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COLLABORATIVE PROJECT DELIVERY WITH EARLY CONTRACTOR INVOLVEMENT AND TARGET COST

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ABSTRACT

Lean and collaborative project delivery aim to increase productivity and create value in construction projects. Early contractor involvement and target costing are key elements in collaborative delivery. This study explores how early contractor involvement and target cost has been implemented, and the effects of these elements, in the collaborative delivery of a building in Norway. After two months of daily observations and a literature study, further data was collected from the main stakeholders through a document study and sixteen semi-structured interviews. Establishing a reasonable scope, allowable cost and procurement strategy in the front-end was identified as important. Early contractor involvement was determined to have improved constructability, commitment, cost estimation, and team building during the design phase. A balanced, equitable and clear risk distribution in the target cost, and continuous involvement of the client and senior management, was identified as important for collaboration in the execution phase. External factors beyond the control of the project group were found to have been impactful throughout the project. The study calls for more research on the impact of external factors, and the involvement of architects, consultants and subcontractors, in Lean and collaborative project delivery.

KEYWORDS

Target cost, Open book, Collaboration, Commitment, Early contractor involvement

INTRODUCTION

The Architecture, Engineering and Construction (AEC) Industry has room for improvement when it comes to optimizing value in projects. The Lean Project Delivery System (LPD) is a Project Delivery Method (PDM) developed for this purpose. Key characteristics of LPD include early involvement, relational contracting, and shared risk (Alarcón et al. 2013; Ballard 2008). Ways of doing relational contracting include partnering, alliancing and Integrated Project Delivery (IPD), and these may in turn be referred to as Collaborative Project Delivery Methods (CDMs) (Engebø et al. 2020;

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Lahdenperä 2012). Interest in Lean and collaborative delivery is growing in Norway (Lohne et al. 2021).

Early Contractor Involvement (ECI) and target costing have been identified by practitioners in the Norwegian AEC Industry as the highest priority elements in collaborative delivery (Hosseini et al. 2016). Previous research has called for more case studies on the implementation and effects of Lean and collaborative elements (Engebø et al. 2020; Tillmann et al. 2017). The purpose of this study is to examine how to optimize early contractor involvement and target cost in collaborative project delivery. By way of a literature review and a case study on a collaborative construction project, this paper seeks to fulfill this purpose through answering the following research questions:

1. How has early contractor involvement and target cost been implemented in collaborative project delivery?
2. What are the effects of early contractor involvement and target cost in collaborative projected delivery?

In this study, a CDM is characterized by its emphasis on improving stakeholder collaboration through increasing stakeholder integration, with cost and stakeholder collaboration being the CDM effects to be measured. The research questions are studied from the perspective of the key players from the client, the architect, the consultants and the design and build contractor. The project was not finished when the data was collected, but the key players had an understanding of how the final results in terms of cost and created value would become.

THEORETICAL BACKGROUND

LEAN PROJECT DELIVERY SYSTEM

According to Alarcón et al. (2013), the Lean Project Delivery System (LPD) can be distinguished from traditional PDMs by a collaborative organization, a flow centred operating system, and relational commercial terms. Key characteristics of LPD include early involvement, integrated teams, value-based procurement, relational contracts, and shared risks and obligations.

Main LPD methods include the Last Planner System (LPS), Target Value Delivery (TVD), and set-based design. An essential aim of LPD is to improve collaboration between project participants through increased integration, and thereby optimize value creation (Ballard 2008).

COLLABORATIVE PROJECT DELIVERY

The term Collaborative Project Delivery Method (CDM) embraces a number of relationship-based PDMs, including partnering, alliancing and Integrated Project Delivery (IPD), with the latter having its roots in Lean Construction (Engebø et al. 2020). Key characteristics of CDMs include early involvement, transparency, shared risks and joint decision-making (Lahdenperä 2012).

Among academics and practitioners alike, a wide array of terms and definitions are used for CDMs (Engebø et al. 2020). Tillmann et al. (2012) found that IPD contributes to collaboration and value generation, while also being demanding to management. Hosseini et al. (2018) identifies the lack of a universal definition of partnering as an obstacle to optimizing its implementation.

To gain a clearer understanding of CDMs, several studies on CDM elements and their effects have been carried out. Hosseini et al. (2016), identified early contractor

involvement and target cost as the two highest priority partnering elements. Studies on Lean have examined how collaborative elements such as Virtual Design and Construction (VDC), Integrated Concurrent Engineering (ICE) and Building Information Modelling (BIM) can be integrated with LPD (Fosse et al. 2017).

