discusses what a true IPD really is.

Integrated Project Delivery			
Cohen (2010) taken from Lahdenperä (2012)	National Association of State Facilities (2010) taken from Lahdenperä (2012)	Empirical studies from 9 projects by Ghassemi and Becerik-Gerber (2011). Characteristics coded from AIA 2007 (American Institute of Architects, 2007a)	Members of the Design and construction industry, AIA (2014) (American Institute of Architects, 2014)
Fundamental characteristics	**Fundamental characteristics**	**Fundamental characteristics**	**Fundamental characteristics**
• Early Involvement of key participants • Shared risk and reward • Multi-party contract • Collaborative decision-making and control • Liability waivers among key participants • Jointly developed and validated project goals **Highly desirable characteristics** • Mutual respect and trust among participants • Collaborative innovation • Intensified early planning • Open communication within the project team • Building information modelling (BIM) • Lean principles • Co-location of teams ('big room') • Transparent financials (open books)	• Key participants bound together as equals • Shared financial risk and reward based on project outcome • Liability waivers between key participants • Fiscal transparency between key participants • Early involvement of key participants • Intensified design • Jointly developed project target criteria • Collaborative decision-making **Behavioural principles** • Mutual respect and trust among participants • Willingness to collaborate • Intensified early planning • Open communication • Building information modelling (BIM) • Lean principles • Co-location of teams ('big room') • Transparent financials (open books) **Catalysts for IPD** • Multi-party agreement • Building information modelling • Lean design and construction • Co-location of team	• Multi-party contract • Early involvement of key participants • Collaborative decision making and control • Shared risks and rewards • Liability waivers among key participants • Jointly developed project goals **Characteristics from findings** • Tight collaboration between the owner, architect, engineer and builders from early design to project handover • Contracts that create integrated project delivery • Mutual trust inspired by bonding • Integrated team players already within an organisation. (Owner can provide planning, design, construction, space management, and maintenance services) • Procurement-Owner selection or RFQ and then RFP • Selection criteria: Prior experience in planning and design, team players, subcontractors who are already integrated, use of IT, open minded, familiar with IPD, conform to open book, and experience of working together • Use of lean tools ('Target Value Design' and 'Last Planner') • Signing of an additional joining agreement (commitment and understanding of IPD) • Lumpsum agreements or Cost reimbursable contracts • Co-location of teams ('big room') • BIM as a tool to integrate different disciplines • Owner establishes project goals (scope, quality, budget, schedule and project approval)	• Continuous involvement of owner and key designers and builders from early design through to project completion • Business interests aligned through shared risk/reward, including financial gain at risk that is dependent upon project outcomes • Joint project control by owner and key designers and builders • A multi-party agreement or equal interlocking agreements • Limited liability among owner and key designers and builders **Desired Conditions** • Early and clear value definition • Collaboration **Behavioural principles** • Trust • Respect • Joint Ownership • Integration **Catalysts for IPD** • Transparency • Safe environment • Share risk and reward • Good technology

3.5. Tools and methods for optimising the IPD process

According to the American Institute of Architects (2014) IPD projects utilise tools and methods in order to "achieve maximum results" (p. 4), it is these tools that incentivise the minimisation of waste and optimisation of efficiency. This is further collaborated by most of the literature where early involvement is specified (H. W. Ashcraft, 2014; Ghassemi & Becerik-Gerber, 2011; Lahdenperä, 2012; Matthews & Howell, 2005), however, it is categorised as a main principle. This can also be seen in Ghassemi and Becerik-Gerber (2011) empirical analysis whereby various technologies and methods are highlighted as necessary tools to facilitate trust among the participants. It is also important to note that H. W. Ashcraft (2014) does highlight that projects need to focus on "effective use of technology, prefabrication, integration of lean principles, and enhanced attention to sustainability" however these tools are not as effective without deep collaboration and integration (p. 22). Yet M. Fischer, Khanzode, Reed, and Ashcraft (2017) and Cleves and DalGallo (2012) tend to add lean as an important method tool in maximising efficiency which is in line with Modig (2012) who suggests that values, principles, methods and tools are not lean but are merely ways of realising a lean operational strategy.

This section will explain further the tools and methods that are often utilised in IPD projects and their benefits to optimize efficiency and reduce waste.

Early involvement

Early involvement involves "moving design decisions upstream as far as possible" as illustrated in the MacLeamy Curve[6] in Figure 10. This concept is based on allowing decisions to be made earlier, "to where they are more effective and less costly. This is perhaps where the "opportunity to influence positive outcomes is maximised and the cost of changes minimised" (American Institute of Architects, 2007a, p. 21). It reduces the chances for rework especially when traditionally information is transferred from design to construction (H. W. Ashcraft, 2014).

[6] Introduced in the Construction Users Roundtable's "Collaboration, Integrated Information, and the Project Lifecycle in Building Design and Construction and Operation" (WP-1202, August, 2004)" taken from American Institute of Architects (2007a, p. 21)

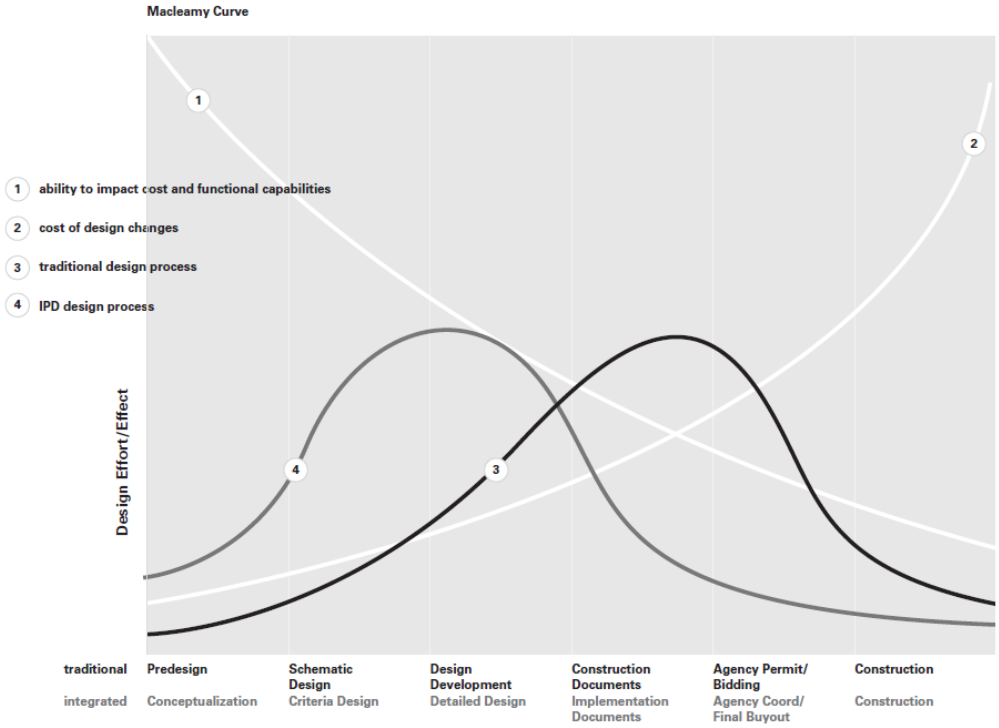


Figure 10: The MacLeamy Curve illustrates the concept of early involvement whereby design decisions are taken early in the project. Source:(American Institute of Architects, 2007a)

Target Value Design (TVD) & Value engineering

Target Value Design (TVD) is a process, see Figure 11, of designing to a financial target, using a number of iterations, rather than estimating a detailed design (American Institute of Architects, 2007a).

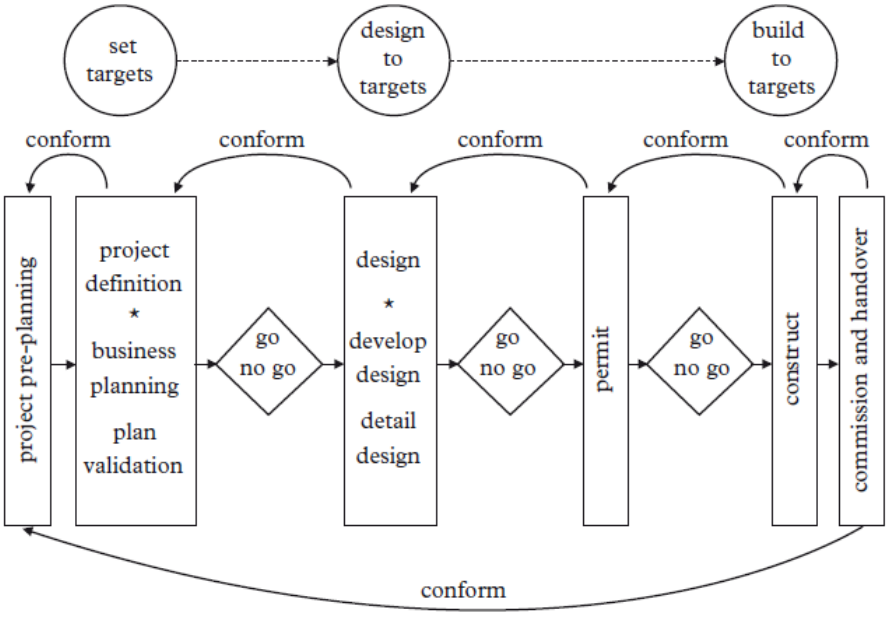


Figure 11 Target Value Design Process. Source (Zimina, Ballard, & Pasquire, 2012)

Zimina et al. (2012) state that the TVD process is based on creating value within budget constraints. It is necessary to look at the budget first and then at the values incorporated in the project goals. Designing has to be in step with the details of the estimate and the aim is customer value. In addition, the processes have to be decided as well as design. There are budget constraints, scheduling and constructability that need to be considered. The TVD team should follow constructability guidelines. The team need to work together to look at the issues involved, to solve problems, to reach decisions jointly, and then design according to those decisions.

"The aim is to define value (desired features and functions of the facility), and constraints, first of all financial, what the client is able and willing to pay to get this value It is here that the team need to consider the whole design rather than make narrow choices for an individual design. The narrow choices are often associated with alternative delivery models, see Table 3

Table 3 Comparison of Target Value Design (TVD) and Alternative delivery approaches. Source (Zimina et al., 2012, p. 391)

	Contract and cost management practices in construction	Target value design
Objective of cost management	Strives to procure a constructed asset for the least price and keep the project cost under control with cost cutting measures.	Strives to procure a constructed asset for no more than its allowable cost while reducing the price paid through gainsharing.
Function of cost targets	Target is for guessing the tender price.	Target is for final construction cost.
Setting a target	Set by client with or without cost adviser, based on cost estimates (historical data and benchmarking).	Set after a feasibility study rooted in the client's business case.
Cost and target management in design	Division of labour—designers do the design and cost advisers perform scheduled estimates of the work done. Builders' role, if any, is limited to cost estimating and after-the-fact constructability reviews.Costing the design. Value engineering as a firefighting measure. Cost targets change.	Cross-functional clusters manage cost and design to cluster targets. 'Over the shoulder estimating'. Design solutions are developed with cost, schedule and constructability as design criteria; built-in value engineering. Target cost cannot be exceeded, value targets are stretch goals to spur innovation.
Role of client	Occasional involvement in case problems occur.	An active and permanent member of the project delivery team throughout the project duration.
Project organization	Cost-based selection. Projects are organized as a sequential process. Poor information flow between the parties working at the project, no involvement of the downstream players. No staff continuity.	Value-based selection. IPD team is formed at the business planning stage. Full engagement of all the key players in the design process. Continuity of staff to retain the knowledge.
Operating system	Project management tools.	Co-location, at least weekly team meetings. Lean set of tools to eliminate process waste.
Commercial terms and role of contract	A set of transaction contracts. Contracts as a control tool. Incentives are better fitted for local optimization. Monetary motivation. Pain/gain share does not distinguish between cost, profits and contingencies.	Relational contract covers the key players. The incentives of all team members are aligned with pursuit of project objectives. Monetary and non-monetary motivation. Separation of cost from profits and contingencies.
Risk management	Risk shifting down the supply chain. Contract as risk management tools, risk is hidden in the commercial terms.	All-for-one, one-for-all thinking. Collaborative decision-making. Risk reduction thanks to the lean organization and operating system.

In order to consider the whole design, it is necessary to have specialists involved throughout, for example the mechanical contractor needs to be involved before even anything mechanical comes into play. Many will be involved pre-project, and there needs to be collaboration which needs to be on-going with the client throughout the project. Conditions of satisfaction remain flexible and can be reviewed by the whole team at any time as design and construction proceeds. In addition,

the TVD team needs to meet regularly in small groups as this is conducive to learning, innovation and continuous improvement. TVD has built-in value engineering (p. 389).

The process of value engineering occurs "at the beginning and throughout the project" and there is nothing stopping team members from holding back ideas. However IPD "relies on careful participant selection" (Matthews & Howell, 2005). This same observation has been mentioned by others also involved in case study research. "Selecting the right people for the project is crucial for success" (Zimina, Ballard, & Pasquire 2012), providing a base for collaboration. Competitive tendering should be avoided. Instead selection should be based on interviews, experience and enthusiasm for lean construction.

3.6. Relational vs Transactional Contracts

Matthews and Howell (2005) state that there are two types of contracts, transactional and relational. When describing transactional contracts, Macneil (1977, p. 900) states that "a system of discrete transactions and its corresponding classical contract law provides for flexibility and change through the market outside the transactions, rather than within them". While a system of relational contacts "remains theoretically structured on the discrete and classical models, but involves significant changes" (p. 900). These contracts are more complex and lasts longer than discrete transactions. Therefore, if these contracts are too rigid, they become dysfunctional. A high degree of flexibility is often needed in planning these types of contracts.

According to Matthews and Howell (2005, p. 60), transactional contracts only "foresee a single outcome" where the parties involved agree on the outcome value and how much money will be spent on the project. These contracts cannot be used for uncertain and complex projects where all contingencies are foreseen, risks have been allocated, opportunistic behaviour is limited and project efficiency is instilled. These situations are more suited for relational contracts because they "foresee many possible outcomes" while parties are bound to "maintain their relationship even as they pursue other objectives" (2005, pp. 60-61).

Relational contracts go beyond traditional contracting which are mostly concerned with the transfer of goods and services between parties whereas a relational contracts involve multi-party contracting whereby more than two people are bound together by one or through equal interlocking agreements (American Institute of Architects, 2014, p. 4) This section will primary focus on the different types of relational contracts.

Multi-party agreements

According to the AIA Californian Counsel (2007a, p. 32), "the primary project participants execute a single contract specifying their respective roles, rights, obligations and liabilities" in multi-party contracts. Each party's contributions and interests are known to everyone. Trust is required as compensations come from project success. They further state that success is dependent on the participants' commitment to work together as a team. Integrated teams are creative and flexible, thus making Multi-Party agreements well suited to handle uncertain or complex projects. They also state that these type of agreements require team building, thorough planning and negotiation,

which needs to take place at an early stage of the project and may be costly. Previous experience with working with the other participants and this type of project is crucial in order to limit the cost of this process. They further state that although this type of agreement varies depending on project needs and participants, there are three shared, key attributes (p. 32);

- *Parties are bound together by a single agreement or an umbrella agreement*
- *The agreement creates a temporary, virtual or formal, organization complete with management and decision making processes*
- *Processes are tailored to support the team environment*
- *Decisions are arrived though consensus and seek "best for project" outcomes*
- *Some portion of comparison is tied to project, not individual, success*
- *Roles are assigned to the person or entity best capable of performing*

The following sections focus on three multi-party agreements: Project Partnering, Project Alliances and Single Purpose Entities.

Project Partnering

Bennett and Jayes (1995, p. 2) define Project Partnering as "a management approach used by two or more organizations to achieve specific business objectives by maximizing the effectiveness of each participant's resources". According to MacDonald (2011, p. 31), this method has been developed for complex projects to avoid or minimize conflict through "unifying all the parties as stakeholders in a project into a team". There is no contract, only a *code of conduct*. Instead, the parties create a working agreement to make sure all parties benefit from the agreement. This approach has its origins from the construction industry in Japan, where Lean manufacturing concepts and total quality management are central elements. However, Partnering is generally viewed as an American approach, which is widely used in Australia, the UK and in public sector procurement in the US (Gunn, 2002, p. 3; MacDonald, 2011, p. 33).

Lloyd-Walker and Walker (2015, p. 25) state that continuous improvement, trust, collaboration and teamwork are important aspect of Partnering. According to Gunn (2002, p. 5), key elements in the partnering culture are "genuine commitment, equitable sharing of risk and benefits and developing of trust and understanding". MacDonald (2011, p. 32) adds that dedication to a common goal is important. Project Partnering can be used in both short-term and long-term commitments. The purpose of these arrangements is to maximize each participant's resources to achieve the project objectives. He further adds that each everyone needs to understand the other

parties' values and expectations. A long-term relationship may be referred to as a Strategic Alliance.

Lloyd-Walker and Walker (2015, p. 26) describe criticisms of Partnering which includes that participants need to show "strong relationship-building skills" and the agreement might remain aspirational. In order for this collaboration to work, all participants need to invest energy and support in addition to changing their mindset from focusing on what benefits their company to the benefit of the project in a market where aggressive leadership is common. This method is also dependent on a "governance system that supports is ideals". Partnering should not be applied in projects where the objectives are stable because this method requires more energy and resources than a traditional method, to achieve the same result.

Project Alliances

Davis and Walker (2009, p. 484) state that project alliances "rely on virtual organisations generating new knowledge that enabling teams to solve interrelated problems in a complex time constrained environment". According to the American Institute of Architects (2007a, p. 33) the owner guarantees for non-owner parties' direct costs, while project outcome defines profit, bonus and overhead payment.. This means that the owner has an unlimited risk, while the other parties only risk their bonus, profit and overhead. Thus indicating that the parties involved will either fail or succeed together However, in larger projects the owner might limit their risk somewhat through various economic risks or "methods of controlling market risk" (p. 39). MacDonald (2011, p. 34) states that they create a "commercial framework" which ensure "best for project decisions that are consistent with and create an environment of exceptional performance and enhanced reward for all participants"

American Institute of Architects (2007a, pp. 38-39) state that parties must waiver all claims, except for willful default, which only happens if a party leaves the project. This means that they do not need a mechanism for dispute resolution. All significant decisions are made together and upper-level decisions need to be unanimous, without dispute resolutions, which forces negotiation between parties. This model was developed for the oil and gas industry in the North Sea, but have since been used in different contexts in Australia, United Kingdom and the United States of America (American Institute of Architects, 2007a, pp. 33-34).

According to American Institute of Architects (2007a, p. 35), risk control and project success are obtained through incentives, while compensation is used in order to minimize risk of failure or

poor outcome. Non-owner parties share small cost overruns and potential gains, while the owner is responsible for major overruns. In order to receive any potential rewards it is important for the parties involved to accurately quantify and describe anticipated project outcomes, how and when these are measured, in addition to creating a key, which describes how profit is distributed among the parties. MacDonald (2011, p. 33) state that capability, systems and approaches are considered when choosing participants, in addition to subjective criteria. He further states that price is not normally considered in the selection process. He further states that a key difference between alliancing and partnering is that alliance have formal contracts, while acting in the best interest of the project is voluntary in partnering.

Criticism of Project Alliances include that it requires skillsets and attributes from the team member and participants, which can be hard to find. Thus, structural hindrance prevent organizations from choosing this method.

All parties come together in a single purpose entity

American Institute of Architects (2007a, p. 33) defines a Single Purpose Entity (SPE) as a "temporary, but formal, legal structure created to realize a specific project" and can be a "corporation, limited liability company, limited partnership or other legal form". Creativity, financial contribution, experience and individual skills are equity interests for key participants. Because this is a new legal independent entity, they must make sure they are properly insured and make additional considerations for management and taxation. Decisions finally rests on a board of directors or control, where the members of these teams in addition to their authority vary depending on the project (p. 34).

Project outcomes are the responsibility of SPE. Lender's investment is secured by project value when financing the project. The only financial risk at stake for equity participants is their equity contributions if the project faces a loss. Participants are responsible for the cost overrun risk in their respective scopes of work. For participants, liability is often modified by contracts, but is supposed to be unlimited towards other participants and SPE (American Institute of Architects, 2007a, p. 40).

Tools for dispute resolution is needed as a result of the parties ability to sue each other, and should therefore be an integrated part of the agreements. Board of Control usually make decisions of the SPE conformed to the type of legal entity chosen for the project. When disputes occur between any of the parties involved in the project, "they should be resolved through an escalating program

of direct negotiation, facilitated negotiation and then binding resolution by arbitration or litigation" (American Institute of Architects, 2007a, p. 41).

3.7. IPD contract (vs Design Build (DB) contract)

This following section will give an overview of common contracting models, its focus is specifically aimed at comparing Design Bid Build (DBB), Design Build (DB), which are traditionally the procurement models used in the construction industry, and Integrated project delivery (IPD), see Table 4. In addition, it examines the risks of using a Norwegian IPD contract used at the Tønsberg project in Norway) versus a standard Norwegian DB (NS8405) contract.

Table 4: Comparison between Design Bid Build (DB, Design Build (DB) and Integrated Project Delivery (IPD)

	Traditional -Single party contracting		**Multiparty contracting**
	DBB	**DB**	**IPD**
Type	- Transactional contracts	- Transactional contracts	- Relational contracts
Team Structure	- Hierarchical	- Hierarchical	- Flat
Contracts	- Separate (and not always consistent) contracts - Setup out detailing how to sue and claim for compensation	- Separate (and not always consistent) contracts - Setup out detailing how to sue and claim for compensation	- Interlocking contracts - Legally: direct and bind team activity - Eliminate or reduce the ability to sue and claim compensation
Risk /Reward	- Risk is primarily allocated: Owner caries the risk for design and construction. Others manage risk, transferring as much as possible. - Reward: payment based on lumpsum, instalments, per delivery ect	- Risk is primarily allocated: Builder carries risk for construction. Others manage risk, transferring as much as possible. - Owner carries risk for quality and pays for additional extras - Reward: Lumpsum payment for construction	- Risk is primarily shared. - Owner caries the risk of overspend but only basic cost - Reward: Pooled profit; distribution is based on team success in achieving project goal - Owner pays for additional extras
Decision control	- Hierarchical	- Hierarchical	- Joint decision making - Major project decisions are taken by Primary group members.

Process	- Linear information - "Silo/bunker" mentality - Sequential: Design, then Tender, then Build	- Linear information - "Silo/bunker" mentality - Design and build done concurrently	- Cross sharing of information - "Best for project" mentality - Design and build done concurrently

The differences in these models are apparent yet when compared to an IPD they are disparate. May authors have commented on the differences between the traditional types of contracting, which can be seen to involve transactional contracts as opposed to relational contracting in an IPD[7]. Transactional contracting still relies on a hierarchical chain of decision making, where silo mentally is rewarded. The contracts are not always consistent with each other and often are worded in such a way that changes in a contract are deemed compensatable. It is here that IPD is so different. Through interlocking agreements, joint decision making and shared risk and reward the organisational structure becomes flat and, eliminates and reduces the ability sue each other. It rewards success of the team by adopting best for project mentality. Ultimately the risk is carried by the owner, who is obliged to pay basic cost, only after the profit pool is used up in the project.

A clear difference between DBB and DB is that the risks are reduced. In a DB it is the builder who takes the risk for the design and the construction. He is often paid a lump sum agreement, but it is here that the owner is at risk of not knowing what kind of quality is, or has been, or will be used in the construction. In a DBB the owner runs the risk for the whole project and the sequential nature of the process where the owner contracts in a team to help him with the design then sets out a tender for the build at which point he involves a construction firm. However, one common feature of both DB and DBB is that both use a very hierarchical structure of command and control. This is also a difference in IPD whereby, joint decision making allows for the organisation to have a flatter structure which results in information being shared. In a DB and a DBB sharing of information is not rewarded, the rewards often come from not sharing information. (American Institute of Architects, 2007a, 2014; Cleves & DalGallo, 2012; M. Fischer et al., 2017)

There are many different variants of project delivery models, which often confuses the issue of isolating the differences, such as the way risk is shared via the number of contracts, the tools and methods that owner choses to use to optimise the project, mentioned earlier, the project requirements to the degree of specialisation required in the project and many more. In addition,

[7] Relational contracts, mentioned early, are also models like Project Partnering (PP) and Project Alliancing (PA). However these models can include just two parties.

there are also many different types of tools and methods that are and can be used to optimise the project.

Risk in a Norwegian Integrated Project Delivery Agreement ("IPD Agreement") versus the Norwegian Design Build (DB) contract.

Risk in contracts is an important aspect in the choice of project delivery model and entering into contracts is an important part of business therefore it is important to understand and avoid every potential risk. As a result, this subsection will examine the differences in the risks involved in the use of the negotiated draft of the Norwegian Integrated Project Delivery Agreement ("IPD Agreement") versus the Norwegian Design Build (DB) contract, often referred to as a NS8405 contract used by the hospital in Vestfold ("**SiV**") as this is applicable to the case in this thesis because of its propriety.

Jon Gresseth (2016) a lawyer who assessed the differences between the contracts, argues that the risk picture between an NS 8405 contract and an IPD agreement in the project is not very different. He states that the risks are summarised as:

> *"The overall risk picture between an NS 8405 contract and an IPD agreement is not really very much different. Therefore, we cannot see that using an IPD agreement - on a general basis – should cause greater risk of exceedances than using an NS 8405 contract. The risk of overruns will, in our experience, be linked to other and more project-specific conditions.*
>
> *If we look at the BH risk of covering the advisor and the contractor's costs exceed the agreed contract amount, so the two models look basically quite different.*
>
> *In an IPD agreement, there exists no limitation of the BH obligation to cover contract parties' costs, even if these exceed both Target Cost and Owners Cost.*
>
> *In an NS 8405 contract, often the contract amount is a fixed price.*
>
> *However, the price is no more fixed than that the contractor may claim additional compensation due to a series of events for example of omissions or changes to the design material, imposed changes, delayed decisions and deliveries from the BH or the BH advisers, delays or errors with sub-contractors, etc.*

Regarding the risks associated with changes, the differences in the contracts are not special big. As we see it, there is probably less room for requesting changes in an IPD agreement than an NS 8405 contract.

Risks related to deficiencies, ground conditions and design errors are essentially similar in the two contract models.

The risk associated with delays to the contractor can be said to be somewhat larger in one IPD agreement, as there are no daily fines. On the other hand, the financial consequences of the BH own delay is less in an IPD- agreement than in an NS contract.

Regarding the differences in the notification rules, we do not consider this to be any difference in risk associated with possible overruns of the contract sum."

A more detailed explanation can be found in Appendix 11.

3.8. Effects of IPD

This involvement of Integrated Project Delivery (IPD) can leads to a shift or change in an organisation and can influence the organisational culture. This section hopes to examine what the effects the introduction of IPD has on its participants.

Owners becomes more involved

Embarking on an IPD changes the participation of the owner. Traditionally the owner would leave it to the experts but, in an IPD, the owner takes an active part. In addition, participants take on an "ownership" mentality. In Ashcraft's group discussion with owners, Wendy Cohen explained that everyone felt a sense of achievement at the end, "it really brings together pride of ownership by the entire team" however she did not know if this was an accidental by-product or planned outcome of IPD (H. Ashcraft, 2013, p. 16).

