

SPINNING THE IPD WHEELS

MOVING TOWARDS FRICTIONLESS PROJECT DELIVERY

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Abstract: IPD, as a project delivery model, has become increasingly popular within the construction industry around the globe. However, there is a need for more studies of collaborative construction projects in order to establish a common framework for projects that apply collaborative project delivery models. In this paper, we investigate to what extent collaborative projects that are not branded as IPD apply methods and mechanisms that are similar to the characteristic mechanisms for IPD. We show, through a multi-case, study how a simple tool can be used as a common reference to compare a specific collaborative delivery model with mechanisms typically applied in IPD projects. Furthermore, we have developed three IPD wheels to illustrate how project managers can identify where they may encounter friction in their specific projects and suggesting which mechanisms can be applied to operate more harmoniously and towards frictionless project delivery.

Keywords: IPD, project management, collaboration

1 Introduction

In September 2017, the prime minister of Norway gave a TV interview with the largest news network in Norway as she visited the first highway construction project in Norway that applied Integrated Project Delivery (IPD). During the interview, the prime minister emphasised how the use of collaborative models, such as IPD, in public projects results in less friction and significant savings for society through reduced planning and construction costs. Since its introduction in the United States in 2005, IPD has received significant attention and its popularity is continuing to grow worldwide for construction- and infrastructure projects.

IPD is a collaborative project delivery model that integrates people, systems, structures and practices in a collaborative process that seeks to exploit the knowledge and talent of participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication and construction (AIA, 2007).

Over the years, numerous collaborative project execution models have been developed both by scholars and practitioners. Often the nuances and variations between the different models are relatively small and for many practitioners, the many names and brandings of unique collaboration models may cause confusion and misunderstandings among practitioners (Engebø et al., 2020).

The purpose of this paper is to investigate to what extent projects that use collaborative models, that have not been branded as IPD projects, use methods and mechanisms that are similar to those that are common for IPD projects. We explore this through the following research question:

RQ: To what extent do collaborative projects that are not branded as IPD apply methods and mechanisms that are similar to the characteristic IPD mechanisms?

This paper is structured as follows. First, we provide a description of the theoretical background and state-of-the-art research on Integrated Project Delivery. Secondly, we describe the research methods applied and how we studied two case projects in Norway that applied a collaborative execution model that was not branded as IPD. Finally, we present the findings and discuss their implications as we

introduce the three IPD wheels, a tool that project managers can use to compare their project with typical IPD projects and help to identify where they may encounter friction in their project.

2 Theoretical Background

2.1 Integrated Project Delivery

Integrated Project Delivery (IPD) is a relatively new collaboration model that was developed in the United States around 2003-2005 (Kalsaas et al., 2020; Kahvandi et al., 2017; Lahdenperä, 2012). IPD has become increasingly popular and spread to different parts of the world and is the most recent addition to collaborative project delivery models. The American Institute of Architects (AIA) defines IPD as follows.

IPD is a method of project delivery distinguished by a contractual arrangement among a minimum of owner, constructor and design professional that aligns business interests of all parties. IPD motivates collaboration throughout the design and construction process by tying stakeholder success to project success and embodies contractual principles (as required traits) and behavioural principles (as desired traits). (Cohen, 2010)

The definition of IPD outlines a project delivery model that requires close collaboration between the parties involved in a project. Through the use of IPD, the aim is to utilise and share the talent, knowledge and insight between the parties for the greater good and achieve more successful projects. Trust is a crucial element to achieve better project value through collaboration, openness, effective communication and the use of new technologies (Walker and Rowlinson, 2019).

A purpose with IPD is to ensure collaboration and involvement between actors in such a way that they trust each other and share a common goal instead of pursuing and securing their own interests (Walker and Rowlinson, 2019; Govender et al., 2018). IPD is a project delivery model that is continuously evolving. Through a literature study, we have in **Table 1** identified key theoretical aspects shared by projects that apply IPD as we sort these in the following three categories: *Contracts, technology & processes, and culture.*

	(Walker and Rowlinson, 2019)	(Pishdad-Bozorgi, 2016)	(Walker and Lloyd-Walker, 2015)	(Lee, et. al, 2014)	(AIA, 2017; 2014)	(Ghassemi and Becerik-Gerber, 2011)	(NASFA, et.al 2010)	(Cohen, 2010)
Multiparty contracts	✓	✓		✓	✓	✓	✓	✓
Shared risk and reward	✓	✓	✓	✓	✓	✓	✓	✓
Early involvement of key actors	✓	✓	✓	✓	✓	✓	✓	✓
Intensified planning	✓	✓			✓		✓	✓
Common decision making	✓	✓	✓	✓	✓	✓	✓	✓
Common goal	✓	✓	✓		✓	✓	✓	✓
No-blame clause	✓	✓	✓	✓	✓	✓	✓	✓
Open books	✓	✓	✓	✓			✓	✓
Lean	✓	✓	✓	✓			✓	✓
Building information modelling (BIM)	✓	✓	✓	✓			✓	✓
Integrated information systems	✓	✓		✓	✓			
Trust and respect	✓	✓	✓	✓	✓		✓	✓
Collaborative behaviour	✓		✓	✓			✓	
Open communication	✓	✓	✓	✓	✓		✓	✓
Co-location	✓	✓	✓				✓	✓

Table 1: Methods and mechanisms in IPD projects, findings from literature review

Contracts

The main actors involved in an IPD project typically apply a common multiparty contract that defines their roles, responsibilities and rewards. Such contracts typically include the client, its main contractor(s), architects and advisors but sometimes also include subcontractors (Hanna, 2016; Lee et al., 2014). For a project to be “truly IPD” the use of such multiparty contracts is a requirement (Pishdad-Bozorgi, 2016). The contract often outlines a compensation format that requires open books, meaning that the different parties share financial information. Hence, successful use of such contracts requires a high degree of trust and willingness between the actors to share information that they would not normally share when using more traditional contracts (Lee et al., 2014; AIA, 2014). Implementing multiparty contracts and, building the right culture, requires significant efforts from all parties, both upfront and during project execution. Therefore, it is often claimed that the largest benefits from using multiparty contracts are achieved for projects with fairly high complexity (AIA, 2007).