Competence, trust, top management support and continuity of personnel has been identified as key success factors in Norwegian construction partnering (Engebø et al. 2019; Falch et al. 2020; Haugseth et al. 2014; Simonsen et al. 2019).

EARLY CONTRACTOR INVOLVEMENT

Approaches to Early Contractor Involvement (ECI) and their relation to Lean have been studied by Wondimu et al. (2016b). Sødal et al. (2014) identified improved constructability, cost estimation and risk management as key advantages with ECI. They identified potential disagreements between contractors and consultants during the design phase as a major disadvantage. Involving the contractor at the right time with strong contractual incentives for collaboration and trust were identified as key success factors.

Wondimu et al. (2016a) identified sufficiently early involvement as the main success factor with ECI, while noting that too early involvement may give the contractor too much influence at the expense of the client. Manageable risk transfer was also determined to be important, as it makes projects more attractive for contractors and facilitates cooperation. Reducing uncertainty before involving the contractor, and having a balanced compensation format, were suggested methods to achieve manageable risk transfer.

TARGET COSTING

In Lean Construction, the application of target costing is referred to as Target Value Delivery (TVD). In the TVD process described by Pennanen and Ballard (2008), an allowable cost is set by the client in the front-end of the project, and the project is subsequently steered towards it. Once the estimated cost is lower than the allowable cost, a target cost lower than the expected cost is set. The target cost serves as a constraint towards which the design and construction can be steered.

Lahdenperä (2016) established a two-stage target cost contractual framework (2STC) with the intention of improving collaboration and avoiding cost overruns. He argued that a 2STC should be adaptable to change, and incentivize the service providers to be cost effective.

Numerous case studies have found that TVD results in lower project costs without compromising either schedule or quality (Do et al. 2014; Zimina et al. 2012) However, Ballard et al. (2015) found that about 15% of TVD projects fail to reach cost targets. The study identified shared commitments as crucial for TVD success, and suggested early involvement and the contractual right to remove people as ways to achieve this. Tillmann et al. (2017) identified early involvement and shared risk and reward between key parties as crucial factors for successful implementation of TVD and IPD. The maturity of TVD implementation in Norwegian public building projects has been studied by Smoge et al. (2020).

Torp (2019) noted the importance of realistic cost estimates in the front-end of TVD projects. Engebø et al. (2021) studied collaborative challenges in a TVD project caused by estimated costs that significantly exceeded allowable cost during the design phase. The study recommended clients to set a realistic allowable cost in the front-end of TVD projects, and prevent drastic increases in scope and expected costs during subsequent design.

RESEACH GAPS

In a scoping review of CDMs, Engebø et al. (2020) found that there is a research gap on how CDM elements impact project performance. Noting the importance of early involvement and shared risk management, Tillmann et al. (2017) calls for further case studies on the internal and external factors influencing TVD and IPD, and the adaption of these methods to non-IPD environments.

RESEARCH METHODS

RESEARCH DESIGN

A qualitative research design was chosen due to the qualitative nature of the research questions and available data (Fellows and Liu 2015). In order to enhance the reliability of the study, data was collected through a triangulation of research techniques (Yin 2017).

LITERATURE STUDY

A literature study was conducted for the purpose of establishing a theoretical framework and identifying research gaps (Fellows and Liu 2015). A preliminary literature search for papers about CDMs, and CDM elements such as ECI and TVD, was done at IGLC.net. Through a snowballing approach, additional papers of relevance were identified. Subsequent searches for papers were conducted in five databases (Scopus, Web of Science, Oria, Dimensions and Google Scholar).

DATA GATHERING

Description of case

The project to be examined in this case study is the construction of a large and complex building in Norway. It is being delivered through a CDM in which the client and the design and build contractor are the key parties. The project is regulated by the Norwegian Law of Public Procurement and a Norwegian quality assurance (QA) scheme. These regulations impose constraints on the procurement strategy, delivery model, choice of concept and allowable cost in large public projects (Lædre et al. 2006; Welde et al. 2015).

The main author held a summer internship as an assistant project manager for the client in 2021, which provided an opportunity collect empirical data. This, combined with the scope, complexity and relevance of the project, made it a suitable choice for a case study. For the purpose of enabling detailed descriptions of stakeholder perspectives on collaboration, the project and its participants have been anonymized.

