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A Proposal for an Integrated Design-Build Project Delivery

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Writing the preface marks the completion of, not only the thesis, but also a year full of experiences in both my personal and professional life. I could not imagine last Christmas that the time was going to fly that fast, and all of a sudden we are now here, almost five months later, closing another chapter and starting a new one at the same time. I am lucky saying that I made the right decision when I accepted the place to take part in Industrial Management Master's program. It has been highly rewarding, as I have had the opportunity to achieve a personal goal and a unique experience, live in a new city, make new friends and learn precious lessons that will definitely stay with me.

One of the most repeated words this year has been "change", change management, change of strategy, change of career and change of life. If I have to define with one word the past months, the word would be "change", and the outcome of such a change would be highly positive.

I would like to thank my Thesis instructor, both of them, first Dr. Satu Terikangas, who guided me at the beginning of this process with her encouraging words, and secondly Dr. Juha Haimala, Head of Department of Industrial Management, who guided me during the second part of this thesis making complicated things seems easy. My thanks go also to Sonja Holappa, MA, Senior Lecturer and Zinaida Grabovskaia, PhL, Senior Lecturer, for their great support and energy. A special thanks to the participants of the thesis interviews, who generously offered me help during the creative stage of this thesis, sharing their expertise with me. I cannot express my gratitude enough to the people who shared this year with me at the school and made it easier and enjoyable, thank you guys!

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<p>The current delivery methods employed in construction projects offer a limited framework based on traditional methods, often times failing in terms of cost, time and quality. Newer, more effective methods have been proved to deliver better results for construction projects in Finnish construction. Therefore, the objective of this study is to propose an enhanced integrated project delivery based on the design-build delivery methods used in the Finnish construction. This proposal collects and combines the strengths of the design-build and newer delivery methods.</p> <p>This study utilizes the case study approach and use qualitative methods to analyse the current state of the traditional design-build method, resulting in the identification of a series of strengths and weaknesses. The current state of the design-build method is analysed through interviews and reports from construction industry experts. The project delivery is divided in three basic components and new methods that can benefit each of these three components presented in the conceptual framework of this study. Based on this analysis, an initial proposal for an enhanced integrated design-build method is presented.</p> <p>The outcome of this study is a proposal for an integrated design-build project delivery method based on the methods used in the Finnish construction industry to learn from the modern construction practices.</p>	
Keywords	Construction project delivery methods, integrated teams, alliance contracts, Lean construction

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1 Introduction

This Master's Thesis explores recent construction methods such as Integrated Project Delivery, Alliance contracts, Lean construction tools and collaborative teams. These methods have proven successful in terms of cost, scheduling and quality as traditional construction methods still in use today. Since even the traditional methods are bound to have certain strengths, the aim is to identify those strengths by studying the traditional methods, particularly the popular design-build project delivery method. Having identified such strengths, the idea is then to use them to create an enhanced integrated model that combines the strengths of both. The enhanced integrated model is intended for the benefit of a wide spectrum of construction projects, without setting restrictions to its use.

1.1 Key Concept

The Project Delivery Method (PDM) is the process that defines the relationship, roles and responsibilities of all parties involved in a project. As every project tend to be different, a different PDM approach must be adopted to fulfil the unique requirements of the project.

Project delivery methods have three basic domains as shown on the Figure 1: the project organization (culture), the project's operating system (project management techniques), and the commercial terms (legal relationships) binding the project participants. In order for the delivery method to be coherent, the structure in each of these domains must be aligned or in balance. (Thomsen et al. 2010).



Figure 1. Project delivery system domains.

1.2 Business Challenge

The construction industry is perceived as a complex and large industrial sector with an important role in the economic growth of the countries. It is not different in Finland, in fact it is a fundamental sector of the economy, being responsible of about 15% of the gross domestic product by contributing at nearly EUR 30 billion. This represents one of the greatest shares among European countries. Moreover it is a growing sector, experiencing a 6% raise during 2016. (Rakennusteollisuus statistics).

The construction industry has been perceived as a low performing sector during the past decades, with projects often blamed for failing in terms of cost, time or quality. This industry has received much critique regarding its conservative practices and lack of innovation, compared to other industries (Koskela 2000, Gann 2000, Rojas and Aramvareekul 2003). However, some recent projects in Finland have been successfully accomplished, resulting in completion below budget and before planned schedule. These projects tend to adopt innovative approaches to traditional construction project delivery methods. These methods have been identified to play a critical role when ensuring the creation of value for the owners and stakeholders. The traditional methods, on the other hand, have been criticized for the fragmentation that they create within the project phases and among stakeholders involved in the project (Pekkanen 2005). It has been said that only companies who are able to introduce novelties and meet client needs are going to stand ahead of others and ensure further growth (Foust 2008). This connection between innovation and the success of construction companies have been confirmed by numerous studies (Winch 1998, Koskela 2000, Slaughter 2000, Gann 2001, Dulaimi et al., 2003, Jimenez-Jimenez 2008)

From this, it can be concluded that innovation is paramount for the future of this sector, not only for construction companies to survive, but also for its major economic impact on the growth of countries. Consequently, there is an opportunity to study the strengths of traditional and newer project delivery methods in order to find the best attributes that by combining them will result in a proposal for an enhanced integrated project delivery method. Such proposal seeks to ensure an improvement on the performance of construction companies and customer expectations.

1.3 Objective and Outcome of the Study

The current delivery methods utilized in construction projects are selected considering various factors such as type of project, type of funding, size of project and scale of project risk, to mention the most relevant. In addition, construction projects tend to follow traditional approaches when selecting the type of delivery method for executing a project, which are normally familiar to the construction actors.

This study focuses on certain novel projects carried out in recent years in Finland and their differences compared to more traditional project approaches, from the perspective of their positive attributes and what both methods can offer to benefit construction projects. Therefore a multiple case study guides this paper. However, the most relevant newer project for the purposes of this study, due to the ease of access to information, is the recently completed project of the Tampere Ranta Tunnel, a large public project, which is considered a success in terms of cost saving and completion before scheduled. This particular project was selected as an example of innovative approach during its execution and its delivery method by integrating the stakeholders of the construction project; a new alliance contract model, one of the first type of its kind in Finland.

The objective of this thesis is *to identify the key success factors of both traditional and newer project approaches and bind them together into a new model from which future projects can benefit.*

To reach this objective and solve this business challenge, this study first analyses the processes employed in traditional and newer project deliveries. For the newer projects, the main project analysed is the Tampere Ranta Tunnel completed in 2016, but not exclusively. This is done by using the data collected from the project documents and an interview with one of the project managers involved in that particular process. In addition, two more contributions from different companies and experienced professionals in similar newer projects contribute to this study, providing insight also on traditional project delivery methods, of which this study centres on the design-build method. After examining this data, the current state analysis of this process is produced by combining the key strengths from both types of projects, allowing for a better understanding of traditional and newer methods used in project delivery. Then, the literature review discusses the key topics from the findings of the current state analysis, creating the conceptual framework for this study. Once the basis is set, an initial proposal is presented, following the evaluation of such proposal. The evaluation is carried out by evaluating how the initial proposal method could have impacted the development of an existing

project that was branded as a failure in terms of cost and time, where the author was closely involved and is well aware of its details. The result of comparing the known project with the initial proposal results in the final proposal, which is the outcome of the thesis, i.e. a proposal for an enhanced integrated construction project delivery method.

1.4 Structure of the Study

This study is written in seven sections. Section 2 describes the research method and approach providing an overview of the study and its components. Section 3 comprises the current state analysis carried out for the case by extracting information from three different interviews and various sources of information involved in case projects. This analysis provides a better understanding of the process as well as identifies strengths and weaknesses. Section 4 discusses a review on existing knowledge, which has been selected according to its relevance to the case study and covers the topics of construction innovation, Lean philosophy, alliance contracts and project delivery methods, creating the conceptual framework based on the literature review for the case study. In addition this section provides the conceptual framework for building the improved model. Section 5 presents the initial proposal model by combining the information obtained in the previous sections three and four and verifies it by comparing the proposal with the data collected from the experienced sources on this field, data obtained through interviews and one workshop with one of the interview participants, in addition to company reports. Section 6 further improves results of the initial proposal via validation of such initial proposal by comparing how a project that failed in its execution using traditional methods could be improved using the proposed method, which promotes fundamentally a better integrated approach. This is followed by the formulation of the final proposal by adopting the required changes upon the validation stage. The final Section 7 concludes the study by providing a summary of the thesis, including next steps and evaluating the reliability and validity of the study.

2 Method and Material

The aim of this section is to present the research approach and design used in this thesis. Firstly, the research approach is described. Then the research process is presented in a diagram. This is followed by a description of the data collection process followed during this research, and a review of the data analysis. The section ends by reflecting on the validity and reliability of this thesis.

2.1 Research Approach

The aim of the research approach is to determine the type of established convection selected to conduct a research.

The research approach is based on the use of a qualitative research method and a multiple case study as its basis in studying the strengths of traditional and newer innovative project delivery methods in the Finnish construction industry, from the perspective of the basic attributes of a project delivery method; organisational (cultural), commercial (legal) and operational (management techniques) components. It is been said that multiple cases strengthen the results by replicating the patterns and therefore increasing the robustness of the findings (Yin 2014). Qualitative research is stated as interpretative and its strength comes from its richness and holism, with a strong potential to reveal real life events (Miles and Huberman 1994). In case study research, the data is organized in specific cases for studying and comparison, being the cases subject of the study everything that can be defined as specific or unique (Patton 2002). Case analysis are preferred when “how” and “why” are the questions objective for the research and the author of such research has little control over the events of the investigation, being the event a contemporary phenomenon within a real-life context. Case study research can be defined as a detailed investigation that attempts to provide an analysis of the context and processes involved in the phenomenon under study (Yin 2014). An illustration of the research process is presented in the following Figure 2.

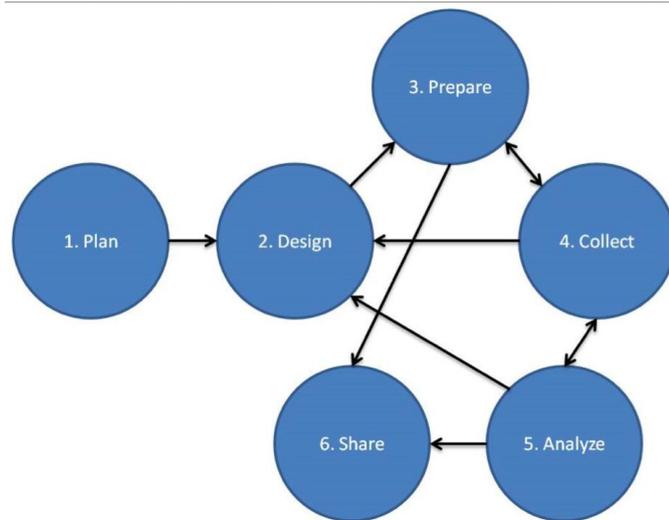


Figure 2. Case study research approach (Yin 2014: 24).

Figure 2 illustrates the research process, where the case study follows a linear but iterative process. The first step is to plan the study in relation with the business challenge. It follows the data collection stage and its analysis, keeping it linked with the initial research question and creating the current state analysis (CSA). Then the Conceptual Framework is presented based on existing knowledge from reliable authors. By combining the two previously described sections, an initial proposal of the model is introduced.

The chosen cases for this study were considered due to their adequate fit with the business challenge, and their current public interest, positive outcome and innovative approach. Thus, as the objective is to produce insights about a given phenomenon, the selected cases are chosen for their validity, being susceptible to exhibit a useful model. The companies chosen for this study follow the same selection criteria based on their approach towards testing and adopting new construction methods. These companies share a common element being usage of similar approached to projects, a collaborative philosophy and alliance contracts in construction projects in Finland. Only three of the thirteen companies selected and contacted replied and accepted to take part of this study by setting up interviews.

The qualitative approach methodology selected to carry out this study supports the research problem in question in addition to enables free opinion and expression from the interviewee. The three cases are examined utilizing primary data. The collected data has been analysed and the key findings have been presented. All the conclusions are based on this analysis.

2.2 Research Design

This study comprises six stages, as shown on the below research design diagram (Figure 3), presenting the sequence of the different stages and their relation with the data collection and the output of each stages.

DATA	PHASE	OUTCOME
	1. OBJECTIVE. * To develop a proposal for an enhanced integrated Project Delivery Method (PDM) from Finnish Construction (Design-Build method).	
DATA 1 Interviews (n=3), company reports, observations	2. CURRENT STATE ANALYSIS * Current state of traditional Design-Build method	Strengths & Weaknesses
	3. EXISTING KNOWLEDGE * Concepts: -- Construction Innovation. ---- Project Delivery Method ----- LEAN Philosophy ----- Strategic Alliances	Conceptual Framework --Organisation ----Operating System -----Commercial Terms
DATA 2 Interviews (n=3), workshop (n=1), company reports, observations	4. BUILDING THE PROPOSAL *Initial Proposal and embedding strengths from traditional methods and newer methods	Initial Proposal for an enhanced integrated PDM
DATA 3 Piloting Initial Proposal with an existing project	5. PROPOSAL VALIDATION *Improvements to the Proposal	Final proposal for an enhanced integrated PDM

Figure 3. Research design of this study.

Following the logic order, the research starts by identifying the business challenge. The second stage, which is the current section, presents the research design. The third stage contains the current state analysis of the case study, produced from the analysis of different data collection sources (Data 1) and focused on the strengths and weaknesses of traditional construction methods, the design-build method in particular.

The fourth part comprises the study of existing knowledge or literature on relevant topics to the findings from the previous section. The findings from the conceptual framework are used as guidelines for building the proposal to solve the current business

case. In the fifth stage the conceptual framework is discussed in combination with the findings from the data collection (Data 2) which focuses on the strengths of newer construction methods that are used as basis for building the initial model proposal to improve the current business case.

The final part is the validation of the proposal and consists on a comparison of a traditional project that failed in its execution, against the proposal, and how those issues could be solved by using the proposed method (Data 3). These findings are then used to enhance the initial proposal and create the final model proposal.

2.3 Data Collection and Analysis

The main focus for the data collection are semi-structured face-to-face interviews, carried out with three relevant professionals from different companies in terms of business but similar in the methods used to deliver construction projects. The goal during the interviews was to understand traditional construction project methods and improve the success of them by focusing on the delivery methods and how utilizing an innovative approach can benefit cost, time and quality of the building.

In order to arrange the interviews, cover letters with the objective of this study were sent by email to selected companies to request for participation. After confirming appointments with the interested participants, an interview guide was given to the interviewees prior to the meeting, to provide a framework for discussion and consistency in collecting data from each of them. The interviews were conducted during February and March of 2017 in the construction industry and digitally recorded for subsequent transcription and analysis.

The interviewees are selected on the basis of their extensive experience in the construction sector (circa 20 years) and belonging to medium-large sized companies working close to traditional methods and actively implicated in developing their businesses by adopting innovative methods such as project delivery and procurement methods.

Primary data is extracted from the interviews and a workshop. The secondary data are company reports and other relevant published documents such as newspapers and a video from a conference. Even if more interviews could have been beneficial to this study, the author found it difficult to engage with more people willing to participate, perhaps due to the language restriction or lack of contacts in this sector in Finland. Further

details about the obtained data such as participants, companies, methods, duration and documentation are given below.

The data collection for this study is divided in three rounds. The initial Data 1 serves to build the current state analysis focused on the traditional design-build method. Following Data 2, which focuses on newer project methods and is used to create the initial model proposal. The last Data 3 is employed to validate the proposal.

Data collection 1 is illustrated in the following Table 1, presented as a summary of the sub-data with the key features. During this stage of data collection, information relevant to traditional methods (Data 1) was discussed with the interview participants.

Table 1. Data collection (Data 1).

Interview 1. M.M. - Finnish Transport Agency					
	Source	Topic	Date	Method	Documented
INTERVIEW					
1	M. M. - Project Manager - Finnish Transport Agency	Traditional Project delivery methods,	03.02. 2017 (Turku)	Face-to-face 2 hours	Notes + voice recording
COMPANY REPORT					
2	Finnish Transport Agency (10.2013)	Procurement methods and track renewal projects	Feb. 2017	-	15 pages
Interview 2. S.P. – Fira Oy					
	Source	Topic	Date	Method	Documented
INTERVIEW					
1	S. P. - Construction Manager – Fira Oy	Current Project delivery methods, stakeholders involvement	06.03. 2017 (Vantaa)	Face-to-face 2 hours	Notes + voice recording
Interview 3. L. M. – Vison Oy					
	Source	Topic	Date	Method	Documented
INTERVIEW					
1	L. M. - Project Manager /Partner – Vison Oy	Current Project Delivery ideas	13.03. 2017 (Helsinki)	Skype 1 hour	Notes + voice recording

As seen from Table 1, the three interviews took place in different locations in the South of Finland. A questionnaire was given prior to the interview as a guideline and was followed in its majority, even though emphasis was observed with certain topics closer to the interviewee expertise. The interviews were extended from the original set time due

to the interest of both interviewee and interviewer. The same participants were involved during data collection 1 and 2.

Data collection 2 (Data 2) is illustrated in the following Table 2, presenting a summary of the sub-data with the key features. This stage of data collection focused on newer construction methods tested and implemented in recent years in Finnish construction with substantial successful outcome.

Table 2. Data collection (Data 2).

Interview 1. M.M. - Finnish Transport Agency					
	Source	Topic	Date	Method	Documented
INTERVIEW					
1	M. M. - Project Manager - Finnish Transport Agency	Tampere Ranta Tunnel	03.02. 2017 (Turku)	Face-to-face 2 hours	Notes + voice recording
VIDEO					
2	M. M. - Project Manager - Finnish Transport Agency (LEAN Conference)	Integrated Project Delivery in Finland	Feb. 2017	-	1h 20m
COMPANY REPORT					
3	Finnish Transport Agency	Project Alliance (06.2014)	Feb. 2017	-	28 pages
4	Ranta Tunnelli Alliance. FTA	Project Plan (06.2013)	Feb. 2017	-	48 pages
5	Ranta Tunnelli Alliance. FTA	Project Development Phase (04.2014)	Feb. 2017	-	40 pages
Interview 2. S.P. – Fira Oy					
	Source	Topic	Date	Method	Documented
INTERVIEW					
1	S. P. - Construction Manager – Fira Oy	Cooperation, IPD, Alliance contracts, short-term investment	06.03. 2017 (Vantaa)	Face-to-face 2 hours	Notes + voice recording
WORKSHOP					
2	S. P. - Construction Manager – Fira Oy.	Big Room	07.03. 2017 (Espoo)	Face-to-face 1.5 hour	Notes
Interview 3. L. M. – Vison Oy					
	Source	Topic	Date	Method	Documented
INTERVIEW					
1	L. M. - Project Manager /Partner – Vison Oy	Alliance Partners	13.03. 2016 (Helsinki)	Skype 1 hour	Notes + voice recording

As can be seen in Table 1 and 2, the interviews carried out during data collection 1 and 2 were face-to-face interviews. Moreover, the interviews were standardized open-ended interviews following the same structure and questions for all participants, although it is worth mentioning that the three participants did not answer all the questions, if they were not relevant to their particular case. The questionnaire used for the interviews can be seen in the Appendices section. However informal conversations took place due to the willingness of participants to go deeper into different but relevant topics or explanations. The interviewing was flexible, allowing therefore finding unplanned information. In addition to the interviews, relevant secondary data such as company reports and news from industry papers was analysed in conjunction with each correspondent interview and integrated with the primary data.