Incentives for shared risk and reward, or pain share/gainshare is a characteristic feature of the compensation format applied in IPD projects (Walker and Rowlinson, 2019). Together, the participants develop a Target Outturn Cost (TOC) for the project and the profit margin for the contractor(s) is placed in a common pot which is at play and which is shared when the project is finished based on a pre-defined agreement (Walker and Lloyd-Walker, 2015, Cohen, 2010,). Savings identified throughout the project will increase the size of the profit that will be shared. Likewise, any cost overruns will be carried by all parties up to a certain cap. Any cost overruns exceeding this cap will be borne by the owner (Walker and Rowlinson, 2019; Ghassemi, 2011). The purpose of incentives for shared risk and reward is to foster a collaborative culture among the participants and focus on a common goal (Simonsen et al., 2019). The term “sink or swim together” is commonly used to illustrate this.

Early involvement of key actors early in the project has shown a positive effect on collaborative behaviour (Jaafar and Yusof, 2019; Rahmani et al., 2018; Hosseini et al., 2016). Early involvement of contractors where they can contribute with their detailed competence at the concept stage enhances the collaboration level (Ahola et al., 2017; Wondimu et al., 2016) and learning in a project (Simonsen et al., 2019). Lack of early involvement may lead to misunderstandings and knowledge sharing may suffer, which again has a negative effect on the trust level in a project (Pishdad-Bozorgi, 2016). Tendering in public projects must comply with public procurement regulations, which sometimes makes it difficult for owners to involve contractors as early as they ideally would have liked to (Bygballe and Swärd, 2019).

Intensified planning is a way to facilitate increased understanding of the project requirements at an early stage. This requires a significant effort, already at project start-up, from both owner and contractor (AIA, 2007). Through intensified planning, the risk for costly changes later in the design- or construction phase is reduced (Simonsen et al., 2019). It is crucial to involve key stakeholders early in order to harvest the benefits from intensified planning (AIA, 2007). This ensures that the requirements from users and other stakeholders are identified at an early stage where it may still be possible to implement these without introducing costly changes and redesign them (AIA, 2014).

Important project decisions should be taken through well-defined processes that involve the right decision-makers (Walker and Rowlinson, 2019; AIA, 2007). Through common decision-making decisions are taken to ensure that the project reaches its goal (Walker and Lloyd-Walker, 2015). The group members should be defined at project start-up to allow for early contractor involvement and intensified planning. The group of decision makers should include key stakeholders to ensure that all perspectives are covered. It is important that the group of decision-makers consists of people that have a different backgrounds in order to foster creativity and innovation (Pishdad-Bozorgi, 2016). Common decision-making increases chances for project success, reduces the potential for conflicts in a project organisation, and is a requirement to achieve a collaborative project environment (Haaskjold et al., 2020; Simonsen et al., 2019).

A common goal must be developed and understood by the actors early in a project (Nevstad et al., 2018). To develop the project goal the owner may choose to invite contractor(s) early to utilise their detailed knowledge and jointly develop the project goals (Walker and Lloyd-Walker, 2015; Ghassemi, 2011). Once defined, the goals for the project must be communicated to all participants in the project to ensure that all project participants have the same understanding of what the owner wants to achieve from the project (Pishdad-Bozorgi, 2016; Cohen, 2010). If there is a lack of clearly defined goals, or if these goals are not understood by project participants, there is an increased chance for delays (Ghassemi, 2011) or cost overruns (Walker and Lloyd-Walker, 2015).

Another mechanism that is commonly applied in IPD-projects is the no blame clause. Through this clause the project actors agree not to make financial claims against each other (Walker and Lloyd-Walker, 2015). This leads to fewer conflicts and improves the collaborative spirit among the project participants (Simonsen et al., 2019). Another positive effect is an increased level of trust and respect in the project team (Pishdad-Bozorgi, 2016) which again increases chances for projects success (Kadefors, 2004).

Open books refer to the mechanisms where the owner and the contractor(s) share each other’s financial information related to the project (Walker and Lloyd-Walker, 2015). The purpose of «opening up the books» is to improve the collaborative spirit and the quality of the communication between client and contractor. This again leads to increased trust (Haaskjold et al., 2019) and a best for project mindset (Walker and Rowlinson, 2019). In terms of financial perspectives, the different actors may have different incentives and by opening up the books the actors get a better understanding for each other’s financial incentives related to the project.

Technology and processes

In IPD projects Lean processes are commonly applied to maximise project performance through reduction of waste (Cruz et al., 2020; Pishdad-Bozorgi, 2016). Lean is a concept with a strong focus on removing activities that do not generate value for the end-user. Such non-value-adding activities are commonly referred to as waste (de Oliveira

Santos and de Carvalho, 2020). Lean as a philosophy is used in several industries, and within the construction industry this is often referred to as Lean Construction (Ballard and Howell, 2003). Lean is considered a natural part of IPD projects (NASFA et al., 2014) and one can consider Lean as a means to operationalise IPD (Bygballe et al., 2019). Applying the Lean philosophy within the framework of IPD helps to maximise value and minimise waste (Fakhimi, et al., 2016; Ghassemi, 2011).