Document study

A significant part of the empirical data stems from a document study (Yin 2017). Access to the web hotels of both the client and the partnering group was given through the internship. With permission from management, several documents of importance were studied, including the procurement strategy, the contractual documents, and the minutes from bi-weekly partnering meetings.

Interviews

The main source of data for the study stems from semi-structured interviews with the key participants in the project (Fellows and Liu 2015). An interview guide was developed to guide the interviews. It was structured after the research questions and included questions about various Lean and collaborative elements found in the literature and case documents.

The interviewees were selectively sampled, with interview requests being limited to invitees to the partnering meetings who were either regular attendees at these meetings or members of the steering group. Sixteen individuals were interviewed, including members of the client and contractor organizations, and architects and consultants.

A substantial majority of the interviewed individuals belonged to the client or contractor organizations, as those organizations had greater involvement in the steering group and partnering meetings. Subcontractors had no involvement in neither and were thus not interviewed. A limited amount of perspectives from architects, consultants and subcontractors thus constitute a limitation for this study.

Observations

During the internship the main author was involved in the daily work at the construction site with the contractors, and participated in various meetings with management, including partnering meetings, steering group meetings, and a partnering workshop. Thirty pages of notes with observations and reflections was produced. These observations served as an additional source of triangulation when evaluating data.

DATA ANALYSIS

The empirical data gathered from the case study was coded in a framework adapted to the research questions. The empirical data served as a basis for creating an illustration and timeline for the project. The model was drawn by the main author on the basis of qualitative and quantitative data. It shows key events internally and externally connected to the examined CDM, and illustrates the effects of these events on the development of cost and culture. Culture is here understood as the quality of collaboration between stakeholders. It should be noted that the recorded effects may be connected to events not mentioned in the model, and that the events may have had other notable effects.

The model incorporates findings from the front-end of the project but focuses on events and effects since contractor involvement. The sample size from the front-end was insufficient for modelling the project culture during this phase. Limited data from the front-end thus constitutes a limitation of this study.

During the rounds of interviews, the model was tested on the interviewees and modified in accordance with their feedback. The model was used as a framework to discuss the findings and look for causality.

FINDINGS

PROCUREMENT

The procurement strategy for the project was established in the fall of 2017 at the end of the pre-project phase, during which it had grown considerably in scope, detail and expected cost. This growth had been supervised by the client and their consultants and architects, in cooperation with public authorities.

The bidding competition was announced the next spring. It followed the specific partnering contract of the client, which in turn is largely based on the Norwegian Standard Design-Build contract (NS 8407). Procurement was to be value-based, with 70% emphasis on quality and 30% emphasis on price. Partnering experience was considered a key element in quality. Contractor involvement was to happen in two stages. The first stage being the signing of a partnering contract for the detailed design of the building. Project cost was to be estimated successively with four budget prices, culminating with the signing of a target cost contract with shared bonus/malus and the subsequent transition

to execution phase. During this transition the contractor would assume control of the consulting engineers and risk for all designed material.

The bidding competition attracted one bidder, who highlighted conceptual solutions for this type of building which they had developed with years of experience with partnering. The offer included suggestions to implement a series of Lean and collaborative elements, including LPS, ICE and BIM. The contract for stage 1 was signed in June 2018. It consisted of a series of contractual documents, including an agreement containing the quantity and unit price for the contractor and subcontractor personnel. Their work was to be done on open book.

EFFECTS

Phase 1

Phase 1 began with a start-up workshop in August 2018, in which a partnering declaration was signed by key stakeholders. A steering group consisting of the project managers and senior management from the main stakeholders was established.

Soon after the beginning of collaborative design, the contractor suggested to modify the design in accordance with their concept, which they believed would enhance constructability. The architects and consultants were sceptical of these modifications, and collaboration in the design team became challenging. Meanwhile, the external quality assurers reported higher costs and uncertainty than what the consultants had estimated in the pre-project. Soon afterwards, the main contractor presented budget price (1), which estimated even higher costs and uncertainty for the project. With the aim of reducing uncertainty, increasing value, and improving collaboration, the client and the steering group became increasingly involved. The design phase was extended, the team partially reorganized, and a design combining the solutions of the architects, consultants and contractors was chosen.