Less arguments between actors in the value chain

One defining principle of the IPD is the IPD agreement and its interconnected rules. The direction taken by the initial agreement affects the success of the project. This agreement has been known to cause less legal disputes and according to The American Institute of Architects, "At the date of publication, no IPD has gone into litigation" (2014, p. 5). In addition the nine case studies described by Ghassemi, & Becerik-Gerber were all successful and none of them "suffered from the issues commonly observed in the AEC industry" (2011, p. 47)

IPD projects are set up in such a way that affects the behaviour of its participants. Based on interviews with professionals involved in IPD, Suttie concluded that IPD influence on organisational culture included "influencing employee behaviour and attitudes" (Suttie, 2013, p. 274) where there is no need for each participant to fight their own individual corner.

The impetus for adversarial disputes is no longer present. Without the presence of any conflict in attitudes, the participants are ready to reach a state of mutual understanding. With cognisance of other team members' perspective, come reciprocal tolerance and respect. The mandates of the contract (or contracts) has its negative elements in that it has to provide for the worst possible scenarios, but it has its positive side in that it sets the scene for a culture of teamwork and collaboration.

Change in incentives

According to H. W. Ashcraft (2014) incentives are integral part of IPD and are used to incentivise project goals and assure goal alignment.

Generally, for most projects in the construction industry the agreed outcome is often based on either: a bonus or payment for reaching milestones with a reduction for underachievement, or a bonus attached to the project process, for example future maintenance or on time project handover. Otherwise it can be based on "quality, sustainability, functionality, lifecycle costs, owner satisfaction" or whatever is agreed upon.

Fundamentally IPD "tie profit to the project and not to individual outcomes" (p. 24). By having profit tied to project goals, instead of individual outcomes, "the team is incentivised to collaborate in pursuit of common objectives" which "disincentivises selfish behaviour"(American Institute of Architects, 2014). H. W. Ashcraft (2014) exemplifies an IPD project with two main motivators: Innovation and execution incentives. The innovation incentive incentivises creativity during the design phase whereas the execution incentive motives participants, during execution phase of the construction, to bring the project under budget. On the other hand, he suggests that other incentives can be added according to the needs of the project and its participants. However, at a higher level of analysis the American Institute of Architects (2014) suggest that IPD incentivise the minimisation of waste (p. 4).

Reducing the barriers and creating direct relationships

In addition, Ashcraft's discussion with owners, Digby Christian found out that relational contracts, such as IPD, included those in the value chain and as a result it was: "much easier. You get direct relationships" (H. Ashcraft, 2013, p. 12). It is these relationships that Koskela suggests that helps with the hierarchical nature which is a barrier to free flow of information and continuous improvement. He suggested "exchange of information across organization borders" and "team building"(Koskela, 1992, pp. 48-49).

Increasing collaboration and coordination

In IPD, collaboration and coordination can be found by the solution of fusing the core organisations into a single organisation - integrated to work together and share ideas (American Institute of Architects, 2014). In an IPD, the constructors are present from the outset. They are part of the team and the team are not just focused on their own speciality. Knowledge and expertise are no longer hoarded (Ghassemi & Becerik-Gerber, 2011).. A "burning platform" is created that forces people to change, where a sense of urgency requires people to get rid of their "preconceived notions, adopt new processes, and jump into trusting each other". (H. Ashcraft, 2013, p. 12)

The group make progress together, as they are aware of risks and rewards, not just their own but for others. They talk honestly together, no longer individually focused on sectional tasks, and willing to see each other's point of view. They not only become accepting of other people's standpoint, but also flexible with an objective outlook, and they are able to collectively focus on what the customer actually wants and the ways in which the customer can be supplied with the best value. The result is "*economic, social, environmental and user value*" (Martin Fischer, Reed, Khanzode, & Ashcraft, 2014, p. 1320). It is no longer about completing unilateral contributions at the least cost. Thus, in moving from the traditional system to IPD, the thinking of participants changes from short term objectives alone to the bigger picture - optimisation and improvement of the whole product.

Adding value

With IPD, the focus is on providing value while remaining within budget. Cost is the first thing to be decided before starting on the design and the participants are co-located so that the constructor also has input. Thus, a design is drawn up within budget, and to give the participants a reason to keep within budget they have a maximum budget spend. Updated by software, the team know continuously whether they are within budget according to the amount allocated for that particular level in the schedule, and they know the amount remaining for covering their costs in the whole

project. There are also incentives for meeting or exceeding project goals. Value depends on the goals of the owner at the outset. Incentives will be connected to these original goals. If these included quality and sustainability, then these will form targets for the team. The owners Ashcraft spoke to, as related in his paper describing his group discussion with owners, were quality oriented, wanting improved value in their projects. Michael Bade talks of "quality and creativity of results" and David Tam says "we accomplished a high quality product" (p. 13)

Learning

Suttie, in her interviews with professionals, found that IPD projects made their greatest impact on organisations through lean and "the increase in understanding and knowledge" gained by co-locating with those from other disciplines (Suttie, 2013, p. 267). In the case of the majority of IPD builds, learning begins before the start of the project. It is only if the personnel have previous IPD experience that training required could possibly be only minimal. Some personnel require more IPD education and training than others. Those whose previous experience was in traditional construction need to understand the IPD system and features. However, not just training in IPD because they will also need to learn about lean techniques and lean philosophy. If they are used to paper-based documentation, a lot of training will be required in the technologies they will be using - lean tools, completely new to them, such as BIM and Last Planner (Forbes & Ahmed, 2010) However, with IPD, learning is a daily occurrence, start to finish. All those involved will find encouragement to put initial training into practice and further expand their knowledge by applying their minds to job flow, job processes, problem solving and individual learning development. Learning and continuous improvement are part of lean philosophy. The key participants are at the centre where they collaborate interactively, develop better understanding, and they work together to overcome challenges throughout.

Discoveries and innovation

From knowledge and understanding comes innovation. During Suttie's interviews with IPD participants, she was informed that some were embarking on changes as a result of IPD participation, and one said that they would have to "challenge the way we've done things in the past" (Suttie, 2013, pp. 272-273) Lean philosophy and IPD practices together encourage a situation where discoveries and innovation are likely to occur. It is part of lean manufacturing and lean construction for an organisation to provide a "big room" for the display of information and the working out of ideas (Ghassemi & Becerik-Gerber, 2011, p. 43). Discoveries and innovation might

occur serendipitously in such environment - just accidentally occur to someone. They could also happen synergistically - by the merging of ideas from different disciplines. Lean continuous improvement applies to people, products, processes and tools, so it is important for an organisation to make provision and encourage discussion and problem solving. The resulting ideas, discoveries and innovations will be valuable to the project, increasing value and efficiency. According to lean philosophy, increasing knowledge and making changes should be a continuous process, with the goal of the elimination of waste. The effect put into continuous improvement is not in itself a waste because you have to "you have to lower the river to reveal the rocks" (Ballard, 2009)

3.9. Criticisms of IPD

While IPD has emerged as a fruitful approach, see (M. Fischer et al., 2017; Matthews & Howell, 2005) it also has been accompanied by various criticisms. The criticisms relate to its appropriateness in being used on any project. Cleves and DalGallo (2012) suggest that IPD is;

> *"not right for every owner, nor will every project, contractor, or architect succeed with IPD. Not all are wired to collaborate, and many do not have the intellectual curiosity that is necessary to succeed using this unfamiliar and rigorous approach. IPD is somewhat the uncharted wilderness for most project teams and only those truly driven to explore and understand can master it.*" (Cleves & DalGallo, 2012, p. 27).

IPD *"is not for everyone or the solution for every project"* as not all projects can use this type of model because of: "*the type of owner and facility, available project financing, and the duration of the project"*. IPD *"come with increased upfront costs"* as an IPD project requires an *"increased time commitment and more leadership from the owner*" in addition to having the *"capacity and desire to participate at this level",* this is not for the passive owner (Cleves & DalGallo, 2012, p. 16).

Financing will also affect the goals of the project, for example a private building company might have a project goal to construct as quickly as possible for the best possible price, because getting to market early will often turn a profit, whereas a public institution has an outside guarantee for the project, in this case public funding, here the owner is seeking best value, because they are not selling the project and are mostly interested in better quality for the budget (Cleves & DalGallo,

2012, p. 48). However, some critics believe that IPD are best suited to repetitive and large complex projects because of the significant initial time investment to establish IPD standards and procedures (Cleves & DalGallo, 2012; Cohen, 2010).

Other criticisms claim that IPD allows for opportunistic pricing, which can occur as team members will be:

> *"tempted to pad the project cost and contingency because they are sharing in the incentive or risk of the project outcome, which will cheapen the design, or reduce scope, which would be an unintended result" (Cleves & DalGallo, 2012, p. 52).*

Opportunistic pricing occurs as a result of not obtaining a fine balance in eliminating "low hanging fruit" meaning that if the risk is too high then fear taking over and trust diminishing likewise if risk is set too low then "earning an incentive is easy" euphoria and overconfident behaviour occurs resulting in team members becoming sub-optimistic in nature.

In addition, a 2015 paper on contracts explains why there have been difficulties in starting to use IPD in Norway because:

> "*on public projects that include public funding, a competitive tendering process may be required by the public contract regulations. All countries that are members of the World Trade Organisation have to follow the Agreement on Public Procurement. In Norway, this specifically states that all public contracts shall undergo an open competitive tendering process that secure transparency and fairness in the process*" (Kristensen, Laedre, Svalestuen, & Lohne 2015 p 600).

He adds further that IPD is not suited to the system in Norway because IPD construction projects require quality which but might not be the cheapest tender. Also, for an IPD to be feasible, all parties need to be inclined to that type of construction. Furthermore, IPD requires relational contracts or equal interlocking agreements which might turn out to be impossible.

4. Reflection on the theoretical framework

4.1. Propositions

Combining the theory with the review of the literature we arrived at the following propositions for the case study compared to traditional contracts (DBB & DB):

According to the Eisenhardt (1989) a problem arises when an "agent" does work on behalf of another party, the "principle whereby actors are often guided by opportunistic behaviour, risk aversion and information asymmetry". This is normally guided by each organisation's self-interest or benefit. In the case of IPD, a completely different dynamic occurs between the owner and the actors in the value chain when the owner is more integrated and involved in all phases during construction. The contracts co-align the interests of the agents and principal, in that all key-players are bound through shared risk and reward and thereby opportunistic behaviour between the parties is reduced and as a result the owner in principal becomes an agent and the agents become principals. The shift occurs from individual self-interest to group interest.

The outcome here is that the actors in the project, since they want to earn a profit on the project as a whole, are able to accomplish this through closely collaborating together so that solutions and problems can be resolved quicker and easier. In addition, IPD aligns the participants interests to achieve value while keeping costs down in the project.

The key mechanism here is the attitudes of the people involved. Other mechanisms or conditions are the normative and owner's pressure, in tandem with the threats and pressure from the social environment and the organisation to fulfil the IPD contract. This can be stated formally as:

Proposition one IPD provides less scope for sub-optimisation and opportunistic behaviour between companies in the value chain.

IPD contracts are different and, in their stipulation of the contractual obligations of the parties, the result is a new set of game rules being established unlike the power struggles often ensuing in traditional construction projects.

Furthermore, a change of power occurs. In a DB the contractor will assume position as owner and is used to carrying the risk of the project but in a IPD this power and risk is shared between all primary members.

The argument here is that IPD changes the game rules so that all parties' interests are focused on the projects goals.

Collaboration in IPD can be seen through co-location activity whereby you can collaborate as a whole which becomes easier to get an answer to a solution rather than waste time sending correspondence while waiting for an answer. Solutions are developed through the instant exchange of ideas to problems in order to achieve the project's goals.

Risk and reward is also a condition that improves collaboration by aligning the primary and the agents to the project's goal. This occurs when the actors are dependent on the project outcomes and discuss solutions in order to ensure success and thus retain their rewards.

In addition, joint decision-making incentivises people to have a sense of ownership in the project. This allows for people to voice concerns, problem solve and jointly debate, and this leads to solutions. Furthermore, traditional contracts limit collaboration because of their transactional nature. The contract is set out detailing what, how much and when the transaction will take place. It enlists a set of rules for compensation and inflicts penalties for non-compliance. Better conditions for collaboration occur when an IPD contract, or a relational contract, details how the parties will collaborate throughout the project.

It is the process of IPD that creates the conditions for equal partnership, collaboration and unified solutions. Unified solutions occur when the parties take set-out-solutions in the implementation phase and swap them for better solutions and one party takes the extra cost in their own budget, for the benefit of the whole project. It is this change in group thinking that gives rise to:

Proposition two IPD provides better conditions for unified solutions (swapping) than traditional contracts.

The outcome here is that the conditions in the IPD ensure that the project becomes cheaper without reducing quality (getting worse). It also removes waste that may be hidden in the (embedded) budget structure.

The mechanism here is that new opportunities are discovered only when the understanding of the project has matured enough through working with the details and when there are no structural restrictions.

Alternative implementation models such as the DB model have often sketched together with a simple functional description that details the owner requirements for the build. Once a contract is signed a different dynamic occurs between the DB contractor and the owner as the DB contractor is responsible for the majority of the design and construction and the owner is no longer present, The DB contractor has control and influence on solutions, methods and products. He does not have sufficient incentive to safeguard the owners needs for constructability and costs, since the owner has no more involvement.

This type of model creates a different set of interests between the principal and the agent whose focus is on lowering costs, by looking for "shortcuts" and "equivalent or lower quality" that will help reduce construction time, save on costs thereby maximising profits. This gives rise to

Proposition three proposes that an IPD safeguards quality and customer value in a better way than alternative implementation models while maintaining constructability.

The outcome here is: The participants are motivated to work together towards the project's success. Furthermore, the collaborative nature of IPD incentivises the participants to work out shared solutions. This ensures that constructability will be equal to or better than buildability obtainable from alternative project delivery models. This is as a result of the integration of principal and agents throughout the design and construction which leads to efficiency and improvement and provides overall value to the customer.

The mechanism here is again the IPD process which includes the owner's involvement, the perceived balance of risk and reward that is shared between all actors, goal alignment with the owner's desire and collaboration which ensures constructability which occurs through the

allowance to make changes during and throughout the project. Other mechanisms can also be seen as provisions in the contract, putting value as prominence (a priority of the contract).

Customer value is defined as: a building that the hospital must have that is favourable for the operation of what it is intended for. It concerns the daily work of the healthcare staff. Secondly, the technical operations must work well with limited resources, including temperature, air quality control etc.

The owner wants reliability and value. The participants are motivated by the collaborative nature of the project, the aligned goals, and the shared risk and reward, to work together towards its success, and the successful outcome of the project includes the safeguarding of quality and customer value.

Furthermore, since the principal knows what the agent is actually doing, it is likely to curb opportunism, especially in terms of moral hazard, because the agent will realise deceiving the principal will only reduce their share of the profits.

In the case of IPD contracts, all actors are inherently responsible for the design, whereby the key players including the owner come together to determine through their collective knowledge and experience how to maximise efficiency, minimise waste, and complete the construction project on or ahead of schedule using tools such as target value design, early involvement, co-location, etc. Here continuous improvement is the goal of the project or, in other words, to be better than it was originally intended. The project's key players can suggest changes that can be used to speed up construction, which would not normally occur in a DB model. Furthermore, since the owner is involved in the IPD process, during the design and construction, he is also able to safeguard his interests in a combination of cost, quality and sustainability. In addition, the owner's involvement also has the advantage that the actors in the project perceive what product the customer wants versus the possible alternatives. Which lays the foundation for:

Proposition four: IPD, in combination with TVD, provides better framework conditions for continuous improvement and innovation compared to a Design Build model (DB).

Structure: IPD is a structure which contains organisational structures where knowledge is shared across disciplines. Associated with IPD are other structures such as contracts and tools to help optimise the project such as lean philosophy and Target Value Design. TVD sets high goals in order to reach for innovation and together with learning and reflection the project team continuously improve.

The sharing of interdisciplinary knowledge leads to learning and innovation which results in continuous improvement. The interaction of Target Value Design and project goals results in increased value within cost limits.

Mechanism: New possibilities are discovered when the costs are used as a driver for design instead of treating cost as an outcome of wasteful redesign iterations. Learning coupled with reflection allows for continuous improvement. In addition, learning and knowledge development are essential to fuel innovation.

As already shown, in IPD, there is a different distribution of power and control. Similarly, proposition 4 is derived from the differing attributes of IPD and Design-Build. The framework conditions are described by the American Institute of Architects (2014) arise from optimising the whole project: trust, respect, joint ownership and integration.

In IPD, the projects participants are brought together as equal partners. The different organisations are brought together collaboratively, whereby there is found collective knowledge. Because of the collaborative nature of IPD, these sources of knowledge come together and through the mechanism of learning produce continuous improvement and innovation.

Target Value Design drives up value and drives down cost. The TVD team, working with this lean tool aim to innovate in a way which keeps costs low without compromising the build's functionality nor its quality. Target Value Design is employed from project start up and does not just involve the TVD team but also designers, the contractor's team and subcontractors. The aim is to provide the value required by the IPD within the constraints of cost and method. The software

informs the team of the financial situation continuously, and so, through successive iterations, the team make changes and savings in pursuit of continuous improvement.

The use of early involvement, in IPD, creates a different set of rules for the architects and engineers who are more focused on designing and then redesigning the working drawings to reflect the contractor's ideas whereas constructors have a strong focus on the costs and schedule, especially in detailed design and so normally the architects and engineers are not able to fully cooperate or design without feeling constrained.

Work is organised in such a way that, it allows for a flatter structure, whereby trades are allowed to make joint decisions, come up with innovative ideas, challenge processes and suggest new ways to experiment. Early involvement is based on increased involvement and cooperation between trades. It is here that there is considerable scope for social interaction as many disciplines are exposed to new experiences and opportunities for learning. In addition, new knowledge is formed through the iterative process of repeatedly translating the owner's wishes and goals into his intended design. Furthermore, a sense of urgency arises when design decisions are moved upstream as far as possible and participants have to get rid of their preconceived notions, adopt new processes, and jump into trusting each other. This can be seen as *transcendent* learning whereby it transforms individual learner's behaviour and personality, through crisis situations, in order to get further.

5. Method

This method chapter aims at establishing the research strategy and the plan of action in order to resolve the applicable research questions or propositions. For the purpose of the current research the most appropriate research design has been determined as critical realism. It is a philosophical approach in ontology concerning what exists. Critical realism distinguishes between the interfaces of our experiences by differentiating between the real (what we don't see but experience), empirical (what we experience) and the actual world (what happens, observed or undetected) (Sayer, 1992). Epistemological is a philosophical approach in the study of knowledge and the way of enquiring our justified belief. This thesis's stance is based on abstraction. A variety of techniques will be involved in the analysis and validation of a case study. The design will be explained in more detail and the organisation of the gathering, categorisation and utilisation of data will be described in the following sections, see also *Table 5* which shows an overview of the research design.

Table 5 Overview of the Research Design

Research Design	Ontology	Critical Realism
	Epistemology	Between positivism and constructionism Inference (Reasoning/Logic): Abstraction
	Methodology	Case study research
	Methods and Techniques	Mix of methods: interviews, survey, observations and documentation.
Data collection and analysis	Literature	Assessed scientific articles, thesis's, conference proceedings, website on project, memorandum, contracts, government reports and legislation (over 1000 read with over 100 used in thesis)
	Interview	Interview guide was created whereby qualitative data was collected through semi structured interviews (Thirteen informants) Interview data: Content analysis using an adaption to the framework analysis method and coded into Excel.
	Survey	Created in Survey-xact and collected via emails, paper and online via web (……informants) Survey data: Survey-xact analysis system
	Observation	Observation of two meetings. Design meeting (fourteen subjects of observation). Production meeting (thirteen subjects of observation). Observation data: Notes taken and triangulated during interviews

5.1. Research design

This chapter gives a description of the theoretical perspectives as well as the methodology used in the thesis. This chapter follows Easterby-Smith, Thorpe, and Jackson (2015, p. 47), illustration of a tree trunk, showing the relationship between the rings, of how research projects are conducted and communicated, which underpins every research project. This analogy is used as a guide to the setup of the method section. First, from the core, the two innermost rings, ontology and epistemology, and discuss them under the term research paradigms. At this point we will examine the different research philosophies and the different inferences, the logic in moving from the research question to the conclusion. Next the methodology section, in other words the strategy used to answer the research question, is explained, lastly the methods and techniques section for data collection is proposed. Finally, this section critically assesses the quality of the research design.

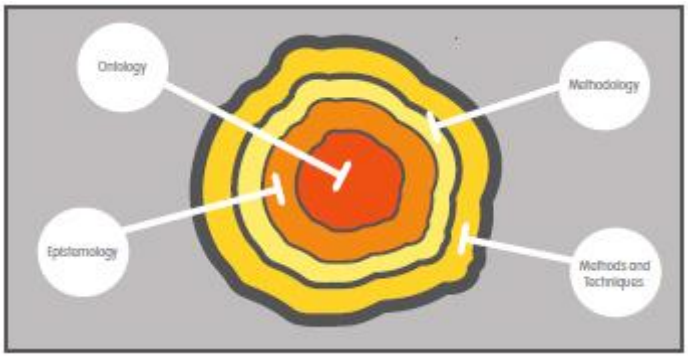


Figure 12: Representation of how research is conducted and communicated. Source: Easterby-Smith et al. (2015, p. 47)

Research Ontology and Epistemology

Over the years there have been several debates about how to conduct research which has led to many philosophical debates about research paradigms (Kuhn, 2012) in other words the philosophical approach or model in how the researcher conducts a study (Johnston & Smith, 2010, p. 46).

In ontology, at one end of the scale there is realism and at the other end is nominalism. In realism your epistemology (how you will investigate), your point of departure is based on positivism. This is more attuned to the natural sciences, where you deduce from theory and use hypothesises to test out and confirm theories. At the other end of the scale, nominalism, its epistemology is based on strong constructionism, which involves, induction from observations, which helps to create generalizations that explains the observations and is more attuned to the social sciences (Johnston

& Smith, 2010, p. 54). This thesis's ontology is critical realism and its epistemology lies between the realms of positivism and constructionism. The main idea behind critical realism is [8]:

a. Theoretically informed empirical studies (Theory should underpin the study)
b. Empirical studies should inform the theory (Findings/results should inform theory)

The reason for this standpoint is based on Johnston & Smith description which involving understanding the "underlining causal relationships". This argument suits this research and our objectives to try to explain why but also what the underlying causes of the events are beyond our perception (2010, p. 28).

Inference are the steps in reasoning that you take from the research question to the conclusion. It is your theoretical perspective to understanding what approach we can use to get out knowledge. Blaikie (2007, p. 8) states that this reasoning or research strategy is one of the most important steps that a researcher must decide on. He proposes four distinct research strategies: inductive, deductive, retroductive and abductive. Each one has a very "distinctive way of answering the research question". Inductive and deductive are the opposites of each other where one involves generating theories whereas the other involves testing out theories, which correlates to positivism and constructionism mentioned earlier. In contrast to both of these is retroductive and abductive.

Koskela (2017) goes back to Aristotle and Plato where he explains how abduction is about explanation, namely discovering the causes behind observed phenomena. He suggests that it is both a method of induction and deduction which begins with "a specific case, via observations, and seeks for explanation through induction which is then applied to other particular cases by deduction" (p. 171). Bergene (2007) claims that "critical realists often employ abductive inference" and it is this explanation that bodes well with this thesis's choice in abduction. Abductive reasoning focus goes beyond just documenting, modelling, creating or testing out theory of the event, it tries to abstract the concepts, mechanisms, meaning and motives of the actors within a social phenomenon which suits the fundamental idea behind critical realism, mentioned earlier.

[8] Presented by Arne Isaksen at a method presentation 01.02.2017, University in Agder.

Research Methodology

This section describes the methodology used and the reasoning for this approach. Here the different research methods will be discussed, to illustrate the strategy or plan that will be used to solve the research question.

The Oxford dictionary defines research as "the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions" (2017). Systematic investigation requires a research design. Yin (1994) suggests that "every empirical study has an implicit if not explicit, research design" (p. 18). The research design methodology should be carried out by using "logic that links the data to be collected and the conclusions to be drawn to the initial questions of a study". Dubois and Gadde (2002) argue that you can systematically combine the abductive approach to case research and it is from this argument that this thesis choses case study research

Yin, a significant author in case study research (1994, p. 9) states that each methodology has its own charteristics in which there are large overlaps. The goal is to avoid using a subservient methodology but to use the most advantagous method. Therefore he recommends that one examines three conditions for the choice of methodology:

a. Form of research question
b. The extent of control a researcher has over the events
c. Degree of focus on contemporary as opposed to historical events

As a result, this thesis takes the standpoint from Yin (1994) and uses case study research methodology for many reasons: First it lies within the branch of social science which is used to "understand complex social phenomena" (p. 4) and can provide a valuable understanding of real life, which we intend to study. Secondly, it is an often-used methodology in critical realism which is common method in the AEC industry[9]. Thirdly it suits this type of "what" question which is actually a "how" and "why" type research question, which we intend to study. Fourthly it suits abstraction methodology, as its focus is on contemporary events which can be examined comprehensively and "likely to involve important contextual conditions"(p. 16) then used to inform the theory. Fifthly the researcher requires, no control over the events.

It is important to explain development and change in organisations. As a result, relational coordination theory, can be used to identify elements of "effective work organisations" which have

[9] Verbalised by Bo Terje Kalsaas at a Masters Meeting 17.10.2017, University in Agder

high levels of coordination between "uncertainty, interdependence, and time constraints". "Effective organisation of work" involves an awareness of all participants to, others in the work process (Gittell, 2000a, p. 517). The areas that are found to be lacking, can be used as feedback in "identify areas of improvement and assessing progress over time" (Gittell, 2000a, p. 536). As a result, the aim of this paper is to test for relational dynamics between the coordination between participants in order to assess its impact on quality, efficiency, learning and innovation.

Case studies can be a lot of work and multiple studies might not allow for efficient study of the case study due to time limitations, so this thesis examined just a single case study. The choice of case study was chosen because our supervisor had prior contact with an IPD project in Tønsberg, Norway.

Research Method

This section examines what methods or tools and techniques that were used to collect the data based on the research methodology. Data is often collected either qualitative or quantitative and the majority of the data collected was more qualitatively.

Yin (1994, p. 103) states that collecting case study evidence can come from many sources such as interviews, documentation, archival records, observation, and physical artifacts. Yet no single source is more advantageous than the others, in fact a good case study relies on multiple sources of evidence. In this regard this thesis focused on simultaneously gathering multiple sources of evidence as it would help to give an insight into the real-life situation, the processes, mechanisms and an overall in-depth understanding of the case.

The data collection methods chosen were based on the research methodology-case study, what would best answer our research questions, to understand other mechanisms that might be in force, which might be unobservable under site conditions and what methods could help validate our findings. An example of this is incentives, they are important for understanding mechanisms and behaviours, which cannot be seen, as they are abstract. As a result, the main documentation for the thesis was measured indirectly, through observations, surveys and interviews.

(Johnston & Smith, 2010, p. 139) suggest that when planning interviews you must consider carfully, if they are going to be sucesssful, between three types: structured, semi structured or unstructured. However, critics of positivism often argue that interviews are formed by researcher bias (p. 54). As a result, it was decided that this thesis would use semi structured interviews to

allow the participators to openly express themselves while themes or topics would help guide them. This approach was a good way of validating the researcher's questions and at the same time trying not to influence the subject's answers.

Systematic Combining

Dubois and Gadde (2002) suggest that abduction and case study research can be systematically combined in relation to induction and deduction. Sayer (1992) suggests that the "problems of evaluating causal explanations are not widely understood" that it is important to analyse between two areas abstract and concrete in order to distinguish between the interfaces of our experiences by differentiating between the real (what we don't see but experience), empirical (what we experience) and the actual world (what happens, observed or undetected).

This process, shown in *Figure 13*, shows a step by step process, not done chronologically but iteratively, with many steps being revisited several times.

