CHALMERS
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# Innovation through Early Contractor Involvement

## A comparable case study of Swedish infrastructure projects and their contractual disposition

Master's thesis in Design and Construction Project Management

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# Innovation through Early Contractor Involvement

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SUMMARY
The use of Early Contractor Involvement (ECI) has gained increased attention in the construction industry as a means to remove the separation of projects' design and construction, thus integrating the contractor's expertise and knowledge in early planning and design work. The benefits seen thereof are numerous, including an improved time- and cost certainty, improved risk management and improved buildability. Another benefit commonly acknowledged is a larger opportunity for and increased innovation, yet current studies of the ECI-concept and its links to innovation have given little attention to how the projects' contractual disposition affects innovation. Thus, this study has investigated this seen knowledge-gap through a qualitative comparable case study of two current ECI-projects within the Swedish infrastructure sector. Moreover, the study has also in a broader perspective investigated the perceived benefits and hindrances seen through ECI-implementation, as well as the challenges seen through the use of target cost principles and economic incentives. Focus has been placed on the projects' initial planning and design phase and empirical material was gathered from interviews with both projects' respective client and contractor organisations. The most notable benefit seen through ECI-implementation was the integration of the contractor's expertise in planning and design, thus allowing considerations of the contractor's input in both decision-making and design development. The hindrances to achieving all ECI-benefits were concluded to stem primarily from the lack of equal commitment and the lack of a compromising attitude among the projects' participating organisations, primarily grounded in accustomed client and contractor roles. These cultural aspects were also seen to create challenges in the projects' target cost processes, in which client and contractor interests pre target cost agreement were seen to stand in conflict with one another, hence creating large difficulties in reaching agreements which both parties perceived as fair. The difficulty in equating the client and contractor's economic interests in the planning and design phase was also seen as impeding an increased level of innovation in both projects, and when paired with a lack of economic incentives for innovation efforts, instead created unwanted incentives as to hide innovative solutions till post target cost agreement at which the contractor was also economically reimbursed for such efforts.

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Keywords: Early Contractor Involvement, infrastructure, target cost, incentives, innovation.

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# 1 Introduction

This chapter aims to outline the master's thesis contextual background and provide a review of the thesis' aim, research questions, and delimitations.

## 1.1 Background

In recent times, the use of collaborative project management models and collaborative contracting have gained increased traction within the world of construction as a mean to combat the industries fragmentation and the thereby seen adversarial nature of contractual relationships (Lahdenperä, 2012). Moreover, these models and contract types have also been implemented in order to remove the separation between project design and execution which is commonly seen in single-stage procurement (Eadie & Graham, 2014; Mosey, 2009; Rahmani, Khalfan & Maqsood, 2013). The benefits of such models have been shown to include better risk management, increased productivity, cost and time savings as well as better consideration of the contractor's expertise in project design (Kadefors & Eriksson, 2014; Lahdenperä, 2012; Mosey, 2009; Volker, Eriksson, Kadefors & Larsson, 2018).

One project delivery model which aims to join the aspects of increased collaboration with that of an increased integration between project design and execution is Early Contractor Involvement (ECI). ECI is a concept which sees that a contractor is procured at an earlier stage than in single-stage procurement as to facilitate their contribution of construction knowledge and experience in the development of the projects planning and design (Eadie & Graham, 2014; Laryea & Watermeyer, 2016; Song et al., 2009). Through the involvement of the contractor in the early design phase, one aims to integrate the design and execution phases of projects, thus striving away from the common approach seen in the construction industry where the contractor is appointed solely for the construction phase (Mosey, 2009). The projects are commonly divided into two phases; phase 1 which entails planning and design, and phase 2 which is constituted by the project's execution and hand-over (Mosey, 2009; Rahmani et al., 2013).

It has been shown that the integration of construction expertise, which the contractor has, provides the largest benefits at an early stage of a project's timeline and that one otherwise inhibits opportunities to solve questions of constructability and the development of innovative solutions in projects (Edwards, 2009; Lahdenperä, 2013). The ECI-concept can further be seen to ensure that a complete project organization is created at a time when the potential to influence the project's design is the largest and where changes to the design have the smallest impact on the project's overall costs (Kristensen et al., 2015; Rekonen & Björklund, 2016). Other benefits seen through the use of ECI include reduced preparation time for projects, greater cost certainty, larger possibility for value engineering, and better collaboration between client, consultant, and contractor (Laryea & Watermeyer, 2016; Mosey, 2009; Nichols, 2007; Scheepbouwer & Humpries, 2011).

One particular benefit which is well documented in current literature of ECI-projects is the project delivery models ability to facilitate and increase innovation in projects. Some authors attribute this to stem from a better and more collaborative relationship between project participants (Mosey, 2009; Nichols, 2007; Song et al., 2009; Volker et al., 2018) while others attribute it to the integration of contractor knowledge and expertise in early design phases (Eadie & Graham, 2014; Lenferink et al., 2012; Walker & Lloyd-Walker, 2012). Of particular importance here are also the findings by Lenferink et al. (2012) and Volker et al. (2018) who argue that in order to maximise the innovative outcome from the use of ECI, one must ensure that the contractor is involved at a time when there is still room left for innovations to take shape as such room is seen to become smaller the longer the planning and design processes continue.

Noteworthily however, there is limited research which has aimed to investigate how the level of innovation and the subsequent innovation outcome are affected by the contractual composition that the ECI project delivery model is created through. In other words, how are aspects like a project's reimbursement model and collaborative arrangement shaping innovation in ECI-projects. This existing gap in literature constitutes the point of departure of this study. Moreover, the study will focus on phase 1 of such projects, the planning and design phase, as the possibility to develop and implement innovations at this stage is seen as larger compared to the subsequent phases of a project.

## 1.2 Aim and research questions

The aim of this thesis is to investigate how the contractual disposition of ECI-projects in the Swedish infrastructure sector affect the perceived level of innovation in projects. Moreover, this thesis aims to assess what benefits and hindrances the implementation of an ECI project delivery model has, as well as to investigate the current use of reimbursement models in such projects. The thesis will through two case studies present the empirical material necessary in order to fulfil these aims. The hereby following research questions will be answered:

- What benefits and hindrances are seen behind the implementation of ECI-projects?

- What challenges does the use of target cost principles and economic incentives create in ECI-projects?

- How are ECI-projects and their current contractual disposition affecting innovation?

- How can economic incentives be used to promote innovation among contractors during the design phase of ECI-projects with target cost contract principles?

## 1.3 Delimitations

The thesis will be delimited as to solely address projects which has employed an ECI project delivery model within the Swedish infrastructure sector. Moreover, the study will focus on the planning and design phase of these projects, thus not considering the projects' execution phases. The empirical material will be

constituted by two case studies involving qualitative interviews with contractors and clients.

## 1.4 Composition

The paper proceeds as follows. First, it gives an overview of ECI as a concept, the dissimilarities seen in current definitions and current implementation ways and methods. Moreover, reimbursement models used in ECI will be presented alongside a brief overview of innovation in construction, after which an account of innovation in ECI is made. Then the used methodology and presentations of the two cases will be introduced, before the section of findings and analysis are accounted for. Finally, conclusions are drawn and presented.

# 2 Theory

This chapter aims to give the reader an explanation of concepts and theory that are used in this thesis. Theory regarding ECI, and its current use as a collaborative contract arrangement will be presented, together with success factors and hinders for ECI-implementation. Continuing, the currently used reimbursement models for ECI-projects will be accounted for before theory regarding innovation in construction, and ECI-projects impact on innovation, are presented. Lastly, the thesis' theoretical lens based on agency theory is introduced.

## 2.1 ECI definitions and implementation

The implementation of ECI as a project delivery method varies between different parts of the world, and so does the concept's meaning and interpretation (Rahmani et al., 2013), the aspect which unifies the understanding is however the contractor's involvement in the design phase. Song et al. (2009) simply define ECI as the involvement of a contractor in the design of a project, implemented through the use design-build (DB) contracts rather than design-bid-build (DBB) contracts. Thus, one has integrated the contractor's expertise in the design development which is seen to improve information flow and construction schedule performance. Lenferink et al. (2012) and Valkenberg et al. (2008) on the other hand do in their studies of road projects define ECI as the involvement of the contractor in the planning stage as for the contractor to offer their input in route determination of the road. Nichols (2007) define ECI as "a partnering approach in which the contractor is appointed at an early stage of project development to assist in planning, assessing buildability and cost estimating." (pg. 31).

Another definition commonly referenced in the current ECI-literature is the one presented by Walker and Lloyd-Walker (2012) in which they also present different models of ECI. They see ECI to be a comprehensively usable concept which can start in the business development phase of a project and which can last until the project completion and handover phase, but that is unified around the understanding that one aims to involve a contractor in a project's planning and design phase as to allow for their expertise and advice to be considered. Continuing, the authors view ECI as possible to implement solely in the business development phase or the design phase, or it can be implemented as a continuous process through the design and execution phases. A proposition is made that ECI can be implemented by a range of approaches that could include traditional DBB, DB, management contracting, project partnering and project alliancing. The deciding factor behind which approach to use in the ECI-implementation is also reasoned to be dependent of the level of commitment between parties that is desired as to balance questions of best-for-project and home-base performance primacy.

One of the most widely used implementations of ECI, thought to have originated out of the British standard contract PPC2000, is through a two-phase procedure where the contractor is procured in the preconstruction phase of the project and where an option exists for the contractor to continue with the project's construction (Mosey, 2009; Kadefors & Eriksson, 2014). In the first phase, the contractor is to jointly with the consultants and client define the project and assist

in design development up until a point where the project's cost estimate or budget is agreed and an agreement for the continuation of the project is reached (Mosey, 2009; Rahmani et al., 2013; Kadefors & Eriksson, 2014). If such an agreement is reached, the contractor will continue with the project execution and hand-over phase, but clients often include a go/no go decision gate in these contracts which enables them to exit the contract if the contractor is not deemed suitable for the continued work or if a sufficient level of collaboration has not been reached (Walker and Lloyd-Walker, 2012). This implementation method of ECI also commonly sees the development of a target cost for the project alongside the design development, this target cost is then used as the baseline price for the project which also allows for the use of economic incentives (Rahmani et al., 2013).

## 2.2 ECI benefits, success factors and hindrances

Benefits:

Through involving contractors in the early stages of the planning and design stage, one gains the benefit of integrating the contractor's knowledge of construction projects at a time when the impact on project success, including time, cost and quality, are the largest in the project timeline (Laryea & Watermeyer, 2016; Nichols, 2007; Song et al., 2009). Moreover, one integrates the actor who is ultimately responsible for the construction operations, hence one can improve the designs buildability and create early opportunities for value-engineering as well as provide earlier input on project risks as to manage them more successfully (Eadie & Graham, 2014; Rahman & Alhassan, 2012). Through creating an integrated team at an earlier stage than other projects, one also increases the opportunity of better inter-organisational relationships and increased collaborative exchanges (Rahman & Alhassan, 2012; Volker et al., 2018).

The benefits seen by the implementation of ECI in projects are extensive, the hereby following table, Table 1, has been compiled to show benefits which are reported in contemporary literature of the ECI-concept and its implementation.

*Table 1 Benefits of ECI-implementation*

| **Benefit** | **Author** |
|---|---|
| Contractor's input in design | Eadie & Graham (2014), Nichols (2007), Rahman & Alhassan (2012), Song et al. (2009), Volker et al. (2018) |
| Improved buildability | Eadie & Graham (2014), Song et al. (2009), Volker et al. (2018) |
| Improved risk management | Eadie & Graham (2014), Rahman & Alhassan (2012), Song et al. (2009), Walker & Lloyd-Walker (2012) |
| Improved project delivery | Eadie & Graham (2014), Rahman & Alhassan (2012) |
| Low tendering costs | Volker et al. (2018) |
| Improved relationship & collaboration | Nichols (2007), Rahman & Alhassan (2012), Volker et al. (2018) |
| Higher potential for and/or increased innovation | Eadie & Graham (2014), Lenferink et al. (2012), Nichols (2007), Song et al. (2009), Volker et al. (2018), Walker & Lloyd-Walker (2012) |
| Time savings | Laryea & Watermeyer (2016), Lenferink et al. (2012), Nichols (2007), Song et al. (2009) |
| Cost savings | Eadie & Graham (2014), Laryea & Watermeyer (2016), Song et al. (2009) |
| Improved cost and time certainty | Eadie & Graham (2014), Lenferink et al. (2012), Nichols (2007) |

Success factors:

As for the factors and conditions for a successful implementation of ECI as a concept, Wondimu et al. (2018) identify six different success factors in a multiple case study performed on 11 bridge construction projects procured by the Norwegian Public Roads Administration. These factors can be summarized as follows:

1. *Timing of ECI application*: one must ensure that the contractor is involved at a stage in planning and design where there is time to make a difference and influence the design outcome, yet one must simultaneously balance the time of involvement as to not increase costs unnecessarily and provide too big contractor impact.
2. *Risk distribution*: a fair distribution of risks between client and contractor is important, this may otherwise result in significant risk markups by the contractor and risks are also seen to commonly create conflicts between parties.
3. *Project owner's competence*: procurement and implementation of ECI is a demanding process for the client, it requires deep knowledge of procurement and contracts, but also a high technical knowledge and competence as to scope out and assess deliverables and end result.
4. *Appropriate compensation*: the contractor must get fair reimbursement for their contribution and work throughout the whole project, one might otherwise risk a lowered interest and eagerness to participate and contribute to design in the early stages.
5. *Qualification of the contractors*: when procuring contractors, the client must ensure that the other parties possess the necessary qualifications to complete the works and to offer design input.
6. *Trust*: the trust between contractor and client is seen of importance both as to ensure the contractor's confidentiality regarding corporate secrets and to maximise the output of the relationship through increased openness and increased contractor input thereof.

In another case study of ECI-projects, Laryea and Watermeyer (2016) present a series of success factors for ECI implementation. Like Wondimu et al. (2018), the two authors also see the experience and skill of the contractor as important, as well as the importance of a knowledgeable client. As contractor one must have the capacity and collaborative attitude as to contribute to the project's design through optimisation and value-adding, while one as client must be capable of specifying requirements and managing the project's outcomes which is of particular importance in the procurement stage. Moreover, Laryea and Watermeyer (2016) emphasise the importance of collaboration as to realise the benefits of ECI, thus one must create a contract which reflects this importance, and which encourages knowledge-sharing, transparency, and risk sharing.

Interestingly, and in contrast with the findings of Wondimu et al. (2018) and Laryea and Watermeyer (2016), Rahman and Alhassan (2012) do in a questionnaire study of a contractor's perception of ECI find a client's technical knowledge to be less important than other issues faced in ECI-projects (ranked 15$^{th}$ out of 20). In doing so, the authors however make the reflection that this can cause an overreliance on the project's consultants and contractor. Moreover, the authors find relationship, trust and commitment-related issues to be of utmost importance in ECI-implementation, ranking above issues concerning a lack of knowledge, thus more relational aspects can be seen to be key in the contractual implementation.

Hindrances:
Apart from the above presented success factors, multiple authors have found hindrances and obstacles which one must address when implementing ECI as to maximise the gain thereof. Mosey (2009) divides these hinders into three different categories in his extensive review of the Early Contractor Involvement concept: project-specific, procedural, and personal obstacles. The project-specific obstacles include the lack of feasibility for ECI in smaller and simpler projects with limited complexity as well as for project's where clients solely wish to be involved in stating performance requirements and thus maintaining an arms-length relationship with the contractor (which is common practice in DB-contracts). The procedural obstacles on the other hand reflect the difficulties clients may face in procurement with constitutional or regulatory constraints, e.g. as in the case of procurement selection for value or for lowest price, as well as concerns of increased transaction costs through the need to create additional agreements or contracts between parties. The third and final category, *personal obstacles*, concern hinders which depend on the project participants personal attitude towards the project delivery model. Apart from mentioning the industry's conservatism as such a hinder, Mosey (2009) also notes the need for functioning personal relationships and personal chemistry as an aspect which can pose to be a hinder if lacking.

Similarly, Rahman and Alhassan (2012) highlight drawbacks which are more relational and personal in nature. The authors emphasise the need for equal commitment and the importance of a compromising attitude from all project participants in the collaborative arrangement that ECI is, without such efforts a successful collaboration is not seen to be reachable, thus hampering the creation of a win-win situation for all project participants which is an important aim of the project delivery model. Continuing, the authors see a lack of continuous and honest communication between project participants, and the inter-relational trust that is created through it, to be a common hinder for successful ECI-implementation. Rahman and Alhassan (2012) emphasise that such a lack of communication and trust may lead to situations where one compromises a common benefit due to commercial pressure, in doing so creating adversarial behaviour and compromising the needed win-win attitude.

One of the major hindrances which Nichols (2007) recognized in his early study of ECI-projects in the UK, also connected to the previously discussed relational aspects, is the need for culture changes among the project participants. In doing so pointing to the need for inter-organisational collaboration and the cultural hinders which accustomed mindsets and roles pose to such collaboration among both contractors and clients. At the time, Nichols (2007) also recognised the novelty of the project delivery model to be a hinder to ECI-implementation in the UK. One should however note that the concept today is widely spread in the UK, yet similar findings are still being reported in studies in other countries, for example in Norway as presented by Wondimu et al. (2018). The authors uphold a lack of experience, a lack of awareness regarding the importance of ECI and a lack of familiarity with ECI-approaches to be hinders to full ECI-implementation in their studied projects.