Data collection 3 (Data 3), corresponding to the validation of the proposal, consist of piloting the initial proposal for an enhanced integrated project delivery method with an existing project. Further analysis and details are presented in the section 6 of this thesis.

The next section focuses on develop the current state analysis of the traditional construction methods based on the design-build method, finding the strengths and weaknesses on this cases.

3 Current State Analysis

This section studies the current project delivery method most commonly used in construction projects, in Finnish construction, the design-build method. This method is quite popular not only in Finland but in the global construction industrial and used for a wide range of projects regardless of the size or typology. The study is carried out through three interviews along with related company documents regarding these methods. The aim of this section is to identify the strengths and weaknesses of the current methods where certain improvements could be made.

3.1 Type of Projects Chosen for the Study

In order to analyse the current state and implications of the design-build project delivery method in Finnish construction, the study conducted three interviews with professionals of the construction industry with extensive experience in Finland and some other countries. Their views of the current situation of this topic and the results of the use of this traditional method are analysed in this section and the current state of the case study presented.

The type of projects selected for this study are various, all of them construction projects but different in terms of size, funding and typology. Therefore, for this study there are samples from large projects (€200M) to small projects (€2M). Regarding the typology of the projects, the samples are from infrastructure, commercial and residential projects, both privately and publicly funded. Even though the sample projects are so different, the methodology and approach in terms of the selection of the project delivery and its implications to the execution of the projects are similar in all the cases and comparable to a certain degree. The varied selection of the sample projects allows obtaining a multiple view of the current situation of the market, not just one, giving a general perspective of the current situation.

The benefit of studying large projects comes from the magnitude of their results, as they are of a significant size, making them easier to understand. Moreover, as those large projects require the involvement of big companies, it is in those cases where the results of the research and development department are applied and clear results exposed. On the other hand, smaller projects with smaller participants do not generate such apparent results, for instance, a saving of €2M from a large project will be per-

ceived as a great success if it is compared against a saving of €200K from a small project. It is for this reason that absolute figures are not taken into account, rather proportional figures given as percentage are more appropriate for a correct interpretation of the projects results.

3.2 Current Practices in the Industry (Review of Data Collection 1)

The current practices in the selection of a project delivery for construction projects were identified based on the analysis of the results of the interviews, both questionnaires and informal conversation, combined with company documents and the researcher's observations. The results are analysed in more detail in the subsequent subsections, leading to the main strengths and weaknesses of the current state of the traditional design-build construction project delivery method.

3.2.1 Overview of the Interviewees

The interviews were structured in two parts: the first part being an informal conversation about the interviewees experience with traditional construction projects and a second part following a series of structured questions, the same for all participants. This second part included 25 questions that were answered in most of the cases. Not answering a certain question was due to it not being relevant to the experience of the particular interviewee.

The first interviewee is a Project Manager for the Finnish transport Agency, with extensive experience, over 20 years, in public infrastructure projects. This person has been closely involved in construction projects, including the newly accomplished Tampere Tunnel project, which was successfully completed using an innovative project delivery method. It is an Alliance type of contract and Integrated Project Delivery method, a pioneering idea exported from projects carried out in Australia in the 90's and the first of its class in Europe. This informant provided valuable insight regarding traditional project delivery methods as well as newly utilized methods in Finnish construction of large infrastructure projects, which is utilized for the initial proposal in a later stage of this thesis.

The second participant is a Construction Manager from Fira Oy with 15 years of experience in construction, from site engineering, R&D investigation and project management. This participant has been working in small-medium sized commercial and residential projects in Finland, and previously in the United States, where he has gained experience with Lean practices, including Integrated Project Delivery methods. Currently he is part of a company that employs traditional project delivery but also adds innovative approaches as Integrated Project Delivery methods and Alliance contracts to its projects, with positive results. This interviewee contributed with his expertise in small-medium sized projects in Finland from a traditional and also a more innovative approach, which is close to the objective of this research, developed in the section 5 of this research.

The third participant of this research is a shareholder of Vison Alliance Oy with over 20 years of extensive experience in the real estate and construction industry, offering consultancy services in the Finnish industry in the fields of Lean construction philosophy and Alliance contracting model, originated in Australia. In addition this participant acquired experience in Lean philosophy in the United States and brought it to Finland, being one of the precursors of the Lean Construction concept. This contribution offered a more theoretical insight of traditional methods, used for the current state analysis of the design-build method, as well as ideas of how innovative models are incorporated to construction projects, offering a vision of current and future direction of newer project delivery methods to be used for building the initial proposal in a later stage of this thesis.

3.2.2 Current Methods

The project delivery method is selected by the owner of the construction project, this method establishes the preconditions for the realization of the project, such as the roles and responsibilities of the participants, including the legal agreements between the parties by setting project target and payment method. This tends to be a critical factor so that if selected correctly, it enables the successful implementation of a construction project. There is no generic rule to decide on which project delivery method to use for a given project, although some methods may be best suited for certain type of projects. The factors determining the selection of the project delivery method are given mainly by the type of project, owner objectives, available resources and knowledge from the

general contractor and degree of risk on the project, in addition, new market trends can be an influencing factor.

The implementation of a construction project involves generally the participation and cooperation of a number of different parties, categorized in the following groups: the owner of the project, the general contractor, various designers and subcontractors. After analysing the conversations with the participants of this study, a clear picture of the most traditional project delivery methods is presented, resulting in three main methods called Design-Build, Design-Bid-Build and Construction Management. These methods are considered traditional and have been in use for decades for the implementation of construction projects, not only in Finland but in a vast number of countries where modern construction methods are followed. These three selected models coincide with Kiiras et al. (2002) as one of the most common project delivery methods employed in Finnish construction. This study explores in more detail the design-build method only, as it was selected during the interviews as the reference method due to its ease of understanding and widespread, simple and well known for the industry.

Despite of focusing only in the design-build method for current state analysis of this study. It makes sense to explain in brief the differences between the three traditional methods for a better understanding of their particular features and effectiveness.

Design-Build is a commonly utilized method, where the project owner contracts a general contractor to be responsible for both design and construction of the projects, based on the requirements given by the owner. This makes up a sole entity for this purpose by the general constructor together with designers and subcontractors.

The Design-Bid-Build is similar to the previous method but with the particularity that the owner assumes responsibility for the design then selects a general contractor just for the construction phase.

Construction Management is the last method described, where an independent project management entity manages the overall design and construction of the project using various contracts to this effect.

These cover the most traditional methods identified during the interview process. It was agreed that the most representative method is the design-build, which is selected to be the subject of the current state analysis of this study, due to its simplicity and widespread know-how among construction companies. The following Figure 4 indicates the

relations between the project participants and the group's subject to be tied by a contract. The owner can delegate all work on a general contractor under contract, making it easier for the owner to manage one sole contact point with the design-construction entity, which is conformed by the general contractor leading designers and subcontractors. The contractual relations between the components of the design-construction entity is an independent type of contract of various forms. Figure 4 also illustrates the different phases of a project and the percentage completed of the total design of the projects, showing the typical stepped engagement points of the stakeholders at different stages of the project. The design phase and construction phase can be overlapped to accelerate the completion of the project at the expense of reducing the project definition during the construction phase

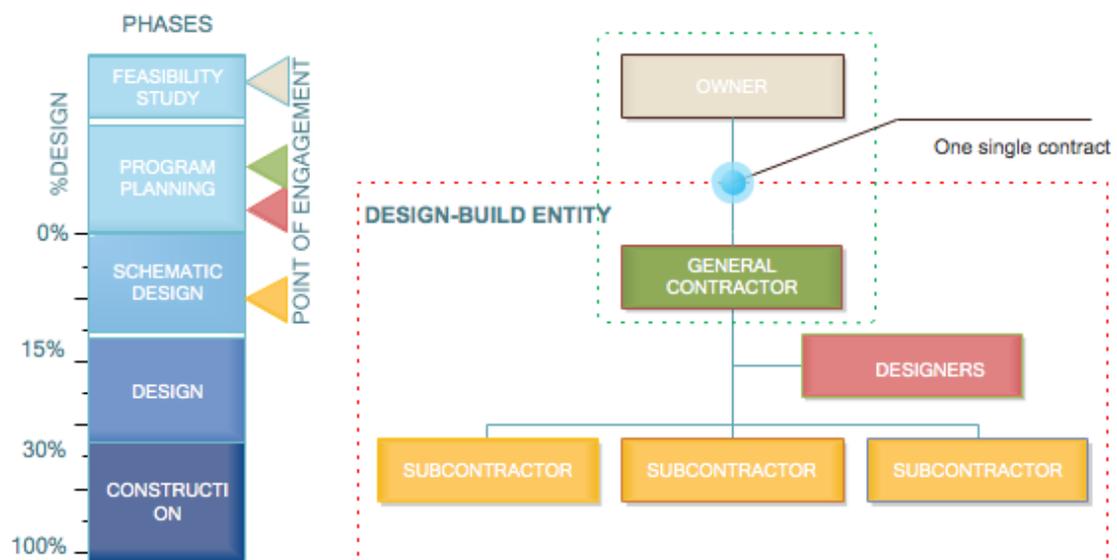


Figure 4. Traditional design-build project delivery method organisation, phases, engagement points and design completion.

As shown in Figure 4, during the different phases of the project, represented in blue tones, the engagement point of the project stakeholders to the project take place at different stages, which is a symptom of the fragmentation that the design-build method can cause due to the setting of individual contracts and targets, not in synchrony with each others. On the other hand, this method enables for fast completion of the project, if planned carefully. This is due to the overlapping of the design and construction phase, where the design phase of the project is not necessarily completed before starting the construction phase. This fact creates at the same time uncertainty in what has to be built, leading often times in additional costs due to unforeseen changes on the

initial design and extra work implied that delays the normal course of the construction phase.

The selection of a project delivery method by the owner only sets the relations between the participants of the project. There is another factor with a direct implication on the development and implementation of the project, it is the contract form that ties the responsibilities and payment method of the stakeholders with the owner. Contract types are independent from the project delivery method selected, therefore there is no single type of contract that can be employed. The type of contracts can be agreed according to the needs, objective and experience of the owner and the type of project.

The most common contract type used in construction projects identified in this study is the Lump Sum or fixed price, it is also the most representative in current practices. In this type of contract, a single price is agreed between the owner and the different party/ies for the materialization of the project prior to starting the construction works. This method is appropriate when the projects are well defined, the degree of risk is low and significant changes to requirements are unlikely during the execution. This type of contract requires from the general contractor an accurate estimation of the works, as the risk is mainly on the general contractor and few mechanisms to change the agreed price exist, although certain variations in the nature of the works can allow for a change on the costs.

3.2.3 Project Phases

The different phases where the components of the project participate is determined by the delivery method and it is a main feature particular of each type of delivery method. Independently to the project delivery method the contract type is selected, where the relations between project participants are defined. Figure 5 illustrates the phases of a construction project and the stages where the components of the projects are directly implicated in a Design-Build project.

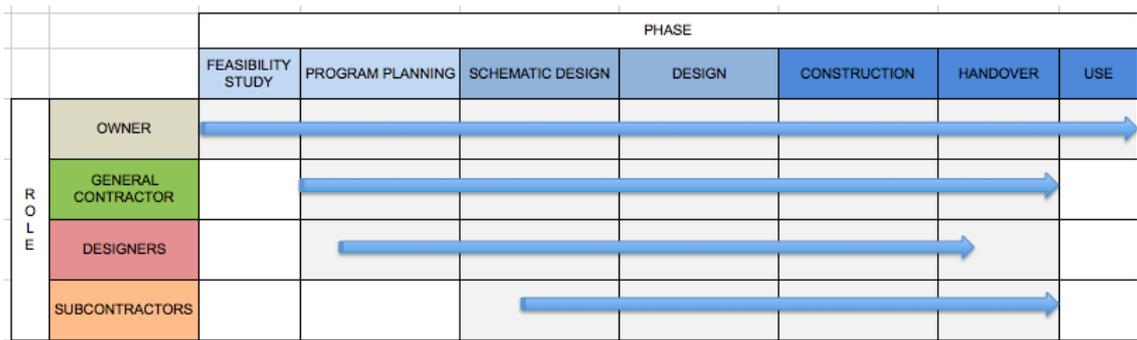


Figure 5. Phases and roles engaged in a design-build project delivery.

As shown on Figure 5, the first phase is the feasibility study of what the owner of the project want to build according to the needs of the project. In this phase only intervenes the owner. Upon decision on what to build the preparation phase takes place, where normally the owner selects a general contractor to carry out the project design and the material execution. The designers are brought later by the general contractor, they will produce the initial design according to the owner objectives and needs and general contractor capability on what can be built. The design is produce in cooperation between the general contractor and the designer. In the following schematic phase, subsequent specific designs start taking place by the different subcontractors, adapted to the initial designs. The design phase follows, where the architect and engineers, under instruction from the owner and general contractor, prepare the comprehensive design of the project. The next phase is the construction of what has been designed, happening in a number of projects the construction phase commences before the completion of the entire design, this is motivated to accelerate the project and it is known as fast-track delivery. During the construction phase all the shareholders of the projects are involved, i.e. designers, general contractor and subcontractors. The next phase is the handover of the completed construction by the general contractor to the owner where defects and guarantees are discussed, according to the contract. And the last phase is the use of the building to the purpose of what it was built by the owner. An addition to this last phase is the maintenance that can be agreed separately with the same or different contractor, or even performed in-house.

3.3 Key Findings from the Current State Analysis (Based on Data 1)

Generally the design-build delivery method has been widely adopted in a wide range of construction projects regardless of size and funding. These projects are well defined,

the risk is known and the participants are familiar with the method, as it is a traditional method, allowing also an early start of the works, often demanded by the project owner.

Presently, the selection of a traditional project delivery, such as the design-build method, entails a number of implications. The first implication is the selection of the contractor, as the owner only defines the scope of the works and the requirements of the project, different contractors will offer different designs and price proposals. Following the evaluation of the different proposals the owners will select a contractor based on quality, price or a combination of both.

The contractual relations of the different parties involved in the project are established by signing an agreement contract with the owner or general contractor, in case this last one is subcontracting any part of the works to a different party. This contract sets the requirements of the job to be done, allocating a timeframe, cost and technical specifications or quality. It also defines the terms on what the party involved in the construction works is paid. It is possible, for example, to impose a bonus or a sanction for early completion or delays that will affect the rest of the works. The common practice on contracts is the lump sum contract, where the different contractors pass a tender to the owner for a given and measured amount of work. If the owner agrees with the cost, then a lump sum contract is signed between both parties where the contractor is responsible for executing the complete contract work for a price.

The phase where the contractors start working and their involvement in the project is agreed under the described contract. In traditional design-build projects, the contractor will only do the work necessary to complete its part, meaning that the contractor plays a single role in the group of works, estimating its part and executing its part only, as agreed in the contract for a price that includes its direct cost plus the profit.

The implication of how changes on the design affect the different phases of the project in a traditional design-build project delivery is shown in Figure 6 below. The biggest amount of work takes place normally during the construction phase, shown in a yellow circle in Figure 6. In the construction phase most of the contractors concentrate on their work, paying less attention to the previous design phases, where changes could be easily made, as nothing has been built yet. The cost of making changes on the design grows exponentially along the evolution of the project, making it more affordable to materialize changes during the early phases and more costly, even abortive, during the construction and final phases.

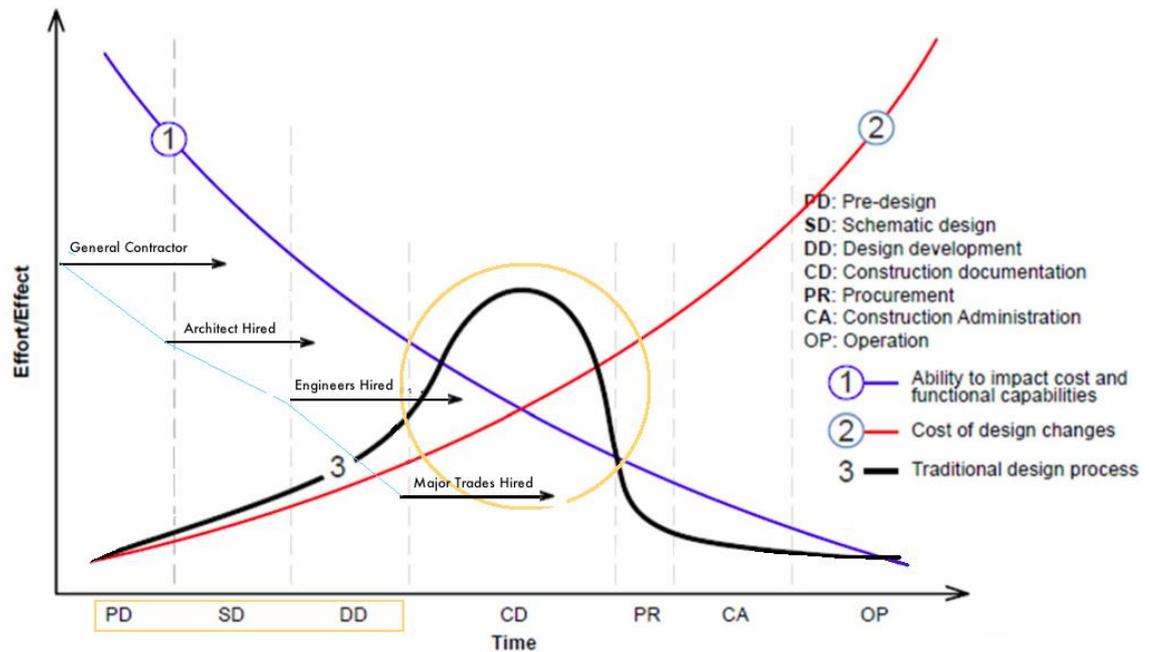


Figure 6. Phase-time-effort (based on a concept of MacLeamy, HOK. CURT 2004: 4).