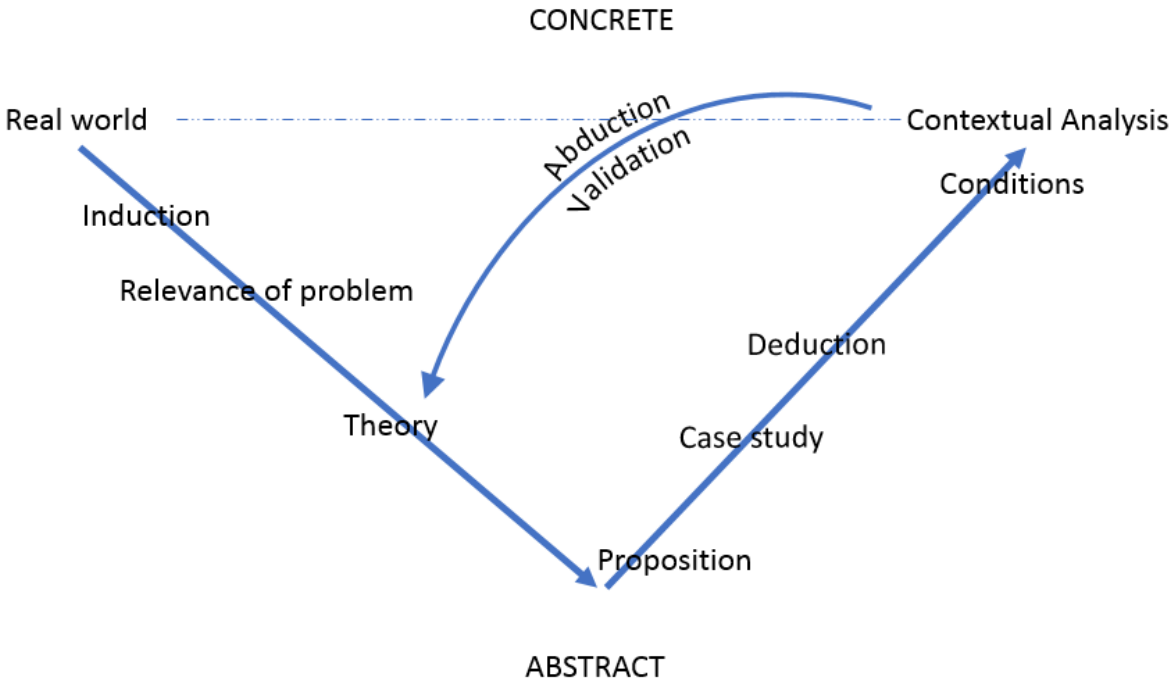


Figure 13 The thesis research design (Based on Kalsaas, 2018[1])

The model shows that from the real world a problem is induced, in other words observed, which allows for the relevance of the problem, then by examining, the theory the mechanisms and structures can be identified in abstract research. It is here that by combining the theory with the case study that the propositions emerge. Then the case is examined to deduce the conditions and contextual analysis, from the events that occur and it is here that you identify the key mechanism, from concrete research. The findings are then used via abduction to validate the theory.

5.2. Data collection and analysis

Data collection and analysis are conducted following the guidelines of abstraction. However, it is important to note that the steps listed in the research design are done simultaneously over the course of the master thesis. Data is collected qualitatively through literature, interviews and observations and quantitatively through a survey.

Literature study

Here it was induced from the real world that there is a need to understand IPD in the AEC industry. This need applies not just to private but to the public sector. A clear example is Nye Veier interest in understanding how different project development models can increase efficiency in road building.

At the start of the literature review a preliminary research question was posed with the aim of gaining an insight into the efficiency in the Architecture and Engineering and Construction Industry (AEC) using Integrated Project Delivery (IPD), while examining how IPD is realized throughout a project and to identify the key mechanisms that underpin what an IPD really is and its applicability for future implementation in the AEC industry. Hence the research question was

- *"What are the possibilities and limitations of Integrated Project Delivery Models (IPD)?"*

This then lead to sub questions which were further investigated:

  - *How and why is IPD implemented?*
  - *What constitutes an IPD?*
  - *What are the key driving mechanisms of IPD?*
  - *What are the perceived effects of IPD compared to other project delivery models*?

The aim of this literature review is to examine extensively what has been written in the field of IPD by examining empirical, theoretical as well as conjectural contributions to literature.

Review of the literature

Here there was a lot of literature to review, so a qualitative data analysis was conducted. This involved examining the theories and concepts that might be applicable. At the same time an extensive examination of the literature was studied whereby coding of key terms drawn from a literature review allowed for identification of common themes. The headings drawn from this coding system collected the attributes deemed to be most important for the thesis.

The whole analysis involved qualitative data coding. First by identifying literature and labelling by usefulness, then by reading more in-depth and highlighting text by theme then more in-depth coding was conducted from the highlighted literature to refine the sections highlighted into highly refined topics. Next the topics were re-examined to interpret any underlining mechanisms or theories/themes that emerged. Finally, the literature reviewed was examined and propositions were determined.

Literature analyses

Literature was first analysed by the most citations and what was deemed relevant was studied in depth. The analysis of these results was then used follow other authors who had been not just the main contributors but had significant issues that were deemed important. The focus was to go back and find the original source, verify that what the readers had said was correct and read literature that would perhaps be inciteful

Over one thousand items of literature, for example articles, books, reports, guide books ect were examined, of those only perhaps one hundred items of literature were used in the thesis. Access was also given to documentation in the case study. Some items were deemed important but on further examination were on topics outside of the area of research. The review tried to voice all concerns from those with an original statement, however those statements that were repeated or reiterated, original authors were cited. It must be noted that a lot of recent literature quotes from the original authors and as a result have been omitted from this review due to lack of contribution however no item read is wasted but added to the readers knowledge of what is written on the subject.

At the start of the review, the focus was on searching for the most cited or peer reviewed literature, with the hope of finding the most influential and latest contributing authors to the literature however literature is published every day and it is very unlikely that all of the most recent publications have been read.

We were also rigorous in the quality of the articles by using only highly acknowledged journals and literature related to the industry.

Interviews

Interviews are a data collection method that are qualitative, meaning that it is non-statistical in nature. Interviews were chosen as a good source of information because it could be used in critical

realism in order to gain an understanding of the underlying reasons and motivations of the events (causal mechanisms), to provide insights into the setting out of the project in other words the context and could be used to generate ideas for discussion, uncover thought and opinion, in order to quantify the propositions by the way of evaluating the phenomena critically (Sayer, 1992).

The interview process could not start without notification of the research study to Norwegian Center for Research Data (NSD) as there were new laws pertaining to personal information in research. A report was submitted 30 days prior to the collection of data.

The interview process

The interview process was designed only after permission was granted from the case study that the research could be carried out and participants could be contacted. An ad-hoc sampling strategy was then used whereby interviewees were selected based on availability. The main focus was to get at least one interviews from each of the primary and supporting members. This involved asking via email for the possibility of an interview. In addition a snowball sampling strategy was also used whereby candidates and interviewees were approached and encouraged to recommended other participants from among those within the IPD who would have time to be interviewed. This strategy was useful in this case study especially with limited access and time restrictions. Next Yin (2013) recommends using unstructured or semi-structured interviews in case studies, whereby focusing on "guided conversations rather than structured queries" (Yin, 2013, p. 106). An interview guide was created and adapted continuously by the supervisor, to account for triangulation and adapt topics according to a person's role in the organisation. The researchers felt that this type of questioning in interviews, would best suit the case study in order to identify important areas that required deeper inquiry but better suit the interviewees as they could talk more openly about what they felt was important for them.

Interviews were conducted first by informing the users by email about the study and the purpose of the research, the data collection method and a section addressing issues surrounding confidentiality and data protection.

Easterby-Smith et al. (2015) suggests that researchers should be aware of the quality of the research collected, the potential bias that can be introduced and what inference is drawn (pp. 215-217). This is in line with critical realism whereby one should look also at the objects, the mechanisms and conditions that can hidden or unseen, which could affect the meaning and interpretation that people may attach to events in what they are saying (Sayer, 1992).

Internal factors that might affect the interview process

Here there was a need to identify and understand the factors that could influence the interview process and perhaps determine the transferability, giving room for speculation about the settings in which the interviews were conducted.

The interviews were based on a short interaction with participants and it is difficult to assess the background or participants motivations. However, some internal factors that could affect the process was the researchers effect on how the participants responded during the interview as interviewees could try to impress the researchers.

Participants under interview can also be motivated to respond in a certain way. These motivations can result from their interactions with the workplace and from the interviewees personality traits. These factors can interfere with the way questions were answered in the interview as some people can be very negative and some just like to complain and use it as a coping mechanism. In addition, there might be a hidden agenda from the interviewee in trying to undermine others in the project or recruit the researcher towards their cause such as power struggle between groups based on their ego and desired position in the group. (Easterby-Smith et al., 2015, p. 215)

External factors that might affect the interview process

There are many unseen factors that are often unknown to the researcher under an interview that influence participant's response to the questions. The location of the interview could be a source of influence. Spaces can impact peoples understanding of the interview situation, this includes things like comfortable chairs, low noise and distractions. In addition, some spaces may not be seen as a neutral space (Easterby-Smith et al., 2015, p. 145). The researchers were aware of some of the factors and tried to reduce the influence of external influences, however based on an ad-hoc sampling strategy and time limitations the researchers had to make do with the meeting room facilities on site.

All interview was held by three researchers. Observations, notes and recordings were taken. After each interview discussions were held together and with the supervisor to resolve unclear aspects, compare notes, discuss the theory, compare answers to earlier interviews (triangulation) and suggest new or alternative propositions. A draft report and a list of follow-up questions was delivered to all interviewees by email. However, it was the recordings that helped reduce the chances for misinterpretation, which were later reflected on 5-7 days later.

Participation and meeting schedules

The researchers interviewed 13 participants in the case study of which all had a IPD contract or interlocking contracts. An overview of the schedule can be found in the appendix 10. In addition to the case study there we were also discussions and Nye Veier workshops whereby discussions were held on procurement and project development models. An overview of the participation schedule for Nye Veier workshops n can be found in appendix 10.

Interview data analysis

All the interviews data was analysed using a method for analysing qualitative research called the framework analysis method, which has been used since the 1980's on large scale social policy research and is popular in medical and health research (Gale, Heath, Cameron, Rashid, & Redwood, 2013). This method was adapted and consisted of 4-5 steps:

Procedure for analysis:

1. Transcribe audio files (12 of 13 audio files in Norwegian, 1 audio file in English)
2. Translate data into English
3. Sort the data and inductively "open code" the data into themes, this involved coding sections that might be relevant from as many different perspectives as possible. Codes referred to applicable themes (e.g. learning, culture, goals, challenges).
4. Once into themes, sort through the themes and put them into broader topics, see chapter on propositions.
5. Write themes into the broader topics and collate overlapping comments.

Survey creation

The survey was created in a software program called SurveyXact. The questions were specific dependant on role and position in the project. For example, the owner would get very specific questions than the architect. The survey question used a combination of selection choices and likert-type scales. These scales are used to give the user a range of response choices, such as partly agree to completely agree. The questions were worded in such a way that they were appropriate, not subject to misinterpretation or have questions that could be taken out of context. However there are some factors that affect the survey as the questions may be subject to distortion from several

causes, such as people trying to be socially correct and avoiding extreme views, trying to be defensive and to avoid negative statements and could be misinterpreted.

Survey analysis

There were 14 responses from the survey. These results were combined with the 11 results from the interview in Microsoft Excel.

It was determined that the most appropriate measure of the likert scales was to use a bar chart and calculate the percentages of the responses and then take the mean of all the responses and display the results in a spider diagram in Microsoft Excel.

5.3. Quality of the research design

There are several criteria that can be used to assess the quality of a research design. Four tests, according to Yin (1994; 2014) establish the quality of the research design based on: construct validity, internal validity, external validity and reliability, see Table 6. However, there is some debate about its use in qualitative inquiry. Qualitative researchers rejected the framework of validity and reliability as being applicable to all research. They argue that different standards for judging the quality of qualitative research should be applied to ensure "rigour". Guba and Lincoln research from 1981 argues that traditional criteria for judging qualitative research such as reliability and validity should be substituted for the concept of "trustworthiness" containing four aspects: credibility, transferability, dependability and confirmability (Lincoln, Guba, & Guba, 1985; Morse, Barrett, Mayan, Olson, & Spiers, 2002; R.K. Yin, 1994).

Table 6 Criteria for quality assessment.

Yin criteria	Guba and Lincoln criteria
Construct validity	Credibility
Internal validity	Transferability
External validity	Dependability
Reliability	Confirmability

Based on these criteria the verification of the quality of the data of the research was evaluated.

Ensuring Validity and Reliability

Construct Validity

Construct validity is about establishing correct operational measures for the concept being studied. Yin suggests that construct validity can be strengthened by using triangulation whereby multiple sources of data is collected and compared. He suggests four types of triangulation in a case study: data, investigator, theory and methodological (R.K. Yin, 1994; 2014).

As a result, the first tactic employed was to use data triangulation using multiple sources of data collection, such as a survey, interviews, observations and documentation in order to triangulate the answers from participants.

Next investigator triangulation, here multiple and different evaluators were used in the interviews. In order to employ theory triangulation, the researchers examined different perspectives supporting the data by ensuring that interviewees were asked questions to verify data collected from previous interviews and observations. This was done continuously and resulted in new interview guides being created. Documentation collected was also triangulated from the interviews, surveys, observations and with the results. Employing methodological triangulation involved using multiple methods such as interviews and observations. The interviews were taped, and notes taken to help have a clearer understanding of the events. During transcription notes and recordings validated what was heard and noted at a specific point in time.

Internal Validity

The second test suggested by Yin is internal validity concerns the determination of causal relationships. The tactic here was to analyse the data collected for expected patterns, in light of the theory, and against the propositions. This is a learning process whereby one looks for patterns in the data, that an earlier event resulted from an earlier occurrence, from the interviews and observation data. This test helped to build an explanation about the case and also consider other possible explanations to not only develop ideas for further study but to revise the propositions. This test was also used in conjunction with finding patterns in the theory to match our proposition to strengthen validity in the case study.

External Validity

External validity concerns analytical generalization, where one generalises based on theory of the phenomenon. Yin states argues that statistical generalisation should not be used to calculate frequencies in the case study. This thesis uses analytical generalization by examining the case study, to try and understand, uncover and document the unseen and unobservable events in other

hidden underneath the surface, and applied to the theoretical propositions. As a result, the finding are transferable to other contexts.

Reliability

Yins final test is reliability, which deals with how reliable the data is. Examples of reliability could be seen throughout the study as the researchers made a habit of using the same interview protocol and recording of the interview guides and schedules in order to repeat the same procedures[10].

However, the remote sending of the survey hinders the reliability of the data as the researchers cannot guarantee that respondents filled out the questionnaire under the right conditions, even though great lengths were employed to ensure user participation. Furthermore only 14 participants responded to the survey which is a weakness of the study.

It should be noted that due to the large amount of data capture in combination with the time restrictions placed on the thesis there was not enough time to treat the data.

Ensuring trustworthiness

Lincoln et al. (1985) suggests that in order to find an alternative to conventional criteria such as validity and reliability one should pose alternative trustworthiness criteria in order to ensure rigor in the process of inquiry. These are described below.

Credibility

Credibility concerns the confidence in the truth in the findings. Here Lincoln et al. (1985) suggests five major techniques: (1) prolonged engagement, persistent observation and triangulation, (2) peer debriefing (3) negative case analysis (4) referential adequacy and (5) member checks (pp. 289-327).

The first technique prolonged engagement and persistent observation was on the most part impossible, due to the location of the case study in relation to the researcher's location and the time limitations of the master's thesis however enough time was spent testing for misinformation and examining and understanding of the context and the contextual factors to identify the mechanisms that exist in the culture of the organisation. In addition, credibility was also ensured through triangulation of the interview guide and in the introduction of the survey. Furthermore,

[10] Meeting schedule and interview guides can be found in the appendices.

unintended distortions which could occur from the researchers and or the respondents, such as retrospective (misunderstanding the interviewers questions) and selective distortions (just wanting to please the interviewer) were difficult to avoid. However, attempts were made to try and minimise distortions and "expose lies, fronts, and deceptions that may be practiced by informants" by reiterating questions and triangulating answers (p. 303).

The second technique, peer debriefing is by working with someone who is unanimous or impartial after the study in order to collect valid information. It was not possible to work with someone unbiased due to the nature of the project however discussions were held afterwards with each researcher for alternative explanations and to identify the underlying mechanisms to events that would test out propositions.

The third technique was negative case analysis, where one reviews the data and reports on negative cases, in order to revisit the hypothesis. Propositions were formulated and re-evaluated during the throughout the data collection. The fourth technique referential adequacy, is where one stores raw data in order to examine later. Credibility was ensured through the collection of audio tapes which could be compared later with notes and observations viewed earlier. The last technique member check ensures overall accuracy of the study. This was conducted as all data collected was sent back to interviewees in order to verify the accuracy of the data collected.

Transferability

Transferability refers to the degree to which the results can be transferred to other contexts. This has been discussed earlier, see external validity.

Dependability

Lincoln describes dependability as a way of showing consistency in the findings. This can be done by showing that the data is valid so is it reliable. Data that is credible is then dependable. This has been talked about earlier.

Confirmability

A major technique of establishing confirmability is using an audit trail. This is a trail of research records which was created that included raw data from each interview, notes and observations, paper survey answers, confidentiality agreements and documents and records collected from the case. Through these mediums the findings are displayed objectively.

5.4. Ethical considerations

This section is concerned with the ethical considerations that have to be taken into consideration in research and that have been employed in carrying out the research involved in this thesis. Bell and Bryman (2007) discover that 50% research community that they consulted agreed on 11 principles whereby the first six are about protecting the interests of the research subjects and the last four are to protect the integrity of the research community.

The researchers protected the interests of the research by consciously promoting high ethical standards, ensuring first throughout all data collection techniques that research participants were fully informed in order to avoid deception about the nature of the research. This included declaring the researcher's involvement with other companies like Nye Veier, to ensure honesty and transparency in communications about the research.

Next the researchers protected the interests of the research subjects ensuring first throughout all data collection techniques that research participants had fully consented to participating in the research. Secondly that all participants were informed that all confidential information, such as correspondent's answers would be kept confidential and anonymity would be protected. information was given to the participants at the end of the interviews, regarding communications by offering participants the chance to change or add to their transcriptions. This was done to promote honesty, transparency and reduce avoidance of any misleading or false reporting about the research findings.

The finally ethical issue concerns the control and use of data obtained by the researcher. In order to ensure confidentiality, the research project was registered with NSD regarding the protection of data during research projects. As a result, all data was backed up on the universities external server (Microsoft Onedrive) and participants personal information was not stored but given a link key. Computer access was protected with a username and password and computer, portable devices, prints and recordings were always stored in a locked room.

5.5. Research limitations

Research often has a number of limitations depending on how the research is carried out (Easterby-Smith et al., 2015). This section highlights the limitations that were faced in the thesis.

Literature review

When examining the literature, there were many limitations in accessing the literature. There is a numerous amount of literature that was not read due to the time restrictions on the thesis, in addition, new books and articles often have limited access due to the admission given by the university, limited access to search for individual chapters and not been requested for by the library.

The literature reviewed was cited only from those having the most citations and from peer reviewed journals. In addition, the literature required a great deal of time to check and find the main authors, even from the most peer reviewed articles, books and websites. The main aim was to go back or find the original source to verify the validity of the source in question. Furthermore, most journals had the highest level in the NSD database (Norwegian register for scientific articles, series and publishers). However one of the sources, The Internet Journal of Society for Social Management Systems (ISSN 2432-552X) was not published as a known source in the database, written by (Huang et al., 2012). Despite the weakness of the source, it was used anyway because of the lack of reliable sources covering recent empirical studies examining incentives in contracts. One source that was not used was the Mckinsey report (2017) called Reinventing Construction: A Route to Higher Productivity because it came from a company which was mainly interesting in marketing its services.

In addition, there is a memorandum that comes from a law firm in Norway that has been used within the literature review. It was deemed a credible source due to its providence furthermore there are several master thesis's which were deemed reliable and were cited.

Data collection - Interviews,

Data was collected by three researchers however a major limitation within the study was the location of the interviews in relation to the researchers. This weakness was overcome through the mixing of data collection methods, such as the use of a survey and observations. In addition, interviews often have many practical limitations that impede the collection of data such as interviewees not always able to open up regardless of the trained interviewer present or the limitation in getting consistent data as the interview guide evolved based on prior respondent's answers and on triangulating the quality of the data.

In some instances, several questions did not get the respondents to express an answer, but as respondents got comfortable, they lowered their guard and eventually answered the questions by expanding on them. This made the analysing of the data very difficult. In addition, perhaps due to

the semi structured nature of the interviews and due to triangulation, the questions were slightly reworded and there could be differences according to who you spoke to.

The data was transcribed into word documents which took a long time because accents and poor audio reception.

Data collection - Observations

Observations that were undertaken, had a number of limitations mostly based on the lack of skill and knowledge level the two inexperienced researchers had in observing meetings. This unawareness limits the quality of the data being recorded as the researchers did not have and understanding what was being observed or what data was vital or trivial. However, the weakness was compensated through, the help of the experienced researcher in observing and triangulating the interviews. In addition, the hardest limitation was acquiring access to repeat observations of the same meeting in order to analyse the effectiveness organisation of work between the participants, mentioned earlier in section See relational coordination theory.

Data collection – Survey

The survey had huge limitations placed on it due to the lack of expert knowledge at the university who understood the software, SurveyXact. This limitation impacted largely the amount of time to design, disseminate and validate the content of the survey. In addition, the survey had an added element of complexity in it being created to examine several other projects, such as the Nye Veier project involvement mentioned earlier. This meant that the complexity of adapting the survey to the respondent's role as well as differentiating the design for the different organisations limited the researchers time in sending out of the surveys as planned.

Data-analysis

The majority of limitations were due to time, for example the time to learn a new software, such as Nvivo. There were no specialists available and the researchers wanted to be sure that the software was fully understood in order to fully achieve a rigorous data analysis. In order to minimise this limitation, the researchers analysed the data side by side in excel.

Based on this discussion it is evident that time is and was a factor that limited the thesis project. Further studies can attempt to learn the new software like Nvivo before starting a master thesis.

6. Case study background and context

This section explains the background and the context for the case study. The case is described including the relevant parties involved. It further describes the organizational structure and a timeline of events.

6.1. Case description

Background and goals

The Hospital in Vestfold – Tønsberg has undergone a renewal of the main part of its building. The process started in 1989 and has been divided into seven stages. Stage 6 finished in the fall of 2015, and at that point 85 % of the building mass had been renewed. The Tønsberg Project (TP) is the seventh stage of this renewal, which started in 2015 and is planned to finish in 2021. This stage consists of two new buildings; psychiatry and somatic (approximately 45.000 m^3 in total). Handover dates for these buildings are in 2019 and 2021, respectively (Tønsbergprosjektet, 2017a, pp. 5-7). The latter is connected to the existing infrastructure, while the former is a detached building. In addition, the project also includes demolition of existing hospital buildings, adaption to existing public infrastructure and energy installations (Tønsbergprosjektet, 2018).

A pre-project was approved by the board for SiV on 23rd May 2014, followed by an approval from the board in Health South-East (Helse Sør-Øst) on 19th June 2016. Health South-East also approved a mandate on 10th March 2015. Contractor and consultant have been a part of establishing the pre-project and were contracted on an early stage in order to contribute with expertise to develop solutions. They have both committed to a completion cost and a progress plan (Tønsbergprosjektet, 2016, p. 6). The purpose of this phase was to establish a foundation to decide how to execute the Tønsberg project. After contractor and consultant had been contracted in June 2016, they established a model and a cost estimate. This cost estimate turned out to be much higher than the cost frame for the project; which resulted in a quality assurance process to check whether the problem was with the new estimates or the original cost frame. The revised cost estimate was still 300 million NOK over the cost frame; which started a round of cost-cutting measures, internally called Sprint 300 (p. 11).

For this project, there are two groups of conditions; those decided by external and internal actors. The former conditions include health and safety requirements, the use of openBIM though all stages of the project, the "early-stage guide" from the Health Directory provides the basis for the project implementation and making sure SiV meets the requirements to meet their patients' needs.

The internal actors set conditions including the project budget, when the two buildings would be finished, the use of BREEAM NOR for environmental classification method (first aimed at level Excellent, then reduced to Very Good) and the use of Lean, Last Planner, IPD, Integrated Concurrent Engineering (ICE), Target Value Design (TVD) and Choosing by Advantages (p. 12).

Project result goals are to build faster, cheaper and better than similar (traditional) projects. Construction time is based on the average of similar projects (mainly hospital constructions in England). LEAN principals and prefabricated concrete construction, facade elements, modules for technical guides in corridors and bathrooms are elements used to reduce this time. They aim at reducing building costs by 10 % (compared to similar hospital projects) by using prefabrication and industrialized construction. During the detailed design phase, the team aims at discovering new ways to improve efficiency through these two methods in addition to Target Value Design. Choosing IPD as delivery model and early involvement from the contractor and sub-contractors has given the opportunity to a delivery model with a high level of maturity, while incentives help reduce costs. This in addition to standardization are central elements for cost reduction. The last result goal is to build better than similar projects by using IPD contract, industrialized construction methodology, aiming for zero injuries, having high environmental and energy requirements (Energy Label A and passive house). Digital collaboration and use of BIM is being used to support the design process and construction phase through colocation, digital processes and common data platform, 4D and 5D. LEAN principles guides the project performance in design, planning and construction process (Tønsbergprosjektet, 2016, pp. 16-19).

The report for the preliminary project (Tønsbergprosjektet, 2016, p. 13), state that in order to achieve their goals they have chosen to establish common tools and references for everyone involved through an IPD contract, colocation and digital interaction. Furthermore, the contractor, Skanska, was found through a tendering process, which was designed to attract qualified companies. In addition, contractor and consultant group were chosen based on the right competence and capacity. IPD was chosen specifically in order to achieve the project goals of cost and time reduction. Activities in the preliminary project were conducted in order to support the project goals. To facilitate a good hospital care and efficient operation for SiV, TP has designed for a 60-year long lifetime for each building with flexible areas and structure to adapt to changing clinical needs.

BuildingSmart International awarded Tønsberg project for having the best project in the category for Design Using Open Technology. TP have used open technology to encourage efficient

collaboration between the parties through a shared platform, where they have worked on an existing design software and developing a new software (Tønsbergprosjektet, 2017b).

Basis for contract

This project is the first to introduce an Integrated Project Delivery (IPD) model in a Norwegian context. The project organization consists of three parties; TP's board, entrepreneur (Skanska) and a group of consultants (CURA). As consultants and main entrepreneur were selected for the project, they initially signed a *Memorandum of Understanding* (June 2016), as a document attachment to the contract, which showed a joint intention to use IPD as the delivery model for this project. Before IPD was chosen, the contractor signed a NS 8407, in addition to the Memorandum (Tønsbergprosjektet, 2015). They committed to conduct the project in accordance to specified costs. IPD was chosen in order to reach their goals to both reduce building costs and time, through close collaboration between the parties (Tønsbergprosjektet, 2016, p. 15). In addition to the three main parties, three technical sub-contractors have signed a mirrored IPD contract; Bravida, Haaland and Assemblin (Tønsbergprosjektet, 2018). Figure 14 shows how the different parties involved are connected to the project through different contracts.