## 2.3 Reimbursement of contractors in ECI-projects

The two-stage process where contractors are involved in project's both in the planning and design phase as well as the construction phase, allows for multiple reimbursement models to be used. Mosey (2009) sees this two-stage pricing process as accepting several different pricing models to be used in the project's construction stage, in doing so mentioning the use reimbursement based on lump sum, cost reimbursable or target cost with or without gain/pain-share incentives. Continuing, Mosey (2009) recognises the use of cost plus contracts as possible, yet emphasise that they will only be appropriate where the client has other means of motivating the main contractor to minimize its expenditure. Rahmani et al. (2013) mentions numerous implementation methods and their different use of reimbursement models. In the UK, client's often make use of jointly prepared target cost as the basis for a pain/gain share formula in ECI-contracts as to motivate the contractor to assist with the most economical delivery option (Nichols, 2007; Rahmani et al., 2013). In Australia, contractors are involved in developing design, planning, and preparing a cost estimate jointly with the project team, after which one submits a lump sum offer for phase 2 which is adjusted according to risks identified in phase 1. In New Zealand, the contractor and client negotiate a fixed price for each stage before work commences (Rahmani et al., 2013).

Target cost contracts:

The use of target costing in ECI-projects is as previously mentioned a widely spread practice, where contractors are commonly involved in the planning and design phase as to prepare a cost estimate for the project's construction and completion (Rahmani et al., 2013; 2014). The target cost is prepared jointly with the project's client and consultants, often as to facilitate the use of open-book accounting in the project's construction phase (Rahmani et al., 2014). Moreover, the premise of the contract generally lies in an agreed target price for the entire project and is thus agreed before construction commences. Mosey (2009) explains how this process allows for work packages completed in the project's design development to be accurately priced alongside the continuous development of the design. The project's detailed design is however commonly seen to be developed after target cost agreement, yet instances where target cost has been agreed after detailed design has proven to provide more accurate pricing (Nichols, 2007). During the planning and design phase, contractors are commonly seen to be reimbursed according to a cost reimbursable scheme using consulting fees (Laryea & Watermeyer, 2016; Mosey, 2009).

Through jointly preparing the project's target cost, one aims to facilitate knowledge-exchange between the project participants and ensure that all information is "on the table" in order to prepare an as accurate price as possible, hence the parties' inter-organisational transparency is key (Mosey, 2009). Moreover, through involving the contractor in the project's budgeting process, one can better facilitate cost risks created by the large uncertainties which exist in early stages of projects. Thus, one can counteract situations where contractors are forced to add substantial risk premiums to their tenders and situations where the contractor needs to claim extra in order to ensure their profitability (Mosey, 2009). Continuing, through involving all contractual parties in the cost estimation

process one can provide better cost certainty and greater cost control during the construction phase (Mosey, 2009; Nichols, 2007). Lenferink et al. (2012) and van Valkenburg (2008) also emphasise that the use of ECI and target costing enables cost estimates to be checked for feasibility at an earlier stage in the planning process. This is seen by the authors to be of particular importance in infrastructure projects where issues regarding the underestimation of costs and the overestimation of benefits are common. The process of jointly developing a target cost does however require greater input from the client than what can be seen in other projects with competitive tendering (Mosey, 2009). This is also recognised by Nichols (2007) who sees that clients can become over-reliant on contractors and consultants in cost estimation due to a low level of experience and expertise of the process, hence one as client has limited ability to review and challenge the other parties' assumptions and estimates.

The use of economic incentives connected to the target cost through sharing of cost over- and underruns is common in ECI-projects, and it allows for increased alignment of client and contractor interests in the project's construction phase (Bröchner, Eriksson, Kadefors, Karrbom Gustavsson & Lind, 2015; Lahdenperä, 2012; Mosey, 2009). Through this inclusion of incentives, one motivates the contractor to be innovative and construct the project on budget and is also seen to increase the contractor's involvement in value engineering as savings are shared between both client and contractor (Laryea & Watermeyer, 2016; Rahmani et al., 2013). Rose and Manley (2012) also highlight that incentive-based payment is suitable when contractors are procured early and involved in the design stage as it can enhance project actors' motivation for joint innovation work. Moreover, this sharing of cost savings is seen as a strength of the model and enables the contractor to increase their profits (Eadie & Graham, 2014; Nichols, 2007). One major weakness with the model highlighted by Bröchner et al. (2015) is the large importance of a fair target cost as the effects on the contractual parties' profits and cost risks are large due to potential sharing of overruns. Hence, the authors emphasise the importance of a thorough preparation of the target cost as to ensure that all potential uncertainties are overseen. Other authors also emphasise that solely using incentives as to create inter-organisational efforts to increase efficiency and effectivity does not assure project motivation and performance, but it is rather to be seen as a supporting tool in the development of trust, cooperation, and motivation (Rose & Manley, 2011). Hence, underlying distrust between contractual parties can result in a negative perception of the incentive intention.

Other ways to further align the client and contractor's interests using the same target cost process as explained above is through the use of a fixed contractor fee where the contractor's profits and central and administrative expenses is fixed as a lump sum rather than a percentage as in cost plus reimbursement (Eriksson & Hane, 2014; Mosey, 2009). This means that reduced project costs will not reduce the main contractor's pre-agreed return from the project. Bröchner et al. (2015) explain how this provides the contractor with an incentive for cost-saving efficiency and innovation as lowered costs provide the contractor with a larger relative profit, while ensuring an overall low project cost for the client. Continuing, the authors see that the focus on the target cost, and discussions thereof, can be diminished as the cost risks is lower for the contractor compared to incentive-

based models. Moreover, Eriksson and Hane (2014) find that the perceived motivational strength of solely an increased relative profit varies between contractors.

Target cost problems seen in ECI-projects

The specific use of target cost reimbursement in ECI-projects is discussed by Nichols (2007) who finds two distinct problem areas and drawbacks to the UK implementation of target costs with incentives. Firstly, the implemented incentive schemes are seen to not work as intended if the cost estimates which they are based on are not robust and well-prepared, hence emphasising the importance of a fair target cost as also done by Bröchner et al. (2015). Secondly, the alignment of the client and contractor's interests is achieved first after the target cost has been agreed, in turn meaning that there are inherent difficulties before reaching an agreeable target cost. Moreover, Nichols (2007) finds the contractor's willingness to ensure a target cost that minimises the risk of cost overruns to be in conflict with the client's optimistic view on costs and related risks as to get approval for the project. This conflict is further stressed by the contractor's will to maximize their potential profit. Similarly, Rosander, Kadefors & Eriksson (2020) find the client's initial budget, with which they gained permission to procure the project, to set the tone for the project participants collaboration as this shapes the client's expectation of the project and its cost. Moreover, the client's project management are seen to experience large pressures from their own organisation as to realise the project to budget.

Difficulties connected to incentive-contracts also recognized by Volker et al. (2018) in two Swedish ECI-projects where the contractor has perceived the sharing of cost over- and underruns to be more of a cost risk than an opportunity due to the large percentage which the contractor had to assume in the case of a cost overrun. Moreover, this was seen to create an incentive for an inflated target cost as the contractor wished to ensure their profits from the project, something which in turn created distrust of the contractor among the client representatives. Continuing, the authors highlight that the impact of contractual incentives is highly complex and that contradictory effects to the efficiency and innovation that the incentives aim to achieve can occur. Volker et al. (2018) also see that the use of target cost contracts may counteract inter-organisational collaboration due to the aforementioned difficulty in aligning client-contractor interests pre target cost agreement.

Additional insight into economic incentives in construction

The construction sector has seen a large use of economic incentives as to increase supplier motivation and the belief of its effects are strong (Kadefors & Badenfelt, 2009; Rose & Manley, 2011). Yet their complexity is large and underlying distrust between participants has been shown to communicate negative intentions behind their implementation. In a study of the roles and risks of incentives, Kadefors and Badenfelt (2009) identified three different functions which an economic incentive can adopt in a contractual relationship. Firstly, as to induce extrinsic motivation in the other party's organisation. Secondly, as a symbol which signals the interest and importance of a particular task or that initiative is desirable, but that can also prove to have negative symbolic effects (e.g. in signalling control and distrust).

Thirdly, as creating organisational processes in the project in which communication and jointly preparing and assessing performance is seen to provide opportunities for knowledge-sharing and trust formation, but undesirable processes can also form (e.g. in the form of recurring negotiations). Continuing, Bröchner et al. (2015) highlight three commonly problematic areas with incentive-based contracts that must be addressed when attempting to successfully implement said incentives. Firstly, random and unpredictable factors cannot have too large of an impact on the outcome unless they cannot be controlled within the incentive-scheme as one otherwise may reward a party solely based on luck. Secondly, the incentive must consider all relevant aspects of the outcome and not solely one aspect as suboptimization can take form which compromises these other parts or aspects. Thirdly, the incentive must take into account the impressionability of the supplier as an incentive solely is useful if it provides motivation and changes the supplier's behaviour as to conform to a desired one.

Other than target cost models, a commonly used incentive type is the use of bonuses (Bröchner et al., 2015; Rose & Manley, 2011). These allow the creation of incentives tied to other aspects than solely project economy, thus allowing for aspects like quality, less timely completion, maintenance improvements and customer satisfaction to be rewarded (Bröchner et al., 2015; Eriksson & Hane, 2014; Rose & Manley, 2011). Moreover, this allows the supplier to be economically rewarded if these performance requirements are exceeded hence providing the incentive to deliver an end-product which exceeds the expectations communicated in the contract (Eriksson & Hane, 2014).

## 2.4 Innovation through ECI

The topic of innovation in construction has been extensively discussed by numerous authors, and the industry has commonly been critiqued for its highly traditional nature and consequently lacking adoption of innovations (see e.g. Blayse & Manley, 2004; Harty, 2005; Rose & Manley, 2012). Moreover, what actually constitutes '*innovation in construction*' has been scrutinized, yet one commonly accepted definition of innovation is the one by Slaughter (1998);

> *Innovation is the actual use of a nontrivial change and improvement in a process, product, or system that is novel to the institution developing the change.*

This widely accepting definition will be used in this study as to allow for numerous perspectives and insights regarding what constitutes innovation in the specific construction project setting, the reason being that the specific type of innovation (e.g. the ones proposed by Slaughter (1998); incremental, radical, system, architectural, modular) is not within the focus of the study. One distinction should however be made regarding the study's specific setting in which these innovation efforts take place, it being the project setting where numerous interrelated actors jointly prepare and develop innovations.

The aspects of inter-organisational collaboration and increased integration is in construction literature attributed to be a key strategy in fostering and improving

innovation in projects (Blayse & Manley, 2004; Lahdenperä, 2012). Moreover, the project-based nature of the construction industry which requires the cooperation and joint efforts of multiple parties in order to achieve success, further emphasises the importance of collaboration to achieve innovation at the project level (Eriksson, 2017; Harty, 2005; Rose & Manley, 2012; Volker et al., 2018). Through integrating multiple project stakeholders and facilitating knowledge and information sharing between actors, one can create an increased openness to innovation and innovative ideas (Lahdenperä, 2012; Mosey, 2009).

ECI and innovation

The connection between early contractor involvement and a larger potential for and increased innovation has been discussed by several authors. Rahman and Alhassan (2012) attribute an increased opportunity for innovation, and their implementation, to stem from an improved relationship between project participants that facilitates more open communication, knowledge-sharing and inter-organisational collaboration, aspects which are seen to lead to more innovations. Volker et al. (2018) on the other hand see the higher potential for innovation also to stem from an earlier than usual involvement of the contractor and that the duration of the collaboration in the project affects the innovative outcome. Walker and Lloyd-Walker (2012) and van Valkenburg et al. (2008) also see the creative input and inclusion of the contractor in design to be a driver for innovation in ECI projects, while Lenferink et al. (2012) emphasises the importance of also challenging the contractor to actively come up with innovations as of importance and that one solely cannot rely on the inclusion of the contractor as a driver for innovation. Moreover, Lenferink et al. (2012) emphasise that the ECI-implementation must facilitate inter-organisational information exchange and collaboration in order to provide an innovative outcome.

As for the innovation outcome of ECI-projects, Volker et al. (2018) find in a case study of projects realised through a collaborative arrangement attribute the use of ECI to have resulted in large design improvements and optimisations which created large cost and time savings, which were deemed to not be possible if the contractor was involved at a later time of the project timeline. Similarly, Rosander et al. (2020) identify in a multiple case study of Swedish ECI-projects four out of the seven studied projects to have seen valuable innovative solutions being added by the early contractor involvement in the planning and design phase, these solutions have provided both cost and time savings or ensured that times have been able to be held.

Several authors like Volker et al. (2018), highlight the importance of the time of ECI-implementation as to facilitate innovation in projects. Lenferink et al. (2012) sees the added value that innovations provide to be dependent on providing the contractor with a sufficient possibility to suggest and develop innovation, a possibility which is decreased the longer the project's planning and design stage proceeds. Similarly, van Valkenburg et al. (2008) conclude "the earlier the start is the more room for innovation is given to contractors." (p.346). In doing so, the authors highlight that in infrastructure projects, and more specifically in road works, a contractor can often be hindered by planning decisions made at an early

stage which dramatically limits the contractor's flexibility in suggesting innovative suggestions. Therefore, one only provides room for optimisation of technical details at a more operational level, for example in terms of logistics or material choices (van Valkenburg et al., 2008). Volker et al. (2018) also recognise this innovation hinder in infrastructure projects through pointing to the fact that these decisions made during the initial planning stages often create legal restrictions for the project.

Other hinders to increased innovation through the implementation of ECI also include a limited timeframe for planning and design work and too large of a cost-focus on the improvements made through innovations by clients (Rosander et al., 2020; Volker et al., 2018). When time is limited, one often sticks to using familiar and existing solutions rather than attempting to develop innovations, a process which is seen as time consuming (Volker et al., 2018).

Despite the efforts to incentivise optimisation and innovation through the use of economic incentives tied to a target cost which is commonly seen in ECI-projects, Volker et al. (2018) find that contractors in these projects perceive the lack of incentive for innovation in the planning and design phase to be a hinder. This observation is also made by Rosander et al. (2020) who however emphasise that such incentive structures must be thoroughly investigated before implementation as to not create unwanted and conflicting interests, but rather to support an increased collaborative exchange. Similar remarks are made by Rahmani et al. (2018) who in a study of Australian ECI-projects recognise that the contractual arrangement can create a hinder to innovation. In these contracts a contractor is awarded a DB-contract for the project's completion, after having completed an ECI-phase where the contractor acts as a consultant. This may then create an incentive for the contractor to hide innovations and improvements to the project's second phase in which the contractor can be rewarded for them in full. Thus, ensuring that the contribution of the contractor to innovation is presented in the planning and design stage can be challenging. Rahmani et al. (2018) conclude: "As a result, their contributions to the design, the degree of commitment, integration, motivation, skill, teamwork and trust that the contractor is supposed to bring to the project is undermined." (p.105).

## 2.5 Theoretical lens – Agency theory

Agency theory stems from the agency relationship in which one party, the agent, is designated to act for, on behalf of, or as representative for the other, the principal, to complete a task (Eisenhardt, 1989; Ross, 1973). Moreover, the theory takes aim to explain the agency problem that occurs when cooperating parties have different goals and division of labour. Jensen and Meckling (1978) further highlight the generality of the agency problem, in doing so stating:

> *"The problem of inducing an "agent" to behave as if he were maximizing the "principal's" welfare is quite general. It exists in all organizations and in all cooperative efforts" (pg. 309).*

Agency theory can however be seen to be based around two problems as done by Eisenhardt (1989). Firstly, it concerns the agency problem that arises when the interest of principal and agent stand in conflict to one another and when it is either difficult or expensive, as principal, to assess and verify the agent's actions. Secondly, it concerns the aspect of risk sharing between principal and agent when the two parties have varying attitudes to said risk, hence problematic situation may occur when the parties may prefer different actions due to the parties' respective risk preferences. The point of focus in this thesis is the principal-agent relationship between buyer and supplier, or in the case of a construction project, a client and contractor. Eisenhardt (1989) summarises as follows; "the domain of agency theory is relationships that mirror the basic agency structure of a principal and an agent who are engaged in cooperative behavior but have differing goals and differing attitudes toward risk." (pg. 59). Moreover, agency theory aims to analyse the contract that is governing the relationship between principal and agent, thus in turn aiming to determine the how to most efficiently govern the said relationship based on assumptions about people, organisations, and information. These assumptions are presented by Eisenhardt (1989) as follows:

- People are seen to act according to their self-interest, are limited by bounded rationality, and are risk averse in nature.
- Organisations are seen to have partial goal conflicts among participants, are measuring efficiency as the effectiveness criterion of choice, and an inherent information asymmetry is seen to exist between principal and agent.
- Information is seen as a purchasable commodity.