Building Information Model (BIM) is a process that combines information and technology to create a digital representation that integrates data from several different sources. The model is developed in parallel through the project phases from conceptualisation, design, construction and operations (Govender et al., 2018). A potential effect of applying BIM in IPD-projects is a reduction of errors and less need for redesign or rework through visualisation in the model and clash checks (Simonsen et al., 2019; Garra and Skripack, 2019). Lean and BIM can be combined through Virtual Design Construction (VDC) (Khanzode et al., 2006). VDC was developed at Stanford University, USA, and is based on Lean principles. VDC considers the following three aspects; product, organisation and process (Kunz and Fischer, 2012). Hence, VDC is both an implementation method for tools such as BIM and Integrated Concurrent Engineering (ICE) to produce virtual models in the early phases of the project as well as a method that focuses on utilising technology to increase chances for project success (Kunz and Fisher, 2012). Through ICE sessions, actors are gathered in a big room regularly to ensure that interdisciplinary decisions can be taken quickly and solutions can be identified through collaboration (Khanzode et al., 2006). Using VDC in IPD projects allows the project actors to use models as interdisciplinary deliverables, which leads to a leaner process and reduction of waste (Garra and Skripac, 2019). Using Integrated information systems is a way to ensure that information, that may be scattered across the projects on multiple platforms and formats, is easily made available for project participants (Lee et al., 2014). Complex projects often require quick decision making as changes occur and through integrated information systems decision-makers get access to accurate and updated information. This ensures that decisions are taken based on the best available information

as integrated information systems allow for increased collaboration across platforms (Simonsen et al., 2019). Effective sharing of information also leads to increased trust (Haaskjold et al., 2019; Pishdad-Bozorgji, 2016; Kadefors, 2004).

Culture

Trust is a key element needed in order to achieve the collaborative culture that is desired to ensure success in an IPD project (Walker and Lloyd-Walker, 2015; Cohen, 2010).

There is a positive relationship between trust and collaboration (Bond-Barnard et al., 2018; Pinto et al., 2009; Kadefors, 2004). Trust is defined by (Rousseau et al., 1998 p. 395) as follows: "Trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intention or behaviour of another". Furthermore, trust can have different forms (Lopres et al., 2021). Calculated trust follows rational choices (Rousseau et al., 1998) and can be tangible in terms of, for examples certificates (Kadefors, 2004). Relational trust is less tangible and develops over time based on previous behaviour, while institutional trust describes how circumstances necessary for trust are created through, for example, legal systems (Rousseau et al., 1998). Openness that encourages sharing of both bad and good news is positively associated with trust (Suprpto et al., 2015). Having effective mechanisms to resolve issues is one of several factors that contribute to trust (Manu et al., 2015). Other elements of trust include role clarity (Henderseon et al., 2016) and empowering team members and contractors with sufficient authority (Schoorman et al., 2007).

Project participants must show a collaborative behaviour in order to be successful when working within IPD projects (Walker and Lloyd-Walker, 2015). It is important to create an environment where the project actors are willing and seek collaboration (Lee et al., 2014). Within traditional project delivery models, it is often challenging to achieve a collaborative culture (Lehto and Aaltonen, 2021; Aarseth et al., 2016). However, within the framework of IPD projects win-win situations are created where success for the project is aligned with success for each project participant (Walker and Lloyd-Walker, 2015; Bitici et al., 2007). Having the right culture enhances the possibilities for both informal- and

formal collaboration between people from different organisations (Aarseth, 2014).

Effective and open communication is important in any project (Haaskjold et al., 2019) but crucial in IPD projects. In these projects, it is particularly important to understand each other's expectations and limitations (Walker and Lloyd-Walker, 2015; Beach, Webster, & Campbell, 2005)). Open and honest communication plays an important role in the collaborative relationship between clients and their contractors (Aliakbarlou et al., 2018). It is important that all parties communicate and understand the objectives and goals of the project (Yeung et al., 2007). Poor communication can lead to misunderstandings and conflicts (Haaskjold et al., 2019). The quality of communication is often best when there is a balance between formal and informal communication (Turner and Muller, 2004).

Geographical co-location, through shared workspaces, often leads to more effective communication and higher collaboration levels among the parties (Walker and Lloyd-Walker, 2015). Co-locating teams is a common mechanism used in IPD projects, and often the parties commit to allocating their key actors full time to a common and shared location (Pishdad-Bozorgji, 2016). To harvest the full benefits, co-locating teams should start already at project start-up.

2.2 Different levels of IPD

IPD is a fairly new project delivery model that combines the elements of contracts, technology and processes and culture. The project participant establishes a formal relationship through a multiparty contract that specifies incentives for shared risk and reward, early involvement of key actors, intensified planning, common decision making, no blame culture and open books.

In terms of technology and processes, IPD projects utilise Lean concepts, VDC and advanced use of BIM. Integrated information systems are applied to gather information from different sources in order to provide decision-makers with the most accurate information real time. When it comes to culture, it is crucial with trust, collaborative behaviour, effective communication, and extensive co-location. These are all critical elements to build the collaborative culture that IPD projects require. Since being introduced in 2003, IPD has been continuously evolving and there exist multiple variants of IPD models.

There are also several other variants of project delivery models that have not been branded IPD, but in which many similar mechanisms are applied. To illustrate to what extent a project model is similar to IPD, existing literature often uses the following three categorisations: Pure IPD, IPDish and IPD light. (Bygballe et al., 2019; Wilson 2018; Hanna 2016; Sive, 2009). Pure IPD describes the situation where the project consists of one integrated team with members from the owner, contractor, architect and advisors who share risk and rewards. IPDish and IPD light describe less integrated teams but who apply many of the same technology and processes, although they still apply more traditional contracts.

2.3 Research Gap

As the popularity of IPD has increased and spread worldwide in the construction industry, many projects claim to be IPD projects, although there may be significant differences between them in terms of to what extent various aspects of IPD mechanisms are implemented. Likewise, many projects using traditional contracts may still apply many of the other characteristics for IPD projects. They may, for example, apply advanced collaborative processes and have a highly collaborative culture even though the project itself has not been "branded" as an IPD project.

As the popularity for IPD continues to grow there is a need to establish a common framework and further develop models, such as those presented by Sive (2009) and NASFFA et al. (2010), so that project managers and researchers can easier differentiate between various projects in terms of to what extent they are in fact IPD projects (Engebø et al. 2020).

There is also a need for more practice-oriented studies of collaboration in construction projects (Baiden et al., 2018; Svejvig and Andersen 2015). Based on this, we have identified a research gap where there is a need for more studies of collaborative construction projects in order to establish a common framework for projects that apply collaborative project delivery models.