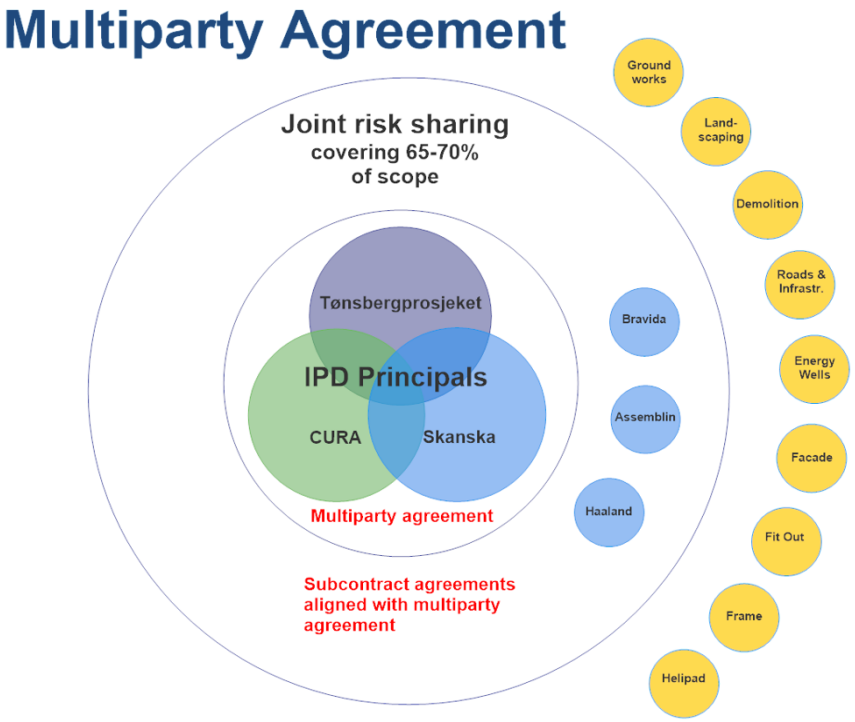


Figure 14: Multiparty agreement from Tønsberg Project (Tønsbergprosjektet, 2018, p. 22).

When signing the Memorandum of understanding, the three parties (including main sub-contractors) agreed to work towards implementing IPD in the project and creating a joint contract

based on an IPD delivery model. In order to integrate IPD, representatives from the main parties, along with some of the main sub-contractors, traveled to California, USA, to learn how an IPD works and study an ongoing IPD project. With guidance from an American attorney with experience from IPD contacts, they set up an IPD contract customized to conform to Norwegian laws.

Parties

Project owner / Client

Vestfold Hospital Trust (Sykehuset i Vestfold HF, SiV) is the project owner and client. Their executive body, Tønsberg project, is responsible for contract signing, planning and execution of the hospital construction (Tønsbergprosjektet, 2015).

Main Contractor

Skanska Norway Ltd is solving this task alongside Skanska Construction UK Ltd UK through a joint venture. Skanska is a world leading project development- and contracting company, with expertise within construction, development of commercial premises, residences and projects in public-private collaborations. They aim to become first choice when it comes to green projects based on their global environmental expertise. Today, they have 43.000 employees throughout Europe and USA (Skanska, 2017).

Originally, a Design Build contract was assigned Skanska AS and Skanska UK, where the sub-contractors Assemblin, Bravida and Haaland are a part of this contract. Estimated construction costs are 1.3 billion NOK (Tønsbergprosjektet, 2015).

Designer/Consultant Group – CURA

CURA is the name of the group of consultants for this project, which consists of; Multiconsult ASA, Hjellnes Consult AS, Erichsen & Horgen AS, LINK Arkitektur AS, Bølgeblikk Arkitekter AS and Henning Larsen Architects. CURA signed the contract in June 2016, which covers all consultant services in the project. This contract is worth approximately 200 million NOK. Together they deliver all consultancy services required in a complex public construction project, including engineering and architecture (Tønsbergprosjektet, 2015).

Economy

According to the preliminary project report (Tønsbergprosjektet, 2016, pp. 20-21), Tønsberg Project has an estimated price of ca. 2.7 billion NOK. Figure 15 shows how project cost and risk have been allocated for the parties involved, including technical sub-contractors, according to the IPD contract and project structure. Cost estimate for this project was established in the preliminary project and is divided into responsibility and contract areas for execution. They further state that principals that are important for establishing this estimate include:

- Joint agreement with contractor, main sub-contractors and consultant group
- All parties success depends on project result
- Risk and reward is separated from all main actors
- Cost reductions according to target price is split 50/50 between owner and parties
- When exceeding target cost; first the IPD reserve is cut into, followed by profit, and then the owner covers direct costs for parties.

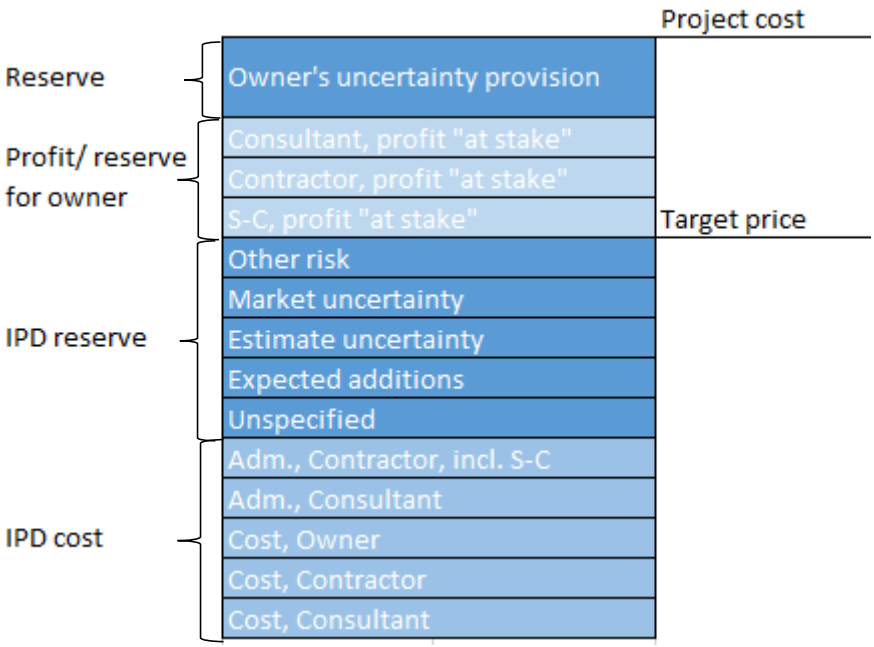


Figure 15 Cost and risk allocation according to IPD model (Tønsbergprosjektet, 2017a, p. 22)

6.2. Organisational structure

IPD was chosen as delivery model because it utilizes LEAN Construction as methodology, new technology (like BIM), and collaboration through relational contracts. Through this model, the different interest form client/owner, contractor and consultant group can be integrated in the same project. New technology also makes sure everyone can work on background material that is continually being updated. One of the main reasons for choosing an IPD are the incentives to work for a higher value for the hospital while focusing on lower costs. These relevant aspects of IPD are being utilized in TP (Tønsbergprosjektet, 2016, p. 27):

- *Relational contracts*
- *Gathering around common goals*
- *Early identification of shared risk*
- *Early involvement of all key competences*
- *Management is shared by all*
- *Openness about costs*
- *Use of Lean Construction methodology and tools*
- *BIM- virtual design and construction*
- *Colocation in Big Room*

Figure 16 shows how the project is organized; the project board leads the project while being governed by the hospital and the Tønsberg project is the executive body for the hospital.

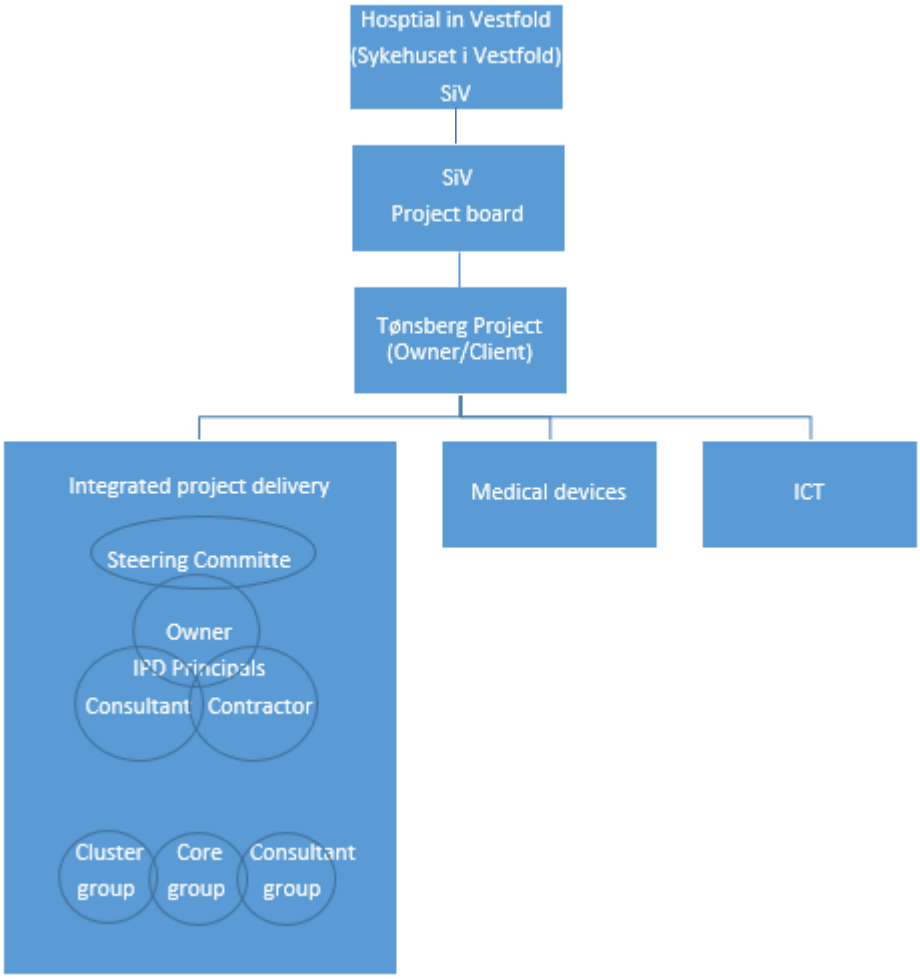


Figure 16 Tønsberg project organizational chart (Tønsbergprosjektet, 2016, p. 27)

IPD principals is a management group with participants from the three main parties; owner/client, consultant group and contractor. "The goal-oriented design, and eventually the construction, will

be carried out in an organization where the project is divided into cluster groups, assisted by core groups and consultancy groups" (Tønsbergprosjektet, 2016, p. 27).

6.3. Timeline of events

The timeline of events shows the milestones and project deliveries the project has gone through, at the time this thesis was written, see Figure 17. According to TP's feasibility study report (Tønsbergprosjektet, 2016, p. 26), the feasibility study for this project was decided to be conducted by Health South-East in 2014. Here they decided to give the CEO the role of project owner while SiV became the legal owner. In accordance with the owner's mandate, in March the following year, the project director, project organization and board started the project feasibility study. From there it took five months (March – July 2015) establishing the client organization, which consists of 20 people. These participants include "employees from SiV, project employees and employees hired through framework agreements as well as *Sykehusbygg HF*" (p. 26).

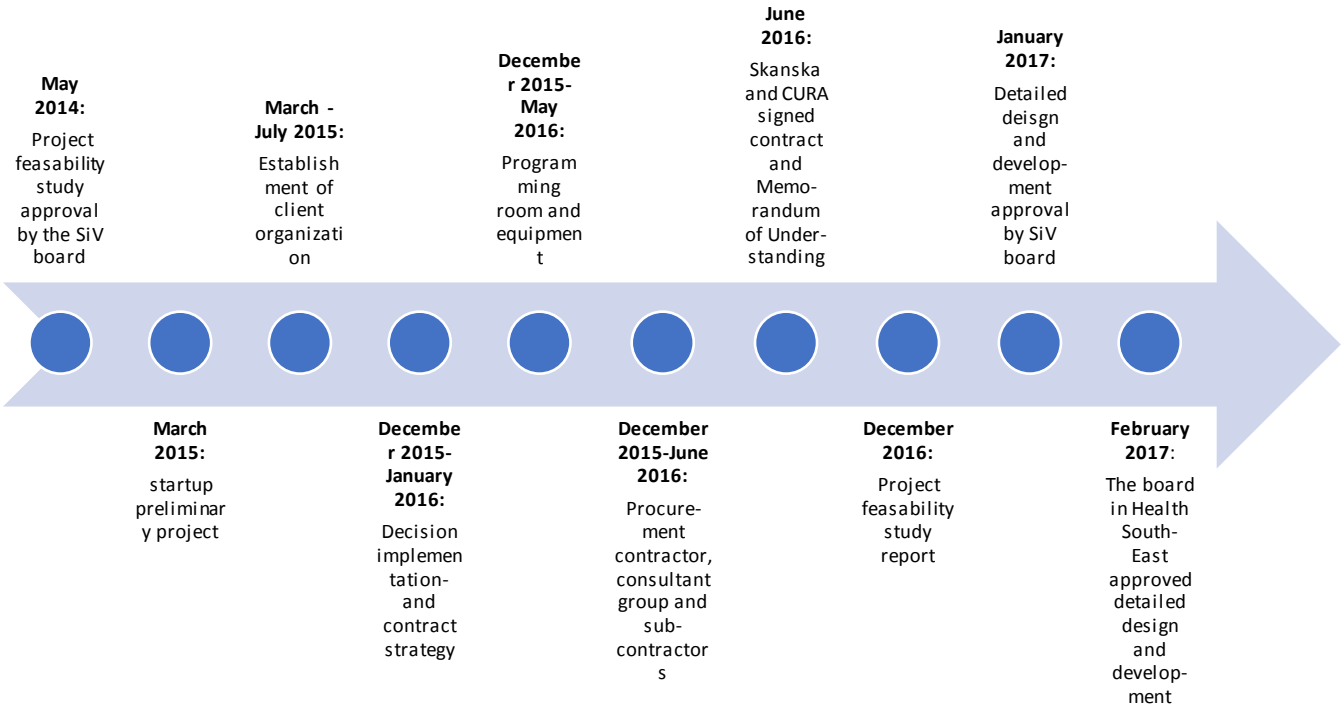


Figure 17 Timeline showing passed milestones and project deliveries

From December 2015 through January 2016, they worked on finding a contract strategy in addition to finding strategies in order to complete the project plan (like BIM, VDC, Big Room). The procurement process for consultant group, main contractor and sub-contractors started in the same period as they decided on what type of contract they wanted for the project. This process was finalized in June 2016. At this point, the contracted parties signed a Design Build contract with an incentive to go over to an IPD. SiV's board approved detailed design and development in January 2017, which was followed by an approval by the board in Health South-East a month later.

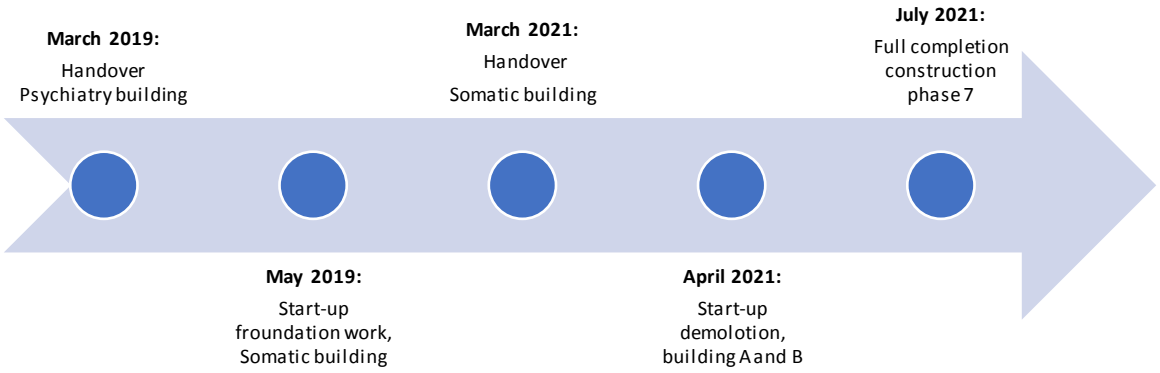


Figure 18: Timeline showing future milestones and project deliveries (Tønsbergprosjektet, 2016, p. 29)

Figure 18 shows the remaining milestones and deliveries the project is yet to complete. The first milestone for the project is in March 2019 when the Psychiatry building is to be handed over to the owner/client. After that the foundation work for the Somatic building will start in May 2019. The Somatic building is scheduled to be finished in March 2021, followed by demolition of two old hospital buildings before construction phase 7 will be completely done in July 2021 (Tønsbergprosjektet, 2016, p. 29).

6.4. Contracting process

Tønsberg project started with defining the specification in the Sketch project (B3) in accordance with a Design Build. In this phase, they determined what and why they were going to build. Client organization was established during a time when this was not completely finished. The next stage, B4, was a decision point, based on the feasibility study containing the project delivery model, process, team etc, Hospital board approved the project and was given a go ahead, see Figure 17.

It was unknown whether TP was going to use an IPD or a DB (NS8407) contract. Which project delivery model to use had not been officially decided by the steering committee, and there were

several who opposed using the IPD, as it was considered an unknown model. It was only accepted by the controlling committee at the very last minute to proceed with using an IPD model. The process towards deciding on an IPD as a deliver model started when considering collaboration under the 6th building phase. Karl Oscar Sandvik (consultant) came to talk about quality assurance in June 2015, where he introduced the topic of an IPD thinking.

Procurement process occurred in accordance with public procurement legislation. During the prequalification and assessment phase, participants were requested to send in information regarding their intensions to solve the problem as well as how they would carry out a project using an IPD. Measurable and evaluation criteria was set up to measure the actors experience with Lean, TVD and BIM tools, IPD, past projects, right mindset, ability to collaborate (weighted heavily) based on prior projects, background checks and interviews.

There were ten offers in the consultant group including some of the largest Norwegian firms, in addition to German, Spanish and Chilean firms. For the contractors there were three companies competing against each other: Skanska AS, Hent AS and MT Hagar AS. A Danish company had to pull out of the process when they heard about the shared responsibility, because they did not have support from Copenhagen. In this group, Hent was the most positive towards working with an IPD.

When evaluating the different companies' measurable criteria, they weighted 20% on price, 40% on task understanding and how they intended to conduct an IPD and the last 40% were on competence. The consultant had an hourly price, while the contractor had a square meter price and a mark-up. Both groups were given a task to examine a BIM model, and then give a price.

Selection of consultant and contractor occurred, after the owner's representative was in place, in June 2016, yet there was no official IPD contract, instead they were given a letter of intent on behalf of the owner and a NS8401 (standard contract between owner and consultants/architect) and NS8407 (DB contract for contractor). This letter was a promise to enter, in conjunction with both parties, into an IPD contract. The contracting process consisted of CURA, Skanska and SiV in addition to their respective lawyers, where they started a process of adaption to contracting rules for the IPD. SiV has not removed anything other than medical-technical equipment and some ICT. Risk-reward members, Bravida, Haaland and Assemblin, have mirrored IPD contracts to the primary IPD contract.

In April 2016, they got Howard Ashcraft in for a conference/seminar. All those in the contract negotiations and the tender team (who helped write the tender) were involved. There was a mismatch in some areas when starting up, where key persons were not involved enough in the tender teams. Documenting the contracting relationship took time, which lasted around seven months, from August 2016 to March 2017. There was also a three-month strike in this period.

With the contractor, they had to differentiate between two offers and give them feedback on topics they could improve. However, they were not able to see whether it was better or not than the others. All offers were very similar, however, there were small differences, like individuals' competence. Skanska had good details about IPD, initiation and completion, so did the consultants who had good competence and experience. Hent, were good at Lean development and gave good information. From the contracting process, there was one access request from the company rated second best among the consultants.

7. Discussion

The following chapter discusses the empirical findings in relation to the theoretical framework, consisting of the applicable literature and theories, presented earlier in the thesis. The discussion aims to explain the results, examine their significance the theoretical importance in relation to the findings and outline and identify any new research questions or areas for future research that could be suggested.

7.1. Proposition 1

When addressing proposition one: IPD provides less scope for sub-optimisation and opportunistic behaviour between companies in the value chain.

However, one representative for the owner (SiV) states that opportunism occurs because:

> *"the users are in one way trying to maximise their part and the contractors are trying to minimise it"*

Representatives for the contractor also reveals that there are two sets of users, the service and clinicians. Her it is the service department that is the dominant factor. A good example from another representative for the contractor explains the problem as:

> *"The customer wants something evaluated and then you spend two days, then you show him, and he says; its good but it's too expensive, I don't want it! Now you have lost two days considering alternative plans, scenarios and materials. You can claim compensation but it's difficult, while in a DB you would demand payment before taking this type of job."*

They further blame the designer's involvement as they have:

> *"set up a bad precedence in terms of consulting with the owner. The owner has a different agenda from what the project has, even though they have their own representatives. It doesn't stop them from asking for more."*

These views were corroborated by the representatives for the owner and technical consultants. The findings also show that all participants interviewed, bar one, had expressed no opportunistic behaviour in the setting up of the contract. One informant, emphasised that some element of opportunistic behaviour could be attributed to the contractor who priced up the project and "held costs internally". However, through triangulation, this statement was found to be contextual, as

the project was first priced up first as a DB and then changed to a IPD project. These aspects will be discussed later in a section on contextual factors.

Other findings from individual participants expressed that: "some people were not doing their job" and claimed that they had to intervene in a process to give advice and opinion which allowed his company to make "*changes and reduce the cost*.

The picture painted by both the representatives for the contractor, express opportunistic behaviour outside the IPD. They state that:

> *"sub- optimization, from DB, is it all gone when it comes to IPD. However, there is opportunism from the guys who get paid a fixed price (per item) for their work. They are good at negotiating money and demands, proper business people. Otherwise, in the rest of the project, it would be visible and there is no room for it in this project. The IPD comes into force and we work closely together."*

> *"The problem also lies by them sticking in variation messages"*

A point that did emerge from the findings was that there might be some elements of sub-optimisation and opportunistic behaviour between companies in the value chain based on past behaviour that is inherent in traditional contracts, such as DB.

According to the consultant's informant:

> *"It takes time and cannot occur overnight because of the more silo thinking, at least on the design side. Designers think more about own work; structural and electro think instead of doing their work. Instead of thinking about the entirety and looking at the interfaces and solving them for the next man tasks."*

Yet according to the representative for the owner:

> *"People are still affected by their past experience. Whenever someone recognizes a similar situation to what they have dealt with before, it is easy to suggest the same method to solve the issue"*

Whereas all representatives for the contractor argued that some of the reasons for the siloed mentality is due to *"not everyone understands what it means to work in a IPD*" that it depends on the people.

One representative said even though "*all conditions are right here for people to work together and there is no definitive answer to that……"* He further adds that *"situations are handled differently because it has to do with people. Unwanted situations can be handled if you're a bit open, you'll find a solution,"* yet he reflects that *"this is not perfect in other projects either."*

Another suggested that:

> *"IPD works best with those who have less experience of alternative delivery models as they don't have egos that make them feel that they are the most important person on the project." Another added that "people like to revert back to what they know"*

Whereas one representative for the owner's states that

> *"IPD boils down to people and not everyone can work in the environment. You need people who are flexible, who want to cooperate but also want to cooperate to make it work."*

In addition, the representatives for both the owner and contractor expressed awareness of the past behaviours of the consultants. Both suggested that blame could be pointed to the consultants because some of them were so used to working in a DB environment and its

> *"because it is an organisation, made up of many different businesses which work differently.*

Furthermore:

> *"It's the way we are organized that people still think this part is just mine and everything else is on the periphery. This is not our goal." "Often parties do not want to build something that is not a part of their budget. They think they should get additional money for that. They then have to be reminded that their budget is not the contract, here it is the function"*

However, some suggest that:

> *"Consultants have a different focus, because they work in a completely different market on a daily basis." "In a DB, consultants are used to creating more work for themselves based on volume of hours. In the IPD the consultants get a fixed price to get the job done, not per hour, which means they will have an incentive to deliver in less hours to earn more money."*

The reason for this type of behaviour could be linked to individual bonuses that would be linked up to the volume of hours generated during a project, so it depends on what drives a person.

However, one informant for the owners, said that:

> *"I think it's the IPD model that benefits the owners, however I hope the consultants find it easier to earn money in this model than in a fixed price (traditional) model"*.

According to one of the informants the architects are not aligned with the goals of the project because they have an agenda.

> *"they will leave in the summer and all they think about is their portfolio, they are not aligned. Individually there are too many agendas"*

This was verified by the representative for the consultants who said that

> *"the architect would rather choose a solution that they think looks good and maybe is a bit more expensive."*

This was also verified by a representative for the contractor who stated that

> *"Decision making and how decisions are brought to the table is a challenge. Lean management techniques do not work for designers. Designers don't like to be pigeonholed, it's a different style of management and you disturb peoples remit which is really confusing."*

This together would imply that some of the architects have an incentive to be very creative and put in the most aesthetically pleasing features into the build in order to enhance their reputation. However, this statement must be seen in relation to the differences of interest, in other words the motives in the project. The differences could be seen between the consultants and contractors in the project. Representatives for the contractors suggests that:

"When we are working together, we think differently in different phases of project. We have different goals in implementation than in the pre-project phase." "There is a disparity between the two cultures, one in the project team and one in design."

"We are not so much opposites as we are relatively united." "The designers are not sat in parity with us, because we don't have the same agenda. Constructors are used to working with compliance, costs and time whereas designers are not used to thinking so much about that we have to point it out"

However, they also argued that the reason for this was perhaps because:

"The designers, because of familiarity, still think they need to consult with the hospital"

And

"collaboration between the constructor and those in the project team vary slightly from person to person"

It was pointed out that the causes for these differences is the principle of joint decision making which creates the flat management structure. As a result, a hidden effect in IPD is the change of power and game rules in the project. As representatives for the contractor point out:

"In a DB as a contractor, we would have greater ability or impact in safeguarding our interests and also claim additional payment for waiting and delays" in addition *"We would always be looking for whose fault it was and then try and notify the architect or the advisory builder."*

"In a DB it's easier to be less flexible in the contract, because in a IPD you solve conflicts as you go, and you don't position yourself with emails and letters towards the end of the build and then have lawyers arguing for months."

Another point that emerges is that:

"IPD is different it allows for equal partners, its fast to lose respect for one another, control people and have power in a DB", "you don't own the designers anymore" "where you would control the engineering and designers", "so you can't influence them in quite the same way" "Now it feels like we are all betting on the same horse……. we are two thirds of way eliminating the disadvantages of a DB"

However, one representative for the contractors was critical to having a democracy and stated that in a traditional project "*I would have been the planning specialist here*". and that the power should be allowed to return to "*the building contractors who are good at finding solutions at the right price*". However, a consultant expressed the feeling that in the democracy

> *"There are different views, many more parties, many people, many who have opinions. It's a flat organization where the strongest party wins here, and everyone has their good arguments."*

However, in reflection he states that there are *"Improvements in the process."*

While most participant expressed that there has been an issue with decision making and unclear roles when there has been a flat management team. Comments such as:

> *"we have this IPD contract and we should have a democracy…… I think that one must keep some areas of responsibility….and we have let it flow a bit ……and this has been a challenge"*

However, these comments were considered contextual due to the forming of a new IPD contract in Norway and the abrupt nature of events which caused a number of knock on effects that purported the participants views on decision making in the project and will be discussed later in subsection, contextual factors.