Moreover, one strand of agency theory concerns the formation of the optimal contract between principal and agent which is seen to either rely on contracting behaviour or contracting outcome (Eisenhardt, 1989). In the case of complete information, when the principal is knowledgeable about what the agent is doing, a contract based on behaviour is the most efficient as the principal simply contracts the said behaviour, and does not wish to needlessly transfer risk to the agent through adopting an outcome-based contract. Yet in the case of asymmetric information, where the principal does not know to a full extent what the agent has done, the agency problem takes place. One particular way in which the agency problem can play out is through what is known as *moral hazard*. This is commonly seen to simply be a lack of effort from the agent, hence not putting forth the

contractually agreed-upon effort for the principal's tasks (Eisenhardt, 1989). Yet it should be noted that the moral hazard problem can more widely be considered as existing also from the principal's side, thus not fulfilling potential obligations towards the agent (Eriksson & Lind, 2016).

To manage the agency problem in its simplest form, one can as principal either a) through investments into information systems reveal the agent's behaviour or b) contract the agent based on the outcome of their behaviour, thus aligning the agent's and principal's interests (Eisenhardt, 1989). This is however done at the expense of the agent having to assume risk due to inherent uncertainties in the outcome which the agent cannot control. Thus, outcome-based contracts are attractive when outcome uncertainty, and therefore risk, is low and when the cost of shifting risk to the agent is low. Yet when outcome uncertainty is high, one sees increased expenses as to shift the risk to the agent, despite the motivational aspect which an outcome-based contract brings. Moreover, when an outcome is difficult to measure and determine, outcome-based contracts are seen as less attractive, thus favouring behaviour-based contracts. The previous argumentation is based around the assumption that a goal conflict exists between principal and agent, and that the agent inherently is more risk averse than the client due to their inability to diversify their employment (Eisenhardt, 1989).

Summarising, Eisenhardt (1989) emphasises two specific contributions for how agency theory can help us better understand organisations and their organisational thinking. Firstly, information is regarded as a commodity which can be exchanged and purchased, hence investments into information systems in order to control the agent's opportunism are possible. Secondly, agency theory assumes that the organisations have uncertain futures and are faced by outcome uncertainty for all actions, an uncertainty which is be perceived as a trade-off between risk and reward. Hence, this outcome uncertainty, alongside the assumption that organisations inherently have different willingness to accept risk, should shape the contracts between principal and agent.

# 3 Method

The following chapter of the thesis outlines the methodology which has been employed for the research process and creation of this master's thesis. An interview study was conducted with client and contractor representatives from two construction projects as a part of a multiple case study. Apart from the interview study, empirical material has also been gathered through a document study of the two cases respective procurement documents.

## 3.1 Research approach and design

A qualitative research approach was used as to provide opportunity to answer the explorative research questions adopted in this thesis, as qualitative research allows a larger emphasis to be put on the way which individuals interpret their social world rather than through quantification in quantitative research (Bryman & Bell, 2011). Continuing, an abductive process known as systematic combining was adopted (Dubois & Gadde, 2002). This allows for a more iterative process where a theoretical framework and understanding is developed alongside the collection and analysis of empirical data which is one of the strengths of Dubois and Gadde's (2002) systematic combining. In this process the researcher is creating an apprehension of the studied topic by both theory and concepts from reality simultaneously, existing research and understandings do therefore not limit the researcher in their creation of an understanding of the problem and topic. Dubois and Gadde (2002) further outline one of the strengths of the process as allowing theory which otherwise cannot be understood without a context of empirics as possible and vice versa. Through adopting systematic combining, the study was able to be continuously developed, as well as give room for new perspectives and create a deeper understanding of the subject.

A case study approach was chosen as to allow for detailed and intensive analysis of each case as the research aims to investigate the specific contextual factors which affect ECI-projects. Bryman and Bell (2011) highlight that the use of case studies allows for the specific focus on a bounded situation or system and its complexity, hence the thesis' research questions that focuses on the specific relationships between project organisation and contract justifies this approach. Moreover, the choice to study two projects was made as to allow for further opportunity to explore general phenomenon as well as allows the researcher to compare and contrast the findings from each case (Bryman & Bell, 2011). Through this comparison, one is seen to promote theoretical reflection on the findings of the respective cases as to what makes each case unique and what similarities there are (Bryman & Bell, 2011). The two projects were in turn chosen based on their accessibility to the researcher as is customary in convenience sampling (Bryman & Bell, 2011). The sampling was thus limited to projects that the contractor firm, which the researcher collaborated with for this master's thesis project, was currently contracted for. However, a series of selection criteria were used as to choose the two specific projects that are the focus of this study, namely that the two projects saw an early contractor involvement, that they employed target cost reimbursement models and that the two projects' planning and design phases were completed.

## 3.2 Empirical data collection

In qualitative research, Bryman and Bell (2011) see the most widely adopted research method to be interviewing, as it as a method allows for large flexibility in adaptation. The two main types of interviewing that is performed as a part of qualitative research are *unstructured interviews* and *semi-structured interviews,* these two interviewing methods allow the interviewee to express their own perspective regarding a topic in a rich and detailed manner (Bryman & Bell, 2011). Moreover, through requiring less structure, the two qualitative interviewing methods mentioned enable the interviewer to depart from the interview guide as to ask follow-up questions and thus the interviewees answers can be explored further. Due to the highly complex nature of the research topic and the qualitative formulation of the research question, qualitative interviews were deemed appropriate in order to allow for data collection with great contextual depth. The interviews were conducted in a semi-structured manner as to ensure that questions regarding the thesis' topic were covered and answered by all interviewees, but also to allow for flexibility in the way which each interviewee answered. This is according to Bryman and Bell (2011) a strength of the interviewing method, as well as the fact that it allows for new questions to be asked following an interviewee's answer.

An interview guide was developed using the results of an early literature study of scientific papers, journals and books focusing on collaborative contract arrangements, the ECI concept, reimbursement models and innovation in construction. Thus, the questions included in the interview guide followed these four themes as to ensure that each interviewee gave their perspective on the themes' connection to the respective projects. Moreover, the projects' procurement material and contracts were used as to provide further background to the cases ahead of the interviews and was also used as to allow for more project specific questions to be asked. The questions were framed in general way as to allow the interviewee flexibility in their answer which according to Bryman and Bell (2011) is needed in semi-structured interviews. The same interview guide was used for all interviews yet directed follow-up questions where pre-prepared ahead of the interview and included in the interview guide as to allow for further scrutinization of the interviewees' answers depending on their role in the project. The interview guide, translated from Swedish, can be found as an appendix to the thesis (see Appendix A – Interview guide).

A total of 11 interviews were conducted, where the interviewees were constituted by current and previous project participants who had been involved in the projects' planning and design phase. Interviews were held with both client and contractor representatives as the main focus of the thesis is to investigate the contractual relationship between these two parties. The interviewees were chosen based on purposive sampling, this has been done in the respective projects in order to ensure that only suitable candidates who were thought to have relevant insight regarding the research questions and topic were interviewed as proposed by Bryman and Bell (2011). Moreover, the interviewees were chosen based on their role in each project both as to ensure that multiple perspectives of the research topic were gathered, as well as to provide the possibility of comparison between the contractual sides and between projects. Furthermore,

this was done to accommodate the time and resource restrains that the master's thesis project poses on the researcher. The complete list of interviewees can be found below in Table 2 for project A and Table 3 for project B.

All interviews were conducted digitally using Microsoft Teams and varied in length between 30min and 1h 20min. The interviews were recorded with permission from the interviewees for transcription purposes and to enable a free dialogue between interviewer and interviewee. All interviews were held and transcribed in Swedish.

*Table 2 Interviewees for Project A.*

| Interviewee | Date of interview | Interview length |
|---|---|---|
| Client's Project Manager 1 | 2021-02-23 | 1h 10min |
| Client's Project Manager 2 | 2021-02-23 | 45min |
| Contractor's Project Manager | 2021-03-03 | 55min |
| Contractor's Design Manager | 2021-02-22 | 1h |
| Contractor's Cost Estimator | 2021-03-02 | 45min |

*Table 3 Interviewees for Project B.*

| Interviewee | Date of interview | Interview length |
|---|---|---|
| Client's Project Manager 1 | 2021-02-25 | 1h |
| Client's Project Manager 2 | 2021-03-11 | 40min |
| Partnering Facilitator | 2021-02-23 | 1h 20min |
| Contractor's Project Manager | 2021-02-22 | 1h 10min |
| Contractor's Design Manager | 2021-02-26 | 1h |
| Contractor's Cost Estimator | 2021-03-05 | 30min |

Apart from the discussed interviews, data was also gathered from each project's procurement documentation as well as the contracts and regulating documents that are in place between client and contractor. Apart from providing background information ahead of the interviews, this material was used as to describe and provide background to the cases that are presented in the thesis.

## 3.3 Data analysis

There are multiple prevalent methods for analysing qualitative data, one such method which has been adopted in this thesis is thematic analysis. Thematic analysis is an approach for the analysis of qualitative data where researchers systematically search through data to detect themes and patterns (Alhojailan, 2012). It is a highly flexible method that can be adopted for multiple research purposes but allows for rich and detailed accounts of data to be communicated (Nowell et al., 2017). Nowell et al. (2017) also highlight that "thematic analysis is a useful method for examining the perspectives of different research participants, highlighting similarities and differences, and generating unanticipated insights."

(pg. 2). Moreover, thematic analysis provides the opportunity to code and categorise data into themes as to make connections between different parts of said data (Alhojailan, 2012).

First, the collected empirical material was interpreted, analysed, and divided into thematic categories in order to make the data more manageable. The categories were developed iteratively upon continuous reviews of the data as well as through adopting thematic categories noticeable in literature of the thesis' topics. This allowed for comparisons to existing literature and for comparisons of the empirical material in both cases. Through adopting this iterative process, one allows for a large flexibility of interpretations which according to Alhojailan (2012) is a strength of the analysis method. Moreover, through comparisons to the thesis' theoretical framework, the study has provided the needed consistency and cohesion which is needed to support the study's empirical claims, as the analysis methods flexibility otherwise can lead to a lack of these aspects as emphasised by Nowell et al. (2017). As a means to further strengthen the analysis of the thematically analysed material, the thesis' theoretical lens was thereafter employed as to provide further nuance and explanations to the seen findings through in-depth comparisons.

## 3.4 Quality of research

Bryman and Bell (2011), drawing from Lincoln and Guba (1985), describe how a researcher must assess and evaluate both the study's *trustworthiness* and *authenticity* in order to ensure the quality of the study. A study's trustworthiness is in turn divided into four different criteria (Bryman & Bell, 2011, pg. 43):

- Credibility — i.e. how believable are the findings?
- Transferability — i.e. do the findings apply to other contexts?
- Dependability — i.e. are the findings likely to apply at other times?
- Confirmability — i.e. has the investigator allowed his or her values to intrude to a high degree?

Firstly, the credibility criterion reflects on the findings' congruence with reality which is of importance in qualitative research as it is often dependent on perceptions of reality (Bryman & Bell, 2011). The study has been conducted using commonly adopted research methods and practices within the field of construction management research (i.e. multi-case studies, semi-structured interviewing). Hence the research can be seen to have been carried out according to good research practice as noted by Bryman and Bell (2011). Moreover, through performing interviews with both client and contractor representatives in both projects, the thesis' credibility is further strengthened as it makes use of data triangulation, i.e. through analysing data from more than one perspective (Amin et al., 2020). Yet the most frequently used process for triangulation, methodological triangulation which draws evidence from multiple research methods, has not been used. Thus, the possibility to compensate for a weakness in a specific research method, through the use of another one, has not been realised in this study (Bryman & Bell, 2011). Moreover, purposive sampling was used as to select the study's interviewees, hence the researchers own bias cannot be neglected.

Secondly, the transferability criterion assesses whether a study's findings are supported in other contexts than the one which is studied (Bryman & Bell, 2011). This is of particular importance in qualitative case study's that emphasise the scrutinization of contextual factors and their uniqueness as to e.g. provide an explanation to said uniqueness (Bryman & Bell, 2011). Hence, the multiple case study approach adopted in this study inherently makes for poor generalizability. Yet the focus of this study has rather been to provide a detailed account of each case and their context as to provide the 'thick description' which is reasoned by Bryman and Bell (2011) as vital in order to increase transferability.

Thirdly, the dependability criterion is included as to allow for the assessment and audit of the adopted research methods and overall research process by a third party (Bryman & Bell, 2011). Through continuous communication and feedback with the master thesis supervisor, the thesis' dependability can be deemed high as guidance regarding research methods has been thoroughly discussed during the full course of the research. Moreover, a peer-review was carried out with another student currently performing their master thesis research, hence further feedback was provided to the researcher.

Finally, the confirmability criterion aims to assess the researcher's objectivity and to ensure that the researcher has acted in good faith and according to good research practice (Bryman & Bell, 2011). Through adopting the systematic combining approach, empirical findings and theoretical insights were gathered simultaneously, hence neither the empirical findings nor the theoretical insights can be seen to have affected the thesis' analysis and conclusion more than the other. Noted should however by the researcher's personal involvement in project B, having spent three months working part time in the project before the commencement of the master thesis research. Thus, the researchers own bias cannot be neglected, yet the third-party supervision provided by the master thesis' supervisor can be seen to have ensured the study's confirmability as reasoned by Bryman and Bell (2011).

As for the authenticity of the study, this has been ensured through managing and describing the thesis' cases, methods and findings in the most transparent, honest and fair way possible.

## 3.5 Ethical aspects

As to ensure that the thesis has been conducted in an ethically correct manner, measures have been made primarily connected to the thesis interview study. Prior to the interviews, a short description of the study was sent alongside the participation request as to allow for the interviewees to ensure that all participants were made aware of the aim and topics of interest. During the interviews, the study's adopted methods were described as a first step, and each interviewee was asked for permission to record their answers for transcription purposes. All interviewees have voluntarily agreed to participate, and all material presented in the thesis have been anonymised as to protect the interviewees identities.

# 4 Case introduction

The following section presents the two studied cases and provides the necessary background to the later presented findings and discussion.

## 4.1 Project A

Project A is a project that entails the construction of approximately 8 kilometres of motorway in the western parts of Sweden for the Swedish Transport Administration (STA). The majority of the motorways route will be constructed on virgin ground and is set to replace the existing road due to its poor capacity and road safety. The project was procured as a two-stage ECI-project based on the Swedish standard contract ABT and the STA's collaboration model "Samverkan Hög". The contract was divided into two phases – a planning and design phase entailing the production of the project's road plan and a construction and handover phase. The contractor's continuation with the second phase was reliant on the agreement of the project's target cost that was prepared during the initial planning and design phase. If a call-off agreement between the client and the contractor could not be reached the client had an exit-option which allowed the cancellation of the contract after the planning and design phase.

The project's first phase was undertaken by the second in the second quarter of 2016 and the call-off agreement for the project's completion was reached in the second quarter of 2020. The project's target cost was set to 436 MSEK at the end of phase 1.

*Table 4 Compilation of project information for Project A.*

| Project delivery method | Contractor reimbursement | Collaborative arrangement |
|---|---|---|
| ECI based on Swedish standard contract for design-build, ABT 06, with an exit option for the client.<br><br>The contract for phase 1 included the creation of the project's road plan as well as other planning and design documents and a jointly developed cost estimation to be used as a target cost.<br><br>The contract for phase 2 included the completion of the project´s detailed design, construction, and handover to the client.<br><br>Open-book accounting in use to allow for full transparency of the project economy. | <u>Phase 1:</u><br>Cost-plus reimbursement.<br><br><u>Phase 2:</u><br>Cost-plus reimbursement with a fixed contractor fee equating to 11,81% of the target cost.<br><br>An incentive system connected to the project's target cost is in use – exceeding costs split 50/50, savings split 60/40 in favour of the contractor.<br><br>The fixed contractor fee is set to cover the contractor's profit, risk, potential costs to remedy errors as well as the contractors general and administrative expenses (in Swedish "CAK"). | The project was undertaken according to the STA's collaboration model "Samverkan Hög". |

## 4.2 Project B

Project B is a project that entails the construction of a new water tower located in close proximity to a smaller town on the Swedish west coast. The projects client is a company that is responsible for the provision of water and sewage services to two neighbouring municipalities and that is wholly owned by the two municipalities. The project was procured using the Swedish standard contract ABT and with a collaborative partnering agreement. Moreover, the contract was divided into two phases – a planning and design phase as well as a production and handover phase, where the project's completion in the second phase was an option that was reliant on a call-off agreement between the client and the contractor. The call-off agreement in turn was reliant on the fulfilment of the jointly determined project goals for the first phase as well as a fully functioning collaboration between the contractual parties as judged by the client. One of the crucial project goals set for the planning and design phase was the development and agreement on the project's target cost.

The project's first phase was undertaken by Veidekke in the first quarter of 2019 and the call-off agreement for the project's completion was reached in the fourth quarter of 2020. The project's target cost was set to 249MSEK at the end of phase 1.