As seen in Figure 6, the phase at which every stakeholder is hired to start the work is represented by an arrow on each phase. Each stakeholder starts in a different phase of the project, being always the general contractor the first integrator of the project, and following the designing team, architect and engineers, followed by the rest of the major trades. The consequence of this step-by-step incorporation of the stakeholders to the project results in a stepped level of understanding of the whole project during the early phases, when the ability to impact cost and functional capabilities is higher.

3.4 Summary of the Current State Analysis

This section summarizes the findings from the current state analysis based on Data Collection 1. The key findings from the above analysis are summarized in a map in Figure 7, organized by their positive or negative impact in eight categories of the design-build method. The categories affecting the project were selected during the discussion with the interviewees due to their relevance. Following the presentation of the collection of findings, first the strengths and secondly the weaknesses of the traditional design-build method are presented. Areas of further improvement are exposed based on those strengths and weaknesses in the last subsection of this section.



Figure 7. Strengths and Weaknesses categorized into project delivery attributes.

In Figure 7, the 5 ultimate categories of a design-build project delivery are represented by dark blue circles and they are the key findings where the attention of this study focuses, in order to address further improvements. The strengths of this method are shown in green circles and the weaknesses in red circles. The impact of each strength or weakness is indicated by a green or red connector, according to the positive or negative effect produced. The green connectors indicate that the action enhances the selected category and the red connectors represent the opposite, i.e. they hinder the selected category. As shown, there are complex relations between the key findings that can be both at the same time, beneficial and problematic when delivering a project.

3.4.1 Strengths of the Current State Analysis

The strengths revealed by the current state analysis are described in Table 3 below, showing 8 findings organized in categories, the same categories as per the previous Figure 7 where the overall summary of the findings is illustrated.

Table 3. Strengths of the current state analysis.

Strengths of the Current State Analysis		
No.	Finding/Challenge	Description/Consequence
1	Widespread know-how	Common method, simple and well known by constructors and owners
2	Contractor contribution early on design	Contractor and designer work together on the best design that can be materialized meeting the objectives and price
3	One entity to complete design and construction	Owner manages only one contract with a single point of responsibility, with the design and construction entity
4	Early knowledge of total cost	By using Lump Sum a fixed price is given at the beginning of the project. Reduces owner concern with cost overrun
5	Well understood objectives	Owner has good idea of objective prior to commencing project
6	Potential for innovation	Same team works closely under one direction
7	Risk transfer	The owner can transfer the risk to the constructor
8	Quick completion: Fast-Track	Possibility of overlap of final phase of design with the commencement of the construction to accelerate the completion

The strengths of the traditional design-build method are shown in Table 3, having all of them direct implications in terms of cost, quality, time, client and the team in charged of the project. The most remarkable strengths are: 1) well known project by main construction trades; 2) owner satisfaction due to the risk transfer to the design-build entity, early knowledge of total cost, one single point of contact with the design-build entity, easier to manage for the client 3) enable quick completion of the project, by overlapping design and construction phases; 4) potential for innovation as teams follow only one instruction from the general contractor and work closely. Some of the strengths can be at the same time weaknesses such as in the case of quick completion, which is explained in the following subsection of weaknesses of the traditional design-build method.

3.4.2 Weaknesses of the Current State Analysis

The weaknesses revealed by the current state analysis are described in Table 4 below, showing 11 findings directly impacting in the main categories of a construction project, same as per the previous Figure 7 where a summary of the findings is illustrated.

Table 4. Weaknesses of the current state analysis.

Weaknesses of the Current State Analysis		
No.	Finding/Challenge	Description/Consequence
1	Fragmented process	Stakeholders interests are not aligned with a common goal
2	Independent designs from architect and engineers	Different designers work independently for their own interests, not in harmony
3	Old roles are hard to change	Traditional individualistic mentality
4	Lack of co-operation and innovation	Transitional construction limits cooperation and innovation
5	Owner loses some control of the design	Due to the designer-general contractor entity
6	Client forced to make quick decisions	Due to insufficient definition of elements during design phase, changes arise during the execution and construction cannot stop
7	Lump sum set restrictions	Only the minimum necessary is done leading in saving or reduction in quality
8	Changes after tender requires difficult negotiations	Design is completed after price is given, making difficult to make changes and understand the nature of such changes
9	Lack of project knowledge at early phase	The construction can start before the completion of the design. Different designers during different phases
10	High initial cost	Due to risk transfer to general contractor and contingencies
11	Inaccurate schedule of works	Schedule is done by general contractor following estimations from subcontractors

As shown in Table 4, the weaknesses of the traditional design-build method can be summarized as: 1) fragmented process, different designers in different phases, individual goals motivated by the type of contract Lump Sum and old cultural roles; 2) lost of control by the client due to the risk transfer, which was a positive attribute in the

strengths section; 3) high initial cost due to the contingencies includes by the general contractor due to the lack of definition in early phase, which enables quick construction stated as an strengths; 4) inaccurate schedule due to starting the construction phase before completing the design and the general contractor creating an schedule from estimates of the subcontractors; 5) changes can compromise quality due the restrictions set by the Lump Sum type of contract and lack of definition during construction phase, due to the quick completion strength previously mentioned.

As can be observed, certain strengths are weaknesses at the same time, the categories are compatible to coexist in both tables depending on the approach adopted to a particular project.

3.4.3 Key Findings from the Current State Analysis

Based on the above analysis, the key findings are summarised in Figure 8 below into the main categories of the project participants; client and service providers and the project attributes; cost, quality and time.

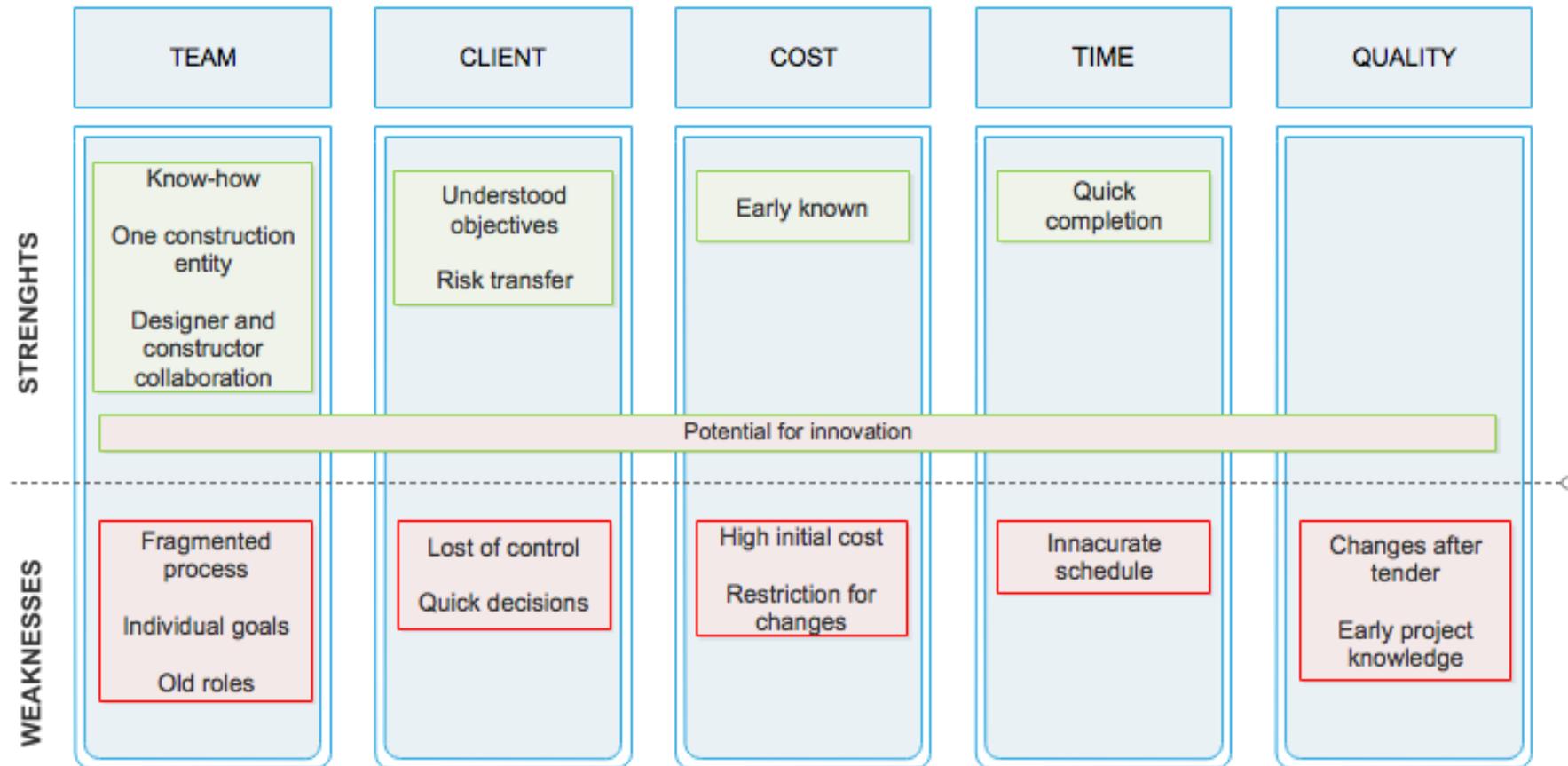


Figure 8. Strengths and weaknesses findings.

As seen in Figure 8, there were both strengths and weaknesses found in all of the categories of the findings from the current state analysis. There are areas susceptible to be improved, as shown on the previous figure. The relation stipulated under a contract between the construction team and the client in relation with the project delivery particularities can solve key aspect of the weakness found if addressed correctly.

The team work is positive as the method is well known by the teams, being managed by one sole entity which is the general contractor and often times beneficial for the client. On the other hand, it is perceived that old cultural roles encourage individualism, existing also resistance to adopt changes that could be beneficial. There is certain level of collaboration between the designers and general contractor despite of the fragmentation of the method in general, due to the individual setting of targets and contracts.

On *the client side*, the strengths are the risk transfer to the design-build entity and the well identification of objectives at the beginning of the project. Also the client can know the total cost at an early stage, which is negative as well due to promoting a higher initial cost and expensive cost if changes happened during the construction phase. On the positive side of the strengths, the most important benefits linked to the used of this delivery method is the acceleration of the delivery time and the relative control over the total cost of the project, if undertaken correctly. This can at the same time bring negative aspects as the lack of definition of the project and expensive changes in case to happen during the construction phase. Also changes lead into delays. The work schedule is produced by the general contractor in charged of the entire project, being often times inaccurate as it is based on estimations from subcontractors works.

Quality is another element that is compromised on the traditional design-build method and the reason for this comes directly from the type of contract that does not allow for easy changes as well as the early start that this method allows. The combination of certain strengths such as one sole entity under the management of one general contractor enables this method to be a subject of innovation.

Based on the findings of the current state analysis, particular attention is put to the group of elements regarding the relation between project stakeholders and definition of roles and responsibilities by contract and working methodology, which seems to be the susceptible for improvement. The main focus in the proposal building stage of this thesis is on developing an enhanced integrated project delivery method based on the strengths of the design-build method and solving the weaknesses, which affect the organisation, commercial and operational features of the project.

The following section explores the existing knowledge in order to find solutions that lead to a proposal for improvements to the findings of the current state analysis of the selected project delivery method.

4 Best Practice and Available Knowledge on Construction Project Delivery Methods

This section discusses the findings from the literature review and existing knowledge related to integration of project stakeholders and collaborative contracts, in order to construct a conceptual framework. This section is presented in four parts, relevant to the study. The first section focuses on construction innovation and serves as the foundation for the following and complementary sections. The second section investigates project delivery methods striving to identify the fundamental components of it. The third section is about Lean philosophy and its influence in a new and more efficient method as well as Lean tools and approach. The fourth and last section addresses strategic alliances focusing on the specific alliance model adopted by Finnish construction (Australian model).

4.1 Construction Innovation

Changes in global economy and shifts in business practices that have taken place during recent years are increasing the importance of innovation in every economic sector, including the construction industry, in order to adapt continuously to the changing conditions of the markets. Innovation is essential for construction organisations due to increasing pressure from clients to improve quality, reduce costs and accelerate the construction processes (Gann 2000). It is worth to consider innovation as the paramount reason for products and service improvements and company profitability can only be achieved through continuous innovation (Egan 1998). In addition, innovation can successfully promote the introduction of new products, processes and/or services, as well as the exploitation of new ideas (Gann 2004). Furthermore, other benefits of innovation have been described by numerous research over the past years, when the topic has gained increased popularity between academics (Winch 1998, Koskela 2000, Slaughter 2000, Gann 2001, Dulaimi et al. 2003, Jimenez-Jimenez 2008). Some of the described benefits include organisational commitment and motivation, integrated processes and teams, customer satisfaction, quality and commitment to people and competitiveness, to name the most relevant. These facts are conclusive when giving reasons to innovate, if construction organizations want to take advantage of changes in market economy, build long-term relations with their clients, increase motivation and improve products and processes. Despite of the multiple beneficial reasons to innovate in the construction industry and the observation of a trend from companies to adopt

new practices, it is still in an early stage.

For the purpose of this study, the most accurate and comprehensive definition of construction innovation is given by Ling (2003: 635) who defines innovation 'as a new idea that is implemented in a construction project with the intention of deriving additional benefits although there might have been associated risks and uncertainties. The new idea may refer to new design, technology, material component or construction method deployed in a project'. The definition seems positive, as it offers some benefits, but also mentions risks and uncertainty associated, as other authors do (Sexton and Barret 2003). Those innovative ideas are not necessarily new to the world but new to the company environment (Sexton and Barret 2003). Despite of the promised benefits of adopting new methods, this adoption entails considerable initial investment, effort and time, which is one of the reasons why the adoption of innovation tend to be slow.

4.1.1 Learning from Projects

The construction industry has specific features that require specific literature, other than literature on generic innovation research. Some of those particularities that make construction innovation different from general innovation are: complex value chains, project based activities and the regulatory influence of its framework, which is often considered as conservative (Bygballe and Ingemansson 2014). For these reasons, the construction industry is often framed in an independently to the general industrial frame. The environment of construction projects is one of the construction particularities that restrict the implementation of innovation as it is not typically implemented within the company but rather during the execution of a project.

A specific model of construction innovation is presented by Winch (1998) where two different parts take place, i.e. a top-down part consisting in the adoption and implementation of the innovation and a second bottom-up part consisting in solving the problem and subsequent learning. For the first part, companies must first decide to adopt a new innovation and be able to implement it during the execution of the project. Projects normally involve other companies as well, forcing companies to negotiate the terms for the implementation of such innovation. The second form is, based on the findings of Slaughter (1993), the idea of a project as innovation and learning process that occurs during the project and can be used as a source of internal learning for the company, following the problem solving during the project. The link between the company internal

innovation process and the implementation of it at the project site is critical for the success of the innovation (Gann and Slater 2000, Slaughter 2000, Ling 2003). Hence, the relation between adopting innovative methods and learning from this process is an important factor.

Learning must be managed due to the opportunities that such learning can offer to the innovation process for companies (Tidd et al. 2001). This learning can be divided into two main aspects: acquisition of new knowledge and feedback granted. Acquiring new knowledge depends on the external available resources and the capacity of a company to incorporate this knowledge. This is seen as a self-reinforcing cycle, the more knowledge the company acquires, the more easily new knowledge can be acquire (Cohen and Levinthal 1990). Receiving feedback makes companies to understand the outcome of the innovation and learn from the experience (Tidd et al. 2001). This can be done by evaluating the adopted knowledge and it is often hard to achieve when different parties are involved in a process or are not involved in the entire process. Some mechanism that have been discussed to improve this situation are: longer relationships between the construction players, provision for parties to be involved during longer period in every project, the facilitation of dialogue and the building of trust. (Anheim and Widen 2001). Given the described mechanisms to improve the learning experience via innovation, it is reasonable to think about enhancing integration of project stakeholder in order to achieve better results when adopting new innovative methods. These innovative methods can be divided in different groups for a better understanding of how they are generated and their impact

4.1.2 Types of Innovation

The forms for innovation are classified in two groups according to their source of motivation: 1) radical innovation as a result of crises or pressure from the external environment; 2) incremental innovation where changes occur in systematic stepped way. The construction industry allows a particular classification for innovation in two groups: 1) organisational which emerges as the result of the introduction of changes to the organisation structure, managerial techniques and corporative strategy; 2) technical innovation which is originated through products or processes, accordingly, the outcome of such innovation is a new product or is a new process by which a product is developed, leading in a more sophisticated method of production, generally more efficient (Egbu 2004). In the construction industry this type of innovation has been traditionally under-

taken by the supplier when new products or processes are improved during the creation of new materials (Gann 2000). Other industries have gone further involving the supplier in their innovative process by giving specifications that the supplier have to meet by being innovative themselves, that is the case for example on the car industry (Womack et al. 1990). In the construction industry, such degree of integration has not been implemented yet, partly due to the fragmentation of the processes, i.e. design and production phases taking place independently of each other. The involvement of construction stakeholders needs to be studied in more detail to understand their roles and responsibilities within the innovation process.

4.1.3 Drivers of Innovation

Various stakeholders are involved in the construction sector, involving clients, contractors, designers, subcontractors and suppliers. Technological innovation, for both products and processes, is normally driven by the suppliers, whereas contractors tend to drive service and organizational innovation (Carassus 2004).

Ample research exist about drivers of innovation in construction projects (Slaughter 1993, 1998, 2000). Five are the internal and external drivers influencing of innovation: The client (Barlow 2000, Gann and Slater 2000, Bygballe and Ingemansson 2014) has been identified as the key actor influencing innovation, but traditionally the connection between companies and clients has been weak. The client can act as a catalyst agent by applying pressure on the supply chain partners to improve performance and guiding them to plan the strategic changes for adapting to the market requirements (Gann and Slater 2000). The client can also integrate knowledge across various organizations by identifying and demanding novelties to contractors, suppliers and operators (Barlow 2000), even generating collaboration and trust between the project parties in order to enable innovation (Bygballe and Ingemansson 2014).