3 Research Methods

The aim of this research was to find out to what extent collaborative projects that are not branded as IPD apply methods and mechanisms that are similar to characteristic IPD mechanisms.

The point of departure for our research was based on theory and we collected empirical data from a case study of two projects and explored our research question through deduction (Yin, 2018; Bryman, 2016). In this paper, we explored the research question through a case study of two projects executed by the Norwegian public project owner Stjørdal municipality. The reason for choosing this specific case was that this project owner had recently developed their own customised collaborative project delivery model, although not branded it as an IPD project. We were, therefore, curious to explore to what extent this specific delivery model is similar to IPD.

A case study is characterized by the desire to understand a phenomenon more thoroughly (Yin, 2018; Bryman, 2016).

There are typically two questions to address when designing case studies. The first is related to whether to use a single-case study or a multi-case study. The second question is related to whether to use one or more analysis units (Yin, 2018). In a single case design, the researcher will receive information from one or more analysis units within the study of a limited system, such as an organization. Multi-case design means that the researcher will receive information from several units within several systems, such as several organizations, (Yin, 2018).

To address the specific research question of this paper, a multi-case design with several analysis units was used. Two different construction projects and several analysis units linked to three different organizations were applied.

3.1 Case description



In the autumn of 2020, Stjørdal municipality was in the implementation phase of two construction projects: A new primary school in collaboration with the contractor HENT, and a new health centre in collaboration with the contractor Veidekke. Key information about these two projects is listed in **Table 2**.

The project owner stated in April 2018 that when conducting these two projects, emphasis was placed on "collaboration between the parties to optimize the project within the tender amount" (Haugen, 2018). According to the owner and its two contractors, "a new collaborative method" is applied in these two projects (Faanes, 2019).

3.2 Data collection – Project documentation and semi-structured interviews

In this paper we collected and analysed data from two projects based on two types of data sources. First, we studied project documentation that was made available by the project owner and the contractors. In parallel, we developed an interview guide and conducted interviews with ten respondents that held key roles in the projects. Combining data from both documentation and interviews allowed us to triangulate and explore our research questions in detail (Saunders et al., 2019; Yin, 2018).

Table 2: Key information about studied case projects.

	Case project 1	Case project 2
Building type	Primary school	Health center
Building size	4.500 m ²	10,000 m ²
Construction period	2019-2020	2019-2021
Project budget	17 million US dollars	36 million US dollars
Contract type	Design-build	Design-build
Project owner	Stjørdal municipality	Stjørdal municipality
Contractor	HENT	Veidekke
		

Collecting data from project documentation

The project owner and the two contractors for case project 1 and case project 2 provided us with multiple project documents that we could study and analyse. This included the design documentation for the two projects and associated plans. Furthermore, we studied the contract documents with its associated exhibits for both the design phase and the construction phase. We also studied the documents that described the specific collaborative project execution model that the project owner had developed, and which was applied on the two projects in the case study. In addition to this we were given access to minutes of meetings and project registers which were referred to as "collaboration notes". Findings from our study of the documentation were registered in a spreadsheet where we synthesised the main findings that we would further explore through interviews.

Recruitment of respondents for interviews

Recruitment of respondents was performed using purposive sampling (Bryman, 2016). The reason for this was to identify respondents that were relevant to our research questions rather than to recruit respondents on a random basis (Bryman, 2016). We identified respondents from both the project owner and the two main contractors that held specific roles that we considered to be particularly relevant for our study and summarised this in **Table 3**. In average, the respondents had 22.4 years of experience with project work. We followed the concept of theoretical saturation (Glaser and Strauss, 1967), which means that we conducted interviews until we learned that additional interviews did not lead to any further significant theoretical understanding. After conducting ten interviews, we reached saturation and did not recruit further respondents

Respondents who participate in interviews must be treated fairly (Bryman, 2016). In Norway, the NSD, Data Protection Official for Research, is an agency that ensures that research is conducted according to Norwegian laws related to protection of the individual's right to privacy. We therefore sent the interview guide to the NSD Data Protection Official for Research for review and received their approval before conducting the interviews. Prior to each interview, we sent a document to the respondent which contained detailed information about the purpose of the interview and how data would be handled. To protect their privacy, we removed the name of the respondents and only presented a short description of their role in the project.

Execution of interviews

We developed a semi-structured interview guide with open-ended questions (Bryman, 2016). Through follow-up questions we explored the argumentation of the respondents and got a more meaningful understanding of the reason behind their responses.

In general, face-to-face meetings are preferable to get comprehensive impression and more accurate answers from the respondents (Bryman, 2016). However, due to the ongoing Covid-19 pandemic it was not possible to conduct the interviews face-to-face and we had to conduct the interviews as video interviews using Microsoft Teams.

The interviews lasted between 60 and 90 minutes and were conducted together by two of the authors of this paper. The interviews were recorded and stored on an encrypted password protected server. There are several reasons to why we chose to record the interviews. Audio-recorded interviewing allows the researcher to examine the interviews in more detail through detailed transcription. It also provides

Table 3: Respondent information

Respondent ID	Current role	Current position	Project Experience in years
Respondent 1	Contractor	Site manager	22
Respondent 2	Contractor	Project manager	16
Respondent 3	Contractor	Project manager	22
Respondent 4	Contractor	Regional manager	39
Respondent 5	Owner	User representative	6
Respondent 6	Contractor	Design manager	29
Respondent 7	Owner	Project manager	40
Respondent 8	Contractor	Project engineer	3
Respondent 9	Owner	Project manager	17
Respondent 10	Owner	Senior advisor	30

high accuracy and reduces the risk of bias from the interviewer. In addition, audio-recorded interviews allow other researchers to conduct secondary analysis later (Bryman, 2016). On the other hand, audio recording may cause respondents to be less willing to share information during the interview (Saunders et al., 2019). Ultimately, the importance of being able to precisely transcribe the interviews was the main reason for why we decided to record the interviews. Shortly after conducting an interview, it was transcribed and stored at an encrypted and password protected server. If respondents shared confidential information, we ensured that such information was anonymized when transcribing the interviews. In total the document containing the detailed interview transcription contained 113 pages and counted 54,000 words.