*Table 5 Compilation of project information for Project B.*

| Project delivery method | Contractor reimbursement | Collaborative arrangement |
|---|---|---|
| Design-build contract (ABT 06)<br><br>The contract for phase 1 included the creation of planning and design documents as well as time schedules and a jointly developed cost estimation to be used as a target cost.<br><br>The contract for phase 2 included the completion of the project´s detailed design, construction, and handover to the client.<br><br>Open-book accounting in use to allow for full transparency of the project economy. | <u>Phase 1:</u><br>Cost-plus reimbursement.<br><br><u>Phase 2:</u><br>Cost-plus reimbursement with a fixed contractor fee equating to 10% of the agreed upon target cost.<br><br>No incentive system connected to the project's target cost.<br><br>The fixed contractor fee is set to cover the contractor's profit, risk, potential costs to remedy errors as well as the contractors general and administrative expenses (in Swedish "CAK"). | The project was undertaken as a partnering project.<br><br>A partnering facilitator was employed by the client to help shape the procurement strategy used when procuring the contractor. This also included developing the project's contract. |

# 5 Findings

The hereby following chapter will present the findings made in the two case studies, and they will be presented in accordance with the thesis' research questions.

## 5.1 Benefits and hindrances of ECI implementation

### 5.1.1 Project A

Project A - benefits:

***Contractor's improved project understanding***: The contractor interviewees believe one major benefit behind their early involvement is that the contractor personnel who are involved in the project, and who will continue to be involved throughout the project's execution phase, will thoroughly know the project, and have a larger understanding to why specific design choices have been made compared to if another project delivery model was in use. The contractor's design manager shares this perception in stating the following:

> *"We have gotten a much better project understanding compared to if the project was procured as a DB-contract on a completed road plan or as a DBB, we have lost far less information than in a more regular contract, that I am sure of." – Contractor's design manager.*

Moreover, one contractor interviewee highlights the benefit the contractor has been presented as to fully learn and understand these early stages in the road plan process which one as contractor regularly is not involved in. This has provided a large opportunity for organisational learning which can prove useful in future projects, both those realised through ECI but also others. It should be noted that the novelty of ECI as a concept in Sweden, and the fact that project A was procured as a pilot project for contractor involvement in the road plan process, both provide reasons for this as contractors in Sweden have not had the opportunity to be involved at such an early stage.

***Contractor's input in decision-making and design***: Other perceived benefits which are emphasised by the contractor interviewees which the contractor's early involvement have provided are a larger sense of security for the client of design choices, specific design input regarding choices of production methods and providing well-founded arguments and input for the temporary land and road use these production methods need. This input regarding temporary land use is also recognised by the client side, who see other benefits to have been the contractor's ability to provide the client with accurate decision-making material of design choices as well as to provide design input to minimise the project's need for material transports.

***Improved client-contractor relationship***: Most interviewees from both contractual parties also highlight an improved relationship between client and contractor to be a benefit created by the ECI-implementation. This has facilitated a well-functioning collaboration to form which on the contractor side is seen to

have improved joint design development as well as joint problem solving. The contractor's project manager summarizes it as follows:

> *"I feel that we have had one united project, we have helped each other out, just the way one wants it to be." – Contractor's project manager.*

In contrast, one interviewee on the contractor side reasons that the project organisation has failed in creating a full understanding of the collaborative arrangement and the underlying reason behind the ECI-implementation as to maximise the benefits which can be seen thereof. It is reasoned that all contractual parties involved in project A would have benefitted from a greater understanding of the methods, ideas, and goals which the collaborative arrangement sets out to use and fulfil as this remained unclear.

Project A – hindrances:

***Contractor's knowledge and impact on early design:*** The strict road plan process that the planning and design phase entailed in project A was seen to offer limited impact from the contractor's input. This was seen to be stemming from two separate reasons, that the contractor's knowledge and expertise of the road plan process was limited and that the knowledge and input which the contractor could offer at these early stages of the process simply were not deciding factors for design choices, especially concerning the route localisation. The time of contractor involvement in the planning and design phase of project A was reasoned by the contractor interviewees to have been too early for themselves to have a real impact, and that the project's technical consultants who were more experienced in road plan development, thus realised the majority of the design work. Moreover, the matters which the contractor were knowledgeable of, primarily questions of buildability, cost estimation and value engineering, were not seen to impact the route localisation due to the small differences in expected construction costs that were seen between route alternatives. These estimates were prepared at a time where large cost uncertainties still existed, making such input limited in usability. All contractor interviewees do however note that the longer the project's planning and design phase has progressed, the larger the impact the contractor has been able to have as the detail-level of the design work increased.

***Client's lack of understanding of the project delivery model***: The lack of understanding of the ECI-implementation and the novelty of the approach was further emphasised by the contractor interviewees who see the client's technical specialists to be unaccustomed to working collaboratively and with the involvement of a contractor at an early stage, something which has proved difficult throughout the planning and design phase of project A. The technical specialists' involvement in multiple projects was seen as problematic and had resulted in that the specialists have not managed project A in any other way than the other projects, despite project A's ECI-implementation and collaborative arrangement. Moreover, the client specialist's lack of commitment to the collaborative work way made their efforts in the project resemble that of a design contract where a technical consultant is contracted for design development directly by the project's client. This was evident as changes and additions were administered by the

specialists directly to the technical consultant without consulting neither the client's nor contractor's respective project management. This can be further emphasised using the words of the contractor's design manager:

> *"There are numerous people who need to learn what this collaborative arrangement actually aims to achieve" - Contractor's design manager.*

***Involving contractor's production personnel early on:*** Noteworthily, one hinder in achieving a complete early contractor involvement and the benefits thereof has been the contractor's difficulty in involving personnel who are to execute and build the project at the early planning and design stages. It is argued that the production personnel are unwilling to work with planning and design as they would rather solely work with project execution, and that they thereby prefer to build other project's during the planning and design phase up until the commencement of the project's second phase. In project A, the contractor representatives that have been involved during the planning and design phase have been design- and project managers, engineers, and technical specialists as well as cost estimators, whereas representation of site managers and site supervisors has been limited. Further, it is argued that the collaborative output from the ECI-implementation could have benefitted even more from the contractor's early involvement if such personnel would have been involved to a larger extent, yet design input from these representatives has been enabled through direct questions regarding production methods and choices within the contractor organisation. The involvement of production personnel in planning and design is however simultaneously argued by a contractor interviewee to be a risk if one does not reach the call-off agreement for the project's execution phase as these personnel oftentimes are involved in other projects, thus early involvement would be done at the expense of another project.

### 5.1.2 Project B

Project B - benefits:

***Contractor's input in design:*** As for the perceived benefits which the interviewees in project B have recognised through the early contractor involvement, is the contractor's ability to offer design and buildability input which ultimately will see the project's complex design possible to realise. Moreover, through the contractor's design involvement, one was able to provide input on desired construction methods and maintain a continuous dialog with the engineering consultants regarding design choices. It is however emphasised by the contractor interviewees that an earlier involvement in the project would have been desirable, as was the intended idea as the contractor was to be procured to be a judge of the project's architecture competition. This procurement was however revised and adjourned after a documentation error was discovered, in turn resulting in the contractor's involvement possible first after the architecture competition. The architectural design was thus fixed when entering the contract and left limited room for the contractor to offer input on larger design changes in terms of value engineering or improved buildability.

***Improved time and cost certainty:*** Other benefits which are recognised by the interviewees due to the ECI implementation was the contractor's ability to control the planning and design stage as to ensure that the development of the project's design became more time efficient as well as being able to offer the client detailed cost estimates of design alternatives when investigating cost reducing measures which was a necessity when the project's cost estimate was seen to exceed the client's initial budget. Moreover, the contractor's inclusion in the design stage and in the preparation of the project's target cost was seen to support the municipality's political steering group and their decision to accept the project's continuation despite the exceeding of the budget. The reason being that more well-founded arguments and cost estimates based on the contractor's experience of projects were presented.

Project B – hindrances:

***Relational problems hindering collaboration***: One hinder which both contractual sides have perceived to have affected the initial planning and design phase is the parties' difficulty in creating a well-functioning relationship and fruitful collaboration between client and contractor. Both contractual sides give evidence of incidents where the other party was deemed to focus on their own benefit rather than for the projects good, as well as moments where one has not acted in a fully transparent manner. This is seen to at times have created distrust between the parties which in turn has affected the parties' collaboration and the benefits thereof. Comments are here made on the importance of equating and jointly defining the view of money, time schedules and quality among the project participants, and that discussions as to do so have been common throughout the planning and design phase and were at times difficult. It is however emphasised that the fact that the call-off agreement for the completion of the project was reached shows that the joint project team has been able to overcome the majority of the shortcomings and distrust from the planning and design phase.

***Imbalance in size and strength of parties:*** Difficulties stemming from an imbalance between the client and contractor organisation's respective size and strength, both in terms of project- and construction expertise, were recognised in the project. This imbalance was seen to affect the parties' respective contribution to the project at times, one specific example being the preparation of the project´s target cost which was prepared solely by the contractor and not jointly which was the initial wish. Moreover, this was seen to create a large reliance on the other project participants from the client, which according to the contractor could be seen to result in an angst of opportunistic behaviour on the client side. A stronger client organisation is also reasoned to diminish the need for excessive audits and controls that were performed by external parties in project B, thus removing these events which the contractor deemed to create distrust. The organisational imbalance is also recognised within the client organisation who sees that a project organisation constituted of participants with more mirrored roles would have benefitted the project, specifically in the development of the project's cost estimate. On the contrary, comments are however made by the client's project manager 2 who sees the involvement of the contractor in the collaborative arrangement as one which aims to create a single organisation with all the

necessary resources and expertise, instead of having multiple project participants with similar expertise and two complete organisations on their own.

### 5.1.3 Summary

In Table 6, the two projects' perceived benefits from ECI-implementation are presented alongside the projects' hindrances to a fully successful ECI-project.

*Table 6 Benefits from and hindrances to ECI-implementation in Project A & B.*

| Project A | | Project B | |
|---|---|---|---|
| **Benefits** | **Hindrances** | **Benefits** | **Hindrances** |
| Contractor's improved project understanding | Contractor's knowledge and impact on early design | Contractor's input in design | Relational problems hindering collaboration |
| Contractor's input in decision-making and design | Client's lack of understanding of the project delivery model | Improved time and cost certainty | Imbalance in size and strength of parties |
| Improved client-contractor relationship | Involving contractor's production personnel early on | | |

## 5.2 Challenges created by target cost principles and economic incentives in ECI-projects

The hereby following section will address the perceived challenges resulting from the use of target costing and incentivization in the respective projects. These findings are presented in accordance with the respective project in which they were perceived.

### 5.2.1 Project A

Project A –Target cost incentives perceived as a cost risk:
The inclusion of incentives connected to the project's target cost was done as a way to create a driver for the contractor to build the project more rationally and cheaply. This potentially positive effect is by the client side emphasised as a large benefit of the reimbursement model, in doing so pointing to the situation in other project's where the contractor often wishes to push up a project's cost estimate as a means to earn more. The client's project manager 2 reasons:

> *"In this case they benefit from it being cheaper, that is great because then you don't have to worry like you do other times that [the contractor] presents things which makes [the project] more expensive, because now they don't profit from that – that is positive." – Client's project manager 2.*

The interviewees on the contractor side welcome the inclusion of an incentive as it creates an important motivating factor for the project. It is also believed to be a question of fairness, as one as contractor should have the right to some benefit in the case of improvements to the project, which the client otherwise would benefit fully from.

As for the incentive-levels used in project A, the perceptions among the two contractual sides differ. It is argued by the client side that the incentive levels are reasonable as the contractor, who has a larger potential impact on cost underruns, thus has the higher potential gain. On the other hand, the cost-risk of potential overruns is shared equally which creates equal reason for both contractual parties to keep the project's costs to a minimum. However, the contractor interviewees see this cost-risk to be too large and something which could have a catastrophic effect on the contractor's profit margins for the project, Moreover, the client's natural unwillingness to agree to too large of a target cost is also recognised and believed to be something which worked against a swift target cost process, particularly due to the 60/40-split of cost underruns in the contractor's favour. The interviewees also recognise the inherent incentive for the contractor to push up the target cost as high as possible in order to maximise the gains one can make from these shared cost underruns. This is seen to create a paradoxical difficulty as the client has a willingness and incentive for a cheaper project completion, thus wishing to keep the target cost low. The contractor's design manager explains his view of this difficulty in finding an agreement between client and contractor:

> *"The biggest risk in a collaborative contract is that you do not manage to equate your views, then you are done. We do not have an incentive to lower the target cost but [the client] has every incentive to lower it." – Contractor's design manager.*

<u>Project A – Client budget shaping cost expectations:</u>
As previously mentioned, the work in the planning and design phase entailed the creation of the project's road plan that also was to be used as the basis for the development of the project's target cost, a target cost which was to decide whether a call-off agreement for the option to build project A could be reached. The process of reaching an agreement did however pose to be a problem due to the two contractual sides different views of what the project was to cost. As part of the project's tendering documents, an early cost estimate was included that was prepared by the client organisation. The estimate was prepared using very rough prerequisites and with a large number of uncertainties and unknowns still remaining as the project's planning and design phase had not yet commenced. This is highlighted by the client's project manager 1 as follows:

> *"We did not know where the road was to be routed, but we knew that it was to go from point A to point B but not the route in between, but I had together with a cost estimator prepared an estimate for what it should cost." – Client's project manager 1.*

Yet when the project's planning and design phase commenced with the contractor and consultant, and the expected costs were seen to overshoot the client's budget, the two contractual parties experienced difficulties in equating their views of these costs. The different view of project costs is proposed by the contractor side to stem from the different levels of detail that the contractor and client use when estimating and assessing costs, a process where the contractor's estimate is seen as more detailed than the client's that is reliant on generalizations to a larger degree.

<u>Project A – Preparation of target cost done by a single party:</u>
The client's project management had initially expressed a wish to employ an alternative cost estimation process in the project where representatives from both the client and contractor were included, yet the result from this process was discarded by the client as it was deemed to be unrealistic as it far overran the client's initially prepared budget. This created a situation where the contractor was made responsible for cost estimation in the project, work that was later controlled by the client. Thus, through not creating the cost estimate jointly and through having vastly different views of project costs from the start, this creation of a joint understanding of the project's expected costs were difficult. This was seen both at the project level, but comments are also made regarding the difficulties for the client's project management to motivate and anchor these cost increases within the own organisation and to their upper management. The contractor interviewees see a high level of transparency in the cost estimation process, together with bring in new price offers from subcontractors and providing comparisons to other project's costs, as having been vital in ensuring that a joint picture of assumptions and estimates was reached. The contractor's project manager concludes:

> *"If we would have entered the target cost discussions in year 1, I don't think we would have reached an agreement. We have now gotten to know each other, and started to trust and like each other, and then one becomes more receptive to the other party's view." – Contractor's project manager.*

<u>Project A – Target cost timing and managing uncertainties:</u>
Another aspect which is seen to have impacted the target cost negotiations was the point in the project timeline at which these negotiations were held. The undetailed nature of the road plan that the target cost was based on, and thus the target cost itself, required the introduction of a list of separate agreements for how cost items where to be regulated after the completion of the project's detailed design and construction. These agreements will act as target cost changers and have been jointly prepared between the client and the contractor during the target cost discussions. The aspect of cost risks is by the contractor side seen as a driving factor behind the inclusion of these separate agreements as the contractor otherwise would have needed to add substantial risk premiums as to manage

these risks, costs which the client would not be willing to pay unnecessarily. A later agreement of the project's target cost is by the contractor side seen to have facilitated an overall easier target cost process, and one where both parties would have a better and more complete picture of the expected costs as the project's design development would have come further.

### 5.2.2 Project B

Project B – Difficulties in equating client-contractor interests:
The choice to use a reimbursement model based on a target cost with a fixed contractor fee was by the client side motivated by an aspiration to create drivers and incentives for the contractor for a more cost-effective project completion. In doing so, creating a common goal for the client and contractor to create the most cost-effective project possible. A weakness to the model, recognised by the contractor interviewees and by the project's partnering facilitator, is the contractor's incentive to increase the target cost in order to ensure that one underruns the target cost and thus has a better percentual profit margin. The difficulty this unwanted incentive created is brought up by one contractor interviewee who explains how the discussions and conflicts regarding the project's cost estimate and reimbursement model quickly made the collaborative environment, that was strived for, deteriorate between the client and contractor. The contractor's project manager makes the following reflection regarding the said difficulty of equating the parties' views of the project's economy:

> *"I experienced a feeling, I think both parties did, that they were to push us down and I think they felt a fear that we tried to push up the target cost. The reimbursement model asks for it, it is constructed in a way for that conflict to emerge." – Contractor's project manager.*

From the client's perspective, similar reflections are made. It is seen that the model has not worked as intended and the model has been seen to increase the parties' protectionism when in target cost discussions. Moreover, a reflection is made that each party's willingness to come out as "winner" in these negotiations can take the upper hand and can spur on the creation of distrust between the parties. A standard cost reimbursable model without the fixed contractor fee on the other hand is reasoned to remove such speculations and aspects which can create distrust, at the expense of a non-existent incentive for a cheaper project completion. An additional aspect of project B's reimbursement model and procurement that is highlighted by the contractor side is the use of a contractor's general and administrative expenses as a procurement assessment criterion, the same percentage that constitutes the project's fixed contractor fee. This is believed to create a willingness for the contractor to make their cost estimates "on the safer side", and without taking on unnecessary risks as potential cost overruns can have a large impact an already low profit margin. This is also recognised by one client interviewee who sees that this can impact the target cost as the contractor wishes to ensure that the business deal, that a project is, is done so in a profitable manner.