The contractor plays a mediator role between the suppliers and specialist consultants, who develop new products and processes, and those who adopt those innovations, i.e. clients and professional institutions (Winch 1998). Contractors generally are responsible for the introduction of different type of innovation according to their scope of expertise. Manufacturers invest the most in R&D and are considered key drivers of technical innovation. The procurement method (Dulamai et al. 2002) has been identified as to play a critical role for organisations to increase their innovation, particularly the Design-

Build methods. The implementation of integrated team/supply chain is paramount to use procurement methods as a driver for innovation (Walker et al. 2003). Attitudes and processes are important for construction organisations and their teams to conduct innovation (Blayse and Manley 2004), demanding a series of challenges as motivation to achieve cooperation between stakeholders to find new ways to improve (Gann 2000) and 'no blame' culture (Dulaimi et al. 2002). All these factors are required to develop the appropriate climate for innovation, representing challenges for construction companies.

The intervention of the client is one of the methods to attempt to address industry problems through the promotion of partnering and relationship contracting (Walker et al. 2003). These relations are set by the procurement system, which can act as an influencer, by establishing parameters such as the degree of risk, bonuses and knowledge sharing. Alliances are system that can tackle the traditional adversarial culture within the construction sector. Alliance contracts are considered an organisational innovation that promote further innovation through a supportive environment and a fair distribution of project costs and profit (Hardie 2009), focusing on maximizing value and value creation for the project as a whole entity. A broader understanding of the meaning and implication of value and value creation between companies and clients is essential to determine the key strategies for companies to be able to offer the best products and services. These tow terms are discussed below.

4.1.4 Value and Value Creation

Value can be defined from a perspective of benefits and sacrifices where a buyer and a seller trade off engaging into a relationship to work together and create value for them. Nowadays a non-monetary idea of value is defined, which includes competitive advantage, market position and social reward. (Walter et al. 2001). Those benefits and sacrifices are not always immediate and may take time to realize, therefore value is considered time dependent (Jørgensen and Emmitt 2009). Short term and long term benefits and sacrifices should be taken into account by buyers (Ahola et al. 2008). Looking at the long term attributes, benefits such as the relationship between customer and suppliers or innovation are found, as well as the sacrifices such as strategic transaction cost and customer capabilities (Ahola et al. 2008).

Value creation must be a winning situation for the supplier when while offering value to the customer also gains benefits from the customer (Walter et al. 2001). The value creation act comprises three phases: value identification, value proposition and value delivery. In the value identification phase the project stakeholders identify their values and needs. The above mentioned value proposition phase take place when the different interests are identified, then those are combined and form a collective purpose and objective for the project. The last phase, i.e. value delivery, merges the different customer and stakeholder needs and objectives to materialize them (Aapaoja 2014).

Many projects today involve numerous stakeholders and a complex value chain, making the concept of value to play a central role in project deliveries (Barima 2009). In this value chain the stakeholders not only create value but also contribute to value creation together with other stakeholders (Aapaoja 2014). For the project stakeholders to create value, their processes must be compatible in order to exploit and benefit from each other expertise and resource (Pekkanen 2005). Ramaswany and Gouillart (2010) have called this situation value co-creation and it is about redefining the process and methods of how organizations involve stakeholders in the value creation process. Value co-creation adds the perspective of project stakeholder collaboration and involvement during the value creation process (Aapaoja 2014). Paying attention to these concept of value and value creation seems to be a new strategy that companies are adopting following the shift from goods to services offering and closing engagement with the clients during the value creation process. The objective of understanding the importance of the term of value is to understand at the same time the mechanism that companies have to deliver this value in different ways, according to the specific requirements of the client. These mechanisms are known in construction as project delivery methods and the selection of the most appropriate method is key for positive results of the project.

Before addressing the study of delivery projects it seems logical to understand the reasons why a company might decide to invest time and resources into improve and implement a new project delivery method. The strategy to motivate this change and the direction to follow by the company is important to understand, despite of not be a critical part of this thesis, as the objective of this thesis is to propose a more efficient project delivery system.

4.1.5 Innovation Management

The strategy for companies to address innovation management is driven by the need to leverage internal and external ideas to achieve corporate objectives for long-term growth, profitability and competitive advantage, articulating the ambitions and long-term vision for innovation (Dodgson et al. 2008).

Two perspectives need to be considered in relation to strategic management. One is about positioning strategies, formulated by Porter (1980) who states that strategy is about finding a favourable position in an industry, cost leadership, differentiation and focus. The other perspective is the resource-based view, where the company is perceived as a batch of resources, and the manners in which those resources are combined differentiates firms (Hamel and Prahalad 1994). This last perspective implies that if the market change, the way in which a firm uses its resources must change as well to be relevant within the market. Recently, the perspective of the Blue Ocean strategy where a company creates its own business (Kim and Mauborgne 2005), has been gaining weight and inspiring strategic thoughts in business. In recent years, a combination of the described strategies is what certain companies who offer new services under a pioneer frame are using for a better positioning in the industry.

From the construction industry has been observed that new services are being included within the traditional offer, such as operations and maintenance, financial services or guaranteed maximum price, to name some of them. This strategy is based on flexibility and offering new products and services that once are used by the customer, these tend to repeat due to the superior results over the traditional offers, perceived as improvement in cost, quality and time. As seen from the previous example, developing and managing innovative strategies is key for companies to stand out of the rest and offer better services.

The strategic management establishes an organizational process that creates value by combining and coordinating resources, people, knowledge, technology and finances, to create a satisfactory result (Dodgson et al. 2008). Developing an innovation strategy is a dynamic process that iterates learning from the external and internal environment to build the knowledge of the company. The success of the strategy depends on the innovation culture, to what degree this culture is tolerant, supportive and encourages learning from failure (Dodgson et al. 2008).

Placing the customer as a collaborator in the value creation process, is one of the Fundamental Premises (No. 6) of the Service-Dominant originally developed by Vargo and Lusch in 2004. The foundation of the Service-Dominant logic is that organizations focus on the exchange of service with customer through a collaborative process of value creation where both, companies and customer co-create value for their common benefit. The co-creation of value is the component that better covers this logic and expresses the most radical rupture from the Good-Dominant logic, which uses value merely as something added to the product (good).

Innovation management can be approached from the conventional industrial approach of new product development, taking the traditional Goods-Dominant logic, from the open innovation perspective and from the most recent Service-Dominant logic. Typical features of the goods-dominant new product development include relying on in-house capabilities and operating under secrecy impeding competitors to learn from new developed processes (Chesbrough 2003). The open innovation approach takes into consideration internal and external ideas, enabling the setting up of relationships with different actors of the industry and integrating several knowledge components (Chesbrough 2008).

The open innovation approach has promoted the concept of success innovation into recognizing the proactive roles of the construction actors and their knowledge interchange, which utilizes the market to exchange valuable knowledge and enables the creation of alternative routes to commercialize the results of the innovation projects (Chesbrough 2003). The service-dominant logic provides a client centric view to analyse needs and develop innovative solutions, therefore the strategy is to target a specific client's needs (Vargo and Lusch 2004), in fact the value of the innovation is defined and co-created with the client during the innovation process. Moreover it has been argued that during the innovation process it is paramount to integrate the innovator's value network in order to define the innovation strategy to be followed for a better achievement of the defined targets set during the co-creation (Lusch et al. 2010).

Once the basis to understand the importance of innovation and its managerial implications established, further understanding is needed of the main attributes that conform a project delivery method in order to determine the possible parts to be improved. Studying project delivery methods in more detail is needed in order to itemise their basic components and their interaction with the main actors of a project. The relationship

between these actors is also established by the delivery method, which is the client responsibility to select according to the project objectives and specifications.

4.2 Project Delivery Methods

The project delivery method is the key means by which the owner creates preconditions for the successful realization of a construction project, thus, selecting the right method may help avoid problems and be key to achieving project specific goals (Lahdenperä 2015).

In addition to the selection of the project delivery method for a project, the contractual arrangements are set by a type of contract, and it is the owner's mission to choose the most appropriate for his needs. This contract basically is the format for how the owner will pay for the service under contract in return for a service provided by the contractor or any other party of the project.

4.2.1 Fundamental Domains of a Project Delivery Method

According to Thomsen et al. (2009), there are three fundamental domains on a project delivery method: 1) The project organization, which is the involvement of the project participants. 2) The commercial terms binding the project participants, which is determined by the types of payment, relation between owner and contractor and procurement of contractor. 3) The operating system, which depends on Managing By Results, where managers establish financial goals and monitor performance against the goals and Management by Means, where managers define the means for sustained performance, relying on process measure for feedback on system performance (Ballard et al., 2004).

4.2.1.1 Project Organization

Traditional delivery methods have been about delivering projects by separating the design and construction phases and in general, splitting the project into small piece,

promoted by tendering by the lowest price rather than by the best quality offer. This issue has led to a fragmentation of the project where the designs and construction parts are not produced by integrated teams. Rather they are just passed to the next team in charge of the execution of an individual part of the project, without precise interaction or information exchange, resulting in stakeholders optimizing just their business area (Aapaoja 2014). The low bidding practice has been recognised as a major determinant of the fragmentation effect of the construction projects, resulting in sub-optimized performance (Lahdenperä 2012).

Traditional methods focused on low bidding prevent the most capable stakeholder to be selected. Furthermore, there is a general tendency to rush to detail in the design phase without exhaustive knowledge of the project specifications and objectives, even though these are essential to maximize customer value (Pekkannen 2005).

As the contractors are not directly involved during the design phase, this creates uncertainty about the meaning of the design, therefore the cost of the project will increase with contingencies by the contractors. Also the project will need to be re-designed during construction phase as new contractors, information about cost, constructability and non-program preferences from owners are incorporated after substantial design has occurred, resulting in waste and extra effort (Thomsen et al. 2009).

Traditional project delivery methods have failed at integrating the participants organizationally, i.e. owner, designer and contractor.

4.2.1.2 Commercial Terms

Traditional projects are based on multiple two-party contracts that create a vertical chain of relationships that flow back to the owner, not connecting project stakeholders by contractual attachments. This contractual arrangement promotes the individual operation of each project participant seeking its own economic incentive regardless of the impact of its actions to the rest of participants. Therefore traditional contracts dissuade project stakeholders to collaborate, leading often times in disputes between contractors. (Thomsen et al. 2009).

It seems logical that selecting the right contract type is key for a successful execution of a construction project, as it is the ultimate document that establishes legal responsi-

bilities and obligations between project participants. It is the type of contract what can encourages and rewards companies to behave as teams.

4.2.1.3 Operating System

The current operating system that guide the management of a construction project follows the traditional definition of construction management, which is as follows: construction management is defined as the judicious allocation of resources to finish a project on time, as budgeted and at the desired quality. The current practices of construction management are based on the activities of the project, ignoring the effect of workflow variation on performance, tracking deviations and optimizing activities performance in order to increase productivity. This result in concerns from the owner point of view, as it is perceived that each of the project parties focus on protecting their own interests. This behaviour does not allow for learning, promote the repetition of mistakes and ignores the creation and delivery of value, to name the most relevant. (Thomsen et al. 2009).

It seem that if bigger implication of the project stakeholders is needed, it can be beneficial a radical approach towards an operating system that includes and promotes the collective participation of the project stakeholders. This collective participation would enable seeking for the best solutions for the project perceived as a whole.

Before finding which project delivery is closer to what this study strives to address, it is fundamental to understand the basic principles of one of the most widespread and simple delivery method, which is also subject of this study; the design-build method.

4.2.2 Design-Build Method

Design and Build is an old method of construction, acquiring more popularity in recent years and in all kind of projects. In addition, its superiority and potential has been proven by research (DBIA 2016, Lahdenperä 2001). Due to its recent widespread use, this method has been affected by variations on its approach, resulting on slight changes and generating a series of alternative methods. However, none of them an object of this study, as they have not shown substantial relevance, since they have been tailored to very specific requirements of particular projects. This study focuses in the study of

the general design-build method only, adapting certain areas to a better-integrated method.

The basis of design-build is the involvement of a single contract between the project owner and the design-build entity, usually managed by a general contractor, covering both the design and construction of the project. This method offers to the owner a single point of responsibility for the design and execution of the whole project, which might release pressure from the owner by transferring the warrants to the general contractor. On the other hand, the downside is the loss of certain degree of control in the project by the owner. Design-build offers different options on the methodology, including financing and operation and maintenance as part of the total package, and has thus been named in those cases as design-build-plus (Lahdenperä 2001).

The allocation of risk for the design usually lays on the general contractor who manages the design-build entity. However, there are other risks in a project that are individually assigned to the party best able to handle and minimize the risk. For each risk that the owner transfer to the design-builder, there is a corresponding cost, in some cases this cost is already included into the contract price by added contingencies. (Lahdenperä 2001).

The fast delivery of a project is one of the strengths when deciding to select this method of construction, which is possible by overlapping the design and construction (preparation) phases. Early completion seems beneficial often times, reducing the construction financing time and allowing earlier use of the building, hence, shorter time span between the investment decision and occupancy that may increase income. This requires from the owner a clear idea of the project objectives and requirements, so the project is understood from the beginning by the designer and contractor who can produce an accurate project, without unexpected scenarios for the owner. In addition starting the construction before finishing the design can cause unexpected costs due to imprecisely estimated lots. Some other features offered by this method are: 1) the achievement of competitive quality, as the design-build entity is the only responsible for it, so cannot shift responsibility for defect to another party.

Contrary to this, it is recommended to have a third party arbitrating and looking after the owner interests, as the designer and general constructor works together, so the owner keeps certain degree of control over the project; 2) favourable cost, the construction part working closely during the design phase allows for optimizing the solutions, also the owner know the initial total cost at an early stage which can reduce the

owner risks and uncertainty. Opposite to this is the higher final cost, as the contractor tends to allow for unforeseen scenarios and contingencies for the risks transferred; 3) smooth execution, the designer and constructors are liable for any defects occurring during the project, which on the other hand tends to increase costs. (Lahdenperä 2001).

All in all, the discussed benefits and caveats related to this method make it more appropriate for certain scenarios. One of the weaknesses of this method is the fragmentation of the processes and team targets that can be addressed by studying new methods to deliver projects that seems to focus on how integrated teams work in relation to a project delivery.

4.2.3 New Methods to Deliver Projects

Traditional project delivery methods are extensively used, producing acceptable results for a wide variety of projects, such as the popular design-build method. These methods have the downside of separating the design and construction phases, splitting the project into small sub-projects and leading into a series of challenges. One remarkable consequence of this fragmentation is tendering by the lowest price, rather than selecting the most suitable contractor who can deliver the best quality and value for the client (Aapaoja 2014).

Due to current challenges, the construction industry has started to search for new methods to deliver projects taking into consideration value creation with the customer, competitive costs and higher quality (Koskela 2000). These new methods encourage the integration of project stakeholders as early as possible (Elfvig 2003) with the idea of conforming the project objective as coherent and realistic as possible, in collaboration with all stakeholder knowledge and expertise. According to Lichtig (2006) the new method can be summarised in five big ideas: 1) real collaboration throughout design, planning and execution; 2) increased collaboration among project stakeholders; 3) making projects networks of commitments; 4) optimizing the project as whole, not pieces; 5) tightly aligning and matching actions with learning. The above five ideas point to a better integration between the project stakeholders, specially paying attention to team work in closer collaboration and understanding of the project as a holistic entity to be undertaken and optimized.

The result of using these new methods should be better integration and relations between the project participants, giving alternative options to the client to achieve the purpose of the project and helping the customer understand the consequences of their desires (Elfving 2003). The most well know of these new methods are project alliancing and integrated project delivery (IPD), also known according to recent research as relational project delivery arrangements (RPDA's) (Lahdenperä 2012).

The use of RPDAs allow for an earlier involvement of project stakeholder in the project, making possible a more efficient use of stakeholders knowledge. This has been identified as a critical factor for more accurate value creation (Elfving 2003, Aaltonen and Kujala 2010). Hence the challenge in RPDA is to consider and balance a variety of stakeholders and their requirements (Aaltonen and Kujala 2010). The project manager then adopts the role of facilitator, as well as collector of the requirements of the various stakeholders of the project, who are required for a closer collaboration during the project delivery. Finding the correct methods for identification, involvement and integration of project stakeholders seems to be challenging, despite of being a need as well. Project delivery method need a better defined process to address the management of collaborative teams in every day more dynamic environments.

It seems that the integration of project stakeholders is key for the success of a project. One of the solutions for managing the different parts of a project is through integrated teams and processes that seek to make these parts work together in better synchrony. This can also solve the issue of the traditional methods regarding the defragmentation of team work and meeting customer needs. Further study of integrated teams and their relation within a project delivery method is presented in the following subsection.

4.2.4 Integrated Teams and Project Delivery Arrangements

The use of integrated teams and project delivery methods was motivated by the increase on trends of project value creation and meeting customer needs alongside with tighter schedules and demanding projects (Moore and Dainty 2001). Traditionally customers have known what they wanted and needed for the construction project. However, new practices have shifted to just implementing a collection of features. Current customers want solutions to their needs from the product or service provider that can address their objectives and at the same time create value when used (Kauppinen et al. 2009).

Therefore, project managers need to challenge the customer understanding of the project objectives, disclose possible conflicts between the customer and other stakeholders and confront customer desires by exploring alternatives that were not considered (Ballard 2008). The means to expose the customer to new alternatives that will help to accomplish their purposes beyond the initial objectives and understand the consequences of their desires, come from new trends such as RPDAs (Ballard 2008). Due to new challenges, the construction industry is searching for new project delivery methods that better adapt to these new times (Davies et al. 2007).

The reality is that the industry needs more interactive collaboration between project stakeholders in order to increase the offer of value to the customer. The next subsection presents the existing integrated project delivery and its features in order to understand how this method work and borrow some ideas for the initial proposal of an enhanced integrated project delivery method.

4.2.5 Integrated Project Delivery

Integrated Project Delivery (IPD) is a method that emphasizes on maximizing the value created for the customer and eliminates waste from the production process. It has been developed in parallel with Koskela idea of Lean construction. IPD is a trademark in the USA and was first used in 2005, according to the co-founder of the Lean Construction Institute, Gregory Howell. A characteristic of this method is the incorporation of several parties to the project right from the beginning in order to ensure and maximize the capabilities and talents of all team members of the project (Merikallio and Haapasalo 2009).

Other important characteristic of IPD is that the objectives of the team members are aligned and risks and benefits are shared equally (Merikallio and Haapasalo 2009). The team members should be trained to understand Lean philosophy and develop the process based on Lean principles and how to apply them to the project. IPD also emphasizes efficient knowledge transfer and learning among the project stakeholders (Merikallio and Haapasalo 2009), which can be achieved by using Building Information Modelling (BIM), a virtual design of the whole project made by computer specific software, and Big Room working space, a shared common space where all the project team works closely and communicates directly during the design phase. IPD is an alternative for common practices as design-build, which has been criticised, as it does

not encourage integration, coordination and communication between the team members.