Yet some citations were undetermined, as to their contextual or part of nature of IPD, for example the production department felt that:

> *"internally the production meetings have become design meetings"* and the challenges in the IPD were in *"planning the day and making decisions about what to do".*

Another undetermined comment expressed by the representative for the technical consultants was:

> *"normally we go through several rounds to get to the solution with the builder but once we get the nod, then it's okay. But here there will be a new round afterwards. It's the biggest challenge here I've seen".*

The data reveals that there is less opportunistic behaviour in the project the majority of interviewees felt that the primary and supporting key members are aligned in the IPD. Examples suggest that:

> *"Nobody tried to sub-optimize." "Compared to traditional projects, all the way from the start, the parties involved have played less games, especially the ones who were involved in creating the contract"*

In addition, the majority of the respondents point out that one of the reasons is due to the shared risk and reward because it:

> *"removes conflict so that you have a common goal which means everyone has a win, win situation and there is "less opportunity, because it affects peoples profits."* Furthermore, *"there is transparency"*

Whereas representatives for the owner states that:

> *"IPD requires trust"* and if the *"contractor lost rights to be compensated for errors in design, all bear the extra cost"* in addition there is *"Low risk as all can lose profit but it never goes less than in zero, so you are assured your costs regardless"*

However, co-location was not mentioned as a theme to hinder opportunism but rather as a benefit to resolve or discuss issues instantly, which could be seen as a mechanism for hindering sub-opportunistic behaviour.

Sub-optimisation and opportunistic behaviour is inherent when two or more parties enter into a contract. When looking at the findings it is important to identify if less of this behaviour is apparent.

The findings show, from those interviewed, that opportunistic behaviour was not evident in the project. The disposition of the contract on risk from Jon Gresseth (2016) a lawyer who assessed the differences between the IPD and DB contract also contributes evidence to this statement. However, his assessment does shed light on how the owner takes on more risk in being liable for all costs in the project after the profit pot is used up and also shifts the responsibility for delays over to the contractor.

At its roots, Principal Agent (PA) theory by Eisenhardt Eisenhardt (1989) is somewhat consistent with proposition one. The contract with reduced liability, shared risk and reward and joint project control and decision-making, limit the problems that normally would arise through risk aversion, opportunistic behaviour and information asymmetry between the parties. In IPD, the owner's involvement and shared risk and reward helps to guard against moral hazard, and also relationships

between companies in the value chain are in held in balance through transparency, thus reducing opportunistic behaviour, such as adverse selection which is consistent with the theory. However, this is under the condition that all of those in the value chain are inside the IPD framework.

On the other hand, hold-up problems described by the theory from Schieg (2008) are a topic for discussion. On one hand hold up can be solved with a very well detailed contract. As the details of the IPD contract are not fully known, it is unknown if the IPD contract could be renegotiated once signed. On the other hand, in this project an option contract was used, so the problem of hold-ups would not happen between the owner and those in the IPD, however this does not account for contracts between IPD members and outside subcontractors.

The empirical findings are also broadly consistent with transaction cost theory by Williamson (1979). Evidence shows that trust is a feature that arises when companies collaborate within the IPD, this concurs with the theory based on Schieg (2008) and Lloyd-Walker and Walker (2015). However, trust can indirectly affect the transaction costs because of the need or lack of information needed as a result of the element of trust between the parties. Thus, because of the existence of trust, there is less need for verification of their behaviour, and the searching, monitoring and of information exchange is reduced, leading to lower transaction costs.

The findings are also consistent with game theory as they show that participants in the case study choose to cooperate as they understand the costs and benefits of cooperating rather than competing.

When we examine the incentives of those in the value chain, we see that the owner (SiV) has the incentive to make the project a success by adding value and optimising the building process, in other words is incentivised to get best value for the money. The contractors, engineers and architect all have the incentive to work together from the shared risk and reward. Their incentive to work together is also increased from the opportunity to gain more profit, through the shared pot, from finding better solutions that increase value and lower costs and through executing the building project ahead of schedule.

All are incentivised under shared risk and reward for the build to be a success. It is the incentives for the people to work together and the attributes of the IPD that interact to bring about an outcome (the build).

In critical realist terms, the incentives are the mechanisms which could be seen as the micro-macro mechanisms.

Yet macro-micro mechanisms can be attributed to IPD, lean philosophy and lean tools. Again, it is a matter for debate, the effect of these mechanisms as they are often unseen and hidden. Another point for debate is the measure of the effects that monetary and non-monetary incentives have in making the individuals in the project less likely to be suboptimal. These non-monetary incentives are things unseen like trust, praise, reputation, opportunity to use your skills, ect, however these might be seen as minor as all individuals need to make money in the project. In order to identify elements of the effective organisation of work, relational coordination theory was applied by Mary parker Follett.

Relational coordination

In terms of relational coordination the emperical results were collected, from a combination of eleven participant asked in the interview plus fourteen of those asked in the surveyand combined to make a total of 25 respondants. The individual results from relation coordination theory showed, that in all the seven areas sixty percent of particpants were either in agreement or total agreement with the teams performance, see appendix 13.

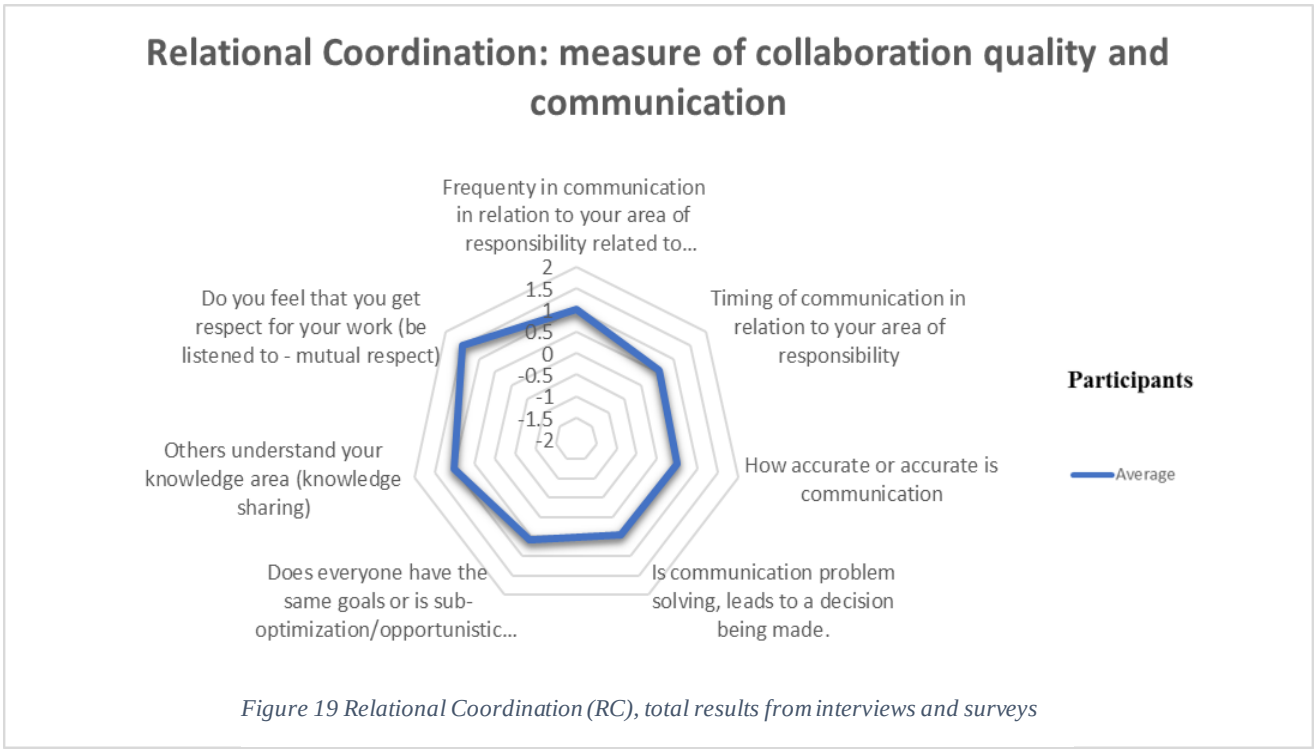


Figure 19 Relational Coordination (RC), total results from interviews and surveys

Figure 19 shows that the results reveal a high degree of mutual respect among members in the IPD environment. Even when IPD members did not agree on a problem or solution, they still felt respected and able to express different viewpoints regardless of their role.

A much greater challenge was communication between the participants, in its timing, accuracy and its ability to solve problems. In addition, relationships were somewhat fragmented through the sharing of a common goals. However less problematic was the frequency of the information and sharing of knowledge.

When examining the results in relation to collaboration theory by Lloyd-Walker and Walker (2015) suggests that alignment of objectives in a project can be measured through three levels: cooperation (low to medium goal alignment), collaboration (medium to high goal alignment) and coalescing (high to very high goal alignment).

The scale used in relational coordination (-2 to +2) combined with the theory on coordination from Lloyd-Walker and Walker (2015), mentioned above, a scale was created, see Figure 20. The survey scale was also attached to these levels in order to express a numerical format.

The results from relational coordination showed a rating of 0.5 on the level of goal alignment in the project. When applied, using the scale, the participants in the IPD are co-operating. This however depends where one places the level between cooperation, collaboration and coalescing. On the hand one could argue that goal alignment is not the best measure of team-work in a project because you can have goal misalignment and still collaborate in a project. If one takes the results based on the relationships in the project, that is the (shared goals, shared knowledge and mutual respect), then a different picture emerges. Shared knowledge and trust are both quite high at 1 and 1.5 and one could argue that a high level of trust shows that high level of collaboration is occurring in the project.

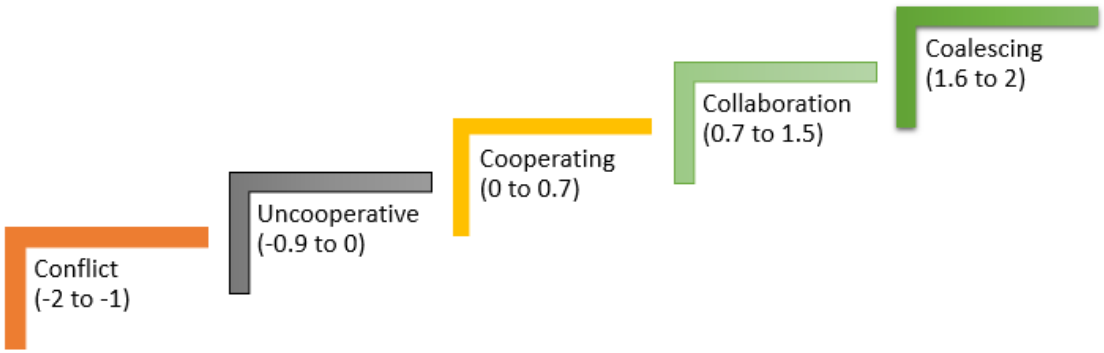


Figure 20 Cooperation, collaboration and coalescing scale, adapted from Lloyd-Walker and Walker (2015)

In addition, the results are deeply affected by the contextual problems in the project. Furthermore, a total of twenty-five respondents participated which is perhaps not completely representative of all the primary and supporting members in the IPD.

The results from the interviews discussed each participants project goal. From the 13 participants interviewed, 10 of the interviewees addressed a project goals. 5 out of the 10 talked about customer value and 6 out of the 10 talked about collaboration as the two most commonly highlighted project goals. When it came to the projects documented goals 7 mentioned zero injuries, building cheaper and faster than similar projects. In addition, some mention their own goals for their area and, building without paper, prefabrication and using tools. The results also reflect well in what people were saying in the survey.

The theoretical works by Mary Parker Follett on relational coordination theory (Gittell, 2011) can be used to identify elements of "effective work organisations" is somewhat shown in the empirical results.

The results from both the interview and survey results highlight some problem with goal alignment. Here we see the effects of suppressing opportunism, which seems to mask itself in other forms, shown by the participants in the project. Both Williamson (1979) and Eisenhardt (1989) talk about opportunism and it is here that we see its accompanying frailties in motive and reason.

Opportunism in a way boils down to motive or intent, which the respondents have exhibited through old style behaviour of being wary of one another and from old habits of self-interest for example the behaviour of stating this is just my work and this is your work, which has created a certain degree of distrust between the participants. This is consistent with Lewicki et al. (2006), who defines distrust as "confident negative expectation regarding another's conduct" and stated in the literature by Lloyd-Walker and Walker (2015) as integrity (matching rhetoric with actions) and the trustworthiness of the other party.

The benefits of relational coordination are perhaps unique to this case study and its participants for greater reflection on group effectivity but also as a tool to improve performance. The data collected is an indication of the dynamic and the effectivity, in a point of time and thus should be seen as that. In addition, the results are somewhat convoluted by the contextual problems in the project.

Conclusion:

The data gathered suggested that no opportunistic behaviour occurred during the setting up of the contract, however not all details of the contract are known.

Some form of opportunistic behaviour was mentioned concerning the users in the project however no data was available from the users, in other words the clinicians and the service department which is a weakness in this study. However nearly all participants suggest that some type of opportunistic behaviour, in the form of regressed, inherited siloed mentality or differences of interest in the project. The hidden or unseen reasons for these behaviours were suggested were due to a flatter structure because power shifted, and game rules changed. The participants have had to change their roles and responsibilities towards a more democratic structure whereby shared risk and reward and transparency are named as having the largest influences on hindering opportunistic and sub-opportunistic behaviour in the value chain. The results also show that there is less opportunistic behaviour between the primary and key supporting players in the IPD model, however it requires the right people in order for this model to work fully. In addition, there are several contextual factors that have occurred as a result of the creation of the IPD contract in Norway, which have affected how interviewees responded.

The results from relational coordination, show that on all seven aspects of coordination they had between 0.5 to 1.5 in value. The areas with low values were in the area of communication in accuracy, timeliness and problem solving. The other area affected was relationships of shared goals. The scale used in relational coordination (-2 to +2) combined with the theory on coordination from Lloyd-Walker and Walker (2015), that a scale could be created. The results, from the survey and the interviews showed that based on this scale the participants in the project were in fact cooperating. In was in line with the results from the interviews where there was not consensus in the projects goal.

However, the data gathered shows that as only 14 participants responded to the survey which makes it a weakness of the study.

In relation to critical realism the mechanisms here for less opportunistic behaviour in the project is linked to the underlying incentives that lie in swapping solutions, finishing the project ahead of schedule and the common profit pot. It is these mechanisms that align the interests of those in the project with the projects goals. There is less incentive to optimise on behalf of one's own interest. In addition, other minor mechanisms play a part, which are the people in the project who are open to change, that leads to them accept to work in this project, coupled with the lean philosophy the lean tools and IPD other principals all help to that aligns the participants interests It is this combination of these factors that creates less scope for sub-optimising and opportunistic behaviour in the value chain. In conclusion proposition 1 has been somewhat verified.

7.2. Proposition 2

The second proposition argues that: IPD provides better conditions for unified solutions (swapping) than traditional contracts.

IPD encourage parties to agree on unified solutions to find the best (and cheapest) solution for the project as a whole. Through reduction in project costs, all parties increase their profit. In order to find these solutions one party must increase their costs for another party to save (more) money for the project. Collaboration is important, to achieve unified solutions, and parties need to be aware of the self-interest it entails. Representatives for the technical consultants describe this along with one of the dilemmas of working towards a unified solution:

> *"The biggest dilemma I experience is, on the consultant's side we are being given extra work to make it all better. If we spend 40 hours to change a solution, then it may save, let's say it costs 40,000 to change the design, so the project saves 100,000. Is it smart? Yes, although I have spent 40 hours over budget. Those who save 100,000 at the other end are bragging because they have saved so much money, however we share the winnings with those who save. So, economically we have a self-interest in it. It works, but it leads to quite a big overrun on engineering."*

Here, the dilemma is having one party spend more money in one area in order to save money for another party, in doing so saving money for the project as a whole, thus providing a larger profit for everyone. Another point that emerges is that unified solutions does work in this project, however, should not necessarily be used in all circumstances:

> *"Is it correct to use 20,000 to save 40,000? Mostly always. Is it correct to use 19,000 to save 21,000? No. We have done many such exercises; we would never have done it in another form of contract. So it works."*

The findings also show that collaboration as a vital part of unified solutions. They argue that this level of collaboration would not occur in a traditional contract:

> "*Now in an IPD we sit down with the contractor and choose a solution that provides rational operation whereas in a DB we design the tender but may not continue in the implementation phase. This is up to the total contractor to decide*."

The findings show that representatives for the technical contractor described a situation where two sub-contractors agree on a solution that is more expensive for one party in order to save money for the other party thus confirming that unified solutions occur in this project when stating: "One party transferred money to another for additional cost of purchase". A representative for the contractor confirms this statement and highlights the shared profit (for the whole project) in an example where two parties have agreed on a solution:

> *"It is not only that the technical trades are saving money while the contractors are losing money, but it's a shared thing."*

The picture painted by representatives for the owner confirms that the parties involved in the IPD are working together towards finding unified solutions for the project:

> *"We need to think about what saves money especially in design (subcontract vs consultants). For example, we sat together and talked about technique regarding the windows, where we now are at detail-level and can most likely stop the design and the supplier can do the rest. If this had been a traditional model, the consultant would not stop and give away hours (especially if they would have had an hour based contract)"*

They further highlight the openness that exist between the parties, while adding to the statement that they all come together to find good solutions instead of addressing the fault to a single party:

> *"Whenever we discover deviations after checking the quality of what has been done, we all come together to work towards finding the best possible solutions for these deviations. This openness makes sure no one is playing any games, trying to hide anything or point fingers at others to figure out who is at fault."*

However, they also argue that finding unified solutions may not be that straight forward:

> "*It's not just if A increases costs at a lower amount than B reduces costs, that will save money for the project, because the you have to look at the whole picture. Administration costs, for example, varies between companies and have to be taken into consideration when calculating profitability"*

Whatever deals parties within the IPD makes to save money, the benefits from this cost reduction has to be shared with the others, to increase the overall profit:

> "*If players can make savings through subcontracts, e.g. buying parts cheaper so it benefits the IPD because of transparency. E.g., some have 10% saving below budget, which they believe they could keep. However, it is not like this here."*

Another representative talks about the challenge the project faces through different mindsets for different parties. Their incentives are not the same and sometimes conflicting. When discussing opportunism and incentives he states that the owner wants to include everything in the project while the others want lower cost (to increase their profit).

Unified solutions are supported by colocation. The picture painted by representatives for the technical consultants consists of certain features like colocation, has worked well to strengthen the relationship between the trades*:*

> *"As now we have laid a completely flat structure, here all are in the same room, everyone can talk to everyone and there are shortcuts, no form of formalism and full transparency however in doing so we are a little vulnerable, in showing our weaknesses as we cannot hide."*

The findings also show that "remote designing has its weaknesses, while sitting co-localized makes the most of change regime". They further state that this provides "a shorter way to unified solution".

However, representatives for the contractor, suggest that colocation only works if people are not too busy with all the other things, for example if you "ask the architect, he is so involved in other things that he cannot give those answers".

According to representatives for the owner, colocation is crucial in an IPD and suggest that there is room for improvement on this issue when stating:

> "*It is impossible to carry out an IPD without a shared location and it is important to consider the structure of the shared location. This could be improved in this project (or improved for the next one).*

Details were provided of a different working environment that through colocation "Bad news come up early because we are so close to each other and no one will get told off. People forget what company they are working for". This shows that the company gets more holistic because they often forget who they work for and begin to see one organization. This is also in line with Koskela who states that several organizations need to break down barriers between organizations involved in the build.

It emerges from the interviews that it is "most rewarding by sitting close". While adding that, the benefit of sitting close is that issues are resolved faster and without unnecessary misunderstandings or hidden agendas:

> *"It is a lot easier to go and talk to someone about a problem than to send an email about the issue. Emails can be misunderstood and issues gets resolved a lot quicker when you bring them up and discuss them in person. That does not mean that we are being naïve and think that being friends solves problems, we are in a contract that needs respect and discussions about the case. There is no hidden agenda".*

The findings also show that IPD-methodology (of principals) support unified solutions. Through interviews with representatives for the owner, one participant argues that this project is doing very well because of the IPD methodology when expressing that:

> *"The project is economically very good and the IPD method is a lot of the reason, and reducing the interfaces between the players".*

Another point that emerges is that the IPD method forces people to change their behaviour in order to benefit the project:

> "*This is a cooperation project with an IPD agreement and one has to act differently, we try and give and take to oil the process. For example we have change messages, which is the same on other projects […] if we disagree then it is sent up, we try and be flexible because it has a mirroring effect*".

Representatives for the contractor highlights having the same goal for all parties involved. They argue that everyone needs to understand the IPD methodology in order to work together to find unified solutions:

> "*You need to have everyone on board otherwise people will constantly be referring to the contract which will disconnect from the whole purpose. People need to understand that the benefit of using the money and at the same time finding solutions*".

Findings also show that many argue that shared risk and rewards support unified solutions. This has already been discussed in proposition one, and will not be further addressed in this proposition.

The empirical findings are consistent with transaction cost theory by Williamson (1979). According to the evidence gathered there are transaction costs that occur by IPD party members coming together to generate value through swapping solutions. The parties need to be in agreement in order to create the swap. Yet, before the parties can negotiate about how to swap, one party must incur transaction costs, in other words the cost of changing and decision making about a solution.

These transaction costs cause a severe problem if a mismatch occurs between the parties' budgets and the magnitude of the transaction costs. In particular, if one party has low transaction costs yet has contributed to lowering the total project cost they feel that their actions are rewarded unfairly in relation to the other party who incurred higher transaction costs and still gets a share of the total profit. Yet the empirical finding show that opportunistic behaviour is reduced by the sharing of risk and reward which transfers these costs to all participants in the project. IPD is a game changer as there is less incentives for the actors in the project to be opportunistic.

In terms of critical realism, the proposition has structures such as: the IPD and meeting participants. The specific condition is that a decision needs to be made while considering alternative solutions. The mechanism is new opportunities are only discovered when an

understanding of the project has matured enough through working with the details and when there are no structural restrictions. This leads to the event which is the swapping of solutions.

In alternative contracts the mechanism for getting a solution is often not apparent as the design is not allowed to mature. In addition, IPD incentivises the participants through shared goals, shared reward etc.

Conclusion:

The data gathered regarding unified solutions shows that agreements occur on swapping solutions, but there is some question about when a swap of a solution is worthwhile. This is explained as not appropriate if the costs of swapping do not result in savings for the project. A solution is only swapped when the transaction cost of swapping the solution is lower than the cost of entering into the transaction. The transaction cost is described as the cost of searching and decision making. This cost results in one party carrying the cost from their budgeted cost, in other words someone has to give up earnings to reduce project costs. Even though this cost is borne by the whole project the party with the highest transaction cost will still feel the cost of less profit.

The incentive for the participants to reach a solution is again driven from the desire to increase their profits, through the shared pot, by finding better solutions that increase value and lower costs. Whenever the project increases its profit, all IPD parties achieve a higher profit. Redesigning of solutions occurs through colocation which empowers the participants and shortens the way to unified solutions. IPD is a game changer as there is less incentives for the actors in the project to be opportunistic.

In terms of critical realism, the mechanism here is that new opportunities are discovered only when an understanding of the project has matured enough through working with the details and when there are no structural restrictions. Proposition two has been verified.

7.3. Proposition 3

Proposition three proposes that: IPD safeguards quality and customer value in a better way than alternative implementation models while maintaining constructability

As already mentioned in proposition one, joint decision-making leads to a flatter structure, which promote democracy. However, some could argue that this is causing waste. As one representative for the consultants describes a challenge connected to decision making in the project:

> "*We have unclear lines as to who is making decisions, therefore we can we spend a lot of time discussing solutions, then someone else will say, no*"

Representatives for the technical consultants describe another issue connected to democracy, where they state that there are "*too many participants in the project meeting to handle details*". In addition, they also give an example of waste in the process: "*a decision is made orally, however it is difficult to follow up because of an unclear organizational structure*". They carry on with a good example:

> *"Normally we go through several rounds to get to the solution with the builder but once we get the nod, then it's okay. But here there will be a new round afterwards. It's the biggest challenge here I've seen. For example: the architect did not like a solution and suggested that pipes should be put on the outside of a wall instead of inbuilt into the wall, but now they have dropped their solution because of noise requirements."*

However, representatives for the consultant felt that iterations were "a part of the process in design with ideas" and "we spend most time on administrating our hours". Another reason that might hinder quality is contextual problems. The findings also show that trying out too many new systems had a negative effect because of accustomization problems:

> "*here we are not prepared, there is a lot of things to get used to, no time to think, there is pressure to go onto the next task and we don't even understand the task*"

The statement about time pressure in decision-making is also supported by representatives for the technical consultants, where it is stated *"deadlines are so short that we cannot use a standard procedure and know you build a basis for making a decision*". While a representative for the contractor emphasise the challenge of working with uncertainties in the project:

> "*The difference between an IPD and DB is the scope, delivery and quality because it is often very clear what to deliver, either function or half described product. Here it is challenging, you don't know where that list is*."

Nevertheless, these comments were considered contextual as the project was first priced up as a DB and inherited a sketch design before becoming an IPD. In addition, the forming of a new IPD

contract incorporated a lot of new systems and processes that the project was obliged to use. This has had a number of knock on effects that purported the participants' views on working in the project and will be discussed later in subsection, contextual factors.

The data gathered also shows that there were several examples of how IPD safeguards quality and maintain constructability. Representatives for the contractor argue that decreased risk for the parties involved in an IPD safeguards value for the customer:

> "*Here the owner can offload risk. The contractor has less risk, so you might get better value as there is no chance of losing money and the owner gets a greater chance to influence the design with his lump of money*."

The findings also show that a traditional method does not safeguard quality and customer value in the same way as an IPD:

> "*The building itself is tricky and is more complicated than one thinks, because you need to account for people who might be out of control so you need something special, it is these details that can be underestimated*."

While representatives for the technical contractors supports that argument and adds that collaboration with the owner safeguards quality:

> *"We still choose the cheapest components because of the budget. We talk about higher quality with the owner which we wouldn't do in another type of contract"*

The picture painted by these informants is confirmed by representatives for the owner. They add that customer value is assured through incentives where choosing an expensive option would directly affect the parties' profit:

> *"In design we give alternatives to the owner, show the offers, it's what you do in a design process before procurement. There must be a good reason to choose an expensive option. We could end up paying the difference in cost. It is a requirement for the hospital to be fast in making a decision as they have other projects ongoing where you are number two."*

Another point that emerges is that an IPD contract is an

> *"Advantage for the owner, because the contractor help consultants stop overdesigning. When handing the design over to the contractor at an early stage, they can discover errors early".*

One informant add that quality was better as

> *"Projects are risks, from the early plan, which you learn from as you go along. The project could be delayed by three months, but there would be no penalties. This contract allows you room to manoeuvre; owner risk is only on ground conditions. E.g. we started digging four months early to search for cables; if we would have waited then it would have cost a fortune for the customer".*

This is due to, as suggested in the proposition, arguments that there is a shift from self-interest to group interest, related to shared risk and reward.

When answering questions about customer value, some participants mentioned colocation as an important reason. Colocation creates and safeguards quality, where the owner's presence throughout the whole process enforces this.. See section on colocation in proposition 2.

Another point that emerges is that participants from different parties seem to agree that customer value is an essential part of the project goal. A representative from the contractor, when asked about the project goal, states, "*The customer value is in the centre*". This statement is confirmed by a representative for the owner when stating that the "*goal of IPD is to spend more time on what creates value*". He further adds that this time cannot be spent "*on emails or defending ourselves by pushing responsibility to others, like traditional conflicts*".

Yet others believe that it is tailoring to the users that safeguards quality. A representative for the contractor states

> "*Everything is tailored, adapted, with large impact from the users. Perhaps this gives the most value for the hospital's money. Which is a bit contrary to the goal of the project*."