Project B – Client budget shaping cost expectations:
The preparation of the project's target cost was done alongside the development of the project's design and grew over time as the creation of a detailed cost estimate was reliant on the material and documents that are simultaneously created by the technical consultants. The contractor interviewees perceive the project's complexity and unique design to have offered limited applicability of generalisations and lessons learned which otherwise commonly are in use, an aspect which further emphasised the reliance of the project's design output. Moreover, the difficulties of overseeing and estimating a project's operating costs without the necessary material from the design process was further seen to limit the contractor from providing the client with earlier indications of costs.

These late indications of the project's estimated cost would however prove to have a detrimental effect on the project's planning and design stage. As part of an initial feasibility study for project B, a consultant had provided a cost estimate based on the project's location which was used internally within the client organisation and later presented to the municipality's steering group as to get approval for the continuation of the project. The budget however proved to be far misjudged as large cost items were not included in the consultant's work, one interviewee bringing up the fact that the project's entire operating cost for the project's construction site had not been included in the budget. Moreover, this early cost estimate failed to consider the impact of the chosen architectural design, an aspect which proved to be a large cost driver when implemented at the pre-determined project location. Both contractual sides share how the client's initial perception of the project's cost was troubling as they went into the project with the wrong expectations. Moreover, the contractor side believes that this inaccurate budget impacted the relationship and discussions between the client and contractor, and that a distrust of the contractor took form as the client felt tricked by the large cost increases, especially within the client's upper management who were not as actively involved in the project. The following comment was made by the client's project manager 2 regarding these difficult economic discussions between client and contractor:

> *"The economic parts are always difficult, we had a picture of project's costs but another one was presented, all while we do not know the outcome yet today. It has meant that we have had to manage it from our side in a way we did not foresee, there has been a lot of audits and questions, and of course that impacts the collaborative environment." – Client's project manager 2.*

Project B – Preparation of target cost done by a single party:
Another aspect which is thought to have impacted the two parties' relationship in the target cost process is the difficulty that the imbalance between the two parties' size and project expertise created. Rather than jointly developing the project's target cost, all contractor interviewees stressed the fact that this process was done solely by the contractor, and that the prepared cost estimate was later presented to the client for discussion and approval. Moreover, this has created a situation where the contractor has had to "defend" the cost estimate and the used assumptions, rather than jointly preparing it. A reflection is made by one of the contractor interviewees that a closer collaboration in the cost estimation process

would have benefitted the project and made for a smoother process, yet this was not possible due to the client organisations lack of resources with the needed expertise. This is also recognised by the client who sees this as a large potential for improvement with a wish of having more resources available. The project's partnering facilitator summarizes the target cost process and the difficulty above as follows:

> *"[…] as time has passed, I have noticed that the relationship has more and more resembled that of two counterparts, I would not necessarily call it distrust, but at times questioning, and where one goes from the idea of a joint cost estimate to that of a contractor's cost estimate and in-turn questioning why the contractor has attributed so many hours to some cost items."* – *Project's partnering facilitator.*

Continuing, this difficulty is recognised as having put large strains on the relationship between client and contractor as the discussions and audits has conveyed a lack of trust between the parties, something which is believed to have been avoidable with a more mirrored organisation. Moreover, the project's partnering facilitator sees the client's questioning as having had a negative impact on the target cost and design development processes, the reason being that the dynamic nature where ideas and alternative cost estimates are shared openly has been smothered by attempts to drive down costs.

Project B – The importance of cost certainty:
An additional aspect of the target cost process which was discussed by members of both contractual parties was the importance of creating an as accurate cost estimate as possible in order to reach a greater certainty of profitability for the contractor and an overall greater cost certainty of the project. It is recognised by the contractor that to minimise the potential occurrence of cost overruns, one as contractor is motivated to push for the continuation of the cost estimation process until the entirety of the project has been designed and controlled in detail. Thus, the contractor ensures their profit margin in the case of a fixed contractor fee in project B. This is also a characteristic of the reimbursement model that is recognised by the client, but apart from noting the contractor's willingness to ensure that a detailed target cost is prepared, the reflection is also made that the same holds true from a client's perspective. The underlying reason being the client's unwillingness to pay more than necessary and the risk of having to internally manage budget overruns with other municipal actors and politicians. Moreover, this aspect is also believed to be a part of the process where the client looks to get evidence and proof, and ultimately an understanding, for the target cost and the underlying assumptions.

## 5.3 Linking ECI, contractual disposition and innovation

The hereby following section addresses innovation in ECI-projects and how the respective projects' contractual disposition has affected innovation. The findings are presented in accordance with the respective project in which they were perceived.

### 5.3.1 Project A

Project A – Opportunity for innovation and innovation outcome:
The client interviewees uphold the opportunity for innovation to have been large throughout the project, specifically pointing to the extended period of time that the contractor has been involved in the design phase, time which is seen to have allowed for extensive investigations into producing the project in smarter and more innovative ways. The opportunity to impact the design development and the extended time which the contractor has been involved in the project are two aspects which the client perceives to have provided the contractor with a larger opportunity to be innovative than in other projects. Yet solely involving the contractor in design development as a means to get suggestions of innovations and of improvements to technical solutions has proved to have limited impact in project A, where one client interviewee emphasises the highly traditional outcome that the planning and design phase has had. The contractor interviewees on the other hand also recognise the possibility for innovations as having been large throughout the project's planning and design phase. Moreover, the client's efforts in allowing time and resources to be used in order to find alternative solutions are emphasised by the contractor, claiming that the client has welcomed such efforts and interests. This is seen to have allowed the contractor the necessary freedom and room for investigations into innovative solutions, hence the client's efforts and behaviour cannot be seen as hindering the innovative outcome in the planning and design phase.

As for the innovation outcome, the contractor interviewees give evidence of multiple solutions which ultimately were discarded. One investigation was made into the use of a fiberglass mesh in the project's asphalt, an effort which could reduce the needed asphalt thickness by half, and which is commonly used in both Denmark and Norway. But this was discarded due to the lack of documented and studied use in Sweden, due to not conforming to the client's design regulations, as well as proving to be costly. Other innovation investigations included the use of alternative binders in concrete and the possibility to use prefabricated bridges, alternatives which were ultimately not chosen due to their higher costs.

Project A – Lack of incentive for innovation in planning and design:
Another driver for innovation which is recognized by interviewees on both contractual sides is the importance of economically rewarding the contractor for their accepted innovative ideas and solutions. It is on the contractor side by one interviewee emphasised to be a necessity to reimbursing the contractor for these efforts as to increase innovation in projects, and a parallel is drawn to the perceived fairness of a situation where the client otherwise would reap all benefits from the contractor's innovative efforts. Similarly, this perceived necessity in rewarding the contractor for their innovation is also recognised on the client side. Here one interviewee emphasises that one must provide the contractor with an economic benefit if one aims to increase the innovativeness in projects, pointing to the contractor's need for profit in projects as the underlying reason. In doing so, the contractor's possibility to gain from the economic incentive in the construction phase is highlighted as providing such a reward.

However, the contractor interviewees share insight into the problems one as contractor can phase in the contractual arrangement that is used in project A, where economic incentives for increased efficiency and innovation solely exist in the projects second phase. Simply put that one potentially will not be rewarded for optimised and innovative solutions in the planning and design phase before the target cost has been agreed. The contractor's project manager makes the following reflection regarding this contractual peculiarity:

> *"If one comes up with a super smart solution, would one dare to share it during the planning and design phase and put a target cost on it and not get any economic incentive for it, because the contract is made for the contractor to get a large incentive if one finds a smart solution, would one share it or possibly think "No we bring it up later, when we can make an alteration"? I do not know; it might have been difficult depending on the situation." – Contractor's project manager.*

Project A – Target cost timing:

Moreover, the contractor interviewees also connect this difficulty to the point in the project timeline at which the target cost negotiations commence and the cost uncertainty which innovations can bring. In the current arrangement where one as contractor is the sole negotiator with the client for the project's target cost, the interviewees see no incentive for the contractor to take on any unnecessary risks or uncertainty as for an innovations cost outcome and thus including them in the target cost. One would rather include a solution which one is sure works and where the solution's costs are certain, also highlighting that one does not often have time to study all solutions in detail before the target cost is set. As for the point in the project timeline at which the target cost negotiations commence, the interviewees perceive the contractor to fully investigate alternative and innovative solutions first after the target cost has been set, largely driven by the will to find cost savings which one is rewarded for. However, the agreement of the project's target cost is in project A seen to have been reached at a late stage which has allowed for limited room for such investigations to prove fruitful, which could explain the limited innovation outcome in the project A. An earlier agreement of the project's target cost is therefore argued to allow increased room and possibility for larger reworks and innovations after the target cost agreement.

Project A – Difficulties in rewarding innovation in early stages:

One major difficulty in rewarding innovation in the planning and design phase of project's is however emphasised to be the nature of the design phase itself where one aims to decide what to build and how it should be built, hence creating a situation where one often does not have a comparison to which the innovative solution can be judged and measured to. This lack of comparison thus creates a situation where one might design an innovative solution without fully seeing its potential benefits or drawbacks, or possibly a situation where one has to design two different solutions simply to provide the ability for comparison.

### 5.3.2 Project B

Project B – Opportunity for innovation and innovation outcome:
One of the assessment criteria for the contractor's tenders in the procurement of project B, as well as an aspect that is emphasised in the project's partnering charter, is the contractor's perception and expected contribution to the development of innovative solutions to be implemented in the project. Moreover, the assessment criteria asked the contractor to reflect over how the project, with its peculiar architectural design, was to be implemented in a cost-effective and efficient manner with a low environmental impact. The client interviewees explain that this was done in order to facilitate a mindset that is open to new ideas and alternative angles of approach, as well as to challenge the project organisation to find better and more cost-effective production methods.

Regarding the outcome of this innovation focus, the interviewees see that it has had a modest impact on the project. Some more explorative investigations concerning production methods and materials are emphasised to have been made, for example into the use of concrete with a lower carbon-footprint and other investigations into more environmentally friendly alternatives and materials, urged on by the client organisation. The partnering facilitator however sees the largest innovation simply to be the water towers architectural design and the design development which has enabled the project to be built. The unique nature of the project is therefore seen as one which requires innovation to be realised and one where the contractor and technical consultants have been challenged to ensure that the architectural vision could be reached.

Project B – Cost risks, profitability, and competitive tendering:
The interviewees from the contractor organisation emphasise multiple limitations to the development of innovations during the project's planning and design phase. One interviewee recognises the uncertainty which innovations and their implementation can create in terms of the cost-aspect of the actual implementation, as well as their impact on worker and machine capacities. This is seen to create a potentially costly risk which the contractor is not rewarded for assuming if such innovations are included in the target cost and their outcome proves costlier than anticipated, hence diminishing the contractor's profit margin. Thus, if the incentive to try alternative and innovative solutions and methods is limited, the uncertainty and connected cost risk can be seen to be an incentive against the implementation and development of such solutions. Another aspect which is discussed and seen as a limiting factor to innovation in project B is the client's choice to procure the project using the contractor's general and administrative expenses as the economic criteria, in the MEAT-evaluation that is needed in order to comply to Swedish public procurement regulations LOU. Thus, in order to win the procurement of the project it was beneficial for the contractor to assign a low percentage value as this was scored higher in the tender evaluation. This has in turn created too large of a focus on discussions of the contractor's profitability and project economics overall in the planning and design phase, and which therefore are seen to have created a wrongful focus in the project for the contractor organisation as these discussions have impeded other discussions for the benefit of the project's outcome.

Project B – Lack of incentive for innovation in planning and design:
Representatives from both contractual sides note the peculiarity that exists in the contract of project B, it being the lack of economic incentives for the contractor to optimise and develop solutions or potential innovations before the target cost has been agreed. This is stressed by the client to be a large downside to the reimbursement model and one which can be a large pitfall for the project. The contractor interviewees also see the lack of economic incentives for such efforts to be a hinder, also highlighting that the economic benefit of such development is one-sided in the client's favour. Moreover, an economic incentive for the contractor to carry through innovation efforts and investigations is seen to potentially create extra motivation in this process.

One contractor interviewee does however emphasise that an attempt to design a subpar solution in order to later optimise it after the target cost has been agreed simply is not feasible to do in reality and even more so in a collaborative contract. Moreover, the troublesome situation which emerges for a contractor if all cost-saving optimisations and innovations have been included in the target cost is also brought up, thus the only incentive for improvements is tied to improving the capacities for personnel and machines. These improvements are however seen to have a very limited impact on cost-efficiency and therefore the contractor's margins.

Project B – Target cost timing:
Continuing, the limited potential for profit-improving cost underruns that the contractor will have in project B have been further impacted by the way which the planning and design phase was realised. The reason being that the contractor enters the construction phase with the detailed design already completed as the project experienced large time delays due to difficulties in finding an agreeable target cost. The initial plan was for the project's detailed design to be developed after the target cost agreement had been reached, but the choice was made to continue the project's design development alongside the target cost negotiations. The contractor's design manager makes the following reflection regarding the problematic situation:

> *"Where is the time to rework the large solutions which can impact the project's cost? There is none, you have got to keep them in mind from the start, otherwise you are way off track… so you have gotten into a catch-22 situation, you cannot wait with the [smart and cost-saving solutions] but on the other hand there are no incentives for us to develop them, all while it is obvious if we try to hide them – you simply can't do that." – Contractor's design manager.*

Project B – Difficulties in rewarding innovation in early stages:
The difficulty of finding ways to measure and evaluate each innovative solution and their effectiveness during the planning and design phase is also recognised by the interviewees in project B. As design solutions are unknown before the planning and design phase is initiated, it is reasoned that such solutions cannot be evaluated as one has neither defined nor prepared a cost estimate for them and their respective impact on the overall project. One contractor interviewee

however believes that a rough cost estimate could have been prepared using the drawings and documents prepared during the architecture competition, a cost estimate which could have been used as this needed baseline. Yet the reflection is made that such a cost estimate might have limited applicability and would not be as detailed as needed as the project's design has not been fully defined at such an early stage. The design manager summarizes the above explained difficulty as the following:

> *"I think the difficulty generally lies in finding what one should proceed from and what one should use as comparison, that is what becomes so fictitious, it is impossible to build a water tower with traditional solutions and then to build one with the innovative solutions just to compare their costs."* – *Contractor's design manager*

Continuing, difficulties in estimating costs of more unique projects and those with a large reliance on ground conditions are also aspects which are perceived to create difficulties if one is to reward innovation. Infrastructure projects and those including large civil works often fulfil both these aspects, thus the potential cost-savings and benefits of innovative solutions are reasoned to be much more difficult to determine compared to more standardised projects and those without large ground works.

# 6 Analysis and discussion

The hereby following chapter will analyse and discuss the study's findings from project A and B using the study's presented theory and literature. The findings will be discussed in accordance with the thesis' research questions.

## 6.1 What benefits and hindrances are seen behind the implementation of ECI-projects?

Numerous benefits and hindrances have been presented in the thesis' literature framework, so also in the findings section based on the perceptions of both client and contractor interviewees in project A and B. The main benefits can be seen through the integration of the contractor expertise in planning and design, hence gaining the contractor's input in decision-making and design development, as well as providing an increased time and cost certainty through an earlier involvement. Another benefit seen in project A, and which is commonly seen throughout literature, is that ECI provides an opportunity for an improved client-contractor relationship. Whereas in project B, the inter-organisational problems in the parties' relationship were seen to hinder all benefits from collaboration to be achieved. Interestingly, one hinder recognised in project A was the contractor's difficulty in involving construction personnel in the planning and design stage. These hereby listed benefits and hindrances will be further discussed below.

<u>ECI-timing and its impact on the contractor's input in design and learning:</u>
As for the time of contractor involvement, Wondimu et al. (2018) see a success factors for a fruitful ECI-implementation to be specifically the *timing of ECI application*. The authors argue that one must involve the contractor at a time when there is room to influence the design outcome, yet too early of a contractor involvement may increase costs unnecessarily and provide the contractor with too large influence. When comparing the two project's point of contractor involvement in the project timeline, these aspects can be further emphasised. In project A the contractor's involvement can be argued to be too early as they proved to have limited impact in the project's earliest stages, including investigations into factors affecting the road plan and the route localisation itself. Continuing, one can therefore argue that this limited impact and influence which the contractor has had, has unnecessarily increased the total project costs as their involvement only provided the project with a limited benefit, similar to the findings by Nichols (2007) who saw a duplication of costs at an early stage as a potential drawback to ECI-implementation.