Figure 9 shows the comparison between historic and integrated project delivery timelines (after Eckblad et al. 2007) and their impact on the development of a shared understanding of the project by the whole team (Lichting 2007), (Source Mossman et al. 2010: 3).

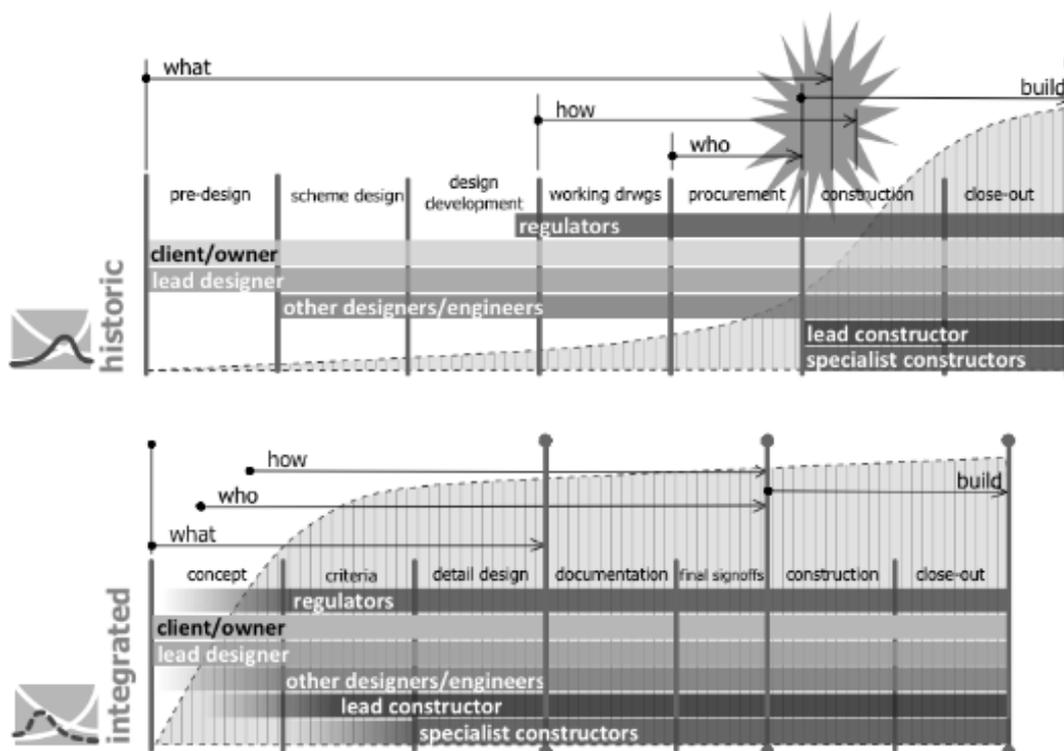


Figure 9. Comparison of traditional and integrated project delivery timelines (after Eckblad et al. 2007) and their impact on the development of a shared understanding of the project by the whole team (Lichting 2007), (Source Mossman et al. 2010: 3).

In Figure 9, it can be seen how in a traditional project delivery the majority of the works concentrate during the construction phase, represented with an explosion cloud on the graph. Because the project design is substantially being completed during the construction phase, the materialization of changes on the design during the construction phase is difficult and costly. The exponentially curved shaded background represents the degree of understanding by the team members, which tends to concentrate and grow at the construction phase (Mossman et al. 2010).

Lichtig (2007) argues that shared understanding may never reach 100% by the members in a traditional project delivery as users often find the completed project different

from what they expected. As seen in Figure 9, the integrated project brings all the actors together at the early design phase of the project, allowing for an accurate understanding of the project objectives early on. The integrated method is intentionally shorter than the historic one as that tends to be what happens. The shorter delivery time is possible due as that this method leverages the experience, knowledge and input of all team members in order to obtain the best possible results, increase value for the client by reducing waste and maximizing efficiency throughout the cycle of the project, from design to completion of the project. The small graphs are MacLeamy Curves and indicates that changes in a project are easier and affordable to achieve during the early design phases, as in the integrated method occurs, which is opposite to the historic way where changes on the design during construction phase are costly, complicated and often times abortive.

Given the above explanation about the features of the integrated project delivery method, its superiority seems notable, as well as more logical, when the integration of the project stakeholders and project phases is sought. This method is a good and proven solution for improving one of the main components of a project delivery such as the organisational structure, impacting directly on the cost, time and quality, including customer satisfaction, of a project. After addressing the improvement of the organisational component, an approach to a particular operating system such as Lean is going to be presented in the next subsection. Lean philosophy can address the needs of the operating system component of a project delivery.

4.3 Lean Philosophy

Lean thinking is a philosophy derived mostly from the Japanese Toyota Production System that aims to maximize the value created for the customer and eliminate all the unnecessary actions that do not add value to the customer from the production process, shortening the lead time from customer order to production delivery by eliminating the wasteful activities. The objective is to produce high quality products with a small amount of resources (Womack et al. 2003).

The base of Lean philosophy is the Toyota production System, which describes the Lean concept. Some of the main pillars of this system are concepts such as Just in Time and Built in Quality, which focus on the elimination of inventories and other waste through small lot production, reduced set-up times, collaboration with suppliers, em-

employee empowerment and other techniques (Liker and Lamb 2001). The main particularity of Lean comparing with other production systems is its understanding of the importance of human motivation (Liker 2004), focusing on rewarding work collaboration towards improvements by changing the wasteful activities into value-adding ones.

Since the characteristics of Lean were described by Womack et al. (1990) the interest towards Lean started to grow. The Lean philosophy has spread outside the car production industry and other businesses are starting to implement its practice, particularly the construction industry. Later, Womack and Jones (2003) captured Lean thinking into five principles: 1) Specifying value from the customer point of view; 2) Identifying value stream for each product to expose waste; 3) Making the value-creating activities flow; 4) Letting the final customer Pull value from its source; 5) Pursuing perfection, creating a learning organization through continuous improvement. These principles focus on understanding and maximizing customer value, which jointly with continuous improvement and respect for people can be seen as the key tenets of Lean. The application of Lean principle to construction is known by the name of Lean construction, which emerged in the mid 1990's as a new concept in the construction industry

4.3.1 Lean Construction

Lean construction is about applying Lean principles, methods and tools to the construction industry, but there is still no universal definition of Lean construction (Jørgensen and Emmit 2009). According to the Lean Construction Institute (LCI 2013) Lean construction can be understood as “a production management-based approach to project delivery – a new way to design and build capital facilities”. “Applied to project design and delivery, Lean changes the way work is done throughout the delivery process. Lean construction extends from the objectives of Lean production systems – maximize value and minimize waste - to specific techniques, and applies them in a new project delivery process”. Lean construction aims to meet customer demands better and improve the interaction in the construction process, by applying new specific methods for product development and production management (LCI 2013). Finland established its own Lean Construction Institute (LCI Finland) in 2008 and the Institute has organized three major researches on “Integration in Construction Industry”, following the key topic of promotion of integration in construction projects (Merikallio 2017). This fact shows that Lean construction principles are gaining popularity and their use is extending within the sector.

The Edgan report (United Kingdom 1998) of great influence in the community of construction innovation researchers and still valid nowadays, point at Lean techniques as best practices to achieve a radical change to improve production within the construction industry. Forgues and Koskela (2009) argue that, for the principles of Lean construction to be effectively applied to current practices, the different project parties need to commit to close cooperation, ultimately promoted through integration. Regarding the use of Lean construction to procurement, there is a strong emphasis upon the importance of promoting co-operative relationships from the outside (i.e. partnering). However, the implementation of Lean practices in the partnering field is not straight forward, due to a number of existing barriers to cooperation, i.e. industrial, cultural and organization, therefore, a fundamental change is required from the parties involved in the partnerships team (Eriksson et al. 2007).

Lean philosophy is presented as an efficient operating system that can address the requirements for a better integration of the construction participants and processes. In order to apply these principles, the construction process need to be defined and a suitable definition of it is as a production process

4.3.2 Construction as Production

The first ideas of Lean applied to construction are from the 1990s, starting with Koskela (1992) challenging the construction industry to explore and adopt new principles and tolls from manufacturing industry. In these days forms of production and project management focus more on activities rather than processes, ignoring flow and value considerations. Construction is understood as a production, in 2000 Koskela establishes a theory for production and demonstrates its use in construction. Thus, the underlying idea behind this theory is that construction should be seen as a flow of work and creation of value rather than be understood only as a transformational process.

From a production point of view, a general definition of the nature of construction is given by Bertelsen and Koskela (2004: 5): “Construction is complex production of a one-of-a-kind product undertaken mainly at the delivery point by cooperation within a multi-skilled ad-hoc team.” This definition states the construction as a type of production conceptualised by Koskela (2000) as transformation, flow and value generation.

As a result of understanding construction as a production system enables the approach

for managing construction as if it were a production process. This concept gives a direction to formulate theories of production to manage construction as a more efficient machinery. Hence, understanding of management of the production process is needed to improve construction and its related project delivery methods.

4.3.3 Managing Production

Managing the three principles of value, transformation and flow is one of the central ideas in Lean construction. The goal of Lean construction is to increase product quality and reduce costs (Yusuf and Adeleye 2002), and in order to achieve this goal it is key to improve the design and construction process. According to Koskela (2000) this can be done in a better way by focusing on the traditional transformational view of construction together with management of flow and value generation.

Managing transformation is achieved by handling what needs to be done, such as managing contracts establishing quality, safety and procedure, a task which is core to traditional project management. Managing transformations is necessary due to the high value involved in contracts, however, the simple project management approach is not enough in dynamic and complex systems as construction projects are (Bertelsen and Koskela 2004).

Managing flow requires new management activities, such as management of supply chain or setting up the logistics for materials and information. These activities struggle to increase and structure the information between the different project phases and stakeholders of the construction process. The mission of these stakeholders is to coordinate the flow of information and the production flow, materials and equipment that conform the final product. (Bertelsen and Koskela 2004).

Managing value generation is perhaps the most difficult task to be approached in a Lean way. Value generation is achieved by ensuring that activities conducted under the transformation and flow process add value to the customer. An early relationship between the client and the designers during the design phase can provide a better understanding of the client value parameter that can be successfully fulfilled (Bertelsen and Koskela 2004).

One-of-a-kind production, such as construction projects, adds complexity to the project, making it necessary to integrate the design and production process (Bertelsen and Koskela 2004). Inadequate, incomplete or out-dated information during design phase

will lead into delays and extra cost during both design and production phases. This can be reduced by improving communication between and within the participating companies of the construction project, at the cost of increasing project complexity (Hong-Minh 2001).

As previously described, a construction project encompasses different components that need to be managed. Lean perspective to management offers an insight of a proven method that can be used to improve the operation component of a project delivery method.

4.3.4 Lean Perspective to Management

Lean management was originated as a production system by Toyota Motors that would be capable to compete with the established mass production system, focusing on eliminating waste from the production process, founded on the premise that the efficiency of a process determines time, which is considered the most important factor (Pekuri 2015). Thus Lean management emphasises the efficiency of production flows over resource efficiency (Womack et al. 1990). The Lean system comprises a series of specific tools and methods used during the production process, with particular emphasis on the feedback loops produce by employees who constantly review the efficiency of activities allowing for continuous improvement.

The other factor contributing to the Lean management has been to go further than merely eliminate waste and reduce costs to an approach that seeks to enhance value for customers and fulfil customer needs (Hines et al. 2004), based on the five principles of Lean Thinking previously described. Those principles position companies in regards of customer perspective as their reason to exist is only to create value for them (Womack and Jones 2003). Recent research (Liker 2004) has emphasized the multidimensional facet of Lean, making it perceived as a comprehensive business system that integrates functional and philosophical aspects of a company centred at creating and promoting a culture of continues improvement.

The specific features of each industrial sector defines the type of innovation process to be applied. The construction sector is a particular one, as well as its features, in terms of deciding a type of project management, which has been defined as deficient and accounting for a low level of innovation. The most influential characteristics of the con-

struction sector are the one of a kind nature of the projects, site production, temporary multi organization and regulatory intervention (Koskela and Vrijhoef 2001), affecting substantially to the type of innovation and management required.

The Lean perspective previously offered as a proposal to address project delivery deficiencies in terms of its operating system, it is also of interest for managing innovation within construction projects.

More interactions between project team can be motivated by contractual relationships such as legal contracts, setting obligations for stakeholders to work closely in a more cooperative way. Alliance contracts are a relatively new solution in the construction industry that creates a collaborative environment for teams enabling to achieve more by working together towards a common goal. This method has offered positive results in a wide range of projects in recent years. Further study on this topic is presented in the following subsection.

4.4 Strategic Alliances

Strategic alliances are collaborative arrangements set between two or more parties in order to achieve a common goal utilizing the best available resources of the companies. This type of collaboration is relatively new in the construction industry, starting in the 1990's and increasing in use in recent years.

4.4.1 New Forms of Collaboration

A form of collaboration address the contract procurement of a project and how the contractual issues are managed, such as risk allocation, client involvement or information channels, creating a high dependency between these factors. Some new forms of collaboration have been recently developed under the form of partnering and project alliance.

Partnering focuses on team building, trust, mutual understanding, objective development and mutual goal between the contractors and the objectives often are to increase quality, reduce cost and delivery time. Partnering can be just for one given project or for a number of projects, long term partnering. Learning is one of the positive factors found in partnering, also helps the different parties to better understand objectives and the requirements of the others. (Lahdenperä 2009).

Four factors were identified by Kangari and Miyatake (1997) than can highly contribute to innovation in Japanese construction, one of them being strategic alliances, a factor that is not comparable to all the countries, but that can be analysed and taken into consideration. The other three factors found are effective information gathering capabilities, reputation through innovation and technology fusion, which are in line with the objective of this study.

Partnering is mainly about improving cooperation but based on traditional contractual frameworks (Walker and Hampson 2003) such as design-build methods, being a just a charter signed by the parties, naming a series of collaborative principle but it is not a legally binding document (Lahdenperä 2009). Project alliance is a relatively new concept, similar to partnering, but mainly differentiated by the risk shared between parties and the shared bonuses gained on the successful completion of the overall project (Lahdenperä 2009).

Project alliance is gaining popularity in the past 5 years in Finland, motivated for its pioneering implementation with successful results. This contracting method address one of issues found in the studied project delivery method that is the contractual component.

4.4.2 Alliance Contracts in Finland

Alliance contracting was developed in the early 1990's for a high risk oil and gas project on the North Sea, to create a more collaborative work environment and share project risk more effectively among the project team (Walker and Hampson 2003). Australia started then to use this method and since then its popularity has grown as a viable contract method in all types of projects.

An alliance is a relational contract with the strong integration of parties to the contract, as well as the early involvement of the key stakeholders. In addition to the early involvement of participants, the integration of an alliance contract also comprises a joint organisation with unanimous decision-making procedure, the common objectives pertaining to all parties, the commercial model aimed at their realisation, as well as sharing of risks and benefits (NAC 2015). An alliance contract specifies the objectives and the operating models promoting confidence between the contracting parties. In addition, confidence building is based on the openness set out in the contract (Merikallio 2017).

In 2012 Finland was one of the first countries in the world, the second in Europe, to use a project alliance in a construction project, and since then several other have been made. By the end of 2016 there were nearly 50 pending or completed integrated project deliveries and a large share of those are delivered applying the alliance model. The alliance model adopted in Finland is based on the Australian model. However, quite a lot of the lean management and lean construction tools from the American IPD models have been introduced into the Finnish model as well (Merikallio 2017).

Alliance and other collaborative project delivery methods represent a solution to decrease the fragmentation in the construction industry (Lahdenperä 2012) by enhancing collaboration between the project members. In alliances projects, usually two or more parties are involved in collaboration throughout the project, based on shared risk and shared reward thinking. In Finland, this type of contracts have been originally used in infrastructure projects that include a high degree of uncertainty and complexity, with positive results (Lahdenperä 2011). The first alliance contract was launched by the Transport Agency in 2007 in a railway renovation project (Lielähti-Kokemäki). Major Finnish construction companies were among the participants in the established research and development project (Lahdenperä 2009). However, the testing of the alliance project took place in 2011. In 2009 a delegation from Finland participated in a construction conference in Australia and met Jim Ross, an Australian pioneer in the field of alliancing. In 2010 Jim Ross visited Finland to provide training to Finnish contracting entities, including The Transport Agency who stated their intent to test the alliance model. The first project was launched in the autumn of 2010. The second pioneer in the field of alliance, the University of Helsinki, Property Centre, launched their first alliance project in 2011. (Merikallio 2016). However, alliances have been successful in the first testing projects in Finland and it is becoming a popular method useful in a wide range of projects regardless its typology and size.

The objectives of the first alliance project are summarized as follows: 1) to improve considerably the productivity of construction works; 2) to change the operating culture in construction towards a more open and trust-based operating practice; 3) to deliver the end product faster, at a higher level of quality and cheaper; 4) to promote innovation and expertise. (FTA 2014). In addition, a number of added objectives have been stated in recent years, including: 5) early integration to ensure the availability of versatile skills at the very inception stage of the project; 6) fair sharing of risks and benefits throughout the entire contracting and delivery chain; 7) optimisation of the project as a whole; 8) transparency, openness and trust between all parties. (Merikallio 2017)

The most significant benefit of the alliance model is achieved at the development stage (Walker et al., 2013), in particular, on early integration of project stakeholders, allowing the link the best possible available resources and skills with different stages and tasks of the projects at a sufficiently early phase. This means that the application of the stakeholder skills and resources are supporting the finding of value-producing solutions, facilitate the delivery and reduce the risk factors at the development stage. (Merikallio 2017). The benefit of the early integration has been proven during the last projects undertaken in Finland under this method.

When striving to achieve the optimum end result, the stakeholders in the alliance need to contribute into developing mutual trust. This underpins innovation created through collaborative efforts, as well as open communication between stakeholders. The mind set and the tools employed for achieving the corporate culture include, cooperation in big rooms, open books finances, to name the most relevant. (Merikallio 2017). In one of the studied cases during data collection 2, it was possible to visit a Big Room used for the design development phase of a project and to understand the insights of this shared working space along with the different tools employed based on Lean.

One of the key preconditions is the owner budget. In Finland it has been successfully demonstrated that it is possible to achieve significant cost savings at the development stage through systematic ideation and innovation, applying, the big room operating model as well as the Virtual Design and Construction (VDC) technology, which is the use of integrated multi-disciplinary performance models of design-construction projects to support business objectives (concept created at Stanford University, Center for Integrated Facility Engineering in 2001). A successful development stage ensures a better control of time schedules, risk management and costs control as well as achieving the set objectives by the owner.