Following each interview, we conducted a self-evaluation in order to further improve the quality of the next interview. This also helped to refine the questions as we prepared the next interview based on what we learned from the previous interview, as recommended by Bryman (2016).

3.3 Data analysis

To analyse the collected data, we used the NVivo 11 software. The purpose of the analysis was to synthesise the findings from both the project documentation and the interviews and explore how these empirical data provided us with answers to our specific research question (Saunders et al., 2019). As a framework for the analysis, we applied the framework of IPD methods that were identified in our literature review, and which were presented in Table 1. By analysing the project documents and the interview transcripts we searched for evidence for where IPD mechanisms had been applied in the two case study projects. This analysis was conducted in parallel as we collected more and more data. This allowed us to probe preliminary findings and verify these further during the following interviews (Yin, 2018; Bryman, 2016). On some occasions, we found contradictory information in the data. In such cases we followed this up further in the following interviews and document studies to clarify and remove uncertainty.

3.4 Criticism to research method

When it comes to reliability and validity, it is fair to argue that the research methods applied have some important limitations.

There are several positive effects that can be harvested when conducting video interviews. For example, video interviews are cost-effective and reduce the need to travel (Saunders et al., 2019). In addition, video interviews are time-efficient, and it can be easier to recruit respondents when the interviews are planned to be conducted via video (Bryman, 2016). Still, we would have preferred to conduct interviews face-to-face instead of using a video-link, but this was not possible due to Covid-19 restrictions. To some extent this reduced our ability to adjust the balance between the interviewer and the respondent (Bryman, 2016). Another aspect is that we, as researchers, did not control where the respondents were physically located. Reluctant respondents may be more willing to share information if they are interviewed in an environment where they feel comfortable (Adler and Adler, 2001). We experienced on some occasions that respondents did not sit inside a meeting room with closed door, but rather sat in an open office area using a headset. This may have affected the respondent's willingness to share information, in particular information that would make them uncomfortable if overheard by colleagues in the office's area.

Although case studies have many strengths in terms of getting a deep and throughout understanding of the specific research question (Yin, 2018) it is only valid for the cases that were studied. Hence, one should not generalise findings from case studies, and it is therefore important to be aware of this limitation. Our findings should therefore be read with the project specific context in mind, also in terms of geographical and cultural aspects (Bryman, 2016).

4 Main Findings

In this paper, we have investigated to what extent collaborative projects that are not branded as IPD apply methods and mechanisms that are similar to the characteristic IPD mechanisms. The two case projects fully applied twelve of the fifteen identified IPD mechanisms while partly applying two mechanisms and not applying one mechanism. We found that the following twelve mechanisms were fully applied: shared risk and reward, early involvement of key actors, common goal, no-blame clause, open books, lean, BIM, integrated information systems, trust and respect, collaborative behaviour, open communication and co-location. The two following mechanisms were partly applied:

intensified planning, common decision making. Multiparty contracts were not applied at all in the two studied case projects.

In Table 4 we have listed the various IPD mechanisms that were identified from our literature review (see Table 1). Furthermore, we indicated with a tick whether we found evidence suggesting that the specific IPD mechanism was applied in the studied case project. For example, we see that for case project 1, we found evidence of the "shared risk and rewards mechanisms" in the project documentation and from planning" and the mechanism "common decision making".

interviews with respondent 2,9 and 10. In such cases, where we found evidence both in the project documentation and this was confirmed by one or more interview respondents, we indicated this with a green colour code.

However, if we found no such evidence, neither in the project documentation nor from our interview respondents, we indicated this with a red colour code. For example, this was the case for the mechanism "multiparty contracts" as we found no evidence that suggested that the mechanism was applied in the two studied cases.

Likewise, we used a yellow colour code to indicate those mechanisms where we either found evidence in the project documentation or from interviews, but not from both sources.

This was the case for both the mechanism "intensified

Table 4: Summary of main findings

	Case project	Colour code	Project documentation	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6	Respondent 7	Respondent 8	Respondent 9	Respondent 10
Contracts													
Multiparty contracts	1	●											
	2	●											
Shared risk and reward	1	●	✓		✓							✓	✓
	2	●	✓				✓						✓
Early involvement of key actors	1	●	✓		✓								✓
	2	●	✓			✓		✓		✓			✓
Intensified planning	1	●		✓									
	2	●			✓					✓			
Common decision making	1	●									✓		✓
	2	●											✓
Common goal	1	●	✓		✓						✓		✓
	2	●	✓					✓					✓
No-blame clause	1	●	✓		✓						✓		✓
	2	●	✓										✓
Open books	1	●	✓		✓							✓	✓
	2	●	✓							✓			✓
Technology and processes													
Lean	1	●	✓		✓								
	2	●	✓			✓	✓		✓				
Building information modelling (BIM)	1	●	✓		✓							✓	
	2	●	✓			✓			✓				
Integrated information systems	1	●	✓	✓	✓						✓	✓	
	2	●	✓			✓		✓					
Culture													
Trust and respect	1	●	✓	✓	✓						✓	✓	✓
	2	●	✓			✓			✓				✓
Collaborative behaviour	1	●	✓		✓								✓
	2	●	✓					✓	✓				✓
Open communication	1	●	✓	✓							✓	✓	✓
	2	●	✓						✓				✓
Co-location	1	●	✓	✓	✓						✓	✓	
	2	●	✓			✓							

5 Analysis and Discussions

In this chapter, we analysis and discuss the main findings from our study. We follow the structure of the three main categories of IPD mechanisms that were outlined in **Table 1**. These are: contracts, technology & processes, and culture.

5.1 Contracts

Multiparty contracts

In our case study, we found that the owner had applied a traditional design-build contract. However, the owner had developed a separate governing collaboration-contract that was signed between the contractor and the owner. Even though this collaboration contract describes how the parties should work together, it is not legally binding as opposed to a true multiparty contract that one can expect to find in full IPD projects. A multi-party contract is a contract that includes the owner, main contractor, architect and advisors (Hanna, 2016). The contract describes the specific roles, rights and commitments between the actors. For a project to be considered a full IPD project, such multiparty contracts must be present (Pishdad-Bozorgi, 2016).