The data gathered demonstrates that the contract is another reason that secures quality. A statement from representatives for the consultant was that they choose the cheapest product that satisfies all requirements from the contract when stating:

> "*The quality is not clearly defined but we pick the cheapest product that satisfies all the requirements, but if owner wants a specific product, then he pays for its, but the users (service division) believe they can get what they want. It has been resource demanding. We have fixed it now and have decided to not ask them all the time what they think just as far as it is within the parameters of the contract*"

The findings also confirm the proposition in regards to maintaining constructability is an important aspect in cooperation and IPD. While this is an important aspect, participants for the contractor describe the challenges of getting constructability into solutions when stating:

> "*In a DB, we control the design. There is a challenge, because as you want to get buildability into those solutions, the cooperation about what we are going to build, training is needed to get it done properly in how we will work together and know what to draw. Yes, we have a drawn pre-project however there is a lot that needs to be solved, for example deciding whether to use cheap vs expensive solutions and when you are new to each other*"

Further findings confirm that the contract is an important aspect of safeguarding quality. It emerges that this is done through choosing products based on Life-Cycle Cost (LCC) values:

> "*Quality for owner lies within products' LLC values. You strive to select products and equipment that result in the lowest possible LCC for the hospital, for a duration of 50 years. However there is a discussion: E.g. if a product satisfies requirements, is compliant, and the second product satisfies requirements but has better LCC values and is more expensive. Is that a change if you are told that you must use this product? Or is that something you should expect*?"

According to representatives for the owner, the product is clearly specified, however, coming to a solution on quality specifications can prove difficult because the client want as much as possible from the project. They also adds that LCC calculations stated in the contract help decision-making:

> "*The basic product, in my opinion, is clearly specified and described in a good way. Now we have our design, in our B4 rapport, detailing what we should build. The quality specification is questionable because we have setup procurement packages, which the*

hospital might object. They have to do LCC calculations. If these values are within contract, we have a right to deliver. The hospital (service division) can say that they want something else and they can pay the additional cost".

Another reason is when people focus on demanding payment in alternative implementation models then they are not focused on quality, solutions or adding value. According to a representative for the contractor, they find project solutions together. Although, whenever the owner require something outside of the contract or the contract does not specify what the owner wants, they have to pay for this solution:

"*In addition, we go to the owner and demand payment when it is not clear or claim for additional extras. Here we defined it together in the pre-project phase, but sometimes DB projects can work in a smooth way*".

One of the ways parties share risk, while giving up the right to be compensated in this project was described by a representative for the owner when stating that the "Contractor lost rights to be compensated for errors in design, all bear the extra cost". Another point that emerges is the difference in behaviour within traditional and IPD projects when dealing with quality issues: "In a DB the contractor gets blame for squeezing quality, here they are conscious to not put in the absolute minimum". In a traditional project, it is natural for the contractor to deliver at a minimum when it comes to quality, to save money. While here, the contractor focus on delivering a good product.

However, a representative for the technical consultants state that the owner is not very involved in decision making for the design:

"*Have not experienced that the owner is involved in choosing a solution. Owner gets drawings for review. However, they do not put their approval stamp on the drawings. Owner is very clear on functional requirements*"

This is in line with theory that the owner is very much involved in the early stages. Findings also show that they spend less time on discussing whether they have delivered enough. Representatives for the owner state:

> *"Contradictory to a traditional fixed price contract, they would have spent more time and have larger incentives to challenge the contractor and owner to say that they have delivered enough".*

The empirical findings show that waste is an issue in the project. This perhaps occurs because IPD is new to Norway, it might be that the root cause of the attitudes displayed by some in the case study which could be based on the contextual problems and in addition because of the participants have encountered a different delivery type. Table 3 shows how IPD has a unique and radical approach compared to traditional construction delivery methods. The project was perceived by some as wasteful and not as smooth as Design Build. The purpose of IPD, being based on lean, is to eliminate waste, not make more waste (American Institute of Architects, 2007a, 2014; Martin Fischer et al., 2014). Traditional methods have been criticised for a long time because of excessive waste (Egan, 1998). On the topic of applying lean to construction, the elimination of waste was emphasised by (Diekmann et al., 2004). The AIA working definition (2014) comprised of five principles aimed at reducing waste and optimising efficiency. Thus, literature seems to point to the opposite conclusion to the negative opinions of the participants (as mentioned above). IPD reduces waste rather than causing waste.

IPD allows for design changes mid-process in order to add value while keeping within budget. However, it seems some would prefer to revert back to a fixed and very detailed design, suggesting rounds of discussion and time spent on evaluation as being wasteful. Again, these observations run contrary to the literature. (Martin Fischer et al., 2014) sees IPD as providing value, not just for the user, but also environmental value and social value. The works by (M. Fischer et al., 2017) et on Target Value Design, say that the use of TVD in IPD helps to reduce costs whilst keeping in line with the project's values and without scope reduction. In the 2014 AIA working definition, the five principles are based on trust and collaboration. This is in line with the lean philosophy of continuous improvement through participation, learning and aligned goals to achieve greater efficiency incrementally.

According to Ballard (2009), the effort put into dealing with problems and providing value within budget does not constitute waste. Taiichi Ohno of Toyota Production Systems said, "you have to lower the river to reveal the rocks". Motor manufacturing and construction project delivery are very different, but the same principle holds true. In both the application of lean philosophy leads to revealing problems in order to solve them. The result is efficiency and success which has been shown to be successful in the US.

The Principal Agent (PA) theory by Eisenhardt (1989) is somewhat consistent with the empirical findings. The incentive for the participants in the project is to safeguard quality lies in the contracts which co-align the interests of the agents and the principal, in that all key-players are bound through shared risk and reward and thereby the opportunistic behaviour between the parties is reduced. It is this that results in the owner in principal becomes an agent and the agents become principals. A shift occurs from individual self-interest to group interest. This lead to the principals and agent focusing on safeguarding the owners goal of value and quality in the build. Now both principal and agents are interested in ensuring and maintaining constructability. Quality is prioritized in all phases of the construction and focus switches to the capability of a design being constructed. The findings also show that the process, expressed as source of waste arises from redesigning for quality and value for the customer. This also in line with the American Institute of Architect organisation (2007a, 2014) which states that people incentives change from individualistic to doing what is best for the project.

Furthermore, PA theory also suggests that moral hazard can occur since the principal does not know what the agent is doing. The results also show that colocation, has unified the participants towards reaching a solution, seen in proposition 2. One could argue that the agent will realise that deceiving the principal will only reduce their share of the profits. In addition, since the owner is involved in the IPD process, during the design and construction, he is also able to safeguard his interests by focusing his efforts to safeguard a combination of cost, quality and sustainability.

The findings also show that quality is safeguarded through the interlocking IPD contracts through shared risk and reward. This makes all actors inherently responsible for the design, whereby key and supporting players of IPD including the owner, come together to determine through their collective knowledge and experience how to maximise efficiency, minimise waste, and complete the construction project on or ahead of schedule using tools such as target value design, early involvement, co-location, etc. The project's key players can suggest changes that can be used to speed up construction, which would not normally occur in a DB model. In addition, the findings also show that Life-cycle cost (LCC) term implied by statute in the contracts is an instrument that can be used to manipulate the participants in order to focus on the LCC costs.

The empirical results are also consistent with the findings that projects utilize tools and methods in order to minimise waste and optimisation the efficient operation of the project (American Institute of Architects, 2014). Despite these benefits, having too many tools and methods can have a counterproductive impact in a project. The data supports H. W. Ashcraft (2014) who states that,

one requires deep collaboration and integration of tools in a project. However, the use of early involvement stated by American Institute of Architects (2007a) and H. W. Ashcraft (2014), which has the ability to potentially impact costs, as shown in the Macleamy Curve, cannot be unproductive but does require deep collaboration. This use of early involvement can be seen in the findings from the "sprint 300" activity to redesign and reduce costs in the project by 300 million.

In critical realist terms, the structures involved here are the customer, participants, the construction project and the IPD principles. There is interaction between the structures by means of mechanisms, which come from the owner's involvement in safeguarding his interests, the customer wanting value by aligning the goals of the participants to the goals of the project, through the incentives of collaboration and shared reward.

In addition, the attributes of IPD is a mechanism that helps to influence the participants to work together and solve problems, reducing cost and adding value. As goals align it results in a mutually dependent interaction between participants and the project, each influencing the other. The outcome is progress as seen in this case study and success in other empirical studies.

This is different to alternative implementation models whereby time is spend focusing on self-interest, which manifests itself by looking to serve the interests of the individual. Attention is focused on finding fault and documenting blame, sub-optimising and risk aversion. Detailed contracts, whereby changes are chargeable does little to put focus on value and redesign of the original design. The parties often overlook buildability because it is often fuel for finding fault and charging for change. Self-interest has little part to play in focusing on customer value in traditional construction projects.

Conclusion:

The data gathered shows that IPD safeguards quality in a way better than alternative models. This is shown through not only the IPD principals but also through shared risk and reward, colocation, the owners involvement, Life Cycle Costs (LCC) and through goal alignment that ensure quality and value for the owner. In addition, constructability is safeguarded sufficiently well through goal alignment and focus on the projects goal which aligns with the owner's interests. This alignment rarely occurs in a DB as the contract gives fuel for finding fault and charging for change. Waste can be seen as a by-product of continuous improvement, but it is through redesigning of the design that waste is minimized. According to literature, IPD should create value and reduce waste. This

includes allowing changes along the way to add value. Some of the problems mentioned that hinder quality, like short deadlines, are contextual. Negative attitudes might come from working on a new delivery method, where IPD is radically different from more familiar (traditional) methods.

In critical realist terms, the mechanisms, come from the owner's involvement in safeguarding his interests, the customer wanting value by aligning the goals of the participants to the goals of the project, through the incentives of collaboration and shared reward. As goals align it results in a mutually dependent interaction between participants and the project, each influencing the other.

In addition, the attributes of IPD help to influence the participants to work together and solve problems, reducing cost and adding value.

Proposition three is verified.

7.4. Proposition 4

Proposition four: IPD, in combination with TVD, provides better framework conditions for continuous improvement and innovation compared to a Design Build model (DB).

Earlier in pro 1,2 and 3 we have discussed the features of IPD mentioned in the case study, like joint decision making, colocation, shared risk and reward, the LCC in the contract and the owners involvement. A closer look at the main aspects within the case study isolated the management practice of TVD in driving the design process. Thus, it is necessary to look at TVD as an encouragement for better value, innovation and continuous improvement.

The findings show that TVD was used in combination with IPD to set high goals in order to create value in design. The owner's representative explains that:

> *"We have Target Value Design (TVD). This means that we need that value bit in here, which means that we all agree is within the scope. And then we're not looking at cost, but we make a solution within the level of quality, which is under budget and is a part of the mechanism. This is something we are supposed to get out of our process to get more value for the hospital and for the money."*

He further states that *"We don't use Target Cost Design (TCD)"*

This was further reiterated by another representative for the owners who add further that:

> "If you don't have Lean, BIM and TVD as tools in an IPD, you have not used any tools that can exploit those possibilities that arise which the IPD is dependent on. If we cannot find any possibilities to do this in a better way, then there will not be surplus to share, and the participants' incentives goes away."

However, not all comments were favourable, many couldn't understand TVD, while some wanted to revert to old behaviour of using Target Cost Design (TCD) where you design and then set the costs and then build. Nevertheless, these comments were seen as linked to the contextual problems in the project, these will be discussed later in the section contextual problems.

The TVD process of setting target costs together with setting target value has a purpose of setting high goals in order to innovate.

Innovation is designing and redesigning ways of doing things better. Examples of which could be seen in scope swapping mentioned earlier and through the consideration of prefabricated units, on and off site. Other ways that were mentioned of being innovative were through suggestions of tools and methods that could improve the process from individuals in the project. For example, the representative for the owner stated that they were using a "Suspension system and a hole-drilling robot." These suggestions came as a result of the IPD features and the TVD process.

While innovation was successful to some degree, some suggested that restrictions in the build limited innovation. For example, the representative for the owner suggest that less innovation was not possible due to the:

"lack of freedom, less space because we are building next to another building for example the ceilings are smaller" while others suggested that innovation would have been greater if the build was not so challenging and tailored. Comments such as

This was verified by the representative for the contractor who stated that

"This project has not been innovative, we have considered some solutions, but they are not feasible because of the bespoke nature of the build. Innovation needs time and money, that's the creator of innovation."

Yet another representative for the contractor suggested that one of the problems lay in the people and the shared risk and reward:

"A limitation in innovation is the risk of trying something untested especially when it is, now your own money."

Other comments on the lack of innovation also came from the owner's representative who states that *"we have suggestions but don't have administrative capacity"*

However, the representative for the technical consultant's stated that:

> *"IPD promotes a very constructive willingness to fulfil contract in new ways but the contract does not promote innovation. NO, it is additional requirements from owner who we keen on prefabrication and industrial solutions and several concepts were tested, but most were not used because they did not meet constructability. If I have a choice between 3-4 solutions, we take the one who fulfils the contract. The industry, however, is not innovative in particular & we are stuck with some old-fashioned attitudes."*

This is also reflected in what one of the representatives for the owner states

> *"IPD combined with TVD there is always customer value however when you ask the contractor they think TCD because they are bringing down the costs. In this way you get two contradictory factors (customer value vs contractor costs)."*

Yet the process of designing and redesigning, coupled the features mentioned earlier creates a continuous learning process, which seems to be unseen by the participants.

The criticisms of IPD, are somewhat consistent with the findings, as Cleves & Dalgallo point out that IPD is not right for everyone, as not all are wired to collaborate. It is also clear from the findings that a number of participants would like to revert to a simple way of doing things, such as a DB. This is consistent with Illeris (2004) learning theory who points out, as occurring in the workplace environment, where workplace practice relates to working identity. When a crisis situation occurs reverting back to the familiar is a trait that would be employed to modify the learning arena before trying to work for a different employer according to Kalsaas (2012).

Zimina et al. (2012) highlights that through greater use of TVD, reworking the design to its desired maturity allow for better choices. However, in alternative development models, the design would either be fixed and connected to the contract whereby changes would proceed to lawsuits and claims, resulting in the making of "narrow choices" or the design would be redesigned only as a firefighting measure when problems are identified during the build. However, the findings from the results show that participants feel that they have spent more time than they should have, which

is perhaps a requirement that TVD and IPD require a high level of commitment from all team members, which requires an investing in learning, which needs to be accounted for.

In addition, after the contractor and consultant had been contracted, they established a cost estimate which was 300 millions NOK over the project cost frame. In order to reduce the estimate, they conducted, what was internally called, Sprint 300. Here they used TVD in order to find ways of reducing cost while securing customer value.

Furthermore it would be favourable for the project to earn money by having enough work for trades on the construction site, (where they get payed per unit) and not outsource work. When keeping labour in-house they are able to remove obstacles and make sure everything flows, which is in line with Lean

The empirical findings are somewhat consistent with the available literature on the effects of IPD, for example the effects of IPD such as the owner getting more involved, reducing barriers, less arguments between actors in the value chain, creating direct relationships, increasing collaboration and coordination, adding value, learning can be seen in the empirical findings (American Institute of Architects, 2014; H. Ashcraft, 2013; Martin Fischer et al., 2014; Ghassemi & Becerik-Gerber, 2011; Koskela, 1992; Suttie, 2013).

In terms of innovation it is somewhat verified in proposition 4 because there are two arguments that are equally important. First the owner puts incentives and new tools and process that will help optimise the project which encourages innovation. In addition, innovation is increased through the use of joint decision making, colocation and the process of TVD where one redesigns and finds good solutions to problems. Secondly, the counter argument is that shared risk and reward hinders the actors from taking chances on new and innovative solutions because they feel that their profit is at risk. Some might argue that risk and reward will actually encourage the actors to take larger risks for higher rewards, however when you look at game theory individuals will always revert back to self-interest. Furthermore because of the democracy that occurs, it is difficult to get all actors to agree to take unnecessary risks. In addition, it has been suggested that a lack of innovative ability lies in the complexity of the build, which has required far too many tailored solutions. This is also evidence that supports process innovation in tackling and solving the problems in the build. However, IPD is important for Innovation but it requires time and a tolerance for failure. The results also show that the project has been hampered by contextual problems which have snowballed throughout the project.

The data gathered shows in relation to Illeris, (2004) learning theory that people often find it hard to change perhaps because as they get older, they get used to specific ways of working. The actors in the project are used to temporary working environments, often with people that they are not familiar with or with those new to the whole building process, yet one could argue that this is the same in a DB environment and learning will occur over time. However, it is the silo thinking that people often revert back to which can hinder learning from taking place. If the learners focus is on finding fault and blame then less emphasis is placed on design and redesign, which is a part of the continuous improvement process. It is this process that helps learning in the workplace to occur. In addition, individual learning occurs easier if the learner is enthusiastic, competent in their work, open and willing to adapt to change, and not stressed. The empirical results showed that many participants, made claims of stress from too much to do in a short space of time and the number of new tools/processes. This in relation to learning theory does not give conditions for an individual's work identity or to reinforce working practice. However, these complaints perhaps come as a result of the contextual problems found in this project that are outside IPD.

Within IPD framework there is extensive involvement and cooperation between trades and across company boundaries which is a result of joint decision making, the owners involvement throughout the process, sharing risk and reward and through interlocking agreements. This represents a considerable change in terms of learning in the workplace based the learning theory by Illeris (2004). The technical organisation learning environment is where large opportunities exist for learning, as most decisions which normally would have been taken place in a DB by the main contractor, are now transferred to the interlocked actors in the project. It is here that many people are exposed to new experiences, which allows them to utilise the six characteristics in this dimension by increasing their opportunity for learning. The findings also show that collaborating on solutions with different trades and disciplines also gives many people a chance to be exposed to new experiences and learn about the different disciplines. Collaboration with trades, on an individual level will depend on the learner's competence and their motivation to learn. The finding are also consistent with the theory that the shared knowledge, that develops within the relationships, provide "favourable settings for learning" (Welch & Wilkinson, 2002).

In terms of critical realism, the mechanism here can only occur as new possibilities are discovered when the costs are used as a driver for design instead of treating cost as an outcome of wasteful redesign iterations.

The empirical findings are also largely supportive of a transcendent learning process occurring based on Illeris learning theory. However, there is a debate as to whether this is caused by the temporary transient environment in other words the fact that the project will come to an end, the crisis situation IPD creates in reference to the burning platform, or the overload of contextual factors in the project. Nevertheless, the empirical findings are somewhat consistent with accommodative learning where the learner has to adapt their current understanding, in this case of what they know, to accommodate new information which can often be demanding on the learner, as joint decision making, and mutual adjustment is a process that provides a basis for new information.

Furthermore, the owner has used new technology and processes such as colocation which creates a common learning arena. The use of co-location, whereby the actors are constantly learning about solving problems and through instant feedback can solutions be remodified or solved. This coupled with the number of new ways of optimising the project through a variety of solution options and learning about other trades increases knowledge development of the project.

The theoretical and empirical findings are consistent with AARI scheme of analysis (Welch & Wilkinson, 2002). When we examine the business relationships in the IPD, through the bonds between the network of actors and each participant's perception of one another, there is a development of mutual trust and understanding. There is a lack of evidence that mistrust and cultural misunderstandings had separated the actors. In fact, the actors seemed bonded by the shared risk and reward and through the number of activities of joint decision making in meetings. The relationships are also connected through the sharing of information and the swapping of work.

The empirical results are somewhat inconsistent in relation to the schema configuration of ideas. There is evidence of the internal and external interactions, in other words the inter-organisational relationships from activity links, resources ties and bonds formed between actors however there is a lack of evidence on how participants perceived their adaption in other company's belief systems and values. The theory suggests that as the couplings occur the organisations become more interrelated and adapt to each other over time. The results show that a number of interviewees expressed resistance to the concept of IPD, perhaps also due to the number of contextual factors.

This resistance would affect whether people adopt each other's beliefs systems and values or whether they stick to their own organisational objectives, values, missions and plans.

Conclusion:

The results show that through the Target Value Design (TVD) process, and innovation occurs. This is where the process is improved by solving problems, viewing things differently, improving efficiency and effectiveness. In addition, this leads to better choices becoming available than that would present themselves in a DB. In addition, after the contractor and consultant had been contracted, they established a cost estimate which was 300 millions NOK over the project cost frame. In order to reduce the estimate, they conducted, what was internally called, Sprint 300. Here they used TVD in order to find ways of reducing cost while securing customer value.

Learning coupled with reflection allows for continuous improvement. It is learning and knowledge development that are essential to fuel innovation. However, IPD is important for Innovation but it requires time and a tolerance for failure.

It would be favourable for the project to earn money by having enough work for trades on the construction site, (where they get payed per unit) and not outsource work. When keeping labour in-house they are able to remove obstacles and make sure everything flows, which is in line with Lean.

IPD also has other good conditions that help facilitate the process, through the use of joint decision making, colocation and through shared risk and reward are the actors encouraged to continuously improve and innovate. The technical organisation learning environment conferred through learning theory by Illerus is where large opportunities exist for learning, as decisions making, and involvement in the continuous improvement process is now transferred and implemented by the actors in the project.

In addition, Illeris points out that stress and workload on an employee can hinder learning, which is largely consistent with the empirical findings. The findings also show that there is some resistance in the process which is consistent with the individuals learning dimension. When we examine the business relationships in the IPD based on the AARI scheme of analysis (Welch & Wilkinson, 2002) theory, Actor, Activities and Resources have formed whereby Ideas should occur however the results are somewhat inclusive. This could be based on the number of contextual problems in the project. In terms of critical realism, the mechanism here can only occur as new possibilities are discovered when the costs are used as a driver for design instead of treating cost as an outcome of wasteful redesign iterations. Proposition 4 is verified.

7.5. Contextual factors

The section explains the way the Tønsberg project was set-up, which had some influence on the respondents' answers to the questions in the interviews. The situation is explained from the contextualised explanations, which were described by the participants. Their influence was considered contextual in the case study.

Inherited a sketch of the design from another company

The results showed that the project had inherited a sketch design from another company, which was introduced in the early stages of setting up the project. An architectural firm created the design in the Design Build (DB) phase of the project. Because of the introduction of the IPD contract, another architectural company was appointed within the consulting group and as a result inherited the design. The results also show that the design was also used by the builder in the DB process to give a quotation for the price of the project, and as one participant states "*it was not buildable*". When the project decided to go over to a IPD the quotation and the design had been calculated using a DB and were thus used as the basis for the project. In addition, this affected the early involvement process. Because of an inherited quotation and design, Target Value Design (TVD) was used to reduce the costs of the project down 300 million. The design was used in the project and may revealed, "*Many didn't understand it"*

Negotiation of a new type of contract: IPD contract

The data gathered demonstrates that negotiation of a new type of contract (IPD contract) has been an issue. One participant states that this created a time pressure on the original timeline due to "*a new form of contract, which had a legal part that was not fully clarified*". One of the challenges and disagreements among the parties the adaption of an American contract into a Norwegian setting and getting the right price. Whereas another participant argues that a "*DB is better than IPD because you have experience*" and that "*setup gave a steep learning curve*". The findings also show that one participant state that the contract has a weakness in its interpretation and "*ambiguity in terms of who's responsible and how to apply the contract*".

The owner wanted to try out many new tools and processes

The results also showed that the owner upon creating the contract had insisted on adding in number of processes, methods and tools that were required in the build. Examples were given of how it affected the process:

> *"BH has had very high ambitions, a little over-ambitious, in this project both in relation to the IPD model, but also the technological way of working, processes, how things are going to happen."*

Another representative felt that the trying out too many new systems had a negative effect because of accustomization problems such as, "*here we are not prepared, it's a lot of things to get used to, no time to think, pressure to go onto next task and don't even understand the task*". They further state that "*process is more complex [...] and trying out too many new systems*" which had a negative effect because "*It was a long time before people got used to it, some don't understand it [...] some are enthusiastic and it's an advantage"*.

The data gathered further show that if they were *"Doing it again I would invest a lot of time in educating them in what the contract entails and how to work, in addition to the systems and software."*.

One could debate whether the lack of time is caused by contextual problems. However, it is hard to say whether this comment, made by a representative for the technical consultant, is an IPD issue or due to the late start-up of the project: "*there is the lack of ability in organizing meetings and to clarify issues because we are pressed for time. Have a feeling that there are many parallel processes*." This is further supported by one participant from the contractor who suggest that co-location only works if people are not too busy with all the other things for example if you "*ask the architect, he is so involved in other things that he cannot give those answer*". If it is an issue then this is part of the accustomization process in an IPD.

Another representative state that:

> "*IPD is new to the industry and there has been a lot of pain in its introduction. There is the contract and a bunch of idealisms around new methods that have disturbed it like*

> *LEAN, LP, Pull-planning, co-location, paperless (i-pad) & BIM. We have Norway's record for trying new methods at once. The majority of these methods didn't give us the success we had hoped for. It is not too many changes at once but it's the introduction of these methods. We have given up LP, it was poorly used plus perhaps because we are in the final phase, but LP could have been good there as well*."

Decision to start and deliver project earlier than necessary (as part of project goal)

The results showed that the owner had decided, at the start of the project, an end of project milestone date. This date as the respondents expressed was not adjusted to take into consideration of the delays in setting up the IPD contract. Furthermore concedes that "*This project is special, halfway due to IPD, but a lot due to short deadlines* […] *it's such a short timeframe from you adopting, projecting and then it's built*". However, one can debate whether the short time frame is a contextual issue or a result of IPD.

Deciding to build even though the design had not reached an appropriate maturity level

Another example of contextual problems was stated as "*normally we go through several rounds to get to the solution with the builder but once we get the nod, then it's okay. But here there will be a new round afterwards. It's the biggest challenge here I've seen"*. This might be a result of late design.

The data further show that one participant state that the

> "*Difference between an IPD and DB is the scope, delivery and quality because it is often very clear what to deliver either function or half described product while here it's challenging you don't know where that list is*."

This is also an example one might debate whether is contextual or a result of a complex project. Other participants state that *"Owner's decision is not a problem, but delayed design is",* which is confirm by another informant who states that they "*got the drawings the same day as they build*" and referred to it as a Just-in-Time principle. The findings also show that some participants state that no one knows who is in charge or what their mandate is.

The data gathered show that a representative state, "*There is more clarity in a DB than in a IPD, you have the details of how things will be built*" which is confirmed by another representative's statement "*In a DB you have more detailed drawings and clearer specifications earlier".* However, another representative argue that this is a contextual factor because if the "basic design is done well it will be good, like it would in any other project." While another informant state that the "*Challenge is clarity in what prices the contractor has given & what is needed to fulfil the functional requirements".*

Snowball effect

The results also showed instances whereby participants blamed the earlier contextual factors, mentioned above, as having an effect in the project. Examples of which were referenced to as having *a challenge due to delays* due to the decision-making process. Other examples corroborated the contextual problems mentioned earlier as "*we have less than 5 days to make all of those decisions". W*hile one participant stated that co-location only works if people are not too busy with all the other things for example if you

> *"Ask the architect, he is so involved in other things that he cannot give you those answers"*

While other remarked that

> *"There is the lack of ability in organizing meetings and to clarify issues because we pressed for time. Have a feeling that there are many parallel processes*."