4.5 Conceptual Framework of This Study

In this section, the conceptual framework was developed from existing knowledge. The premise for building the conceptual framework is that project delivery methods, generally, consist of the elements of commercial arrangements, organisational arrangements and operating system, as illustrated in Figure 10.

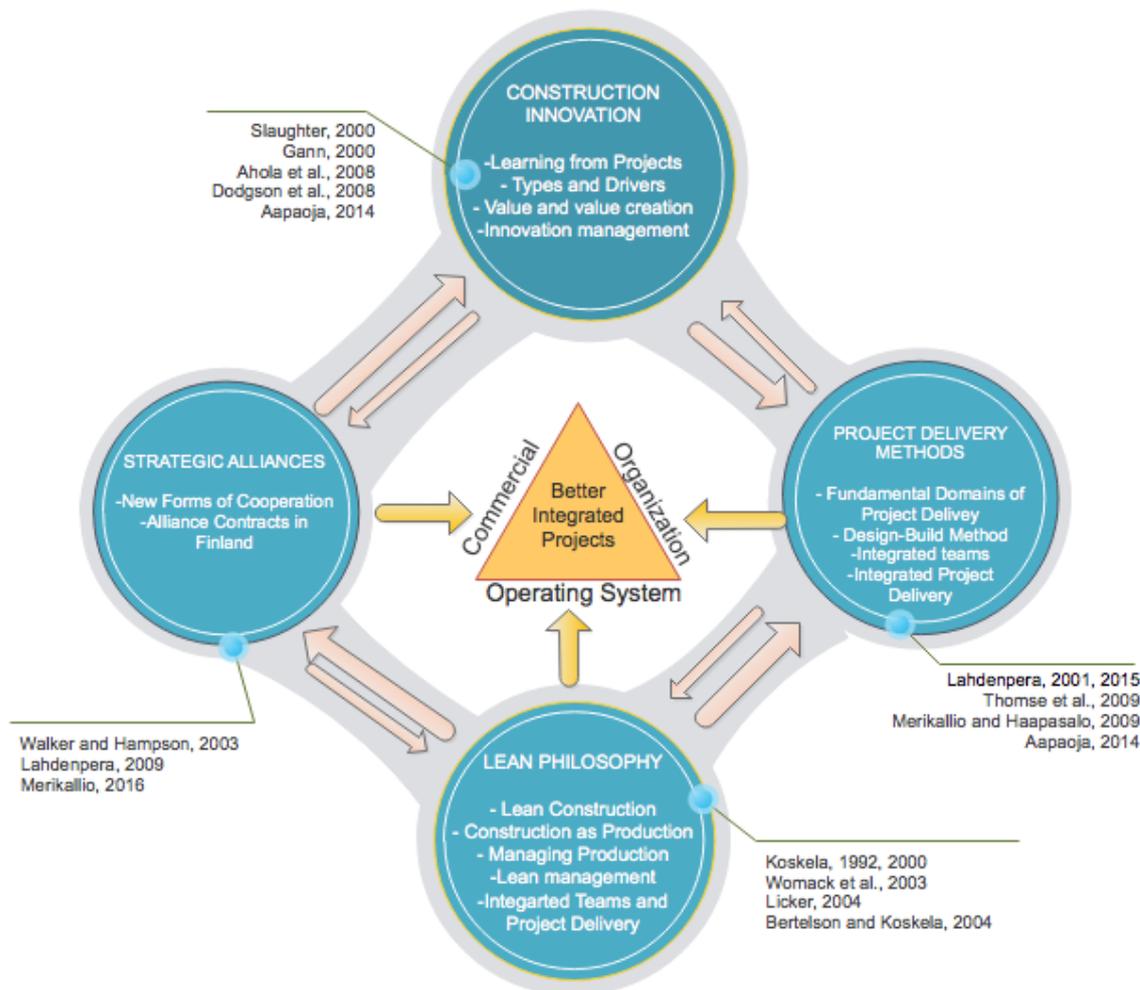


Figure 10. Conceptual framework for a better integrated construction project delivery.

As seen in Figure 10, there are four components of the conceptual framework, with construction innovation as the basis of the other three sections, which impact on the three components of the project delivery method, in the centre of the illustration.

Lean philosophy seems to answer a number of the weaknesses found on the operating system component, through the Lean principles and Lean tools. The strategic alliances section expands into alliance contract in Finland, which has been proven to be a new successful model to take into consideration as a potential commercial component promoting collaboration between project teams. The project delivery methods study in detail the particular integrated delivery method, which is a logic formula to tackle the fragmented organizational component and improve fulfilment of client needs.

With the conceptual framework in place, the next section presents the initial proposal for an enhanced integrated project delivery method, objective of this study.

5 Building the Proposal for the Construction Project Delivery

This section presents the initial proposal for an enhanced integrated construction project delivery method, based on the traditional design-build method. The findings from the current state analysis, based on the data collection 1, and the conceptual framework from the literature review are combined with data collection 2, which encompasses the results of the interviews, one workshop and company reports focused on newer project delivery methods. These results are combined to build the initial proposal. This section first presents the logic for building the proposal from the finding of data collection 2. Then follows the presentation of the results of data collection 2 that conform the initial proposal, introduced in the last part of this section.

5.1 Overview of Proposal Building Stage

The case studied into this thesis is the traditional and newer delivery method utilized in construction projects in Finland. The newer methods promote collaboration between project stakeholders as their main particularity and have been successfully used in recent years in Finland, which is the main reason to conduct this study. Therefore, the object of this study is to develop a proposal for an enhanced integrated project delivery method. Special interest has been taken into the design-build delivery method due to its simplicity and widespread that serves as the reference method for the study.

In order to understand and determine the parts of the design-build delivery method that needs to be addressed, its components have been divided into three, organizational component, contractual component and operating system. These three components, and not others, were selected after analysing the data collection 1 which served as the basis for presenting the current state analysis in the section 3 of this thesis. A more thorough understanding from the literature review is presented in the section 4, conforming the conceptual framework to this study. This conceptual framework was then applied to the analysis of the current state analysis and the weakness and strengths of the process are identified.

This section 5 combines the previously described findings, as well as data collection 2 into an initial proposal, which aims to present an adjusted project delivery model giving particular importance to the integration of its processes. Data collection 2 was extracted from three interviews, one workshop and relevant company reports, where the alli-

ance contracts and integrated project delivery was the main focus, as the interviewees are experienced using these methods in pioneers projects carried out mainly in Finland. Special mention has to be made to the positive outcome of these projects undertaken with a new approach. The initial proposal in detail is presented in the following lines of this section.

5.2 Findings of Data Collection 2

The development needs were identified based on Data collection 2, three interviews, one workshop and company reports. These interviews were conducted with the same participants than for the data collection 1. Those participants pointed out at three main factors affecting the result of the projects carried out under newer delivery methods.

The first participant was a project manager from the Finnish Transport Agency, pioneers at using the Alliance contracting method in Finland in large public infrastructure projects, who emphasizes: 1) Early involvement of project stakeholders from the beginning of the design phase, resulting in a total design where all the expertise of the stakeholders is taking into consideration. Therefore, the design of the project is substantially completed before the construction phase starts; 2) Alliance contracts is an option that is giving positive results in large projects where the risk is elevated, by allowing sharing the risk but also the profit of the project by seeking common objectives and goals, treating the project as a whole. Furthermore, this type of contract enables innovation as the opinion of all the team members is collected and the best methods agreed and executed; 3) Cultural change is needed in terms of educating team members who have been using traditional systems. In order to do that, prior training and constant follow up is an appropriate method to implement and evaluate the performance of the teams working under a new collaborative method. Most of the training involves Lean philosophy and tools as the use of a common working space called the "Big Room".

As a general comment expressed by this interviewee regarding the use of newer methods as the Big Room employed during the construction of the Ranta Tunnels in Tampere, it is key to give team members the tools and training on how to use cooperative methods of work between different teams.

“Before the different teams started working together in the Big Room, training was provided to ensure we all knew how to collaborate and use this space.” (M.M. Interviewee 1)

The second participant was a construction manager from Fira, where Lean approaches are used for the execution of small-medium construction projects, residential and commercial types. A workshop in a “Big Room“ was also part of the data collection 2, where the working method of this common shared space was studied. This interviewee emphasized the following three points: 1) Early involvement of project stakeholders, working together in the “Big Room” common space, resulting in completion of the project design before the construction phase start; 2) Use of alliance contracts as part of design-build project delivery method, maintaining the sole contact point between the client and the general contractor, but tying the designers and subcontractor together with the general contractor, therefore sharing common objectives and goals for the project; 3) Use of Lean philosophy and tools as the operating system of the company, looking at minimizing waste and optimizing results, shortening the delivery time as well. Some of the tools employed are the “Big room”, “choosing by advantages” for decision making, use of the figure of the “facilitator” as a mediator between the different parties, “reliable promising” for adjusting promises to real results, and the “BIM” to produce a comprehensive virtual design of the entire project that can be visualized and tested before the construction phase, with the input of all the project stakeholders.

A comment expressed by this interviewee gives a clear idea of the mentality needed to start using new project methods. The key idea is to be able to see the long term benefit that the use of new methods can bring, despite of the initial investment that can discourage the adoption of these newer methods.

“When trying to change the business, creating a new business model, there are always problems at the beginning, but it’s the price that needs to be paid to learn something new...invest in the short term to see the results in the long term.” (S.P., Interviewee 2)

This interviewee also pointed out the predisposition of the young generation to collaborate, seen as a rupture with the old mentality and enabling positive result in collaborative work environment.

“It is part of the company philosophy; discuss, present, coordinate, facilitate....to other people to achieve more. Younger generations

they collaborate by nature (internet, social media...)." (S.P., Interviewee 2)

The third interview was with an expert on partnership and alliances contract from Vison, with an extensive background as training and helping companies to adopt Lean construction principles and cooperative working methods, as well as forming working under alliance type of contract. The three main points were emphasized: 1) Use of collaborative contexts for construction projects where the project stakeholders share their expertise in order to build an integrated team; 2) the use of Lean construction philosophy and tools, allowing the optimization of knowledge and resources for a common goal; 3) Cultural change needed as part of the shift towards more collaborative working teams where common targets are set between the project stakeholders and client, allowing all the team members for a close cooperation in order to achieve those targets, avoiding blaming each other and open to understating for the benefit of the project and, eventually the profit to be gained for the project. This cultural shift needs to be guided by providing training and giving feedback on the adoption of new working methods.

This interviewee emphasized the need of focusing on educating people rather than utilizing new tools or methods in order to achieve positive changes in the old fashioned mentality of the construction industry.

"Focus on people, working with people, discussing with people, developing people are the key to change working methods, not the tools, not the methods but the people". (L.M., Interviewee 3)

The summary of the findings from data collection 2 is presented in the Figure 11 below, relating each of the main ideas recollected to one of the three main components of a project delivery method, produced from the findings of the current state analysis and the conceptual framework.

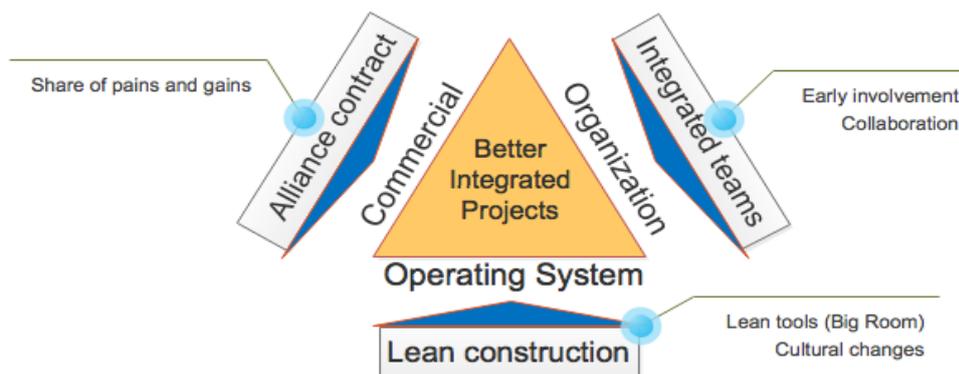


Figure 11. Main ideas found from data collection 2, making reference to each component of the proposed project delivery.

As seen from Figure 11, the integration of teams by promoting collaboration work during a project is a key factor impacting on the organizational structure of the project delivery. This factor can be seen as the main component to be promoted in a project delivery as it is also partly in the other two components of a project delivery. It is the driver of the alliance contracts and Lean construction ideas.

5.3 Proposal Draft for a Better Integrated Construction Project Delivery

In this section the strengths identified during the data collection 2 focused on newer and successful construction project methods are presented. These strengths are group together within the components of a project delivery conforming the initial proposal for an enhanced integrated design-build project delivery method.

From the conceptual framework is taken the idea that innovation is a need as it works as the engine to keep companies in constant search for the best methods that adjust to them to differentiate from competitors, provide better services to customers and use new technologies and methods that increase productivity. The use of company knowledge and learning for future projects is another important factor, related with the openness and collaboration with other project stakeholders. Furthermore, this learning process can improve the relations with clients, which are seen as the main drivers for the use of new methods that provide better results for construction projects. Therefore, companies are seen as the providers of those new methods, and often times are the companies who need to offer different alternatives to the clients, always aiming for co-

creation the projects with them. Value co-creation between companies and clients is of key importance for companies.

5.3.1 Integrated Teams in the Organisational Component

Integration of project teams seems a potential option that is been proven to be successful when seeking to optimize the main attributes of a project, time, cost and quality. A closer collaboration between team members from different companies necessarily add value to the entire project, the construction project costs tend to be optimized as the best solutions from the best experts are proposed, minimizing the waste or changes during the costly construction phase, even though the deign phase tend to be more costly. Delivery time seems to be reduced due to the accurate planning of all the project stages, thanks to the close an early involvement of the project stakeholders in the design phase. The project tends to be delivered with less faults and the best quality according to budget and original planning, suffering less changes. Less conflicts between project stakeholder is also possible, due to the common shared goals allocated, risk and profit, understanding the project as a collective contribution.

Hence integrated teams solve the majority of the issues arising when using a traditional project delivery method. Figure 12 shows the implications of the incorporation of integrated teams on the conceptual map produced from the current state analysis findings.



Figure 12. Integrated teams effect on the project delivery.

As seen from Figure 12, integrated teams produce a positive effect in certain of the weaknesses found from the current state analysis. This positive effect is shown by changing the colour of the circles. What was a weakness, represented by a red circle, in the previous current state analysis map turns into a strength and is represented in light green circle when adding the integration of teams. Some of the light green circles affected by the integration of teams are: fragmented process, difficulties after tenders to produce changes on the design, inaccurate schedule, due to the close collaboration of the project stakeholders from the early stage of the project.

5.3.2 Lean Construction in the Operating System Component

Lean construction philosophy offers an adequate environment of ideas and tools to develop an integrated team and work under a more efficient approach than the traditional culture. Lean construction promotes the cooperation between project stakeholders, closer collaboration with the client during the beginning of the project and therefore a better value co-creation process, offering the best alternative options. In addition, it enhances the reduction of unnecessary processes by reducing waste and optimizing the construction production. Lean philosophy needs to be taught to team members as it is a novelty in nowadays projects that requires a shift into a different way of thinking. This can cost money and time at the beginning of the adoption of this set of ideas, but this cost certainly is believed to pay off at the long term.

Lean tools as the previously cited “Big Room” and the “facilitator” figure, it is proven to help during the early phase of the project when project objectives need to accurately be defined and coordinated during the design phase. The design phase encompasses the total design of the project prior the construction phase, in an accurate model produced using “BIM” technology, which is a virtual design of the entire project to be executed. Other tools to help the team to choose the best decision among a collection of options and enhance communication with the client, form part of Lean tools, that are not an exhaustive part of this study.

Hence Lean construction philosophy provides a functional operating system that supports the objective of the integrated team, looking for optimization by collaboration. Figure 13 presents the impact of Lean construction philosophy on the conceptual map of the project delivery strengths and weaknesses found from the current state analysis.

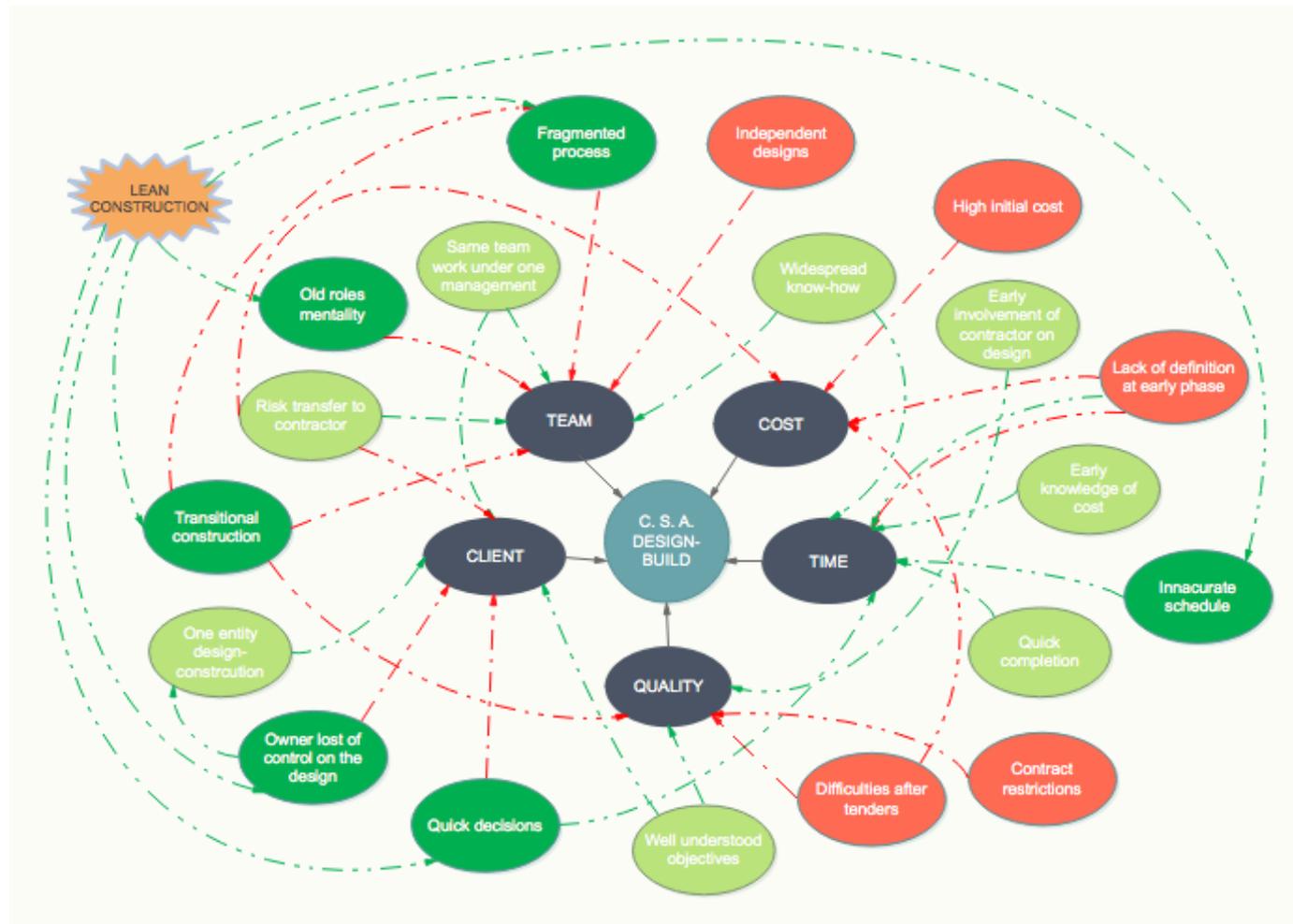


Figure 13. Lean construction effect on the project delivery.