Whereas in project B, the contractor's involvement can be argued to be too late as their impact was limited by an already fixed architectural design and pre-decided localisation. Noteworthy here is however the client's wish to achieve a great architectural design due to the project's location, making it a new landmark for the region. Changes to the project's design proposed by the contractor as to improve buildability or lower completion costs were by the client side deemed to be too rash and impact the project's aesthetics negatively. Hence, through an earlier inclusion of the contractor, the client's uncompromising focus on design aesthetics could have been at risk if one follows Wondimu et al.'s (2018) reasoning where the contractor's influence is seen to be larger the earlier that they are

involved in the project. However, such an argument fails to consider the contractor's input regarding questions of buildability, cost estimation, and value engineering. Through involving the contractor earlier in project B, acting as judge in the architecture competition and assessing buildability and expected costs, one could potentially have better realised these benefits and strengths which one integrates through early contractor involvement. Moreover, such an execution could be argued to increase the potential for a more collaborative continued development of the architectural design between architect and contractor, both as to satisfy a high level of aesthetic design but also to achieve better buildability and opportunity for value engineering through the contractor's involvement.

Another benefit which would have been impacted by the timing of contractor involvement would have been the contractor's increased understanding of the project and design stages as seen in project A. If the contractor would have been procured at a later time in the planning and design stage of the project, one would also limit the contractor's increased understanding of the project and their opportunity of learning which was perceived as an important benefit for the contractor organisation. The aspects of organisational learning and benefits seen through integration of the design and execution phase, for example less information loss, are commonly recognised benefits which are not exclusive for ECI-project, see for example Styhre, Josephson and Knauseder (2004) and their study of DB-contracts. The novelty of the project delivery model that ECI has in Sweden, can from a contractor perspective however warrant this early inclusion as a means to integrate and create an increased collaboration between actors through better understanding of these earliest planning and design stages in future projects.

A client must in turn recognise the previously discussed trade-off between earlier involvement of the contractor which may provide benefits in the project and increased project costs seen through this earlier involvement. The difficulty here lies in valuing the contractor's input and gained benefits thereof at a time when the project often has not been fully scoped, thus making such valuations and estimates difficult guesswork for the client. Yet depending on the perceived complexity of the project, questions of buildability, cost estimation and value engineering which are seen to be the contractor's expertise, can be of different value at such an early stage as seen by Mosey (2009). Hence, in projects with high complexity and where buildability, cost certainty and increased value for money are key, an earlier involvement of the contractor can be warranted compared to projects with lower complexity. One significant distinguishing factor between project A and project B can here be seen to be the uniqueness and complexity of the respective projects. In project A the aim was to design and construct a section of motorway on virgin ground, something which both client and contractor had previous experience of, whereas project B entailed the design and construction of an architecturally unique water tower which neither client nor contractor had experiences of. As to best manage this complexity, as well as provide input regarding the project's architectural design and localisation, project B could therefore be argued to have benefitted from an earlier involvement than what was realised.

Improved client-contractor relationship and collaboration through ECI:
The importance of collaboration in ECI, and its achievability through the implementation of ECI, has been discussed by multiple authors as previously presented (see e.g. Laryea & Watermeyer, 2016; Nichols, 2007; Rahman & Alhassan, 2012; Volker et al., 2018). In project A particularly, an improved client-contractor relationship, and overall well-functioning collaboration, was achieved through the implementation of the collaborative contract arrangement that ECI is. Yet in both project A and project B, some hinders to the achievement of all benefits through collaboration were still found.

In project A, the lack of understanding of the project delivery model was seen to hamper collaboration between the client's internal technical specialists and the contractor. This was made evident through the contractor interviewees comments regarding the technical specialists' choice to manage the project like one without a collaborative contract arrangement. Following Rahman and Alhassan's (2012) reasoning, that in order to achieve a successful collaboration there is a need for equal commitment and of a compromising attitude from all project participants, the technical specialists' unequal commitment and uncompromising attitude can thus be argued to have negatively impacting the potential win-win situation which the project delivery model sets out to create through collaboration. Due to the novelty of the ECI-approach in Sweden, a parallel can here be drawn to the findings made by Wondimu et al. (2018) who find a lack of awareness of the importance of ECI and a lack of experience in the use of ECI as two hinders to full implementation. In project A the lack of experience of ECI can be seen to be inherent due to the novelty of the adopted ECI-implementation and one can also argue that the client has failed in communicating and creating the necessary awareness on the importance of ECI for all project members, thus hindering the realisation of all benefits. Moreover, this problem is project A can also be linked to the necessary culture changes which all project participants must undergo in order to fully succeed with ECI as explained by Nichols (2007).

The collaborative difficulties seen in project B on the other hand resemble the problems and drawbacks recognised by Rahman and Alhassan (2012) in that problems that are relational in nature are common in ECI-projects, and of utmost importance to be managed. The importance of trust and transparency, and of collaboration overall, is recognised by Wondimu et al. (2018) and Laryea and Watermeyer (2016) who see these factors as detrimental for ECI success as to maximise the output of the relationship through increased openness and knowledge-sharing. Hence, the incidents seen in project B where the parties' transparency was not complete and which were seen to impact trust negatively, may have impacted the benefits seen through the ECI-implementation. Moreover, the incidents seen where both parties acted in their own interest rather than for the project's good were seen to further create distrust between client and contractor. Through once again looking to Rahman and Alhassan (2012), one can clearly see that this contradicts the compromising attitude needed for successful ECI-implementation in that one wishes to maximise their own benefit from the project regardless of how it impacts the other party. Moreover, this gives evidence of the agency problem where the client, as principal, has contracted the contractor, as agent, to perform work for them, yet internal interests in the respective

organisations are differing and driving the two parties to pursue and behave as to best serve themselves (Eisenhardt, 1989). The information asymmetry between principal and agent that is seen in the agency problem can also be seen to exist in project B due to the parties' lack of inter-organisational transparency. Hence, one can also argue that this lack of transparency has resulted in a two-way moral hazard problem where neither contractual party has fulfilled their obligation to act transparently and in accordance with the projects best as expected when implementing a collaborative arrangement.

Of particular interest when comparing the two findings of the two projects is that the interviewees of project A perceived the implementation of ECI to improve the relationship and collaboration between client and contractor compared to other projects, but contrarily in project B, the parties experienced difficulties in creating a well-functioning relationship and fruitful collaboration. Moreover, in project A the general perception was that the ECI-implementation had created a united project organisation, yet such a perception was not shared in the case of project B. Drawing from Rahman and Alhassan (2012) and Volker et al. (2018), through the creation of an integrated team at an earlier stage than other projects, one increases the opportunity of better inter-organisational relationships and increased collaborative exchanges. The word to note here should be *opportunity*, in that the implementation of a collaborative contract arrangement, like ECI is, one cannot simply expect the likes of client and contractor to get along and collaborate from day one. Continuing, the difficulties experienced in project B as for the project organisation's attempts to equate and jointly define the view of money, time schedules and quality among the project participants, gives further evidence of this. One should, as emphasised by Nichols (2007), rather see that all project participants must undergo large culture changes in order for ECI to be successful. As the success of the ECI-implementation is reliant on each involved organisation, both client and contractor must commit and compromise as to change accustomed culture and work ways into more collaborative ones.

<u>Difficulty in integrating contractor's production personnel in design:</u>
Through adopting ECI as a project delivery model, one wishes to integrate the entire project team as to facilitate increased knowledge exchange between parties and incorporate the contractor's construction expertise already in early planning and design. As emphasised by Edwards (2009) and Lahdenperä (2013), the largest benefits from the integration of construction expertise are seen if it is achieved at an early stage of a project's timeline, and that one otherwise inhibits opportunities to solve questions of constructability and the development of innovative solutions in projects. However, one finding of interest in this thesis, which to the thesis author's knowledge has not previously been observed and reported in ECI-literature, was the production personnel's unwillingness to participate in planning and design in project A, instead preferring to be involved first from the project's detailed design and construction. Following Mosey's (2009) reasoning, that one through ECI-implementation attempts to integrate the contractor in the entirety of the project as to not see their contribution solely in the construction phase, one can argue that this objective has not been reached in project A, meaning that the project has failed to achieve the contractor's full integration in planning and design. Moreover, this can be argued to be a hinder to

the desired knowledge-exchange of the contractor's expertise in planning and design as the site managers and site supervisors who are to be involved in the construction phase, have had highly limited influence in the planning and design phase. Continuing, one can also argue that this will require increased efforts as to facilitate inter-organisational collaboration between the parties when the new project participants will enter at a later stage.

Of further interest with the previous in mind was the comments shared by the contractor's project manager in project A, that the involvement of production personnel in the planning and design phase was perceived to be a risk as one cannot guarantee to reach the call-off agreement for the project's execution phase. Thus, one would rather involve the production personnel first after this agreement has been reached and that they can be a part of other projects throughout the planning and design phase. Hence, the difficulties seen in involving the contractor's production personnel cannot only be seen to stem from the personal conviction and will to only participate in the construction phase among these contractor representatives, but rather that it is twofold and is impacted by this perceived risk within the contractor organisation. The underlying reason why this is perceived to be a risk was not further explained nor investigate, yet a possible reason could be argued to be due to an economic aspect. Wondimu et al. (2018) argued that in order to achieve success from ECI-implementation, the contractor must get fair reimbursement for their contribution and work throughout the whole project, as one might otherwise risk a lowered interest and eagerness to participate and contribute to design in the early stages. Following this reasoning, if the contractor organisation did not perceive the economic compensation to be appropriate in planning and design, and that one could profit even more from the production personnel's involvement in other projects, one would get a lowered interest to involve production personnel in planning and design, thus perceiving it as a risk. Moreover, looking to agency theory we can further develop this argumentation as agent according to Eisenhardt (1989) can be assumed to be risk averse due to their difficulty, or even inability, to diversify their employment. Yet if the contractor has multiple projects at once to which they can assign their personnel, this can be seen as an attempt to better manage risk through diversification. However, one could also argue that the novelty of the project delivery approach and a lack of awareness regarding the importance of ECI, as presented by Wondimu et al. (2018), could be reasons to why this is perceived as a risk.

## 6.2 What challenges does the use of target cost principles and economic incentives create in ECI-projects?

The use of target costing in ECI-projects is common, so also as observed in both project A and B, yet the adopted reimbursement models differed between the projects. In project A, the contractor's reimbursement was incentive-based through a gain-share/pain-share formula tied to the agreed target cost, whereas in project B the contractor was reimbursed according to a fixed contractor fee calculated as a percentage value of the project's agreed target cost. As for the perceived challenges this target cost reimbursement created, there were numerous both in project A and B, and large similarities could be seen between said difficulties.

Target cost timing and the challenges seen with the reimbursement models:
As for the time of target cost agreement, the two projects were managed distinctively different which provided both benefits and drawbacks for either project. In project A the target cost negotiations and agreements were reached upon the completion of the project's road plan and before the commencement of the project's detailed design development. Hence the level of detail in the design work was low and provided large uncertainties which required separate agreements to be made regarding the scope and quantities of cost items. Yet in project B, the difficulties in reaching an agreement of the project's target cost meant that the process was prolonged until the project's detailed design was almost completed. The level of design development was here seen to allow for a more accurate target cost to be prepared, thus creating better cost certainty, yet limiting the contractor's opportunity to benefit from cost-saving improvements.

Even though the involvement of a contractor in early design has been shown to provide better cost certainty (e.g. Mosey, 2009; Eadie & Graham, 2014; Lenfering et al., 2012), one can in the case of project A argue that such a certainty has not been reached due to the still high level of uncertainty at the time of target cost agreement. Yet one should also note the benefit seen by Mosey (2009) in that the involvement of a contractor in the development of a target cost facilitates more accurate pricing as unnecessary risk premiums can be removed. Through the creation of separate agreements that are to be managed according to the actual turn-out in the project, the project team has thus found a way for the contractor to be reimbursed accurately and where the client will not be forced to pay these risk premiums. However, the aforementioned cost uncertainty that this solution provides can be a difficulty, especially for the project's client representatives who according to the findings of Rosander et al. (2020) often experience internal pressures to realise the project to budget. With the previous in mind, the contractor interviewees in project A also reasoned that an agreement reached at a later stage of the project where the design's detail level was greater would have provided a more accurate target cost and would have diminished the need for separate agreements to be made, thus making the target cost negotiations both easier and shorter. This can be seen to be in line with Nichols (2007) who sees the most common approach to target costing in ECI to be realised before the project's detailed design development begins, yet that preparing the target cost based on the project's detailed design allows for more accurate and detailed cost estimates.

With the previous in mind, the target cost process seen in project B resembled the second one described by Nichols (2007) where a more accurate and detailed cost estimate is prepared. This aspect of accuracy and cost certainty is also recognised by both contractual parties in project B, both in terms of an overall greater cost certainty but also in turn as to ensure the contractor's certainty of profitability. In doing so, a reflection is also made that there is an incentive to prolong the project's target cost process in order to accurately scope, design and quantify all cost items and the project's constituent parts. Following the same reasoning, one can draw parallels to Bröchner et al. (2015) who argue that an accurate and fair target cost is of utmost importance as to ensure that cost risks and questions regarding profitability are managed well. One must however note that this reasoning is made

by Bröchner et al. (2015) regarding pain- and gainshare incentives, yet it can be seen to be applicable also to contracts with a fixed contractor fee as is the case of project B.

Looking to agency theory and its discussion of outcome uncertainty, we can attempt to further explain the seen difficulties seen in project A and B. The level of outcome uncertainty as for the projects total costs can be argued to decrease the longer the project continues, hence making estimates and assumptions in the early design stage inherently have a higher level of uncertainty than those prepared at a later stage. This was also argued to be true in the case of project A and B where later target cost agreements were perceived to provide more accurate and certain cost estimates. This is of particular interest when looking at the debate between outcome- and behaviour-based contracts, in which outcome-based contracts between principal and agent are seen as less attractive when outcome uncertainty is high or when the outcome is difficult to measure (Eisenhardt, 1989). Thus, the inclusion of outcome-based contracts, in the shape of incentive-based reimbursement in project A and a fixed contractor fee in project B, inherently calls for increased costs as to shift this risk (due to uncertainty) to the agent (the contractor) if following the reasoning provided in the thesis' theoretical lens. Due to the agent's unwillingness to assume risk, and the principal and agent's varying attitudes to said risk, the parties may prefer different actions, thus providing an explanation to the contractor's desire to prolong the target cost process as to minimise outcome uncertainty and therefore risk which they will have to assume through the contract.

Summarising, in project A an earlier agreement was reached with lesser cost certainty and a need for separate cost item agreements as trade-off, and in project B a later agreement was reached with greater cost certainty yet with trade-offs being increased time for the target cost process. Thus, there is also an importance as client to consider the implications which a prolonged cost estimation and target cost process creates regarding the increased costs of the planning and design phase. One must here find a balance between an increased cost certainty and that of an increased expenditure caused by the involvement of the contractor's personnel in a lengthier target cost process. Moreover, the time spent in achieving this improved cost certainty can prove to be better used elsewhere, for example through an earlier start of the project's construction and consequently an earlier handover.

<u>Equating client-contractor views and interests pre target cost agreement:</u>
One strength of both incentive-based and fixed contractor fee contracts is recognised to be an increased alignment of client-contractor interests after the agreement of the project's target cost (Bröchner et al., 2015; Eriksson & Hane, 2014). Yet as made evident by Nichols (2007), the alignment of client-contractor interests is only achieved after the target cost has been agreed, and there are inherent difficulties in reaching this agreement in the planning and design stage. Such difficulties in aligning client-contractor views and interests during the planning and design phase were also seen in project A and B.

In project A, equating the parties' interests pre target cost agreement was emphasised to be one of the most difficult challenges which the project team faced, and that the parties' interests regarding economic matters were seen to be in stark conflict to one another. The inclusion of economic incentives based on the project's target cost were seen to spur on the contractor's willingness to ensure that the agreed target cost minimised the risk of cost overruns and simultaneously maximise their potential profit. Hence closely resembling the difficulties the contractor sees according to Nichols (2007) in that one wishes to agree to a target cost which minimises the risk of overruns and maximises profitability. However, the client's inherent willingness and incentive to ensure that the total project cost is kept low as to not spend money unnecessarily was in project A seen to create this aforementioned conflict of interest. Similarly, for project B, the interviewees recognise the conflict between the contractor's willingness to ensure their profitability through a higher target cost and the client's willingness to keep costs to a minimum also in a project with a fixed contractor fee. Interestingly, Bröchner et al. (2015) emphasise that projects with a fixed contractor fee have a lower relative cost risk as for the impact on profitability compared to projects with incentive-based reimbursement, thus minimising the focus on the project's target cost. Yet in project B, the interviewees perceived the focus on the target cost and project economy to be substantial and too large in the project's planning and design phase. Moreover, this disparity in interests in project A and B, and the varying attitudes and perceptions of risk between the parties, is the essence of the agency problem (Eisenhardt, 1989). The interests, as to ensure profitability and keep project costs low, where in conflict between the principal (client) and agent (contractor) in both projects, and the agents perceived the potential impact on their profitability as a cost risk hence giving evidence of risk averseness commonly seen among agents.