Shared risk and rewards

From our case study, we found evidence of shared risk and rewards incentives similar to what one may typically find in full IPD projects. There were legal binding documents stating a target outturn cost and formal descriptions about how savings should be shared 50/50 between the owner and the contractor. Likewise, it was described how cost overruns should be split 50/50 between the owner and contractors, something that was confirmed by interview respondents.

Interview respondents also highlighted how these incentives created a collaborative culture between the organisations, similar to what was found by Simonsen et al. (2019). Respondents described how this concept also had been expanded to now also be applied in the relationship between the contractor and its subcontractors. From the interviews, we learned how respondents confirmed that the effects are similar to what is described in existing theory such as Walker and Lloyd-Walker (2015). Respondents described how there was a strong collaboration between the organisations at the construction site that created win-win situations (Bitici et al., 2007). Shared risk and reward is a mechanism where the project actors define a target outturn cost for the project

(Walker and Lloyd-Walker, 2015). Any savings achieved during project execution will increase the profit which is shared between the actors. Similarly, cost overruns are shared between the actors up to a certain cap.

Early involvement of key actors

Early involvement should lead to good technical and buildable solutions, good coordination between users and the project organization, as well as learning between the actors (Simonsen et al., 2019). Keeping the rhythm throughout the project requires continuous coordination with the project participants and other actors. Late involvement makes it demanding to achieve the desired effect of IPD (Ghassemi, 2011).

Early involvement of key personnel and continuity of key personnel was described as a success factor in the governing documents for the case projects. In addition, there were sanction possibilities if key persons did not complete their role until the completion. Respondents confirmed that work had been done according to a principle of early involvement of key personnel where they worked with coordination between users and the project organization. It also turns out that early involvement of key personnel has a social dimension for creating a culture of cooperation in the early phase with trust and ownership in focus.

None of the case study project documents are clear in terms of defining early involvement of key personnel, other than that it is stated that it "is desirable with an active participation so that all actors can use their expertise to achieve agreed goals". The literature describes that the desired effect of early involvement of key personnel includes a degree of learning between the actors (Walker and Lloyd-Walker, 2015). The respondents confirmed that early involvement of key personnel had been carried out and their experiences correspond with the positive effects that the literature highlights. Early involvement of key personnel means selecting the right project participants as early as possible in the project phase and involving them at the beginning of the project (Ghassemi, 2011).

Intensified planning

Intensified planning was carried out in the projects as part of the early phase of the case projects and this was confirmed by respondents who said that projects of this type are

characterized by a lot to do in a short time. As an example, the entire preliminary project for the Health Center was, according to one of the respondents, completed in 4-5 months against the normal 1 - 1.5 years. Intensified planning in the projects was carried out with both consultant, architect, owner and users. However, even though some respondents described how intensified planning was used, we found no evidence for this in the project documents and there were several respondents who did not describe the use of intensified planning. We, therefore, suggest that although elements of intensified planning may have been used in the case projects, we do not find enough evidence supporting that this mechanism was fully used as opposed to what one could expect for a full IPD project. Intensified planning is a tool for facilitating good planning and an increased understanding of what the design is to be based on. It requires a great deal of effort in the start-up phase from both owner and contractor (AIA, 2007). Intensified planning aims to provide fewer changes in the construction phase (Simonsen et al., 2019).

Common decision making

Critical decisions in projects should be made by groups of project participants who, through processes and methods, take decisions that are to the project's best interests (AIA, 2007). The group must consist of several key actors but should represent a cross-section of other actors in order to have the effect of innovation. There should be regular meetings in the decision-making group (AIA, 2007). The desired effect is to reduce the level of conflict and increase the probability of good collaboration and project success (Simonsen et al., 2019).

Joint decision-making in the projects has been carried out at several levels in the case project organization. Project documents also describe how the collaboration model applied has been chosen precisely to provide a greater opportunity for the client's participation and make it easier for users to contribute. Construction meetings, design meetings and morning meetings have been held to have a good flow of communication with several involved actors for joint decision-making. The major decisions have been implemented by a collaboration committee, which consists of two representatives from the owner and contractor. From our

analysis we found some evidence in project documents and from interviews that the joint decision making was used to reduce the level of conflict and increase the probability of good collaboration and project success (Simonsen et al., 2019).

Common goal

Project goals must be set early in the project and communicated to the actors in such a way that they are respected by all and that the various goals of the project are ready for the first meeting with the actors (AIA, 2007). The owner decides what the goals should consist of, but it is important that the actors should be consulted for advice (Ghassemi, 2011). A common definition of goals provides coordination of interests among the project participants (Simonsen et al., 2019). Respondents described that the owner set the main goals from the start as part of the competitive basis in both projects. The goals were discussed and evaluated along the way. The collaboration agreement for Hegra primary school shows how project goals were communicated in the early phase. Respondents confirmed that commonly defined goals had been used, but they had different views on how well the goals had been communicated in the various phases. In total, we found enough evidence that suggest that the collaboration model used in the case projects utilise the common goal mechanisms in a similar manner to what one could expect to find in and IPD project (Simonsen et al., 2019).

No-blame clause

An agreement to keep each other free of guilt should reduce the need for conflict management (Simonsen et al., 2019). The no-blame clause promotes proactive problem solving by owner and contractor (Pishdad-Bozorgi, 2016). Some respondents expressed that the project was characterized by a low level of conflict, an experience of trust and respect and thus also good cooperation and a healthy working environment. In addition, several mechanisms had been added in project documents to minimize the level of conflict. A collaboration committee had been established to handle disagreements in the project. As a starting point, disagreements about changes should be resolved at the level at which they arose (Pishdad-Bozorgi, 2016). The contracts describe the establishment of mutual trust between

the parties as a success factor, and that it is important to clarify common goals and action plans for goal achievement. The project documents and respondents provide evidence for the use of no-blame clauses in the case study projects similar to what existing literature suggest would be found in full IPD projects (Walker and Lloyd-Walker, 2015).