As seen in Figure 13, the Lean construction environment affect positively to the following weaknesses of the current state analysis of the traditional design-build method: fragmented process, old roles mentality, traditional construction and inaccurate schedule of work by promoting cooperation and finding the best possible solutions from the project stakeholders. In addition, the owner gain more control on the project in general and quick decisions are not a need anymore which increase the client satisfaction.

5.3.3 Alliance Contracts in the Commercial Component

Alliance contract is the commercial framework that sets the rules between two or more parties to carry out a project in such a manner that all parties involved work as a team towards the set targets, sharing the pains and gains. The team is established under the alliancing, setting common goals, engaging to innovate and to reach the best execution of the project, sharing the risks and bonuses under an open book system where there is nothing to hide and all parties openly show their finances and knowledge, avoiding blame or dispute between the participants. This contract type allows project stakeholders to learn from each other as well, which result beneficial for the team members of each different trade.

A contract is the ultimate form of agreement, with legal implications and as a difference from the previous two points, it is more than words and good intentions. It is a legal agreement with real implications for each party of the contract. Therefore, alliancing contract is a suitable framework where cooperation of integrated teams and Lean construction principles and tools are best deployed and combined.

Figure 14 shows in which parts of the current state analysis map the alliance contract has positive implication.

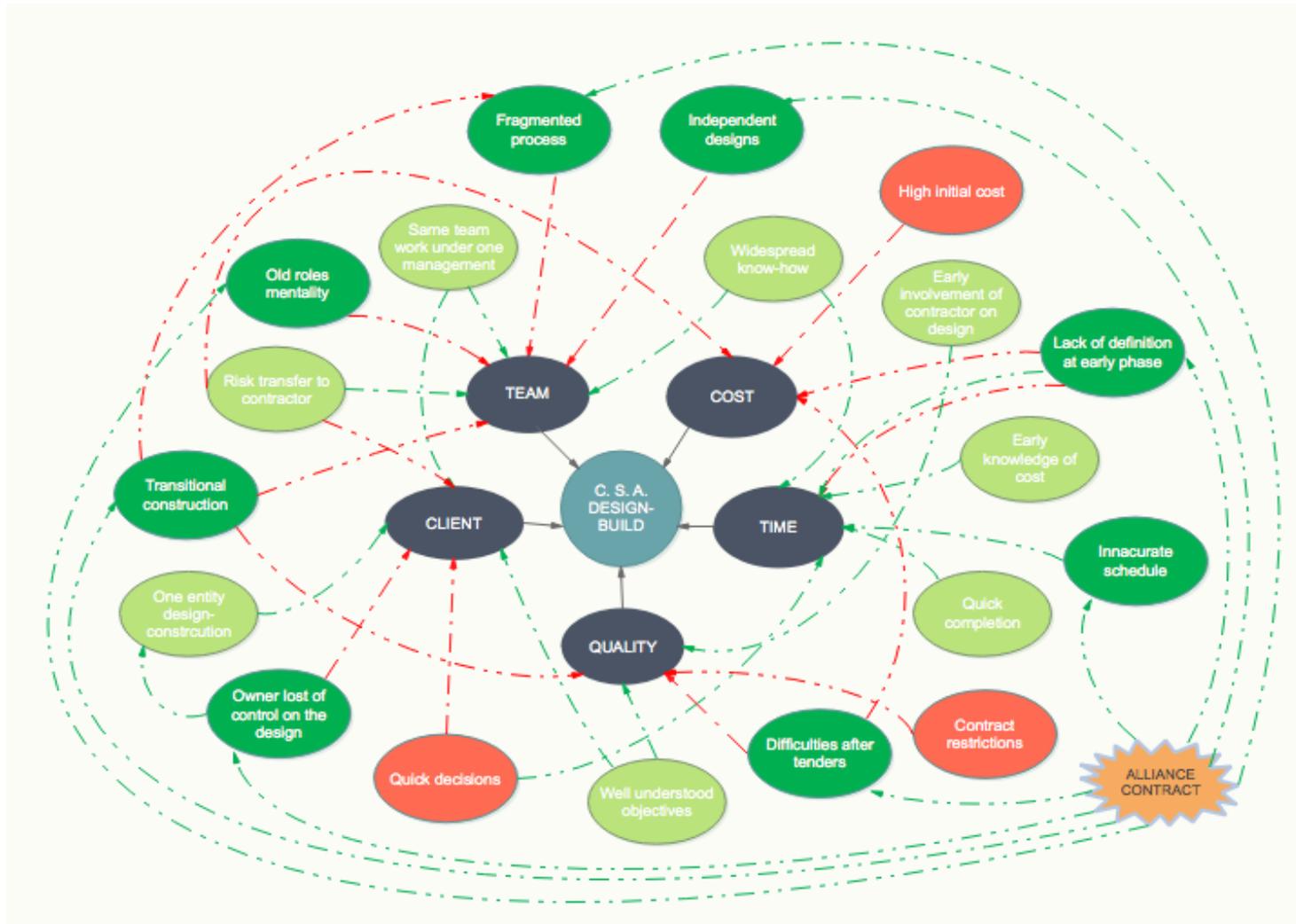


Figure 14. Alliance contract effect on the project delivery.

As seen from Figure 14, the alliance contract brings many positive changes in the weaknesses of the design-build method previously described and analysed. It can be seen that its impact affects on most of the components of the map, with the most remarkable being lack of definition at early stage, independent designs for different parts of the project and client satisfaction in general.

5.4 Initial Proposal of an enhanced integrated Project Delivery

In this section, the three elements of the project delivery method are combined in the initial proposal for an enhanced integrated method, based on the design-build method. Figure 15 below presents the initial proposal.

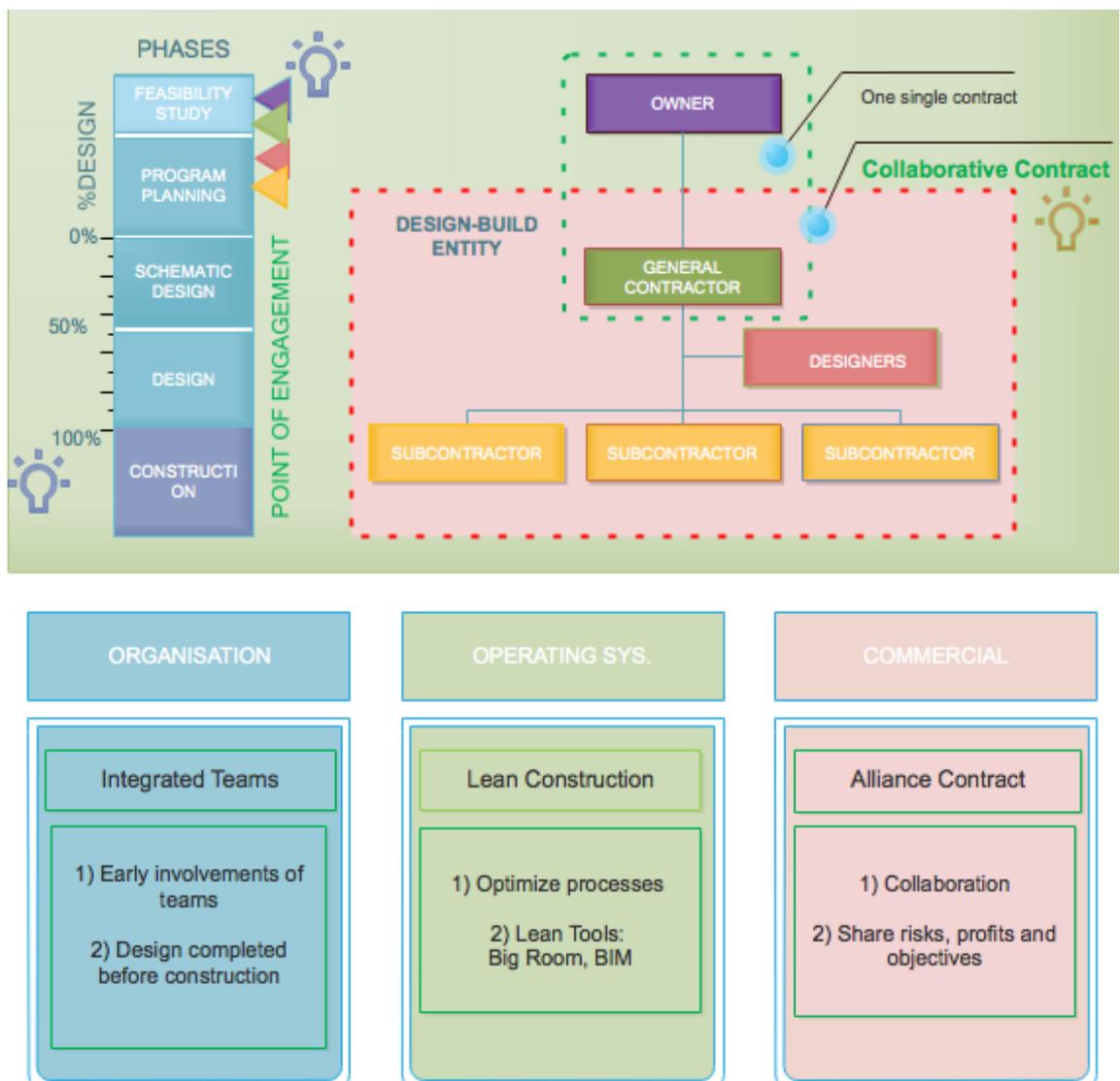


Figure 15. Initial Proposal for an enhanced integrated design-build project delivery.

As seen from Figure 15, the three elements suggested for this initial proposal of an enhanced integrated delivery method corresponding to each of the three components of the project delivery are: 1) integrated team for the organisational component, represented in blue colour. The integrated teams are engaged during the project from an early phase, adding the expertise of the different stakeholders and producing a better design more coherent respect the different parts designed. The design completed before the construction phase starts also increase the understanding of what is going to be build, reducing changes during construction phase which affect positively to follow the original schedule of works and cost. 2) Lean construction, represented in green colour, act as the operating system setting the working methods to follow for the execution of the project. Lean construction allows for a more appropriate working environment where the best solutions are sought while looking at optimizing the construction processes. Tools such as the Big Room provides a collaborative environment where this operating system can be discussed and applied. BIM tools are also used for the virtual completion of the design including the best ideas from the different stakeholders and resulting in a model with less faults and closer to the real construction. 3) Alliance contract is represented in red colours and is set the legal obligations between project stakeholders by forcing cooperation between them. Alliance contract set project objectives and instructions for project stakeholders on how to achieve the objective while sharing the risks and gains, which act as a motivational factor to enhance collaboration between teams. The client is the one who decides on the conditions of the contract and find suitable contractors willing to work under this type of contract, therefore these contractors show a predisposition to collaborate and find the best solution for the project from the beginning.

The next section 6 discusses the validation of the proposal by piloting the initial proposal against a project carried out using a traditional method, then comparing what the outcome would have had by utilizing the initial proposal.

6 Validating the Proposal

This section presents the validation of the initial proposal, describing the adopted plan and method carried out for such validation. It is followed by the final proposal result along with recommendations for the next steps.

6.1 Overview of the Validation Stage and Data Collection 3

For validating the initial proposal, the ideal scenario would be to implement a construction project where the proposal could be tested in a real scenario and under the influence of normal project factors. Due to the time restriction, this type of validation cannot be conducted, as it would take at least the duration of an entire project where the author could be involved, an average of 10-12 months. Alternatively, it was planned to ask for feedback to the initial proposal from one of the interview participants, turning this unsuccessful due to incompatibility of agendas. Hence, the ultimate validation method adopted is by piloting the initial proposal against a known project carried out using a traditional design-build method, then comparing what the outcome would have been by employing such proposal and following adjustments and further recommendations. This type of validation requires certain level of abstraction, as the result is based on a hypothetical scenario. The validation of the proposal in more detail is described on the following section.

6.2 Validation of the Proposal

An existing project, carried out in London, UK, where the author collaborated during the construction phase, has been selected to be compared against the initial proposal method of the thesis, as it was undertaken under the same design-build delivery method, but following a traditional approach. To the effect of this study, the comparison of the same method in two different locations, London and Finland, does not affect the result of the validation, as the design-build method is broadly used in both countries and practically identical.

The author of this thesis was involved during the design phase of the project in London, which overlapped the construction phases, so simultaneous design, and construction happened at the same time in the project subject of the comparison. The overlap of

both design and construct phase has the purpose of accelerate the completion time of the project, and it is a common practice on the majority of small and medium sized residential projects.

The main issues arising from the use of the traditional design-build delivery method during this project were the following: 1) Unclear definition of objectives from the client at design phases resulting in costly changes during construction phase; 2) Design and construction phases overlapping resulting on costly changes due to the advanced stage of the construction phase and delays; 3) Subcontractors focused only on their part of the contracted work resulting on disputes between trades and compromising quality. Subsequently, the consequences of the previously described issues were: 1) 7 months delay over schedule; 2) 30% approximately more expensive over initial quote; 3) Compromise on quality of the finishes; 4) Conflicts between subcontractors; 5) Unsatisfied client.

Extrapolating the original method used on the London project with the initial proposal method of this thesis, it can be observed that some of the issues from the traditional design-build delivery method could have been minimized. The initial quote for the job would be perhaps higher, as it requires greater involvement of project stakeholders during the early design phase of the project, and perhaps initial schedule of works would have been longer at the short term, due to the requirement of completion of design before starting the construction phase.

A more detailed impact of the use of the initial proposal method of this thesis in the described London project is as follows: 1) Early involvement of project stakeholders would enable a completed definition of the construction features of the project and compatible with project stakeholders works, resulting on better definition of client objectives and project requirements, better follow up of original schedule and less conflicts between subcontractors; 2) Completion of design before construction starts would result on minor and affordable changes during construction phase, if any; 3) Collaborative contracts, as the alliance contract, between project stakeholders would minimize disputes between them, resulting on the best solutions adopted during the project, reducing waste and optimizing execution times. However, there would exist difficulties in the implementation of new working methods, as none of the construction parties have never employed different practices than the traditional ones. Therefore, a cultural change and training on new practices as collaborative teams and Lean tools like the "Big Rooms" and BIM design should be provided. The adoption of such methods would

start progressively, from small changes to a total adoption of the method, motivated upon positive results, if that is the case.

6.3 Final Proposal

Based on the validation of the initial proposal, a final proposal is made, maintaining the original proposal methods without substantial changes. The immediate changes that are deduced are related with the implementation of the three proposed components of a project delivery, shown in red letters in Figure 16. The implementation of the organisational component would require an exterior consultant or internal team leader experienced in this method who can guide the team towards collaborative work between team members, sharing and learning from best ideas and from each others' expertise. Build trust is something essential when a shift from individual to collaborative work methods take place, individual need to perceived other teams from different trades as a source of specialised knowledge and learning.

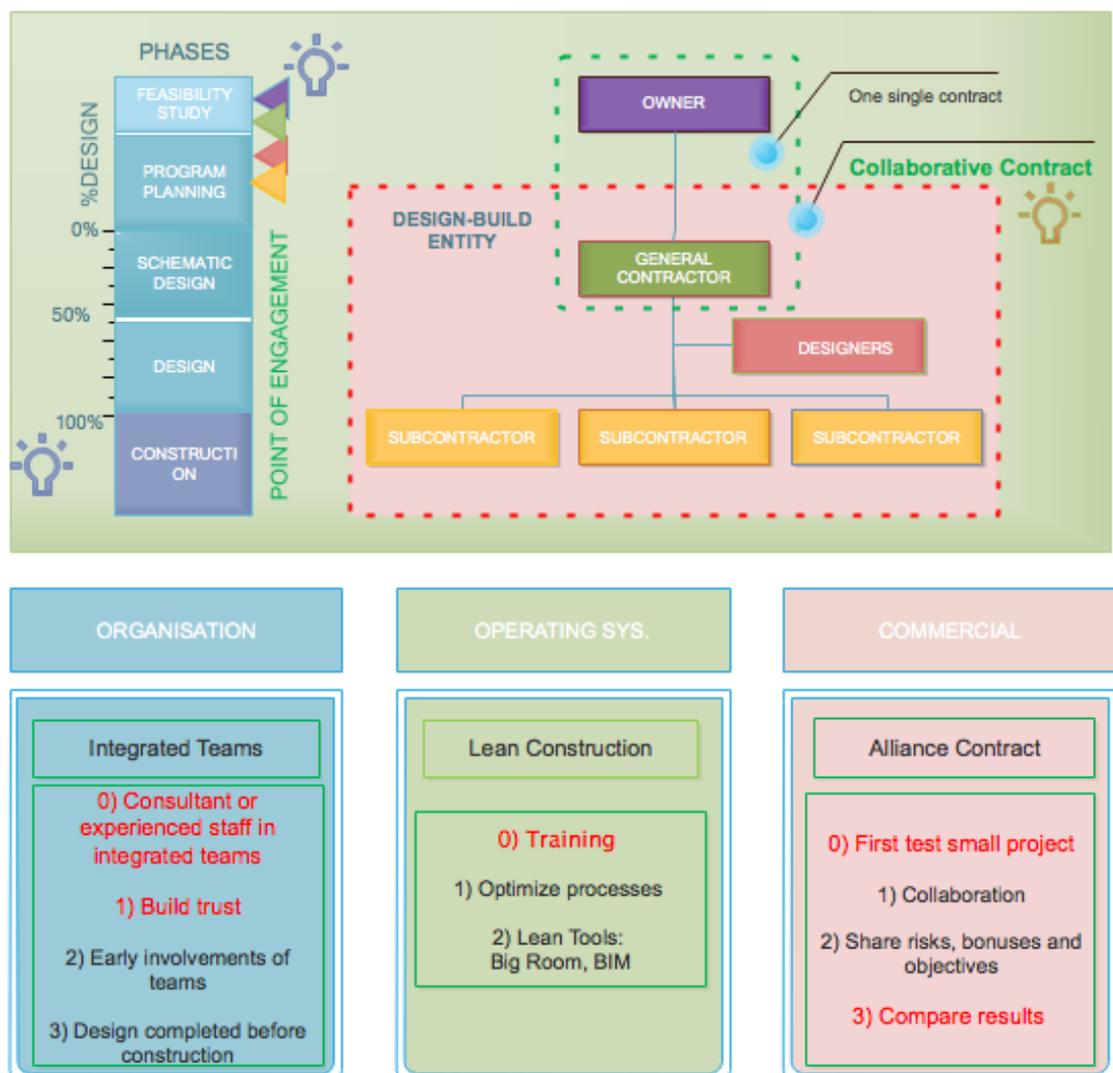


Figure 16. Final Proposal for an enhanced integrated design-build project delivery.