Other contextual factors

The results revealed other factors that were emphasised during the interviews in the case study that were deemed contextual in nature, because all projects would be subject to these factors. The participants indicated that the cultural differences between Skanska UK and Skanska Norway, listing English as a cause for misunderstandings. Other cultural differences mention concerned the designers and the contractors. Those with not a "*good command of English so its uncomfortable to give their opinion or give comments, in that they might feel intimidated"* yet while some were very positive and stated that *"it's good to have people from another culture with other points of view".* Other results indicated that the weather was mentioned as a problem which again was listed as a contextual factor. As one example states the *"weather problems which are always going to have an impact but are maybe more detrimental in combination with other things"*

8. Future work

This section states the future work that was proposed from the discussion of results from the propositions. It should be noted that due to the large amount of data capture in combination with the time restrictions placed on the thesis there was not enough time to treat the data. This is one of the main recommendations for future work in this thesis.

Proposition 1

In conducting this research and analysing principal agent, game theory and transaction cost theory, it has come to light that further research is needed in measuring opportunistic behaviour in the value chain when and if mutual cooperation ends as a result of the removal of the shared risk and reward through overspend of the profits. Theory suggest that if there is no more shared profit, people will revert to self-interest and they will no longer cooperate, but instead try to compete with one another and find ways to be opportunistic in their work.

Further work needs to identify if this is the result of suppressing opportunism. Also, what are the repercussions if problems are missed or misconstrued and opportunism is ignored or suppressed. Strategic behaviour has now been engaged. In addition, non-monetary perks, such as praise and feeling valued associated with power should also be investigated.

In addition, future work should test out the general mechanisms in other empirical studies for example using shared risk and rewards and its effects on the value chain. Do you get full alignment of the projects goal or will it cause an underling behaviour to occur without the remaining IPD framework? In addition, the survey results should be used for future research.

Further examination should be done to fully examine the extent the power and game rules change by comparing the case study to a DB which has just risk and rewards to see whether the same results will be reflected.

Documentation of additional cases is needed to assure that this case study can be compared in relation to the results. In addition, the proposed future strategies need to be tested and improved.

Relational coordination

In terms of relational coordination future work should focus on measuring the participants views over time. It is without doubt that, as the project goes through the next upcoming phases and

participants learn more about how to work with one other within this new concept of IPD another picture will emerge. It is here that relational coordination should be measured.

The findings should also be used for further research to compare with similar projects, using IPD and alternative project delivery models, at a similar stage in a projects life cycle. A point of weakness of RC is it measures subjective experiences and perhaps this should be further investigated in the future.

It is important to explore cases of IPD in Norway which can be used as a comparison for future research. In addition, research should be conducted on measuring relational Coordination in alternative implementation models for comparability. Furthermore, the results from the survey can also be used for further research.

Proposition 2

Research is needed in measuring when it is worthwhile for a solution swap to occur. because participants indicated that there were hidden costs, such as administrative costs.

Proposition 3

It is important here to examine how does an IPD guarantee quality and ensure constructability, without incentives and here it is also important to investigate how much influence the owner has and an investigate owner's experiences, using IPD, in safeguarding quality. This should then be compared with other implementation models?

In addition, future work should try and measure the effects the collocation in relation to Principal agent theory and its sustained effects in reducing opportunism in terms of moral hazard and thus safeguarding quality in the build.

Proposition 4

People who are resistant do they learn to collaborate! How does behaviour change over time in IPD projects, do they reject IPD fully or adopt some aspects of it? This can be linked to Illeris, (2004) learning theory whereby learning can be used to compare behavioural change in alignment with the theory. In addition, future work should try to focus on measuring learning in Design-Build compared to IPD.

In addition, when you examine the schema configuration of ideas, theory suggests that as the couplings occur the organisations become more interrelated and adapt to other company's belief systems and values over time. Through the lack of consensus of the main goals in the project, which might be due to the contextual problems in the project. As a result the schema configuration of ideas requires further examination, perhaps at the end of the IPD project.

9. Conclusion

This thesis examines Integrated project delivery (IPD) in Norwegian construction projects by examining the sharing of risk and opportunities aimed at better collaboration and project achievement. It studies used critical realism to not only analyse the context but examine the causal explanations that can affect the events present in the case study, the Tønsberg Project. Four propositions were resolved based on the events that transpired and through abstraction of the theory. The results showed that in almost all cases the propositions were verified, and the mechanisms identified such as new opportunities are discovered only when understanding of the project matures through working through the details.

Proposition one states that IPD provides less scope for sub-optimisation and opportunistic behaviour between companies in the value chain. The findings are inconclusive in suggesting if there was opportunistic behaviour or sub-optimisation. However, there was found to be some lack of understanding of IPD and some resistance to change. In relation to critical realism the mechanisms here for less opportunistic behaviour in the project is linked to the underlying incentives that lie in swapping solutions, finishing the project ahead of schedule and the common profit pot.

Proposition two states that IPD provides better conditions for unified solutions (swapping) than traditional contracts. The findings were that unified solutions (swapping) were taking place as a result of the fact that the clauses of the IPD contract made it a better option to collaborate and cooperate to find unified solutions, and swap job tasks and costs if necessary, than proceed with an unsatisfactory solution, and IPD is a game changer as there is less incentives for the actors in the project to be opportunistic. The mechanism is new opportunities are only discovered when an understanding of the project has matured enough through working with the details and when there are no structural restrictions. This leads to the event which is the swapping of solutions.

Proposition three states that IPD safeguards quality and customer value in a better way than alternative implementation models while maintaining constructability. The findings showed that constructability was safeguarded sufficiently well because of the goal alignment of the participants' goal with the owner's interests. In addition, the attributes of IPD is a mechanism that helps influence the participants to work together and solve problems, thus reducing cost and adding value for the customer. The data gathered showed that IPD does, in fact, safeguard quality and customer value in a better way than alternative implementation models. In critical realist terms,

the mechanisms, come from the owner's involvement in safeguarding his interests, the customer wanting value by aligning the goals of the participants to the goals of the project, through the incentives of collaboration and shared reward. As goals align it results in a mutually dependent interaction between participants and the project, each influencing the other.

Proposition four states that IPD, in combination with TVD, provides better framework conditions for continuous improvement and innovation compared to a Design Build model. The findings showed that innovation took place, both in process innovation and also in tools and materials innovation. Also continuous improvement in design occurred, and this was aided by TVD. In addition, after the contractor and consultant had been contracted, they established a cost estimate which was 300 millions NOK over the project cost frame. In order to reduce the estimate, they conducted, what was internally called, Sprint 300. Here they used TVD in order to find ways of reducing cost while securing customer value.

It would be favourable for the project to earn money by having enough work for trades on the construction site, (where they get payed per unit) and not outsource work. When keeping labour in-house they are able to remove obstacles and make sure everything flows, which is in line with Lean.

Not only did innovation and continuous improvement take place, but more so than in Design Build where detailed contracts make changes chargeable. IPD is important for Innovation but it requires time and a tolerance for failure. In terms of critical realism, the mechanism here can only occur as new possibilities are discovered when the costs are used as a driver for design instead of treating cost as an outcome of wasteful redesign iterations.

Finally, the critical realist analysis of the four propositions found IPD to be a complex with many interesting structures which has many interactions with other structures by means of generative mechanisms, resulting in a quality and efficient build with elimination of much waste through lean processes.

The findings are valuable to both academics and companies. Our findings also suggest future areas of research that need to be taken into consideration. Our study lays a foundation for further in-depth research in IPD and its effects on suppressing opportunism which can be of benefit to various organizations and companies. Therefore, there is a real need for further studies in this area given the emergence of IPD and the challenges in the construction industry.

Reflection on the propositions

The propositions suit this case study and can be used in other case studies concerning IPD, however dealing with the contextual issues, affects the balance between what is part of the IPD and what is contextual. This project has and is plagued by contextual problems which convolutes the whole process of analysing the project.

Reflections on the methodology

Using an approach that explores the case study has the potential to not just generalise the findings but to search for the structure and mechanisms which spurs creative thinking. The theoretical reflection allows for abstraction and creative thinking in combining theoretical perspectives with empirical findings. However, there are some limitations with this approach. The mechanisms can be too generic as a result one can fail to find the underlying or hidden explanation for the event. While on the other hand the mechanism can be too specific and can only arise from only one event. It requires training and learning in finding this delicate balance.

The thesis provides researchers with an overview of critical realism and applies it to show how causal explanations in IPD research can be identified. It is useful to analyse, in organisational settings where complex interactions occur the mechanisms which are often hard to perceive. The paper makes a contribution by showing how critical realism can be used within a pre-existing case study to better explain the nature of causation in complex social interactions and identifies mechanisms which are often hidden.

This critical realism aspect of this thesis should be of interest to PhD students examining IPD, experienced researchers not familiar with critical realism, IPD consultants and critical realism students.

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Appendices

Appendix 1: Student-Supervisor Agreement

Appendix 2: Confidentiality Agreement

Appendix 3: General Information guide

Appendix 4: Interview guides, Contractor

Appendix 5: Overview of schedule at Tønsberg Project

Appendix 6 Lawyers interpretation of the risks in IPD vs DB

Appendix 7 AIA (2014), Integrated Project Delivery Principles (IPD)

Appendix 8: Results from Relational Coordination

Appendix 1: Student-Supervisor Agreement

UNIVERSITETET I AGDER
HANDELSHØYSKOLEN

Avtale om veiledning i forbindelse med

IND-590 Masteroppgave i Industriell økonomi og teknologiledelse

Formålet med avtalen er å regulere

- studentenes rett til å motta veiledning.
- Veileders plikt til å gi veiledning og
- Instituttets (institusjonens) og øvrige parters rettigheter/plikter

i forbindelse med gjennomføring av masteroppgaver.

Avtalen inngås mellom

Christine Bydall (student)

UNA NWAJEI (student)

(veileder)

(institusjonen v/ studieprogramleder/instituttleder)

Oppgavens tittel:

OF PRODUCTION EFFICIENCY IN AEC INDUSTRY USING AND APPLYING IPD CONTRACTS IN THE TUNSBERG PROJECT

(arbeidstittel eller endelig tittel)

UNIVERSITETET I AGDER
HANDELSHØYSKOLEN

1. Masteroppgaven utgjør 30 studiepoeng og skrives normalt i 4. (siste) semester av mastergradsstudiet. Masteroppgaven skrives enten alene eller to studenter sammen.

   Det er utarbeidet en egen emnebeskrivelse for oppgaven (IND590-G).
   Målet med masteroppgaven er at studentene skal lære å anvende vitenskapelige metoder på en problemstilling som er innenfor . Oppgaven bør ta utgangspunkt i en problemstilling som er relevant innenfor emner i innovasjon og kunnskapsutvikling. Den skal omfatte en analytisk tilnærming og ofte en empirisk undersøkelse av aspekter ved problemstillingen.

   Ved skriving og innlevering av oppgaven skal de sentrale retningslinjer fastsatt av universitetet for mastergradsoppgaver følges, se

   https://www.uia.no/student/eksamen/innlevering-av-oppgaver/masteroppgave

2. Oppgaven skal leveres:

   ....1. juni....

   (1. juni eller 1. desember vedkommende år)

   NB! Hver enkelt student må være vurderingsmeldt, dvs. meldt opp til eksamen i IND590-G (Masteroppgaven i industriell økonomi og teknologiledelse) i det semesteret han/hun planlegger å levere oppgaven.

   Endring i denne dato skal avtales skriftlig mellom partene. Hvis masteroppgaven leveres senere enn denne dato, må den aktuelle studenten sørge for å trekke seg fra eksamen i dette semesteret samt betale semesteravgift, semesterregistrere seg og melde seg opp til eksamen innen fastsatte frister i det semesteret de skal levere.

   Studenter som utsetter innleveringen av masteroppgaven har ikke krav på å få forlenget veiledningsperioden. Hvis slik forlengelse medfører at ny veileder må oppnevnes, skal veiledningens totale omfang holdes innenfor det omfang som er fastsatt i pkt. 3.

3. Partene avtaler hvordan veiledningstiden mest hensiktsmessig kan disponeres. Studenten har plikt til aktivt å oppsøke veileder når han/hun mener å ha behov for veiledning Det er obligatorisk deltakelse i to (2) veiledningsmøter. Dersom flere studenter har samme veileder kan deler av veiledningen skje ved samlinger hvor flere studenter deltar.

4. Oppstår det problemer i veiledningsforholdet skal saken først forsøkes løst i samråd med studiekoordinator. Hvis ikke dette fører frem, har veileder/student rett til å bli løst fra veiledningsavtalen. Det påligger da instituttleder i samråd med studiekoordinator og student å oppnevne ny veileder.

5. Ved uforutsett lengre fravær hos veileder kan det medføre behov for ny veileder. Det påligger da instituttet å skaffe ny kvalifisert veileder. Om mulig skal dette gjøres i samråd med studenten.

UNIVERSITETET I AGDER
HANDELSHØYSKOLEN

6. Universitetet i Agder har ikke noe ansvar i forhold til 3. person for det arbeid som studenten og/eller veileder utfører ved innhenting av opplysninger, dokumenter m. v. til bruk i masteroppgaven. Institusjonen har heller ikke noe ansvar for opplysninger, vurderinger, konklusjoner m. v. som fremkommer i oppgaven.

   Dersom student og/eller veileder er i tvil om opplysninger m. v. vil krenke 3. persons rettigheter, plikter disse å ta kontakt med instituttledelsen før opplysningene publiseres eller gjøres kjent på annen måte.

   Studenten har taushetsplikt etter forvaltningsloven dersom arbeidet med oppgaven medfører kjennskap til opplysninger som er taushetsbelagt.

   Dersom arbeidet med masteroppgaven medfører at informasjon (forskningsdata) hentes inn fra tredje person ved bruk av spørreskjema, intervjuer eller lignende, skal Universitetet i Agders «Rutiner for behandling av personopplysninger i forskning og studentoppgaver» følges. Se http://www.uia.no/forskning/om-forskningen/rutiner-for-behandling-av-personopplysninger-iforskning-og-i-studentoppgaver.

7. Dersom masteroppgaven resulterer i at det frembringes opplysninger /resultater e. l. som kan utnyttes kommersielt, vil institusjonen og studenten – med mindre annet avtales skriftlig - sammen ha rett til slik utnyttelse.

   Dersom oppgaven er initiert av ekstern institusjon/virksomhet skal det avtales særskilt hvem – oppdragsgiver, student(er) eller institusjon - som skal ha rett til eventuelt kommersiell utnyttelse av opplysninger, resultater e. l. som oppgaven frembringer.

Grimstad, 4/1-18
(dato)

Christine Bydall
(signatur: student)

Ida Ulvøy
(signatur: student)

(signatur: veileder)

(signatur: studieprogramleder/instituttleder)

Handelshøyskolen ved UiA

Kopi av avtalen sendes til:
Fakultetsadministrasjonen ved Handelshøyskolen ved UiA, v/Nertila Stringa

Appendix 2: Confidentiality Agreement

UNIVERSITETET I AGDER

FAKULTET FOR TEKNOLOGI OG REALFAG

Fastsatt av Dekan ved UiA Fakultet for teknologi og realfag 30.01.2018.

STANDARDAVTALE

om utføring av masteroppgave/bacheloroppgave/prosjektoppgave (oppgave) i samarbeid med bedrift/ekstern virksomhet (bedrift).

Avtalen er ufravikelig for studentoppgaver ved UiA Institutt for Ingeniørvitenskap som utføres i samarbeid med bedrift.

Partene har ansvar for å klarere eventuelle immaterielle rettigheter som tredjeperson (som ikke er part i avtalen) kan ha til prosjektbakgrunn før bruk i forbindelse med utførelse av oppgaven.

Avtale mellom

Student: [illegible] født: [illegible]

Veileder(e) ved UiA: Bo Terje Kalsaas

Bedrift/ekstern virksomhet: TØNSBERGPROSJEKTET, SYKEHUSET I VESTFOLD HF

og

UiA v/instituttleder [illegible] HANNÅS

om bruk og utnyttelse av resultater fra masteroppgave/prosjektoppgave.

1. Utførelse av oppgave

Studenten skal utføre

Bacheloroppgave	☐
Masteroppgave	☒
Prosjektoppgave	☐

(sett kryss)

i samarbeid med

TØNSBERGPROSJEKTET

bedrift/ekstern virksomhet

1/1 – 1/6 - 2018

startdato – sluttdato

Oppgavens tittel er:

EFFICIENCY OF PRODUCTION IN AEC INDUSTRY USING AND APPLYING IPD CONTRACTS IN THE TØNSBERG PROJECT

Side 1 av 4 Versjon UiA 2017-12-01

Ansvarlig veileder ved UiA har det overordnede faglige ansvaret for utforming og godkjenning av prosjektbeskrivelse og studentens læring.

2. Bedriftens plikter

Bedriften skal stille med en kontaktperson som skal gi studenten nødvendig tilretteleggelse av arbeidet ved virksomheten og kan om mulig bidra i veiledning i samarbeid med veileder ved UiA. Bedriftens kontaktperson er:

Bjørn Vikdal

Formålet med oppgaven er studentarbeid. Oppgaven utføres som ledd i studiet, og studenten skal ikke motta lønn eller lignende godtgjørelse fra bedriften. Bedriften skal dekke følgende utgifter knyttet til utførelse av oppgaven:

3. Partenes rettigheter

a) Studenten

Studenten har opphavsrett til oppgaven. Alle immaterielle rettigheter til resultater av oppgaven skapt av studenten alene gjennom oppgavearbeidet, eies av studenten med de reservasjoner som følger av punktene b) og c) nedenfor.

Studenten har rett til å inngå egen avtale med UiA om publisering av sin oppgave i UiA sine institusjonelle arkiv på internett. Studenten har også rett til å publisere oppgaven eller deler av den i andre sammenhenger dersom det ikke i denne avtalen er avtalt begrensninger i adgangen til å publisere, jfr punkt 4.

b) Bedriften

Der oppgaven bygger på, eller videreutvikler materiale og/eller metoder (prosjektbakgrunn) som eies av bedriften, eies prosjektbakgrunnen fortsatt av bedriften. Eventuell utnyttelse av videreutviklingen, som inkluderer prosjektbakgrunnen, forutsetter at det inngås egen avtale om dette mellom student og bedrift.

Bedriften skal ha rett til å benytte resultatene av oppgaven i egen virksomhet dersom utnyttelsen faller innenfor bedriftens virksomhetsområde. Dette skal fortolkes i samsvar med begrepets innhold i Arbeidstakeroppfinnelsesloven[1] § 4. Retten er ikke-eksklusiv.

Bruk av resultatet av oppgaven utenfor bedriften sitt virksomhetsområde, jfr. avsnittet ovenfor, forutsetter at det inngås egen avtale mellom studenten og bedriften. Avtale mellom bedrift og

[1] Lov av 17. april 1970 om retten til oppfinnelser som er gjort av arbeidstakere http://www.lovdata.no/all/hl-19700417-021.html

student om rettigheter til oppgaveresultater som er skapt av studenten, skal inngås skriftlig og er ikke gyldig inngått før UiA (ved instituttleder) har mottatt skriftlig gjenpart av avtalen.

Dersom verdien av bruken av resultatene av oppgaven er betydelig, dvs. overstiger NOK 100.000, se fotnote [2], er studenten berettiget til et rimelig vederlag. Arbeidstakeroppfinnelsesloven § 7 gis anvendelse på vederlagsberegningen. Denne vederlagsretten gjelder også for ikke-patenterbare resultater. Fristbestemmelsene i § 7 gis tilsvarende anvendelse.

c) UiA
De innleverte eksemplarer/filer av oppgaven med vedlegg, som er nødvendig for sensur og arkivering ved UIA, tilhører UiA. UiA får en vederlagsfri bruksrett til resultatene av oppgaven, inkludert vedlegg til denne, og kan benytte dette til undervisnings- og forskningsformål med de eventuelle begrensninger som fremgår i punkt 4.

4. Utsatt offentliggjøring – Ikke aktuelt.

Hovedregelen er at studentoppgaver skal være offentlige. I særlige tilfeller kan partene bli enig om at hele eller deler av oppgaven skal være undergitt utsatt offentliggjøring i maksimalt 5 år, dvs. ikke tilgjengelig for andre enn student og bedrift i denne perioden.

Oppgaven skal være undergitt utsatt offentliggjøring i

ett år	☐
to år	☐
tre år	☐
fem år	☐

Oppgaven skal ikke offentliggjøres

(sett kryss bak antall år hvis dette punktet er aktuelt)

Behovet for utsatt offentliggjøring er begrunnet ut fra følgende:

De delene av oppgaven som ikke er undergitt utsatt offentliggjøring, kan publiseres i UiA sine institusjonelle arkiv, jfr punkt 3 a), andre avsnitt.

Selv om oppgaven er undergitt utsatt offentliggjøring, skal bedriften akseptere at studenten kan benytte hele eller deler av oppgaven i forbindelse med eventuelle jobbsøknader, samt videreføring i et eventuelt doktorgradsarbeid.

5. Generelt

Denne avtalen skal ha gyldighet foran andre avtaler som er eller blir opprettet mellom to av partene som er nevnt ovenfor. Dersom student og bedrift skal inngå avtale om konfidensialitet

[2] innkomne inntekter etter at utgifter til erververvsmessig utnyttelse er trukket fra, herunder kostnader forbundet med rettighetssikring og kommersialisering.

om det som studenten får kjennskap til i bedriften, skal UiA sin standardmal for konfidensialitetsavtale benyttes. Eventuell avtale om dette skal vedlegges denne avtalen.

Eventuell uenighet som følge av denne avtalen skal søkes løst ved forhandlinger. Hvis dette ikke fører frem, er partene enige om at tvisten avgjøres ved voldgift i henhold til norsk lov. Tvisten avgjøres av sorenskriveren ved Agder tingrett eller den han/hun oppnevner.

Denne avtale er underskrevet i 4 - fire - eksemplarer hvor partene skal ha hvert sitt eksemplar. Avtalen er gyldig når den er godkjent og underskrevet av UiA v/instituttleder.

16.05.18 GRIMSTAD	Christine Bydall
Sted, dato	student

Grimstad, 16/5-2018	
Sted, dato	veileder ved UiA

Kristiansand 22/5-18		Inst. for Økonomi og Innovasjon
Sted, dato	instituttleder, UiA	institutt

Tønsberg 23/5-2018	
Sted, dato	for bedriften/institusjonen stempel og signatur

Appendix 3: General Information Guide

Purpose of the Interview

This is a master thesis project conducted at the University of Agder and our purpose her today, is to explore and examine the efficiency of production in the Architecture, Engineering and Construction industry (AEC) using and applying IPD.

We intend to look the possibilities and limitations in the use of IPD to help understand our preliminary research question: what affects does an IPD model have on collaboration quality in the supply chain within a projects lifecycle.

Our focus areas will be early involvement in the recruitment, the preliminary project and the design process, with the construction phase being examined for the quality in information sharing and decision making. The Tønsberg project is not due to reach the handover phase and as a result will be excluded.

Our research has numerous contributions not just to the owners but to the primary and key participants within the supply chain. It will serve not just to inform how well participant feel IPD work contrary to other PD models but can be used as a tool to innovate better ways of working. Nye Veier has expressed interest in the use of IPD and the master thesis will as a result be beneficial in understanding how IPD's work but their contribution in improving efficiency. It addition it will also benefit other business owners thinking of introducing IPD.

Our plan today is to conduct a series of interviews and perhaps observe, if possible, during some meetings.

Information about the Interviews

This interview is designed to last no longer than (1-1.5 hours). This interview guide will be used to help the participants and main themes or topics will be used for discussion.

This interview is going to be recorded, and all conversations conducted between the participants and interviewees will be confidential. Recorded interviews will be deleted after processing and any sensitive information, will only by published by agreement with the informant as soon as possible after the interview (max 5 days).

All information gathered will be anonymous and data collected will be presented in such a way that it will not be traceable back to any respondents. As a result, only participant numbers will be used in the master thesis.

A report will be sent to the respondent for quality assurance and follow-up questions might be needed, which will be asked by phone or e-mail.

Appendix 4: Example of an interview guide

19 -04 -2018 / Bo Terje Kalsaas, University of Agder

Project Implementation Models (2017-2020) . A research collaboration between Nye Veier road project and the University of Agder .

Tønsberg project , IPD project Intervjuguide . Project Manager General Contractor. Confidential

Place, date , duration : ..... ;

Respondent (Code for Key Info, Name and Function / Role / Position - Handling of Personal Information) : ....

The project :

1. How do you see your role in the project?
2. What are your biggest professional challenges?
3. What are the main goals for the project, broken down to your tasks and what do these goals mean when it comes to your work?
4. How would you describe the clarity in goals, needs and requirements (scale from 1-5).
5. How do you rate the complexity of the challenges in the project
6. (also in regards to unknown methods and/or solutions) (scale 1-5) ?

If you were involved in the contracting and transformation process to the IPD contract:

6. How was you involved?
7. How was the process of establishing the IPD contract (with budget) viewed from your perspective? Risk and reward?
8. What do you consider to be the most important in the IPD ?
9. Do you have experience with IPD or similar contracts from the UK? Differences?

Implementation phase :

1. What can you say about the "lesson learned" so far regarding the use of the IPD in the Tonsberg project?
2. IPD is described as a game changer. How does the collaboration work in regards to the owner and the project team? (Constructionability - Time - Flow / Productivity - Customer Value / Quality?)

3. We have heard that the design has been delivered late to the production department when it comes to construction of the psychiatry building. Comments?
4. How do you follow up in the project?
5. Until now has there been any delays due to late decision-making from the owner?
6. How is the contract applied or used in the project?
7. How are unpredictable situations/discrepancies/and differences of opinion handled?
8. What are the biggest challenges in terms of time, cost and quality based on your perspective?
9. Do you have experience using a design build project delivery model?
   If yes, how would you compare it to a IPD? What are you doing differently? How do your thoughts? What are the advantages / disadvantages in your opinion?
10. Do you optimize resources between, those in the value chain (all those involved in the Tønsberg project), to increase value?
11. Have you come up with suggestions for improvements (innovation) in the implementation phase (can you possibly mention how many with some examples) ?
12. In your opinion would you say sub-optimization removed or do you see it as a challenge in the IPD?
13. In your opinion would you say that you have had fewer change messages generated from the designers?
14. Is there new competence in the project?
15. In your opinion would you say IPD's promote innovation? Examples.
16. How does the BiM system works in relation to the contractor's needs?

Interaction Quality & Communication (Relational Coordination) :

17. Do you experience cultural differences between Skanska UK and Skanska Norway?
17. Are there any differences between construction sites between the UK and Norway?

Appendix 5: Overview of schedule at Tønsberg project

Meeting	Date	Duration	Type
1.	24.01.18	2 hours 30 min	Interview
2.	12.02.18	2 hours 30 min	Interview
3.	21.03.18	1 hours 30 min	Interview
4.	21.03.18	3 hours	Observation- Design meeting
5.	22.03.18	1 hours	Interview
6.	22.03.18	3 hours	Observation- Operational meeting
7.	22.03.18	2 hours	Interview
8.	22.03.18	45 min	Interview
9.	03.04.18	1 hour	Interview
10.	26.04.18	1 hour	Interview
11.	26.04.18	1 hour	Interview
12.	26.04.18	1 hour	Interview
13.	26.04.18	1 hour	Interview
14.	26.04.18	1 hour	Interview
15.	26.04.18	1 hour	Interview
16.	04.05.18	-	Survey approved and distributed

An overview of the participation schedule for Nye Veier workshops

Meeting	Date	Duration	Type
A	17.01.18	3 hours	Workshop
B	06.02.18	3 hours	Workshop
C	14.03.18	3 hours	Workshop
D	26.03.18	3 hours	Meeting
E	11.04.18	3 hours	Workshop
E	15.05.18	3 hours	Workshop

Appendix 6: Lawyer interpretation of the risks in IPD vs DB

MEMO

To: The hospital in Vestfold HF v / Jostein Todal — Trondheim, December 23, 2016

From: Arntzen de Besche Advokatfirma v / Jon Gresseth and Erlend Solberg — Responsible lawyer: Jon Gresseth — Our ref: TKL / tkl.