This disparity in interests between client and contractor can be further emphasised in the case of project A. Volker et al. (2018) recognised that a large percentage of shared cost over- and underruns is perceived to be a cost risk more than an opportunity for the contractor, hence creating an additional incentive to inflate the project's target cost. This is also perceived to be the case in project A according to the contractor interviewees who see the risk of sharing a large target cost overrun as having a detrimental effect on their profitability from the project. Interestingly, the client side perceived the incentive levels of said overruns to be fair as an equal share of potential overruns was believed to create equal reason for both contractual parties to ensure that the project was realised to budget. Hence, the client and contractor's views and interests can once more be shown to stand in conflict to one another. Moreover, agency theory provides further explanation to this disparity as principal and agent are often seen to have varying attitudes towards risk and risk sharing between the parties. Hence, the principals transfer of risk to the agent was in project A according to the principal seen as valid and as an important motivational factor, yet by the agent it was seen as transferring too much risk. Due to the agent's risk averseness, this was therefore perceived as problematic and something which further misaligned the principal and agent's interests pre target cost agreement.

Interestingly, further difficulties were recognised to stem from this disparity of client-contractor interests in project B, namely that it affected the inter-organisational collaboration between the parties negatively. Through these experienced difficulties, the focus on project costs and discussions thereof became large, and distrust formed among the participants on both contractual sides due to a too large focus on how the own organisation was affected by said target cost. Similarly, Rahman and Alhassan (2012) recognise a lack of communication and trust to lead to situations where one compromises a common benefit due to commercial pressure. The difficulties in creating a joint view of the project, and its deliverables and prerequisites, can also be argued to stem from an uncompromising attitude among the project participants which Rahman and Alhassan (2012) uphold as a hinder to successful collaboration through ECI-implementation. Continuing, the cultural hinders which accustomed mindsets and roles pose to collaboration, as recognised by Nichols (2007), may have affected project B and provide an explanation to some of these shortcomings. The common contractor has often been described as being opportunistic and adversarial whereas the common client is seen as controlling and suspicious of the contractor and their work. In project B, the controls and audits of the target cost employed by the client proved to negatively affect the inter-organisational relationship in the project and was by the contractor perceived to create distrust. Hence, the client's actions were perceived by the contractor as too controlling and the cultural hinder created through an accustomed client role may thus provide an explanation to this shortcoming. Moreover, the angst of opportunistic behaviour which the client side showed, resulting from the reliance on the contractor in the target cost process gives further evidence to how deeply rooted cultural mindsets and roles may impact collaboration. However, as made evident by the incidents where both parties showed opportunistic behaviour and not acting transparently, the contractor cannot be said to be faultless as for how the cultural hinders recognised by Nichols (2007) may have impacted the parties' collaboration.

Interestingly with the previous discussion of target costs in mind, Volker et al. (2018) recognised that the inclusion of target costing in ECI-contracts may counteract inter-organisational collaboration before the target cost agreement has been reached, due to the previously discussed difficulties in aligning the client-contractor interests. The authors see this in incentive-based contracts, yet similarities to this difficulty can also be seen in project B which has employed a remuneration model based on a fixed contractor fee. This can be argued due to that both reimbursement models share the same drawback in that the contractor's willingness to drive up the target cost, in order to minimise cost risks of overruns and maximise profitability, stands in conflict with the client's incentive to realise the project as cheaply as possible and to budget. As for project B, the relational difficulties experienced between client and contractor during the target cost discussion and negotiations, negatively affected the parties' collaboration, hence giving evidence to Volker et al.'s (2018) connection between target costing and collaboration also in the case of project B. One must here emphasise the potential economic implications which this will have as for the need for investments as to reinstate a functioning collaborative environment in the shape of e.g. teambuilding. Moreover, the contractor could ultimately face the risk of not being assigned the option to complete the project if one cannot collaborate and find an

agreeable target cost, which for the client also would have a negative economic implication as a new contractor would have to be procured.

These difficulties and conflicts, both stemming from the use of economic incentives and the project's incentive levels, were seen to prolong the target cost negotiations in project A as the client and contractor had large difficulties in equating their views and interests of the project, and ultimately agree on a target cost which was perceived as fair by both parties. This disparity in views and interests between client and contractor was ultimately the driver for the long extension of the target cost negotiations also in project B, and for the parties' increased protectionism when in target cost discussions. Moreover, through looking to agency theory we can see that problems experienced in both project A and B closely resemble the common agency problem stemming from the principal and agent's different interests and attitudes towards risk. Through the inclusion of outcome-based contracts in the construction and handover phase of project A and B, the client, as principal, has attempted to align the parties' interests for the construction phase. Yet one must also consider the implications this has on the project's initial planning and design phase in which these interests and risks are to be divided among the parties, in project A and B proving to further emphasise the misalignment between principal and agent.

Client budget providing wrongful expectations of costs:
As for a potential underlying reason to these difficulties, we can look to Rosander et al. (2020) who sees the client's initial budget, with which they get permission to procure the project, as setting the tone for the collaborative contract in that it shapes the client's view and expectation of project costs. In both project A and B, the early budgets prepared internally by the clients proved to severely misjudge the expected costs of the project, hence creating wrongful expectations which proved difficult to manage when entering the target cost discussions. As Rosander et al. (2020) explains, clients are often pressured by the own organisation as to realise the project to budget, which thus further separates the client-contractor interests in the case of the target cost exceeding the client's initial budget. This would then from a client perspective create a situation where one has misjudged and underestimated costs which shapes one's expectations, as well as experiencing a strong internal pressure to realise the project to the said budget if following Rosander et al.'s (2020) reasoning. Moreover, the interviewees in project A also gave evidence of the difficulties which the client's project management had faced when communicating this disparity between budget and target cost internally to their upper management, possibly due to the aforementioned internal pressure of budget conformance. As for project B, this early underestimation of costs, which according to Lenferink et al. (2012) and van Valkenburg (2008) is common in infrastructure projects, also created distrust and a situation where the client felt tricked by the contractor.

One can in both project A and B, from a client's perspective see the connection between Rosander et al.'s (2020) budget expectations and the importance of a target cost which is perceived as fair by both contractual parties as emphasised by Bröchner et al. (2015). As the contractor-prepared target cost was shown to far exceed the client's initial budget, the client's perception of the target cost as far

too high can therefore be understood and provide an understanding behind why the client felt tricked by the contractor. However, as to equate the two parties' views on project costs, a large series of audits and questioning was used by the client as to provide proof for the large disparity between the client budget and contractor-prepared target cost.

Target cost prepared solely by one party – the contractor:
One step in equating the client and contractor's views of a project's expected costs in the planning and design phase is through the joint preparation of the projects target cost, an aspect which neither project A nor B have realised. In both projects the contractor prepared the target cost, which was then audited and controlled by the client, or by the client's contracted consultants, despite both projects' clients communicating the wish to perform this process jointly. Mosey (2009) explained how one through a joint target cost process facilitates improved knowledge-exchange and a more accurate estimate thereof, yet a joint target cost process can also be seen to facilitate the development of a joint view of the project's expected costs. This is also of importance when comparing the findings from project A and B with those of Nichols (2007) who found the clients in his study to become over-reliant on contractors and consultants in the cost estimation process due to a low level of experience and expertise of such work. As made evident in both projects, the clients became reliant on the contractors to provide the projects' cost estimates.

Continuing, Nichols (2007) saw that this lack of experience and expertise further limited the client in their ability to review and challenge the other parties' assumptions and estimates. Similarly, both clients in project A and B expressed difficulties in understanding the contractor's highly detailed cost estimates, and where external consultants and audits were used in both projects as to control the contractor's work. Hence, the lack of experience and expertise of cost estimation did in both projects provide difficulties which resulted in that the client was forced to contract another external party simply to control the contractors work, in turn additionally increasing their reliance on another party.

The target cost process, and its completion solely by the contractor, can be argued to present the most compelling evidence for the asymmetric divide of information between the project's principals and agents in both project A and B. In agency theory, this asymmetry is seen to inherently exist where the agent has more information than the contracting principal, as also proved to be the case in the two studied projects where the client, as principal, did not know to a full extent what the contractor, as agent, had done. Hence, as to reveal the agent's behaviour, the principals invested into information systems, in the shape of external target cost audits, as to equate the information imbalance. One can however argue that the realisation of the target cost process solely by the contractor unnecessarily created angst of the agent's opportunism and the moral hazard problem among the two projects' principals. Thus, through preparing the target cost jointly and with transparency between principal and agent from the start, one could possibly have avoided the need to make the aforementioned investments into external audits as the joint process in itself could be seen as an information system which revealed the agent's behaviour for the principal.

## 6.3 How are ECI-projects and their current contractual disposition affecting innovation in projects?

Multiple contractual aspects in both project A and B were seen to impact the contractor's willingness to suggest and implement innovations in the projects' planning and design phase, they will hereby following be discussed.

Timing of ECI-implementation and target cost agreement:

One main aspect affecting the opportunity for innovations in ECI-projects is the contractors point of involvement in the project, and multiple authors see that an earlier involvement increases the contractor's opportunity to suggest and develop innovations (Lenferink et al., 2012; van Valkenburg et al., 2008; Volker et al., 2018). This was also seen to be the perception among both the client and contractor interviewees, that the early involvement of the contractor and their lengthy integration in the project's design involvement had facilitated a larger opportunity to propose and develop innovations compared to other projects without such a long contractor involvement. Another aspect of timing in both project A's and B's planning and design phase was highlighted as impacting innovation, the point at which the target cost was agreed. Even though this aspect of target cost timing already has been discussed, the difficulties thereof seen in both projects warrants further discussion as for how the target cost agreement impacts how the contractor is rewarded economically for their innovations.

In project A, the majority of innovation and improvement efforts were seen to be concentrated to the project's detailed design development, after the target cost agreement. The underlying reason driving this was according to the contractor their opportunity to economically benefit through such efforts first after the target cost agreement, due to the project's incentive scheme in the construction and handover phase. Thus, the point in time of the target cost agreement was seen to limit the contractor's possibility to benefit from such innovations and improvements whereas an earlier agreement was seen to provide larger opportunity for the contractor to profit from these. Moreover, a shortage of time was also reasoned to be a contributing factor where an earlier target cost agreement would have allowed larger reworks and investigations into innovations to be made than what was now deemed possible during the detailed design development. A clear connection can here be seen to the innovation hinder which Rosander et al. (2020) and Volker et al. (2018) recognise, it being a limited timeframe for such efforts during planning and design development. As for project B, similar reasoning and perceptions were evident. The extended target cost process meant that the projects design development was close to completed, thus creating an even smaller possibility for the contractor to suggest and implement innovations if one follows Lenferink et al.'s (2012) reasoning, that this possibility decreases the longer the project's planning and design development proceeds. Once again this is reliant on the contractor's perception that one must be able to profit economically from innovations in order to fully engage in innovation efforts, thus focusing on such efforts first after the target cost agreement. Hence, the problem can rather be seen to stem from the lack of economic incentive for the contractor to engage in innovation work in the planning and design phase.

The lack of incentive for innovation in planning and design:

This lack of incentive is as made evident in the thesis' findings mentioned by the interviewees of both project A and B as a hinder to increased innovation. In project A, both contractual sides see the importance of economically rewarding the contractor for their innovation efforts and see this as a driver for increased innovation in projects. The contractor interviewees even perceive it to be a question of fairness in that efforts which improve the project should be rewarded, regardless of the point in time when they are suggested and implemented in the project. Thus, a connection can also be seen to the aforementioned difficulty in aligning client and contractor interests pre target cost agreement.

For a client, the inherent willingness is to achieve the best possible project at the highest value for money throughout all stages of the project timeline, and as made evident by Kristensen et al. (2015) and Rekonen and Björklund (2016) the most beneficial time at which to implement innovations and improvement is as early as possible as to increase their impact and realise them to the lowest cost possible. Yet for the contractor in project A the most economically beneficial time to implement these cost-saving innovations would be first after the target cost has been agreed. Hence the client's and contractor's interest as to the best time to suggest these innovations can be seen to be in conflict to one another. Moreover, both in project A and B the contractor interviewees perceive the implementation of an innovation to bring large uncertainties as for the cost outcome of such an innovation. Thus, through realising such an innovation and including the cost-benefits it may bring in the target cost, as the contractor not only assumes the cost risk such an innovation might have if the implementation proves more costly than expected but also limits the gains one might receive through cost-savings achieved in the projects planning and design phase.

Continuing, this disparity in interests is also made evident by the comments of one contractor interviewee who reflects over whether one potentially would hide a highly beneficial innovative solution till after the target cost agreement as to ensure that one benefits economically from it. Similarly, Rahmani et al. (2018) recognised a similar difficulty in Australian ECI-projects in which the contractor had no incentive to share innovations in the project's planning and design phase, but rather had an incentive to hide them till the project's construction phase in which the contractor can be rewarded for them in full. This unwanted incentive was also seen to be evident in project B where the contractual arrangement, and the lack of economic incentive in phase 1, was perceived as limiting innovation. Moreover, similar reasoning to that in project A and the one recognised by Rahmani et al. (2018) was also made by the contractor in project B, yet the contractor emphasise that to opportunistically hide innovative solutions from the client in the collaborative contract simply would not be feasible and would contravene their business principles. However, looking back at the conclusion drawn by Rahmani et al. (2018), this unwanted incentive was seen to undermine the contractor's "[…] contributions to the design, the degree of commitment, integration, motivation, skill, teamwork and trust that the contractor is supposed to bring to the project […]." (pg. 105).

Looking to agency theory, the effect of this disparity of client-contractor interests and the uncertainty of cost outcome from innovations can be seen as twofold. Firstly, the principal and agent's interests as to when to suggest and implement these innovations differ due to the parties' different economic interests, and the principal will have large difficulties as to assess whether the agent's actions can be seen as valid as they potentially may hide solutions as explained above. Developing this further, one can also question whether hiding an innovative solution as agent should be perceived as a moral hazard in that the agent, through exploiting an informational advantage, puts in a lack of effort for the principal's task during the project's planning and design phase, thus instead opting to develop the solution first when one gains an economic benefit from doing so. One does however in such an argumentation fail to address whether such innovative efforts can be seen to be within the agent's contractually agreed-upon obligations towards the principal, hence making it a matter of moral hazard, or if such efforts can be seen as extending past the agent's contractual obligations during the planning and design phase, hence not making it a matter of moral hazard. If following Rahmani et al.'s (2018) argument above, that this disparity of interests creates an unwanted incentive for the contractor to undermine their contribution in planning and design, one can understand if such a matter would be perceived as moral hazard from the principal's perspective. Yet from the agents side one could motivate it to stem from not being appropriately compensated for their efforts and contribution in the planning and design phase, which according to Wondimu et al. (2018) is a success factor to ECI, particularly in early stages where one otherwise could face the risk of a lowered interest and eagerness to contribute to design as contractor, and thus agent in this analogy.

Secondly, the disparity between the principal's and agent's attitude towards risk, and the agents risk awareness, also creates a problematic situation as to if one should include an innovation in the project's target cost. This is by the projects' contractors (agents) perceived as increasing the outcome uncertainty as to whether one will overrun the target cost due to the inherent uncertainty of innovations and their implementation. This could then negatively affect the agents' profitability due to the projects' outcome-based contracts. Hence, one would not only transfer part of the risk to the agent through the adoption of the outcome-based contracts, but also increase the outcome uncertainty, and thus risk, through including these uncertain innovations in the project's target cost. This therefore also warrants the discussion of how outcome uncertainty affects outcome-based contracts. As presented by Eisenhardt (1989), outcome-based contracts are attractive when the outcome is easy to measure and determine, or simply when the outcome uncertainty is low. Yet as emphasised earlier, through including an innovation in the target cost one increases the outcome uncertainty, hence contradicting the situation when an outcome-based contract is attractive. Eisenhardt (1989) also emphasises that the higher the outcome uncertainty is in an outcome-based contract, the higher the cost will be to shift the risk to the risk averse agent. Yet through including an innovation in the project's target cost, the contractors (agents) in project A and B argued that the potential benefits seen through the cost-saving ability of an innovation would be passed in full to the projects' clients (principals) as the contractor was not rewarded for such suggestions in the planning and design phase. Hence, one can once more question

whether the contractor, as agent, is appropriately compensated for assuming this level of risk which inherently comes through the adoption of outcome-based contracts, and which is further extended through suggesting and including uncertain innovations in the project's target cost.

Connecting back to Rahmani et al. (2018), the client-contractor interest disparity was also seen as potentially affecting other contractor contributions in design, including motivation, teamwork, and skill. Hence, the lack of economic incentive in the planning and design phase, and the unwanted incentive this creates for the contractor, also warrants the matter to be discussed from a perspective which considers the potential impact on client-contractor collaboration. The importance of inter-organisational collaboration both as to facilitate and increase innovation is recognised both within ECI-literature (Lenferink et al., 2012; Rahman & Alhassan, 2012) and in construction in general (Blayse & Manley, 2004; Lahdenperä, 2012). Yet if following the previously mentioned reasoning by Rahmani et al. (2018), this collaboration may be at risk due to the current contractual dispositions, and the interest disparity thereof, in both project A and B. As to ensure the innovation outcome of projects, the goal must be to facilitate better alignment of client and contractor interests pre target cost agreement as this in turn impacts collaboration. Moreover, the way in which the target cost discussions and negotiations commenced in project B, that negatively impacted collaboration due to these different interests, can be argued to mirror the potential difficulty otherwise seen if such an alignment is not achieved. Through aligning the client and contractor's economic interests regarding the proposal and implementation of innovations in the planning and design phase, one can argue that the innovation outcome thus will improve, and that the alignment of interests will facilitate an improved collaboration, which in turn is seen to facilitate and increase innovation in projects.