As seen from Figure 16, the implementation of Lean construction principles and tools would also require preliminary training of team members by experts on teaching Lean practices in construction. The alliance contract would need legal expertise in terms of setting the right contract for all parties, as well as starting with a first small alliancing project and review of results upon completion. It seems important to do a trial of this type of contract in a small project where the effort to less and the learning is the same as in a bigger project. Less risk exists in case the first tests are not successful. In case of probable positive results, as seen from the projects studied for this thesis, this could encourage contractors to continue testing this method in future projects.

From this preliminary validation can be deduced the managerial implications for the next step required in order to implement the proposal. Those next steps are the natural recommendation when a change on established methods takes place into stagnated organizations. Accordingly further recommendations are given in the following section.

The following section 7 presents a summary of the thesis and suggests further steps for the practical implementation of the proposal. Finally, the section evaluates the outcome of the thesis, taking into consideration the original perspective of the initial objective of this thesis, and from the validity and reliability perspective.

7 Discussion and Conclusion

This section summarises the results of this study, following a discussion of practical and managerial recommendations. Finally, it evaluates the result of the thesis study against the objective set in the beginning.

7.1 Summary

This study focused on the improvement of the construction project delivery, particularly the design-build method. The objective of this thesis was to propose an enhanced integrated project delivery model, in order to achieve improvements and optimize results in the construction sector, which is an industry that innovates and evolves at a lower speed compared to other sectors. Therefore, a need for improvement was clearly observed, especially after reviewing results from a recent project in Finnish construction, where a different, if not innovative approach, to the traditional project delivery model was employed showing relatively positive outcomes in terms of cost, time and quality.

The research method is a multiple case analysis undertaken with the collaboration of three experts from three different companies of the construction sector. The opinion of these experts with many years of experience delivering construction projects utilizing traditional and newer methods was collected during interviews. These interviews, in addition to company reports, one workshop and observations formed the data collection for this thesis that was used to carry out the current state analysis and build an initial proposal.

The current state analysis showed the strengths and weaknesses of the traditional design-build delivery model, of which the most remarkable were the fragmentation of the process and the need for integration of the different stakeholder tasks. This led to the development of the conceptual framework based on existing knowledge and focused on construction innovation, Lean construction, integrated project delivery methods and alliance contracts. By combining these two stages of the thesis and the findings from the second round of interviews focused on a newer project delivery models employed in Finnish construction, the initial proposal for an enhanced integrated delivery model is presented.

The initial proposal encompasses a series of adjustments related to the three components of a project delivery model, in particular to the design-build project delivery, used

as reference throughout this thesis. The three components of a project delivery identified and their correspondent adjustments are: 1) integrated teams for the organizational component; 2) alliance contracts for the commercial component; and 3) Lean construction for the operating system component. These adjustments can be extrapolated to other delivery models, as they are not specific for only the design-build model. As a summary of the initial proposed, it aims for an enhanced integrated delivery model, as one of the key findings from the current state analysis were the defragmentation of the construction process, a factor driving failure and reducing productivity of projects. The proposal seeks to enhance cooperation between project stakeholders, minimise waste elements such as time and optimize the use of resources, which is in line with the Lean construction approach. This can be implemented in close combination with integration of teams and the alliancing contract type, which has been newly employed in construction projects in Finland and is gaining popularity due to their positive results. The implementation of the proposal into organizations' approach to projects seems to be hard and costly, as it usually is the case when changes take place, especially if the implementation has to start from a zero stage. On the other hand, these proposed changes seem to be beneficial for the long term strategy of improving a company's project model. The initial proposal was then evaluated and the final proposal of the construction project delivery model was presented.

The ideal validation of the initial proposal would have been to test it in a new project, but for many reasons such as time limitations, this type of validation was not possible for this thesis. The alternative validation adopted was to compare the proposal against an existing project carried out using a traditional design-build project delivery, where the author collaborated. The validation process analysed what the outcome of utilizing the proposed design-build model would have been. The project selected for the validation of the proposal is a well known project by the author with clear issues that could have been addressed, or minimized at least by employing the proposed model, representing a good model to theoretically contrast the initial proposal. After the validation process, certain small improvements to the final proposal were suggested, most of them related to the implementation phase and follow up of the results. In the light of these results, it can be determined that the proposed model produce improvements into the project delivery respect the results offered by the use of traditional methods.

This study is intended to be used for the improvement of the traditional design-build delivery model of construction projects by enhancing the integration of team work during design and construction phase. Regardless of the cost of the initial adoption of the

proposed model for a company who use traditional delivery models, the results are promising and encouraging to the adoption of this model in order to achieve a substantial improvement of the cost, quality and delivery time of a project. This positive results could be one of the main reasons to motivate organisations to a future shift to the proposed model.

7.2 Practical Recommendations

In order to understand the needs and requirements of organisations and clients perspective, managers should evaluate whether or not their companies are using the best methods to meet their customers' needs and their own company interests. When the answer is that more can be done and further improvement can be achieved, a look into the proposed method of this thesis makes sense. What has been proposed is a change into the fundamental components of a project delivery, which in summary involve people, or teams, work philosophy and legal contracts.

These changes require a first project where to implement them and be able of learn the new methods minimizing the possible risk of failure during a first test. How managers can decide to go ahead with the change, motivate personnel and make the change effective, is a future next step towards the implementation of the proposal. This will require a shift in the company methods used to deliver projects that would require training for the staff and leaders to guide this process. Hence consultation with professionals on the topic or incorporation of new staff with knowledge on the proposed topics would be of benefit, if not of paramount importance. Table 5 below presents future steps that should be taken in order to effectively implement the proposed delivery method.

Table 5. Next steps for the implementation of the proposed project delivery model.

STEP	WHAT	RESPONSIBLE
BEFORE PROJECT IMPLEMENTATION		
1	Understand the need for a change of project delivery methods. Are improvements needed and possible?	Company Director
2	Provide training and expert advice for the adoption of the new methods	Manager
DURING PROJECT IMPLEMENTATION		
3	Periodical follow up of staff performance on the new methods	Manager
AFTER PROJECT IMPLEMENTATION		
4	Review of outcome and results after using the new method. Upon result decide further direction .	Company Director, Manager

As shown from Table 5, four are the steps proposed for the implementation of the proposal, divided into three stages during a project: before, during and after the project take place. Before starting to use the proposed method, a systematic plan is needed to evaluate whether or not there is a need to improve current practices in the company and therefore, adoption of the proposed method. Then will follow the implementation of the proposed method, which encompasses expert advise and training for staff on the use of Lean tools and cooperation between teams as well as legal advise on the structure of an alliance contract. During the project implementation a contact review and follow up of the new methods employed is critical as it is an unknown path for most of the team members. At the final stage, upon completion of the project under the new proposed methodology, a review of the results can show if the results are better than with traditional methods and what has been learnt for future projects.

7.3 Thesis Evaluation

The thesis proposed an enhanced integrated project delivery model, without giving any performance indicators or figures, but just aiming to improve project delivery time, company profit and project quality, factors that lead to client satisfaction, which also impact positively on the company. Three components of the project delivery need to be addressed and follow the proposal, which are the organisational, commercial and op-

erating system components. The three of them need to be implemented for an effective result of the proposal and aimed objectives, as they affect each other.

The ideal validation of the initial proposal would have been to test it in a new project, but for obvious reasons, such as time limitations, this type of validation was not possible for this thesis. The alternative validation adopted was by comparison against an existing project carried out using a traditional design-build project delivery, where the author collaborated. However, until the proposed model is not implemented in a real project, little can be said about the effectiveness of the proposal, even though the theoretical approach and experts' opinion from real life projects offer promising results.

Regarding the outcome of the thesis and what could be improved, the main ideas are collected and presented in the following Table 6.

Table 6. Summary of the evaluation of the Thesis.

No.	WHAT
ACCORDING TO PLAN	
1	SOLUTION MATCHS INITIAL OBJECTIVE
2	PROPOSAL GROUNDED ON PROVEN METHODS FROM REAL LIFE
3	PROPOSAL OFFERS PROMISING RESULTS
COULD BE IMPROVED	
1	NOT A CASE COMPANY
	→COMPANY BACKING UP
2	LACK OF INTERCATION/FEEDBACK FROM EXPERTS TO VALIDATE PROPOSAL
	→ COMPANY BACKING UP - OR - EXTENSION OF TIME
3	TIME LIMITATION FOR REAL PROJECT VALIDATION
	→ EXTENSION OF TIME - AND - PROEJCT AVAILABLE FOR TESTING

As shown in Table 6, the outcome of the thesis is satisfactory as the solution seems to match the original objective and the results are grounded on real project experience. The expertise of the interviewees makes it possible to incorporate results from projects tested in real life. Finally, the proposal offers promising results, however, as previously mentioned, it need to be tested in a real project, then evaluate the benefits that the proposed method can offer over traditional methods.

As usually happens once a project, or in this case a thesis, is completed, there is time to reflect and look back at what could have been done in a better way. What seems a major influencing factor is that the thesis did not have a sponsor or company backing up the process. As a consequence, finding guidance or feedback for the proposal was difficult, taking also into consideration the time constraint.

7.4 Relevance, Validity and Reliability of this Study

The objective of this study was to develop a proposal for an enhanced integrated project delivery model, based on the design-build method. It was aimed to be developed not for any particular company but as a contribution for the improvement of construction projects, where according to numerous research and expert opinions, where there is considerable space for improvements. Now at the final stage, perhaps certain changes on the perspective of this study could have been done, but this would have never been known until reaching this final stage. In terms of whether or not the results promised are real, this can only be proved by trying the proposal in a real project, which is the personal goal of the author of this thesis. It is worth mentioning that certainly some companies have possibly used the described proposal, but only research about independent use of pieces of the proposal have been found by the author, never as a defined whole model.

However, qualitative researchers need to test and demonstrate that their studies are credible, and the researcher is the instrument on what the research intends to accredit the research. (Patton 2002). Thus the credibility depends on the ability and effort of the researchers. Therefore, the research design is a critical element of such a study that chooses to integrate the different elements of existing methods in a logical and coherent way. Thereby, reliability and validity of all research are key elements that must be ensured to produce a good thesis as well as credible and trustworthy findings.

The nature of qualitative research does not allow for empirical validity, so the system adopted to probe validity of the research is by seeking the same ends through different methods. Validity refers to establishing appropriate research setting for the concepts being studied (Yin 2014).

Reliability assesses the stability, consistency and repeatability of the research process and it is related to the ability of the researcher to collect and record information accurately and be able to provide the same results over repeated tests (Dooley 1995),

Many tactics are available to test how reliability and validity requirements of a research are met. This study follows the tactics described by Yin (2014), which are described in the Table 7 below, indicating which of those tactics are used during and the phase of the study where they were employed.

Table 7. Tactics to test validity and reliability in case study (Based on Yin 2014).

Test	Case Study Tactic	Phase of research in which tactic occurs
Construct Validity	Use multiple sources of evidence	Data collection
	Establish chain of evidence	Data collection
	Have key informants review draft case study report	Data analysis
Internal Validity	Do pattern matching	Data analysis
	Do explanation building	Data analysis
	Discuss the research approaches and results with the supervisor	Research design and Data analysis
	Use logic models	Data analysis
External Validity	Clearly defined scope and boundaries of the research (case study, selected interviewees, data collection methods)	Research design
	Use replication logic in multiple case studies	Research design
Reliability	Follow the same interview settings for every interview	Research design and Data collection
	Standardized data collection methods (survey and semi structured interviews)	Data collection
	Recorded, transcribed and stored data	Data collection

To explain the key elements appearing in Table 7, *Construct validity* refers to identifying correct research settings for the concepts being studied (Yin 2014). This is ensured in this studies by utilizing multiple and representative sources from different roles in construction roles for the triangulation data, studying the same issue from different per-

spectives that complement and verify each other. The sources selected for the data collection were trusted and experienced on the construction field. The proposal is also presented to the participants for their opinion. Furthermore, various data collection techniques, interviews and workshop were employed, establishing a chain of evidence.

Internal validity refers to the extent to which research findings are a true reflection of the reality (Denzin 1970). The credibility of the research is evaluated by the study participants. In this study, the internal validity is ensured by analysing cases of real life and interviewing people that maintain a close relation with these cases, analysing general concerns that any actors of the construction industry experiences in the daily life. Furthermore, the research follows a logic model and its approaches were discussed with the supervisor of the study.

External validity addresses the extent to which such reflections of reality are legitimately applicable across groups (Denzin 1970). That is generalization of the results, often challenging in qualitative research, therefore there is no intention to generalize the study, but rather to discuss and explore the context of the selected case study. As this research is a multiple case study, each case is carefully selected so that it produces similar results (replication). In this study, the boundaries are defined, which include the case study, number of interviewees and data collection methods, making also this study transferable to a similar context but limited to the construction sector. The development of a rich conceptual framework is also important during this step, as it will be the vehicle for generalizing to new cases.

Reliability addresses the repetitiveness of the research operations, such as data collection procedures. In addition, reliability is the degree to which the results of the research correspond with the real world (Yin 2014). This is ensured in this study by using multiple sources of data and standardizing the data collection methods employed, conducting semi structured and recorded interviews in the case study. Methods included interviews, a workshop, analysis of company reports and articles and literature review. Literature review from existing knowledge further improves the reliability too. Moreover, detailed field notes are taken during the workshop and meetings, to document additional comments to the main topics. The interview template has well defined questions and to increase transparency, the questionnaire is available in the Appendix of this study. The same questionnaire and interview set up has been used throughout the interviews, decreasing the possibility of researcher bias. Therefore the operations of the study, as the data collection, can be repeated with very likely the same result.

Although research validity and reliability can be considered to be high in this study, there is room for improvement, as this is the first research of this type for the author. Perhaps by adding more observations and interviews participants who could have offered more points of view as a method of the data collection, as well as being more experienced at conducting interviews, could have increased the validity and reliability of the research.

7.5 Closing Words

This thesis was motivated by the lack of innovation observed in construction projects. Upon researching for ideas, it was noticed that there is a considerable amount of studies proposing improvements to the stagnated construction methods. Most of the improvements pointed to new technologies and collaborative teams. The adoption of the technological innovation seems more natural, but the shift toward collaborative work and integration of processes seems so obvious that it is overlooked. That is the reason for selecting the topic for this study. Continuous improvement is a need for companies to maintain competitiveness and maximize productivity, this can be done by adopting innovative approaches such as Lean construction in particular for this field, which offers proven results.

The study of the weaknesses of a traditional method does not necessarily discard the complete method, as it is obvious that it also has advantages that have been valid and tested over time. Continuous improvement only requires the substitution of the inefficient parts of those methods, and this is what this thesis intended to do. What is proposed is mainly a shift into a new mentality of more collaboration, less individualism. Then more can be learnt and built with less. Changes are not easy, especially if they do not occur often. There should not be reticence of changing established models, there is always time to go back and the best thing that could happen is just changes for better.

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Appendix

Appendix 1. Interview questionnaire

Research Interview (“Innovation in Construction Project Delivery”) - Antonio Galvez

Table 1

Informant Details:		Intro:	
Name (code)		Presentation - myself & research thesis	x
Company and Position		Recording	x
Date and Document		Confidentiality	x
Duration and Place			

Field notes (Interview 1)

	Topic(s) of the interview	QUESTIONS	FIELD NOTES
1 3"	Intro... Starting point: Interviewee 's experience	<p><i>What is your background in construction projects?</i></p> <p><i>---Positions...</i></p> <p><i>---Years of experience as project team...</i></p> <p><i>How have you been involved in relevant Projects?</i></p> <p><i>---Role, responsibility</i></p>	
2 7"	Rationale. Purpose	<p><i>Type of projects ?</i></p> <p><i>What is the reason to carry out projects from a different approach?</i></p> <p><i>How was your Company involved.... size, experience?</i></p> <p><i>What was the work model adopted/ partnering?</i></p> <p><i>What are the advantages of the selected model?</i></p> <p><i>How was the risk managed in tis project?</i></p> <p><i>How did employees react to this work model?</i></p>	

<p>3 5"</p>	<p>Outcome Identify strengths/pro blems</p> <p>Strengths</p> <p>Concerns</p>	<p><i>How would you evaluate the outcome/success of the Project/s?</i></p> <p><i>What metrics are helpful indicators of success of a project?</i></p> <p><i>What are the key factors behind the success?</i></p> <p><i>What is your company strength in the process of working in this project/st?</i></p> <p>What are your key concerns about the approach to this project?</p> <p>Any legislative, regulation... issues preventing different work approaches?</p>	
<p>4 10"</p>	<p>Analysis</p>	<p><i>What was new/ different in these project/s?</i></p> <p><i>How is innovation originated in this project/s?</i></p> <p><i>What were the innovations in the Project/s?</i></p> <p><i>Based on...</i></p> <p><i>Are these ideas recombined from other projects or this is unique?</i></p> <p><i>What was the impact of LEAN practices (if they were adopted)?</i></p> <p><i>In which areas do you think there is space for further improvement?</i></p>	
<p>5 2"</p>	<p>Best practice</p>	<p><i>Does your company have a guideline for this type of project?</i></p> <p><i>Any key points to consider for future projects?</i></p>	

6 2"	Development needs	<i>How could the company avoid problems in future similar projects?</i> <i>What is the lesson learned from this project that could be taken for future use?</i> <i>Future directions to look at...</i>	
7 1"	To add	Would you like to add anything that we haven't discussed?	

Table 2

NOTES:

Thank you! Future contact for clarification or validation?