The interviewees from all stakeholders agree that these measures greatly improved collaboration and performance. They also noted that the measures probably would have been less needed if the contractor had been involved even earlier in the project, as this would have facilitated even better team building and constructability. According to the interviewees from the client, the fact that the front-end of the project consisted of a single phase made it difficult to find a suitable time for earlier contractor involvement. The interviewees from the contractor generally argued in favour of earlier involvement and greater influence on the procurement of consultants, while the interviewed architects and consultants instead emphasised the importance of early involvement on equal terms. They also noted the importance of formulating the procurement strategy early, so that the design can be aligned with it.

In the spring of 2019, design was progressing, and budget price (4) was estimated at an uncertainty workshop involving the key members of the project group. While uncertainty had been reduced and value increased, the estimated cost was significantly higher than the estimates which had previously been presented to the public. As a result, the authorities hesitated to initiate execution, and commissioned external quality assurers to verify the estimates. In the meantime, the client gave the design team the go-ahead to complete detailed design. The interviewees from the design team concur that shared commitments and support from the client was instrumental in securing strong collaboration during this process. They noted that the postponement of execution probably would have been shorter if the early cost estimates for the project had been more realistic.

As detailed design was being finalized, the client and the contractor opened target cost negotiations. During these negotiations, the client argued that the project was sufficiently specified to set the uncertainty at a low level, but the managers from the contractor could not agree to set uncertainty as low due to corporate rules. In order to secure a target cost acceptable for all stakeholders, several elements of the target cost were separated and made fully cost reimbursable.

Phase 2

In the spring of 2020, the cost estimates for the project were verified by the external quality assurers, but the setting of allowable cost by the authorities was delayed, largely due to the onset of the COVID-19 pandemic. To keep collaboration strong, the client independently provided funding for the contractor to initiate execution, and allowable cost was set by the authorities a few weeks later. During this transition the contracts with the consultants were transferred from the client to the contractors, while the architects kept their contract with the client. Several new individuals joined the project organization, while others left it, requiring increased emphasis on team building and continuity.

As the execution phase progressed, Norway repeatedly went into lockdown, making schedule planning more challenging. As the subcontractors began installing technical installations, discussions arose concerning design constructability. Since all stakeholders had been involved in the design during phase 1, the project group had a shared commitment to the design, which encouraged them to seek shared problem solving. However, the contractor believed that the design would have been more constructible if detailed design had been carried out in phase 2, during which the contractor had the contracts with the consultants. At this time the client organized a partnering workshop for the involved stakeholders, which according to the interviewees significantly improved collaboration and performance.

As the lockdowns continued, inflating prices for construction materials and services, and disadvantageous changes in currency values, resulted in higher-than-expected costs. While the contractor sought to handle many of the growing costs through the cost reimbursable elements of the target cost, the client argued that cost increases avoidable through design or execution should be handled through the contingency. The interviewees noted that these discussions would have been easier to resolve if the risk distribution in the target cost had been more balanced and clearer. Active involvement of senior management in the steering group helped ensure constructive collaboration at this time, and open book helped maintain trust. The contractor agreed to spend more of the contingency to alleviate costs increases, while the client successfully requested the authorities to increase the allowable cost. The importance of early involvement of stakeholders in ensuring optimal collaboration is summarized by an interviewee from the client organization:

> A key argument for early involvement in collaborative project delivery is the fact that it enables the stakeholders to get to know each other and the project, and to develop shared commitments. This ensures that when challenges occur, we avoid pointing fingers at one another, and instead focus on solving things together. These principles have been perfectly exemplified in this project.

In the spring of 2022, as the project was reaching delivery, the client and the main contractor signed a partnering contract for the construction of an additional building of the same type. The new building will according to interviewees be delivered through a similar model, but with earlier contractor involvement, greater contractor influence on

the procurement of architects and consultants, a more balanced risk distribution, and an earlier target cost agreement and transition to phase 2, which will encompass both detailed design and execution.