Open books

In the studied project documents, we found requirement for mutual insight into finances, with requirements for open books, finance system and estimation tools. Both organizations were given full access to relevant information about finances and full access to systems in general. Respondents also confirmed that financial transparency was practiced in the projects with access to accounts and continuous review of the budget. Invoice checks have also been made on invoices to uncover discrepancies. Financial transparency in the projects has further led to good cooperation across all organisations. We found evidence that the open books mechanism has been applied in the two case projects in a similar manner as one could expect for full IPD projects (Walker and Lloyd-Walker, 2015). Financial transparency through open books is a tool that gives the owner the right to inspect the contractor's finances in connection with a project (AIA, 2007). The purpose is to improve collaboration and communication that will increase trust and understanding of costs in the project (Simonsen et al., 2019).

5.2 Technology and processes

Lean

Lean focuses on maximizing value and is a mindset that focuses on removing non-value-adding activities which are referred to as waste (Ballard and Howell, 2003). Lean is referred to as a natural part of IPD projects (NASFA et al., 2010). Both the two studied case project applied lean principles and referred to Lean as a success factor in the collaboration agreement that is signed by owner and contractor. One of the two case study projects was finished one month ahead of schedule and respondents suggest that a significant reason for this was the strong focus on Lean construction both within owner and contractor organisations. In general, we found evidence for that the case study projects used Lean principles in a similar manner as what one typically finds in full IPD projects (Lee et al., 2014).

Building Information Modelling (BIM)

In the case projects we learned how VDC was applied to link the principles of Lean with BIM. In the case projects VDC was extensively applied and there was the frequent use of ICE sessions to enhance interdisciplinary collaboration and efficient decision making (Simonsen et al., 2019). The use of BIM was anchored both in project documents and explained by interview respondents. The collaboration agreement that was signed by owner and contractors clearly describes how BIM shall be applied to enhance collaboration. Respondents described how BIM had been used in all phases and had a positive effect on avoiding mistakes and reducing rework (Simonsen et al., 2019; Garra and Skripack, 2019). In total, we found that the two case projects applied BIM in a similar manner as what one can expect to find in full-IPD projects (Rischmoller et al., 2018). BIM is a process that combines information and technology to create a digital representation of a project that integrates data from different sources. (Govender et al., 2018).

Integrated Information Systems

Integrated information systems are used to provide decision-makers with data from different sources (Pishdad-Bozorgi, 2016). This provides decision-makers with the best available information. Both case study projects applied "Projectplace" as an integrated information system and for one of the projects Projectplace was combined with Sharepoint. Respondents described a general satisfaction with the systems, although there were identified some opportunities for improvement in terms of connecting more data sources in real-time. Still, we found evidence that integrated information systems were applied in the case projects and provided participants with precise information from multiple sources in a similar manner as one typically finds in full-IPD projects (Simonsen et al., 2019).

5.3 Culture

Trust and respect

A clearly defined contract with fair distribution between risk and reward is one of several measures to create mutual respect and trust (Pishdad-Bozorgi, 2016). Working with relationships, good communication, common ownership and commonly defined goals provide good opportunities for mutual respect and trust (Evans et al., 2020) and can just as

easily be described in separate relationship contracts with guidelines (Pishdad-Bozorgi, 2016). Focus on team spirit, common understanding and personal contact between the parties is highlighted as success factors in the case study documents. Relationship contracts were established in the project teams for both projects. Respondents described a working environment where there was a high degree of mutual respect and trust. We also found evidence in project documents that suggested that there was a high degree of trust in the projects, similar to what is found in successful IPD projects (Walker and Lloyd-Walker, 2015).

Collaborative behaviour

The project must create an environment that supports and encourages project participants to choose to collaborate (NASFA et al., 2010). Cohesion contributes to an increased acquaintance, increases the chance for interdisciplinary collaboration and in turn also mutual respect and trust (Simonsen et al., 2019). In project documents, we found requirements stating that the organizations must be staffed with competent persons for the purpose of maintaining effective collaboration. The contract also provides an opportunity to replace people in the project if they were not able to show the right collaborative behaviour. In one case project this happened as one key actor in the project had to be replaced as a result of lack of collaborative behaviour. This decision was taken as a joint decision by owner and contractor. Interview respondents emphasized the importance of good personal chemistry. The respondents talked warmly about the collaboration and reported that there was a low level of conflict. The willingness to collaborate had worked so well that the steering group had not been involved at all. The level of collaborative behaviour found in the two case projects is similar to the collaborative behaviour found in IPD projects (NASFA et al., 2010).

Open communication

Interview respondents described extensive use of e-mail communication and several situations where it would have been more effective to make a phone call instead. Turner and Muller (2004) argue that having the right balance between formal and informal communication is crucial to achieving good collaboration. Open and effective communication is a requirement in order to achieve

successful collaboration (Haaskjold et al., 2019; Simonsen et al., 2019). We found several evidences of effective communication in the case projects and there was a very good meeting culture in the case projects. Interview respondents also highlighted how the written collaboration agreement acted as an effective guideline to ensure good communication routines, similar to what one would expect to find in a full IPD project (Walker and Lloyd-Walker, 2015; Lee et al., 2014).

Co-location

Co-location of the project organization is a way to facilitate good communication, unity and trust (Pishdad-Bozorgi, 2016). The co-location should already start in the design phase (Simonsen et al., 2019). In the case project we found evidence of extensive co-location. There were formal requirements in the contract documents that owner and contractor co-located their teams to a common location. Big-rooms were extensively used to ensure efficient ICE meetings and quick decision making. Interview respondents described how the co-location had led to better communication, more effective decision making and increased efficiency. This is similar to what one would typically find in full IPD projects (Walker and Lloyd-Walker, 2015).