# 7 Recommendations

The hereby following chapter will provide recommendations for both clients and contractors regarding the current implementation of ECI in Swedish infrastructure projects. Firstly, the chapter will address incentivization of innovations as a potential remedy to the previously discussed hinders to innovation in ECI-projects seen in project A and B. Secondly, more general recommendations and points to consider are proposed.

## 7.1 How can economic incentives be used to promote innovation among contractors during the design phase of ECI-projects with target cost contract principles?

Attempting to incentivise innovation through the implementation of economic incentive structures must be done with care and require thorough investigations as to increase collaborative exchange and minimise the risk that other interests crowd out the desired one (Rosander et al., 2020). Hence the following section of the thesis will discuss limitations and aspects to consider when attempting to do so.

Client and contractor interviewees both in project A and B note the difficulty in attempting to reward innovation and tie it primarily to one factor, the lack of or limited comparison to which one can assess an innovation's effect and output. In project A it is reasoned that the nature of the design phase where one attempts to scope out the project and how it is to be achieved inherently creates this difficulty. In project B this is further elaborated on as unique projects with large ground works are reasoned to often come with large uncertainties which are impossible to foresee, uncertainties which can pose to have a large effect on the potential cost-savings and benefits of innovative solutions. In project B the idea to prepare two cost estimates, one when entering the project and one later when entering target cost negotiations, is brought up by a contractor interviewee. This would allow the inclusion of a sharing-scheme of cost savings between the two parties thus aligning the client's and contractor's economic interests as the contractor thus would be able to profit from said innovations and improvements in the planning and design phase. Yet the increased efforts needed to prepare two estimates instead of one should not be overlooked, neither should the contractor interviewees reasoning that this early cost estimate could prove to have limited applicability due to the low level of detail that has been achieved in design at such a point. Continuing, Bröchner et al. (2015) reasoned that both parties must perceive the target cost, which the gain-share/pain-share mechanism is based on, to be fair as one otherwise run the risk of facing conflicts due to these inherent conflicts of interest previously discussed. Moreover, the authors also emphasised that the target cost must be prepared thoroughly as to ensure that all foreseeable uncertainties are overseen. Hence the large uncertainties which exist in the early stages of planning and design make such a detailed and thoroughly prepared target cost highly difficult to achieve, thus creating unwanted opportunities for conflicts to emerge between client and contractor regarding the perceived level of fairness of this early cost estimate. This can in turn damage the parties' inter-organisational trust and collaboration.

Interestingly is however that the interviewees in both projects reflect over this comparative difficulty solely tied to one aspect, it being the innovations effect on project costs and acting as a cost saver. This is of particular importance when addressing the findings by Rosander et al. (2020) and Volker et al. (2018) who see a client's focus on improvements through innovations solely from a cost-saving perspective often to be too large, thus acting as a hinder to innovation. For project A and B however, the contractor representatives were also seen to narrowly focus on the innovations' potential cost-saving abilities. Following Bröchner et al.'s (2015) reasoning, that suboptimization can take place if one solely emphasises a single aspect to judge and reward through the incentive scheme, this focus can therefore be seen to be troublesome. Hence, this calls for both client and contractor to widen their view as to the impact and outcome of an innovation to also address other aspects than solely as cost-savers. Thus, in order to incentivise innovation in planning and design, and allow for multiple aspects to be considered, the best suited incentive type is argued to be bonus incentives as no other commonly used incentive type allow for this multi-aspect focus.

Through looking to agency theory, we can further validate and expand the reasoning above as for the appropriateness of bonus incentivisation. Due to the previously discussed levels of uncertainty inherent in early design stages, and in innovations themselves, outcome-based contracts must be deemed unattractive as outcome uncertainty is high and as the cost of shifting said risk to the agent should be high. Moreover, the difficulty as to find suitable comparisons for the cost-benefit of an innovation further extends the above reasoning as the outcome will be difficult to measure and determine. Hence, as to process situations with high outcome uncertainty, agency theory suggests that the principal should contract the agent using behaviour-based contracts rather than outcome-based contracts. As previously explained, bonus incentivisation allows for other aspects than solely the cost outcome to be assessed, hence allowing for an agent's behaviour to be assessed by the principal as to reward their innovation efforts.

Connecting back to Rosander et al.'s (2020) reasoning that the implementation of economic incentive structures must be done with care and require thorough investigations, the following aspects drawn from the thesis' literature framework should be considered when developing such a bonus incentive for innovation:

- The incentive should be used as a supporting tool in the development of inter-organisational trust, collaboration and motivation as emphasised by Rose and Mandley (2011), and not as a controlling tool to assure project motivation and performance.

- The incentive should be communicated transparently as to ensure that the client's intentions are clear, thus minimising the likelihood that the incentive is perceived as a method for control. If not done properly, one potentially faces the risk that distrust forms between the parties which by Rose and Manley (2011) has been shown to jeopardise the desired motivation one wishes to achieve via the incentive.

- The incentive should be developed jointly between client and contractor as to facilitate knowledge-sharing and trust formation as highlighted by Kadefors and Badenfelt (2009). Thus, one not only creates an opportunity for increased collaborative exchanges but also the likelihood that both parties perceive the incentive-structures as fair. This also allows discussions regarding the contractor's impressionability to be addressed which according to Bröchner et al. (2015) is seen as a common problem area in incentive contracts. The outcome as to whether a bonus should be rewarded or not should be assessed jointly as to further address the perceived fairness of the incentive outcome.

- The incentive should extend to other aspects than solely costs as to ensure that solutions are not suboptimized as emphasised by Bröchner et al. (2015). Hence, aspects like quality, environmental impact and maintenance improvements should be considered depending on the client's interests and intentions behind the project.

- The factors affecting the measured aspect to which the incentive is tied, be it unknown ground conditions or other unforeseeable factors, must be managed as to not reward the contractor purely based on luck. Hence, the measured aspect must also be selected as to provide a sound basis for the incentive. The inherent cost uncertainties that early planning and design stages brings may here oppose the assessment of an innovations cost saving ability, hence demanding that the innovation is measured according to other aspects.

## 7.2 Other recommendations and aspects to consider for future ECI-projects

Several recommendations and aspects to consider for both client and contractor are hereby proposed as to better achieve the complete benefits of ECI-implementation.

- The point in time of contractor involvement has been shown to impact the contractor's input in design and the contractor's ability to suggest and implement innovations. The earlier the contractor's involvement, the larger the contractor's opportunity to impact design development and innovation processes. Moreover, earlier involvement allows for lengthier collaboration and increased opportunity for organisational learning. Yet as emphasised in the thesis' discussion, this increased contractor involvement must be weighed against increased costs in the planning and design phase. Hence, in projects with high complexity and where the contractor's expertise in buildability, cost certainty and increased value for money are key, an earlier involvement of the contractor can be warranted compared to projects with lower complexity.

- The importance of cost estimation expertise among both client and contractor has been shown as this proved to be a hinder for a collaborative cost estimation and target cost process in both project A and B. Hence, if employing target cost remuneration, both parties must have the

organisational capacity to contribute equally as to minimise relational conflicts and the formation of distrust. If a client does not possess the required expertise among their personnel, this could in a short-term perspective be solved through the inclusion of consultants who are integrated into the client organisation and who are involved throughout the project. Transparency throughout the whole cost estimation process is also seen to be key in equating client-contractor views of project costs.

- The point in time of target cost agreement was seen to impact the cost certainty of the prepared target cost as the detail level of the cost estimate is reliant on the level of detail in design. Later target cost agreements provide larger cost certainty for both client and contractor, yet the contractors perceive a late agreement to limit their ability and willingness to suggest improvements and reworks. An early target cost agreement can be seen to inherently include large uncertainties which the contractor simultaneously perceive to be a cost risk due to the potential impact this may have on their profitability. One must therefore consider the consequent impact on the project's incentive scheme as for the time of target cost agreement.

- The implementation of ECI in projects requires commitment and a compromising attitude from both parties, hence the participants constituting the project organisation must be selected as to fulfil these prerequisites and to ensure a successful collaboration. Moreover, due to the novelty of the project delivery model, the objective and expectations must be communicated and discussed among all involved personnel.

- Through looking to agency theory and its attempt to optimise contracts between principal and agent, one can question the use of outcome-based contracts if one as principal has as objective that the agent is to deliver an innovative project outcome. Thus, if one as client looks to achieve innovation through the implementation of ECI, the use of target cost contracts can prove to be a hinder due to the high level of outcome uncertainty which exists in innovation and the design phase. One could instead opt to implement behaviour-based contracts which are not reliant on an outcome for assessment, yet one should note the increased efforts one as principal must go through as to manage the asymmetric information divide between principal and agent.

# 8 Conclusion

The implementation of Early Contractor Involvement as to integrate the entire project team that are to realise the project is in Sweden a novel approach. This thesis has contributed as to assess what benefits and hindrances the implementation of an ECI project delivery model has had in the planning and design phase of two Swedish ECI-projects. Moreover, the current use of reimbursement models, and challenges thereof, has been scrutinized. Ultimately, the thesis has also investigated how the contractual disposition of ECI-projects in the Swedish infrastructure sector affect the perceived level of innovation in projects. Through adopting agency theory as the thesis' theoretical lens, these topics have been thoroughly explored and noteworthy future considerations have been presented. The research questions which the thesis has addressed will hereby be answered below.

**What benefits and hindrances are seen behind the implementation of ECI-projects?**

Numerous benefits and hindrances have been presented in the thesis' literature framework, so also in the findings section based on the perceptions of both client and contractor interviewees in project A and B. The main benefits can be seen through the integration of the contractor's expertise in planning and design, hence gaining the contractor's input in decision-making and design development, as well as providing an increased time and cost certainty through an earlier involvement. Noteworthily, in project A, the ECI-implementation provided an opportunity for an improved client-contractor relationship, whereas in project B, the inter-organisational problems in the parties' relationship were seen to hinder all benefits from collaboration to be achieved. Moreover, in project A, the contractor experienced difficulties in involving production personnel in planning and design, thus failing to achieve full integration.

What can be concluded here, and which is seen as a success factor for ECI-implementation in literature, is that realising the project through this collaborative arrangement requires equal commitment and a willingness to compromise from all involved parties. Moreover, a majority of difficulties and hindrances are argued to stem from the novelty of the project delivery model in Sweden as well as inadequate communication as to what the ECI-concept entails and how it should be implemented. To conclude, as to overcome the hindrances experienced in both project A and B both client and contractor must approach the project delivery model with accustomed roles and views left behind, hence giving way for more compromising viewpoints and better collaboration. Moreover, both clients and contractors must note that this collaborative arrangement puts other demands on their respective organisations than other projects, and that equal commitment and increased transparency are key in achieving all benefits of ECI.

**What challenges does the use of target cost principles and economic incentives create in ECI-projects?**

The use of target costing in ECI-projects is common, so also as observed in both project A and B. Even though the adopted reimbursement models differed

between the projects, the perceived challenges that stemmed from the use of target costing showed large similarities between project A and B. The difficulty as to equate the client and contractor's interest pre target cost agreement was seen to be the largest, where the contractor's willingness to ensure profitability was seen to stand in stark conflict with the client's aspirations to keep costs down. Thus, reaching an agreeable compromise in target cost negotiations was difficult, and in turn lead to largely extended target cost processes both in project A and B. Another difficulty which was seen to further complicate the target cost processes was the impact that the client's initial project budget had on the entirety of the client organisation, thus creating wrongful expectations of costs as these proved to have been underestimates in both project A and B. This further required large efforts as to equate the client and contractor's views, where different cost estimation routines, different levels of detail between client and contractor's estimates, and imbalance in cost estimation experience proved to be subsequent hinders. Moreover, the fact that the projects' target costs were not prepared jointly by both client and contractor was further seen to affect these difficulties, at times creating more of a two-party relationship than a collaborative one.

Concluding, through jointly developing a project's target cost, one not only creates an improved and shared understanding of the project's estimated costs but also provides both parties with an increased insight into the other's cost expectations. Moreover, the joint target cost process can also be seen as an opportunity for knowledge-exchange and learning. However, the aspect of equal commitment in ECI is once again seen to be key in achieving this desired collaborative target cost process, hence both clients and contractors must ensure that they possess the required resources with cost estimation expertise before entering the contract.

**How are ECI-projects and their current contractual disposition affecting innovation in projects?**

One finding can be seen to be of particular importance as for how the currently implemented contracts impeded an increased level of innovation in projects A and B is the lack of economic incentive in planning and design. Moreover, the current use of incentive-based reimbursement and fixed target cost, both based on an agreed target cost, was seen to create an unwanted incentive as for the contractor to hide innovative solutions till post target cost agreement after which they would benefit from an innovations potentially cost-saving outcome. The point in time of target cost agreement was thereof also seen to have an impact as an earlier agreement would spur on the suggestion of innovations earlier in turn. Continuing, the inherent uncertainty in innovations where here seen to further deter the contractor from suggesting innovations as this uncertainty of outcome was seen as a cost risk which ultimately may impact their profitability.

Concluding, the disparity in economic interests between client and contractor was seen to limit innovation in projects, hence calling for measures as to equate these interests to be explored and tested in the projects' planning and design phase.

**How can economic incentives be used to promote innovation among contractors during the design phase of ECI-projects with target cost contract principles?**

Due to the lack of comparisons as well as the large uncertainties and unknowns that exist in both innovations and in the early planning and design phase, the use of outcome-based incentives is argued as unattractive. Moreover, a large focus on economic aspects, or simply the economic outcome of an innovation, was seen in the study's empirical findings, yet such a focus is argued as limiting and as potentially crowding out other important aspects which are also of interest. Hence, a suggestion to how incentivization of innovations in the early planning and design phase could be implemented has been made in the shape of economic bonuses. Through incentivization through bonuses, one does not limit the assessment of an innovations impact to solely the economic effect, hence allowing for behaviour-based incentivization to be used.

## 8.1 Limitations

There are limitations to the study. Firstly, the main limitation of the study is the limited empirical investigation based on a small number of interviews, thus limiting the generalizability of the findings. Moreover, the quality of data may be affected by the subjectivity and bias of the interviewees, therefore providing the chance that the interviewees perceptions are not representative for the entire organisations. Continuing, the sampling of projects was limited to one contractor firm hence bias existing within the organisation may have impacted the results.
Secondly, qualitative research is necessarily subjective, and may hence be affected by the researcher's bias. This limitation has been addressed through third-party audits by the thesis author's supervisor, yet the limitation remains, and future quantitative research is recommended to validate the research results. Thirdly, the sole focus on contractors and clients can be seen as a limitation to a study investigating collaborative contract arrangements, to which ECI can be counted, hence excluding other involved stakeholders.

## 8.2 Suggestions for future research

More quantitative and longitudinal studies that aim to study and assess if innovation is achieved to a larger extent through early contractor involvement than other projects would be of interest as to fully scrutinize the perceived connection between increased innovation and ECI. The current school of literature investigating innovation and ECI, so also including this thesis, have primarily adopted a qualitative case study approach, hence warranting the adoption of more quantitative methods. Further, this thesis has solely emphasised the contractual connection between client and contractor in the planning and design phase, thus omitting the project's technical consultants and their impact on innovation and the ECI-concept. Studies investigating innovation through early contractor involvement from a network perspective, involving client, contractor, and consultants, are therefore of interest.

One contractual aspect which has not been studied in this thesis is whether the use of the Swedish standard contracts, primarily ABK09 and ABT06, create

hinders to increased innovation through the implementation of ECI. One specific point which could be of interest to investigate is whether the long warranty periods included in said contracts create hinders due to the contractor's risk aversion and the inherent uncertainties seen in innovation implementation.

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# Appendix A – Interview guide

Introduction:

- Could you introduce yourself and the role you have had in the project?

Collaboration and ECI:

- What constitutes collaboration for you? How has the collaborative environment been in this project? What has worked well and what can be improved?

- How has it been to be/have a contractor involved in the early stages of planning and design? In what ways have you/they contributed?

Planning and design phase:

- What has the planning and design phase constituted and what has it comprised for you? Which difficulties have you faced and what learnings have you gained?

Reimbursement model:

- Describe the reimbursement model for the contractor in the project. What is your opinion of it? Is it suitable for the project? Why/why not?

- Describe the process of preparing the project's target cost. What role did you have in the process?

- Has the project's reimbursement model (and incentives) affected the project during the initial planning and design phase? In what way?

Innovation:

- Describe how you perceive the opportunity to create innovation in the project to have been.

- What drivers and hinders to innovations and alternative solutions do you perceive to have/could have affected the project?

- How do you perceive one to best promote innovation in a project?

Finishing questions:

- Do you have any further thoughts or comments that you wish to share? Do you have any questions for me?

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