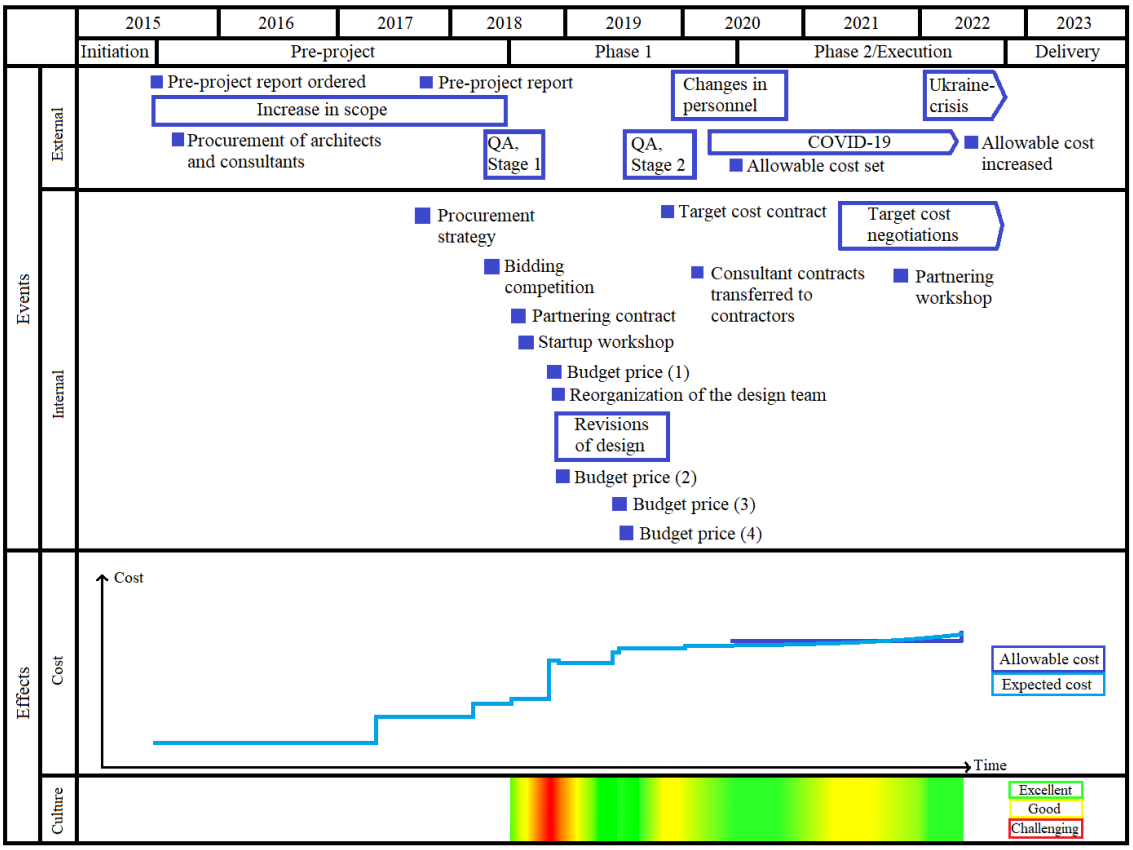

Figure 1: Timeline of events and effects in the examined case.

DISCUSSION

PROCUREMENT

Figure 1 shows that the project jumped straight from initiation to the pre-project phase, and that the pre-project phase continued for a long time until the procurement strategy was formulated. This in turn influenced the design and the timing for contractor involvement in the project, suggesting that the front-end is essential in optimizing collaborative delivery.

The finding of Sødal et al. (2014) that ECI may make architects and consultants feel marginalized is corroborated in this case. Nevertheless, it is noteworthy that the interviewed architects and consultants endorsed ECI in collaborative delivery as long as contractor influence remains limited. Rather than immediately giving the contractor direct control of the consultants, it may be a better idea for the client to involve both stakeholders at an early point on equal terms, and thereafter work on team building on a collaborative basis. By having a sufficient number of increments in the delivery model, decision makers can facilitate an incremental increase in contractor responsibility. The identification of sufficiently early involvement as a key success factor in ECI and LPD corresponds with the findings of Wondimu et al. (2016a) and Tillmann et al. (2017).

PHASE 1

The observation from phase 1 that ECI ensured greater design quality, cost estimation and collaboration correspond with the findings of Sødal et al. (2014). That there is a connection between collaboration, and increases in scope and expected costs during design, is in line with the findings of Engebø et al. (2021).

The effects in the later parts of phase 1 illustrate the importance of having a realistic cost estimate in the front-end, as noted by Torp (2019). However, while the target cost contract in the project observed by Engebø et al. (2021) was reduced through reducing project scope, the case studied here secured a contract through transferring risk from the contractor to the client. If the initial cost estimates had been more realistic, the client and the contractor would probably have been able to negotiate a target cost contract at an earlier point in time, and the client would have had more flexibility in negotiations, which may have resulted in a more balanced, equitable and clear risk distribution, and thereby better collaboration.