Copy: Tønsberg project by Tom Einertsen

OVERVIEW COMPARISON OF RISK - IPD AND NS 8405

The hospital in Vestfold ("**SiV**") has asked Arntzen de Besche Law Firm Trondheim AS ("**AdeB**") to prepare an overall comparison of the most important risk factors associated with the negotiated draft Integrated Project Delivery Agreement ("**IPD Agreement**") and NS 8405.

The IPD agreement has not yet been negotiated, so the comparison below is based on the draft in the state that was available on December 12, 2016 after the review as IPD-Principals ("**IPD-P**"). There are still some points, of which the insurance solution is probably the most important. However, we have reached a point in the negotiations where we have a sufficiently good picture of how the contract will appear to point to the main differences regarding risk.

In order to better understand our description of the IPD agreement, here we will give a brief presentation of some particular characteristics of the IPD agreement, and how this agreement model differs from those most other contract models. There are several variations within IPD agreements, so our description is attached to the specific negotiated agreement.

The IPD agreement is a three-party agreement where both the builder (SiV), the contractor (Skanska) and the consultant (Cura) unanimously lead. The parties will undertake a comprehensive phase of cooperation, where they they will sit together before they start the build. The basic idea is that they in this way, can find the best and most cost-effective solutions, and that though through planning will avoid time-playing and delays in the construction phase. To give entrepreneur and adviser a financial incentive, their profits are separated from their costs and predetermined to a given amount, so that profits are not affected by how much work or how much materials that are added to the project (see the remuneration model in the table below).

Responsibility for the day-to-day operation of the project has been added to the body IPD-P, where all decisions must be unanimously led. Over IPD-P we have a Project Steering Committee ("**PSC**") that takes responsibility for the questions IPD-P cannot agree on and where decisions are made through the majority vote. All the details of the project will be designed by Core, Cluster and Consultant Groups ("**CCCs**") under management of IPD-P. PSC and IPD-P will both consist of three members, one from the builder, one from advisory group and one from the entrepreneur. The composition of CCCs will vary according to the specific tasks they are set to solve, but will mostly be interdisciplinary.

Comparing the risk of the two models is somewhat challenging. Risk in a project is

much more than the provisions on risk contained in the contractual provisions. Organization of the project, the key personnel expertise, the market, how early advisors and contractors are involved etc. will affect the builder's risk. A project carried out after an NS 8405 contract, can of course also be organized in many ways - something that obviously will affect the risk for the builder. In

the following, we have nevertheless tried to compare the risk regulation in the two agreements, quite independently of how the projects are organized. This is to get a pure comparison of the agreement terms as possible. But for the sake of completeness it is important to note that in most projects that use through the use of utførelsesentrepriser, a lot of changes will be made to the provisions of NS 8405.

In this context it is also very important to make sure that the entire IPD agreement's idea is based the assumption that close cooperation and the parties' common economic interest will lead them to the following provisions on risk allocation should not arise. The numbers that the TP have received, presented from 110 IPD projects in the United States, seems to support this starting point.

In the continuation we will first briefly describe how the two models regulate the different themes, before we then give a verbatim comparison of the risks to the same theme.

Theme	IPD Agreement	NS 8405
Compensation	**IPD agreements, sections 7, 8 and 9**	**NS8405 point 27, cf. section 2.8**
	Early in the design those involved (the parties) agree on a Target Cost that should contain all projected costs in the project, but without any profit to the contractor and adviser. In addition, the parties agree on one amount as profit that the contractor and adviser should have for the project. When the project is completed the costs must be collate (Chargeable Costs) and compared against Target Cost. If Chargeable Cost is higher than Target Cost, the profit, for the Entrepreneur and adviser should be reduced Kr for Kr. If the difference is greater than the profits the entrepreneur and adviser will not make a profit. The BH musts always cover the cost (containing no profit). If Chargeable Cost is lower than Target Cost, the savings will be distributed 50/50 between builder and adviser/contractor.	NS 8405 does not specify a clear starting point for which compensation format is required. The contract thus opens to that workers can be paid at a fixed price with fixed amount (fixed price), or fixed price per unit (unit prices), or after receipts. In construction contracts, where the building largely will be designed and specified before pricing, the compensation will often be a fixed price with fixed amounts. NS 8405 still assumes the quantities first will be locked until the contractor has conducted a quantity control, to a subsequent deadline to be within the demands of regulatory amounts. Only after a quantity control, will the contractor be liable for the quantities. From NS 8405 paragraph 27.2.
	Risk **Comparison:** The IPD puts the risk of exceeding the contracted amount ("owners cost") on the BH, in that costs beyond "owners cost" are always covered. There are thus theoretically no limitations in the BH duty to pay the adviser's and contractor costs. At the same time, the contractor and adviser in an IPD agreement must give up all of their profit before the BH will cover additional costs. In an NS 8405, the entrepreneurs will initially have the risk of exceeding the contract amount ("Fixed rate"). However, in an NS 8405 contract, the price is not that fixed as the contractor can demand additional payment for a number of events. For example, the contractor will have the opportunity to claim addition payment for changes and	

	additional costs for production-related conditions ("Plunder and staple") Therefore, the difference in risk in this area should not be exaggerated.	
Changes and additional compensation	**IPD agreements, item 11**	**NS 8405, Item 22**
	Legal changes to an IPD agreement are in essentially: - Changes in the performance BH decides along the way - Unforeseen ground conditions. - Changes to laws and regulations as the parties could not predict. - Changes through a so-called «Client's Directive», see below. Changes in the project will initially take place, through decisions making in the IPD-P, possibly PSC if IPD-P is not in agreement. If one of the other parties in the PSC is in agreement with the BH assessment that a condition, that is not a change, is the question decided. If the BH is voted against in PSC he can nevertheless always instructs the parties through a Client's Directive. Changes adopted will normally affect the target cost but will usually not increase or reduce profits. The last point is however, not finally clarified in the negotiations, as Skanska and Cure demand that profit be automatically changed with changes in the project like it is in the NS system. There are no limitations in the BH right to demand changes, but it must probably be interpreted as a limitation that neither the advisors nor the contractor can be ordered to perform work that is of a completely different kind.	The developer has the right to make changes in form of addition, deduction and altered execution. A change may also be imposed on the delay and change of implementation in the project, cf. 22.2, as long as this can be done within a reasonable framework. BH is not entitled to impose changes resulting in additions to the contract sum of more than 15%. A change must nevertheless be connected with what the contract includes, and not be substantially different from the original agreed work. If the reduction of the contractor's total remuneration after the contract is 15% or more of the contract sum, this should be regarded as cancellation that triggers a cancellation allowance, cf. section 38. Changes are honoured by compensation adjustment according to the rules in paragraph 25, which also includes profit for the contractor. Change work must be imposed by formal change order, cf. section 22.3 There are separate rules for so-called "irregular changes" in section 23. These deal with situations where the BH orders execution of further work, which the contractor believes is a change. The contractor will after the rules in section 25 could claim compensation for additional costs to the execution of the build, those that come from consequence of changes, delay/failure in BH delivery and other obstacles that the BH carries the risk for. Such compensation adjustment includes, among other things, compensation, loss in productivity, rig and operational maintenance, etc. Compensation adjustment must also include profit for the contractor, and is thus

		not limited to just pure replacement for applied costs
	Risk **Comparison:** The IPD model aims to reduce the focus on changes that you normally have in an NS-contract, in that the contractor and the consultant always get their costs covered and not automatically claim additional profits on changes. Furthermore, in an IPD agreement, there are less room for demanding changes In an NS 8405 contract, there will largely be opportunities for the contractor to claim payment for changes to all conditions that differ from the terms and conditions of the contract, including missing and incorrect design, lack of co-operation and deliverance from the BH etc. Probably the risk associated with changes will be somewhat less in an IPD agreement than in an NS 8405-contract	
Cancellation	**IPD-agreement section. 17**	**NS 8405 section. 38.1**
	In general, the builder can always cancel and pay for all work done (including a proportionate share of profit) and cover a given percentage of the value of remaining work (3% for Skanska, 0% for Cura) to cover lost profits. This is one point where the parties are not yet totally in agreement. Furthermore, it is agreed separate cancellation rights where advisers and contractor are not entitled to future lost profit. Access is fully open until B4 but can also be made in B5 if certain additional conditions are met, that the project is not finally approved by BH.	BH has the right to cancel work. If the reduction in the contractor's total compensation is less than 15% of the contract amount, the reduction will always treated according to the rules of change. If the reduction is 15% or more, the contractor can claim for cancellation reimbursement for the financial loss he suffers as a result of the cancellation, ie the positive contract interest. Such losses include EBITDA and fixed costs, cancellation reimbursement costs that the contractor has for the subcontractors, etc. However, the contractor will have a loss obligation, including the released of his resources to take on other income-generating assignments.
	Risk **Comparison:** The IPD agreement gives greater rights to cancellation than a standard NS 8405, unless similar specific deviations are also agreed under an NS.	
Risk of design errors	**IPD Agreements, Item 12**	**NS 8405, points 1, 13.1 and 19.2**
	The advisors have in principle responsible for design errors in the IPD agreement. After delivery the responsibility will be as in a traditional enterprise agreement. Before delivery, all costs will be (though not profits) for additional work due to design errors always covered by the BH.	It appears from NS 8405, paragraph 1, that the standard is intended to be used where most of the design must be delivered by the BH. The BH will in line with the function distribution carry the risk of errors in his own design, cf. section 19.2.

	If this is the result that Chargeable Cost exceeds Target Cost, then this this will be taken from the profits of both the adviser and entrepreneur.	Thus, it will be the BH that carries the main design risk in NS 8405 contracts. If the contractor is doing the design, something that is normally done at one or another level, he still carries the risk of this line with the function distribution, cf. NS 8405 section 13.1.
	Risk **Comparison:** Prior to handover, the risk of design errors in an IPD agreement is both less and larger than in NS 8405. Less additional costs will be covered by the contractor and the advisor's profits, but if the costs are so large that they exceed the whole profits the BH has to cover it (excluding profit). We have understood that it would be possible to insure design errors that manifest themselves before handover. After delivery, the risk will in practice, correspond to NS 8405. Overall, therefore, the risk associated with design errors can be said to be somewhat greater in an IPD- agreement than in an NS 8405 contract. However If supplementary insurance is taken the difference in risk will be equalized.	
The risk of deficiencies in design	**IPD agreements, item 12 cf. item 15**	**NS 8405, item 36**
	The entrepreneur is in principle responsible for missing contracted work in the IPD agreement. After delivery, the responsibility will be as in a traditional contract. Before delivery, all costs will be (though not profits) for additional work due to deficiencies in the contracted work are always covered by the BH. If this results in Chargeable Cost exceeding Target Cost this will be taken out of profits of both the contractor and adviser.	The entrepreneur is at risk of deficiencies in the contracted work and is obliged to rectify, or to give a discount, and respond to replacement according to the rules in paragraph 36
	Risk **Comparison:** Prior to handover, the risk of shortcomings in the contracted work in the IPD agreement is both smaller and larger than in NS 8405. Less additional costs will be covered by the contractor and the adviser profit, but if the costs are so large that they exceed the entire profit, the BH still covers costs (excluding profits). After delivery, the risk will in practice correspond to NS 8405. Overall, the risk associated with deficiencies is claimed to be somewhat greater in an IPD agreement than in an NS 8405 contract.	
	IPD Agreement Section 6.1, cf. Section 12	**NS 8405 Section 19.3**

Risk of ground conditions	BH has the risk for ground conditions, if these deviate from what the adviser and Entrepreneur have used when they entered into the agreement, and after investigating the construction site and other available information	BH has the risk for ground conditions, if they differ from what the contractor had used in the contract, the nature of the assignment and other circumstances in general. The risk distribution will thus depend on which information the contractor had about ground conditions at upon entering the contract in this case. In a project like TP, where the work is too a great degree designed and specified in charge of the BH prior to entering into the contract with the contractor, will the contractor normally receive geotechnical reports prepared by the BH. BH will bear the risk if the ground conditions differ from that which is described in the rapports.
	Risk **Comparison:** BH runs the risk for ground conditions and is for all practical purposes similar to the two contract models.	
Delays and deadline extension.	IPD Agreements Section 11.2	NS 8405, points 24 and 25
	The IPD Agreement does not contain provisions about daily fines by delays, but based on an assumption that delays will cause increased costs in the project and that the contractor will try to avoid delays because of an increase in costs reduces his profits. BH may require a delay in the progress, but if this entails increases the costs will both the entrepreneur and adviser request an increase in Target Cost so that this does not reduce their originally agreed profit	If the work gets delayed and this is due to the circumstances the contractor has the risk for, it will basically be answered by a daily fine after the rules in paragraph 34. If progress is hindered by conditions the BH has the risk for the contractor hs the right to an extension of time. This apply for example to changes, delay or failure of the BH to deliver and other obstacles the BH carries the risk of. Similarly, the BH is also entitled to an extension to his own deadlines, if he is prevented as a result of circumstances the contractor is responsible for. Like we have mentioned above, will nevertheless the BH could impose on the contractor travel delay for a change even if this is due to circumstances he himself carries the risk of.
	Risk **Comparison:** If there are delays due to conditions on the part of the contractor, the IPD agreement will carry a greater risk than NS 8405 because the builder cannot demand daily fines and also must cover the cost (without profit). But if delays are due to conditions on behalf of the contractor, the risk in the IPD agreement will be less because the contractor will only claim for costs and no increased profits.	

Notification rules and preclusion **Deadlines to answer final settlement and lawsuits.**	**IPD Agreements, Item 16**	**NS 8405 has consistently strict notification deadlines.**
	The IPD agreements have to a limited extent pre-exclusive deadline, which is related to the purpose which is to limit the number processes around changes. However, the BH loses the right to claim if conditions that should have been discovered by handover. For conditions detected later it must be claimed within a reasonable time and no later than 3 years for claims against the advisors and 5 years for claims against the contractor. There is no agreement on legal action deadlines.	Especially relevant are these in connection with irregular changes (item 23), requirement for deadline extension (item 24) and requirement for remuneration adjustment (item 25). The deadlines are short and notice is due consistently given "without undue delay" after the party has become aware of the conditions that trigger the notification. The consequence for late notification isn basically, the party loses that right the notification contains (preclusion). It follows from NS 8405, paragraph 8, third paragraph that the party who invokes preclusion as a result of late notice, must do this without undue delay after receiving notification. If the party does not do this, he loses the preclusion objection. This also applies for the BH to provide his objections to the contractor's final settlement within 2 months from receipt of the final settlement. Objections and counterclaims that are not included within the deadline will as a rule, be lost. This follows from NS 8405, item 33.2. In cases of contested claims for change, extension of time or compensation adjustment in final settlement, the contractor must within 8 months from the takeover start a lawsuit for his demands. If the contractor does not do this, he loses. claims against the BH. This is according to NS 8405 Section 26.3.
	Risk **Comparison:** The IPD agreement entails a certain increased risk that claims may be promoted at a later date than in NS 8405. At the same time, there are other elements of the IPD agreement that attempts to curb the number of conflicts and disputes. To the extent that they function according to their purpose under Norwegian conditions this may cause the number of disputes under IPD agreements to be less than under traditional NS-contracts. On the other hand, neither the BH of an IPD agreement will lose his right to come objections to, for example, change requirements and so on	
Summary	To the best of our knowledge, there has never been an IPD project in Norway after that model that is being used by the TP. Neither the BH, advisory group nor entrepreneur has had any involvement with such agreements. Our company has not previously	

	assisted in designing such contracts. In this, of course, there is a risk that the parties involved have less experience with the IPD agreement. On the other hand, it has been shown to have very good experiences with hospital building using the IPD model from USA. Many in TP, both from the BH side, as well as advisors and contractors, have received knowledge of these projects through presentations in the US, exploration of IPD projects, talks with IPD players in the USA and through multiple talks and work meetings with lawyer Howard Ashcraft junior, who was here in Norway in the last year. We have no basis to assume that the positive experiences with IPD in hospital projects made in the USA are not transferable to Norway. As we see it, IPD agreements are in many ways a further development of cooperation agreements such as has been used in large projects recently, for example, the development of New St. Olavs Hospital in Trondheim. Using this background, there are many elements both in the process and in provisions in the agreement document that should be known in the Norwegian, land-based enterprise environment. The overall risk picture between an NS 8405 contract and an IPD agreement is not really very much different. Therefore, we cannot see that using an IPD agreement - on a general basis – should cause greater risk of exceedances than using an NS 8405 contract. The risk of overruns will, in our experience, be linked to other and more project-specific conditions. We repeat some of the above-mentioned points associated with risk: - If we look at the BH risk of covering the advisor and the contractor's costs exceed the agreed contract amount, so the two models look basically quite different. In an IPD agreement, there exists no limitation of the BH obligation to cover contract parties' costs, even if these exceed both Target Cost and Owners Cost. In an NS 8405 contract, often the contract amount is a fixed price. However, the price is no more fixed than that the contractor may claim additional compensation due to a series of events for example of omissions or changes to the design material, imposed changes, delayed decisions and deliveries from the BH or the BH advisers, delays or errors with sub-contractors, etc. - Regarding the risks associated with changes, the differences in the contracts are not special big. As we see it, there is probably less room for requesting changes in an IPD agreement than an NS 8405 contract. - Risks related to deficiencies, ground conditions and design errors are essentially similar in the two contract models. - The risk associated with delays to the contractor can be said to be somewhat larger in one IPD agreement, as there are no daily fines. On the other hand, the financial consequences of the BH own delay is less in an IPD- agreement than in an NS contract. - Regarding the differences in the notification rules, we do not consider this to be any difference in risk associated with possible overruns of the contract sum.

Appendix 7: AIA (2014), Integrated Project Delivery Principals (IPD)

IPD—THE DEFINITION:

Integrated Project Delivery (IPD) is a project delivery method that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction. The Integrated Project Delivery method contains, at a minimum, all of the following elements:

- **Continuous involvement of owner and key designers and builders from early design through project completion**
- **Business interests aligned through shared risk/reward, including financial gain at risk that is dependent upon project outcomes**
- **Joint project control by owner and key designers and builders**
- **A multi-party agreement or equal interlocking agreements**
- **Limited liability among owner and key designers and builders**

IPD requirements, as a project delivery model, are noted above. Projects using components of IPD, not in its entirety, are not IPD. This document's goal is to state that projects wanting to use IPD must incorporate all aspects of the definition for it to be considered IPD.

Note: Integrated Project Delivery teams will usually include members well beyond the basic triad of owner, designer and contractor. At a minimum, though, an integrated project includes tight collaboration between the owner, architect/engineers, and builders ultimately responsible for construction of the project, from early design through project handover.

Many of the essential elements of Integrated Project Delivery may be applied to a variety of collaborative project delivery methods, such as Design-Build or CM at Risk, that may not inherently contain every required IPD element mentioned above.

FURTHER EXPLANATION:

- **Integrated Project Delivery (IPD) is a project delivery method:** IPD is a unique and separate project method, distinctly different from Design-Bid-Build, Design-Build, CM at Risk, and Multiple Prime. All benefits for innovation and efficiency return to the project team as opposed to the individual firms. All parties agree to the business terms to share the financial savings for optimizing the Owner's business case.
- **Integrates people, systems, business structures and practices:** The foundation for IPD is the development of a virtual project organization. The organization of "the firms" includes the individual team members for the owner, designer(s), consultants and builder(s). The project organization's mission and responsibilities are committed to "best for project" decision making, and this commitment is supported by alignment of the firms' business interests through shared risk and reward.
- **Collaboratively harnesses the talents and insights of all participants:** The primary purpose of the virtual organization is collaboration. The project firms and individuals are committed to create a team culture of joint decision-making. Team members are formally organized in multidisciplinary clusters responsive to the project goals. Team members are individually accountable to contribute alternatives to design and construction issues. Builders' input is not left until the construction phase, when it is typically too late to benefit the design.
- **Reduce waste and optimize efficiency:** IPD incentivizes minimization of waste. In addition to integration and collaboration, the method utilizes formal tools to achieve maximum results. Typical tools include: Building Information Modeling (BIM), prefabrication, manufacturing of larger integrated units, process improvement metrics and LEAN design and construction techniques.

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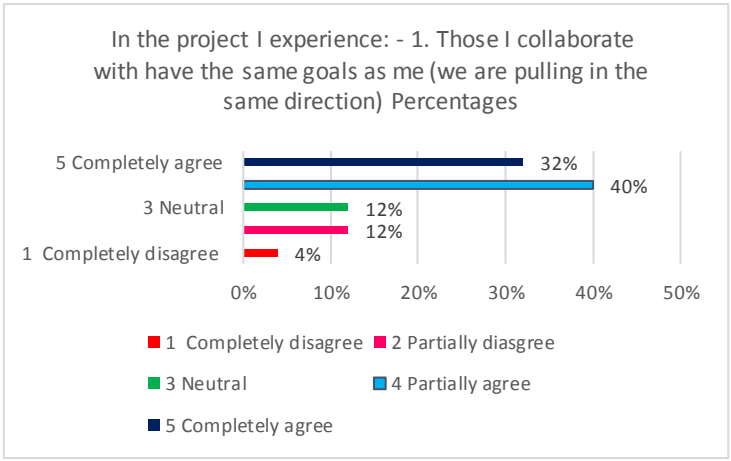
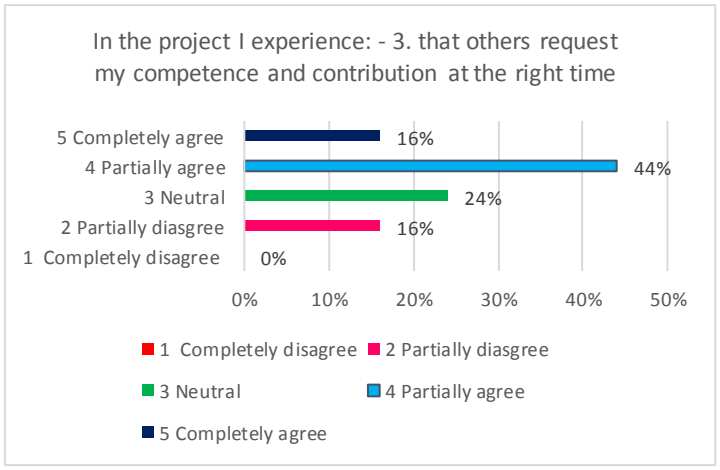
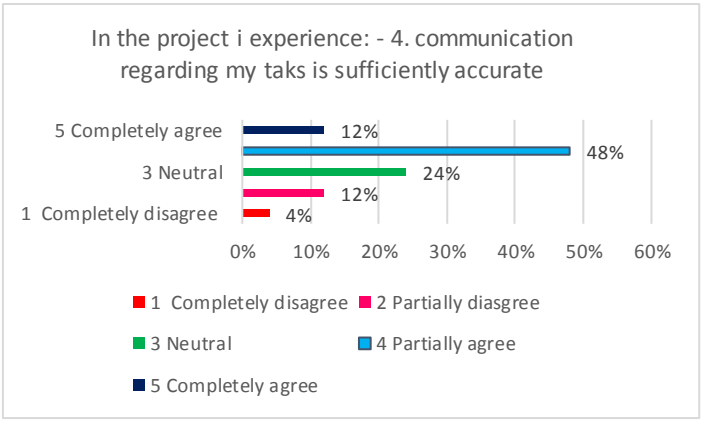
Appendix 8: Results from Relational Coordination



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3 Neutral
1 Completely disagree
12%
48%
24%
12%
4%
0%
10%
20%
30%
40%
50%
60%
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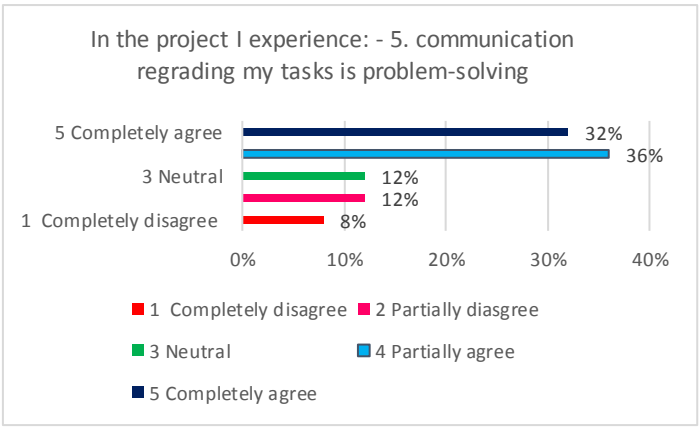
2 Partially diasgree
3 Neutral
4 Partially agree
5 Completely agree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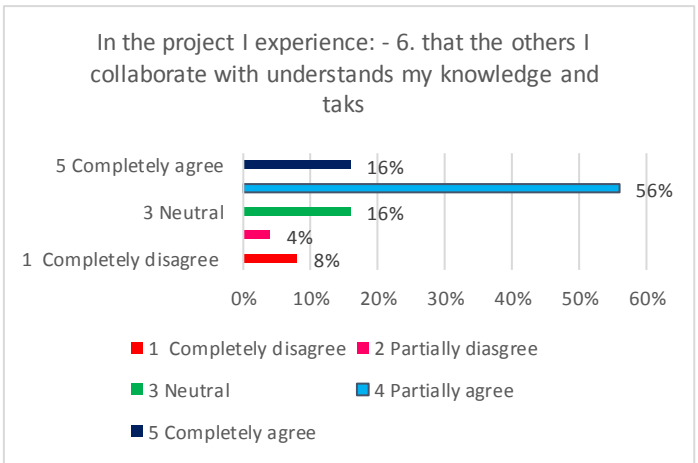
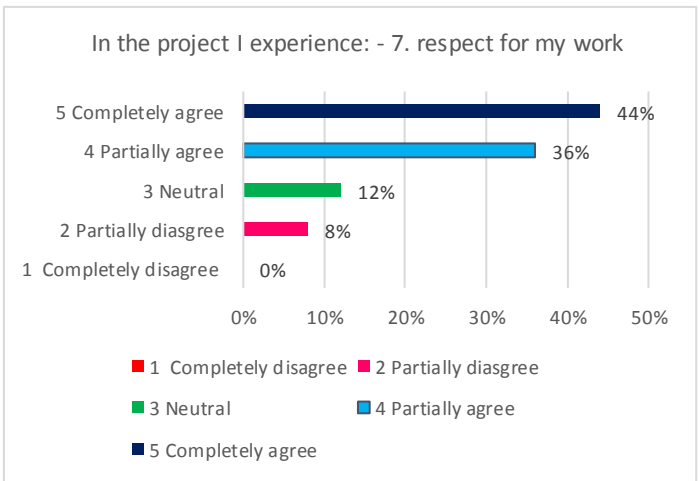
5 Completely agree
3 Neutral
1 Completely disagree
32%
36%
12%
12%
8%
0%
10%
20%
30%
40%
1 Completely disagree
2 Partially diasgree
3 Neutral
4 Partially agree
5 Completely agree


In the project I experience: - 6. that the others I collaborate with understands my knowledge and taks
5 Completely agree
3 Neutral
1 Completely disagree
16%
56%
16%
4%
8%
0%
10%
20%
30%
40%
50%
60%
1 Completely disagree
2 Partially diasgree
3 Neutral
4 Partially agree
5 Completely agree


In the project I experience: - 7. respect for my work
5 Completely agree
4 Partially agree
3 Neutral
2 Partially diasgree
1 Completely disagree
44%
36%
12%
8%
0%
0%
10%
20%
30%
40%
50%
1 Completely disagree
2 Partially diasgree
3 Neutral
4 Partially agree
5 Completely agree