5.4 Spinning the IPD wheels

In **Figure 1**, we introduce the three IPD wheels as a way to easy illustrate to what extent a project utilises the various IPD-mechanisms. We illustrate this by plotting the findings from one of the case projects. We see that all mechanisms in the "Technology and processes" category are green. This indicates that all these mechanisms are applied in the project. Likewise, we also see that all the mechanisms in the Culture category are green, and this indicates that also all the mechanisms within this category have been applied in the project. However, for the third wheel we see both yellow and red sections. This indicates that the project only applies some of the eight mechanisms within the Contract category.

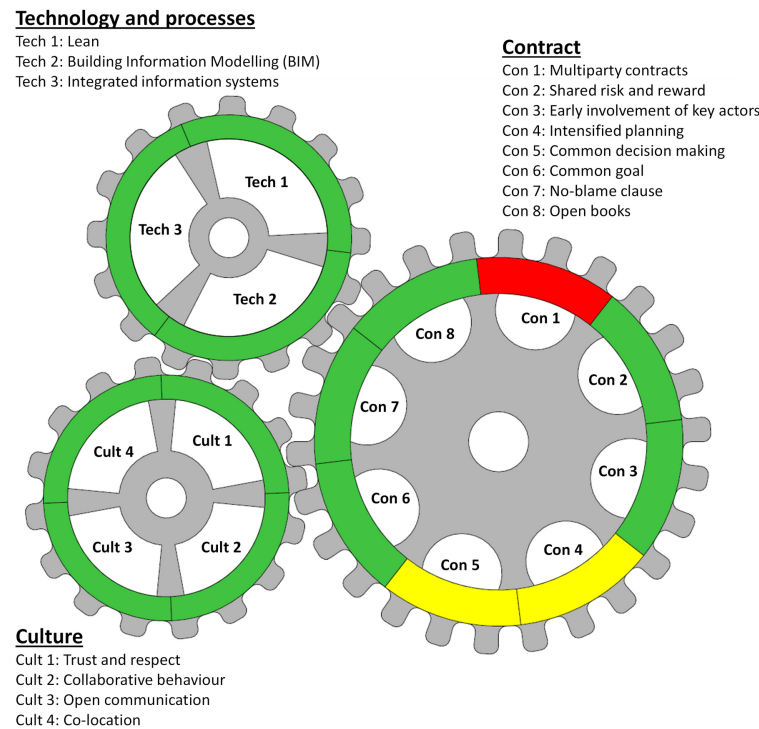


Figure 1: Spinning the three IPD-Wheels

For a project to be a “true” IPD project one should expect that all elements of the three wheels are green, meaning that the project utilises the full extent of the available IPD-mechanisms. For such a scenario, the wheels can turn with a minimum of friction, indicating a high-performing collaborative project.

The collaborative execution model that was applied in the case project applied many of the same mechanisms as one typically finds in full IPD projects. In terms of contractual mechanisms (Pishdad-Bozorgi, 2016), we have found evidence of extensive use of shared risk and reward, early involvement of key actors, common decision making, common goal, no-blame clauses and open books. Intensified planning and common decision making were partly applied. However, multiparty contracts were not used. With reference to Figure 1, this means that we have five green sections, two yellow sections and one red section of the contract wheel. This indicates that there might be some friction once the wheel starts to rotate, and the non-green parts of the wheel get in contact with the other two wheels.

When it comes to technology and mechanisms (Lee et al., 2014) all sections of the wheel were green as Lean, BIM and integrated information systems were applied in the case projects. Similarly, in terms of culture mechanisms (Walker and Lloyd-Walker, 2015) the wheel is also fully green as we found extensive evidence of trust, collaborative behaviour and co-location.

The collaborative delivery model that was used by the public owner in these case projects is not branded as IPD, but we see that the model has many similarities to a typical IPD light model (Bygballe et al., 2019). For project delivery models that are not branded as IPD we can use the three IPD wheels to systematically compare the use of the various mechanisms that existing literature suggest is typical for IPD projects to map similarities and differences.

As we rotate the three separate wheels we can identify where we can expect friction to occur if one of the red sections encounters another wheel. In a full IPD project (Walker and Lloyd-Walker, 2015) all wheels should rotate harmoniously with a minimum of friction.

6 Conclusions

The purpose of this paper was to investigate to what extent collaborative projects that are not branded as IPD apply methods and mechanisms that are similar to the characteristic mechanisms for IPD. We have studied two case projects and investigated to what extent these projects applied various IPD methods and mechanisms even though the projects had not been branded as IPD projects. We found that the two case projects fully applied twelve of the fifteen identified IPD mechanisms while partly applying two mechanisms and not applying one mechanism.

To illustrate our findings, we have developed three “IPD-wheels”. We believe that this is a tool that project managers can utilise in their own projects and investigate to what extent their project execution model is similar to a full IPD model. Project managers can also rotate the wheels to identify where friction could occur in their project so that they can be proactive and implement the necessary means to increase collaboration and operate more frictionless.

The academic contribution from this paper mainly consists of two parts. First, we contribute to the state-of-the-art research on IPD simply by increasing the number of studies in the field as we respond to the call for more practice-oriented studies (Svejvig and Anderson 2015). Secondly, we have further developed the frameworks created by Sive (2009) and NASFFA et al. (2010) to differentiate between the various types of IPD projects as we introduce a finer mesh that can be used to study in more detail to what extent a project is similar to a full IPD project along the following three dimensions: contracts, technology & processes and culture.

The main practical contribution is that we provide a tool that project managers can use in their daily practice to plot the signature of their specific project and compare this with the reference values for a “full IPD project”. This allows project managers to easier communicate the signature of the specific project to its team members, key stakeholders and colleagues. The aim is that the IPD wheels can help practitioners to develop a common reference when they compare projects that use different collaborative models that may be company-specific or that uses unique terminology for a specific sector or geographical region.

A limitation to our study is that it only includes case projects from Norway. However, we argue that one can still

generalise the findings outside the Norwegian context since the two case studies consist of construction of a primary school and a health centre. These are building types that are not unique to Norway but relevant worldwide.

We welcome further research in the area and believe it would be particularly interesting if other researchers applied the three IPD wheels on more case study projects in other parts of the world.

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