The characteristics of the studied delivery model are in line with the characteristics of LPDs described by Ballard (2008) and Alarcón et al. (2013), and the characteristics of CDMs as described by Lahdenperä (2012). However, the degrees of early involvement, team integration and risk sharing vary significantly among the key stakeholders in the examined project, and it thus differs somewhat from theory in that regard. In addition, the late setting of allowable cost and increases in expected costs differ significantly from the TVD methodology described by Pennanen and Ballard (2008). The identification of ECI and target costing as key partnering elements are in corroboration with the findings of Hosseini et al. (2016).

PHASE 2

Figure 1 suggests that collaboration in phase 2 became more challenging at a point when COVID-19 was impacting cost performance. At this time the pandemic was also impacting schedule, while new personnel entered the project and subcontractors began installing technical installations. There seems to be a combination of underlying reasons for the challenges, which may have arisen independently of each other, with external factors having a major effect. That partnering can be more challenging during execution is nevertheless also observed by Falch et al. (2020). However, it is noteworthy that the early part of the execution phase was characterized by optimal collaboration. This suggests that more attention should be given to optimizing collaboration in the later part of the execution phase. As ECI secures greater commitments and team building, it may be a key element in securing such optimization. Involving subcontractors in the target cost could perhaps have increased shared commitments even further.

As can be seen from Figure 1, target cost discussions among management in phase 2 were opened at a time expected cost was nearing allowable cost. This suggests that optimizing collaboration requires optimizing the setting of both expected cost and allowable cost. The right level of allowable cost was difficult to foresee in this project, given external world events that have happened during execution. Having a more balanced, equitable and clear risk distribution in the target cost would nevertheless have made the delivery model more resilient to the mentioned external factors. The observed importance of shared risks and reward for collaboration are in line with the findings of Tillmann et al. (2017). The risk distribution of the target cost contract was in turn decisively influenced by front-end decisions, which underscores the influence external factors have on the implementation and effects of LPDs and CDMs. In the studied project,

continuous involvement of senior management in the steering group ensured constructive collaboration despite the challenges. The steering group therefore appears to be a key element in optimizing the resilience of CDMs and target cost contracts to external factors.

The fact that the client and the contractor during the end of the execution phase signed a contract to construct a similar building with a similar delivery model is noteworthy. It is also significant that the delivery model for the new project has been modified in the sense that it aims to secure earlier involvement, more joint decision making and a more balanced sharing of risks. These modifications make the model more in line with Lean and collaborative delivery as described in theory.

CONCLUSIONS

THEORETICAL CONTRIBUTIONS

Through examining a complex construction project with many Lean and collaborative elements, this study provides empirical data that can further develop theory. The study substantiates benefits and pitfalls found in previous studies. Another significant find is the fact when the stakeholders in the studied case decided to collaborate on a new project with a similar delivery model, the modified delivery model for the new project further approached Lean and collaborative delivery as described in theory.

PRACTICAL IMPLICATIONS

To optimize collaborative project delivery, it is important to establish a realistic allowable cost and clear scope in the front-end of projects, and then align the design with these constraints. Such alignment requires active participation of the client and senior management, and benefits from early involvement of key stakeholders.

Procurement strategies should be considered early and adapted to the specific project, and the delivery model should be incremented in a way which enables early and incremental involvement. In value-based procurement, collaborative competence should be strongly emphasized, and stakeholders should be made to feel that they are included on equal terms.

When negotiating target cost contracts, the stakeholders should ensure that the risk distribution is balanced, equitable and clear. Management should avoid specifying a project in too much detail before negotiating a target cost, as this may result in disagreements over uncertainty and increased vulnerability to external factors. Continuity between phases ensures greater commitment and collaboration.

Collaborative project delivery with early contractor involvement and target cost helps ensure improved design, commitment, risk management, team building and cost estimation, and is therefore found to be useful for the delivery of complex projects such as the studied case.

FURTHER RESEARCH

The front-end and external factors appear to have a major influence on the implementation and effects of Lean and collaborative elements. The generalizability of this should be tested through further case studies. The connection between the elements and created value for various stakeholders should be examined further. Also, more attention should be given to the role of architects, consultants and subcontractors. More specifically, methods for involving these stakeholders in collaborative projects, and target cost contracts in particular, should be subjected to further study.

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