How public client's control systems affect contractors' innovation possibilities

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Abstract

Purpose – This paper aims to identify how a public client's use of control systems (process, output and social control) affect innovation possibilities in construction projects.

Design/methodology/approach – Semi-structured interviews about six infrastructure projects were conducted to identify respondents' views on innovation possibilities. These possibilities were then analyzed from an organizational control perspective within principal–agent relationships between the Swedish Transport Administration (STA) and their contractors.

Findings – How the client uses control systems affects innovation possibilities. Relying on process control could negatively affect innovation opportunities, whereas output control could have a positive influence. In addition, social control seems to have a weak effect, as the STA appears not to use social control to facilitate joint innovation. Public clients must comply with the Public Procurement Act and, therefore, retain the requirements specified in the tendering documents. Much of the steering of the execution is connected to the ex ante phase (before signing the contract), which affects innovation possibilities in the design and execution phases for the contractor.

Research limitations/implications – This study was conducted with only one client, thus limiting its generalizability. However, the findings provide an important stepping stone to further investigation into balancing control systems and creating innovation possibilities in a principal–agent relationship.

Originality/value – Although public procurement has increasingly been emphasized as a major potential source of innovation, studying how a public client's use of organizational control systems affects innovation possibilities in the construction sector has received scant attention.

Keywords Organizational control, Inter-organizational relationships, Innovation, Public procurement

Paper type Research paper

Introduction

During the 21st century, public demand has increasingly been emphasized as a major potential source of innovation in the European Union (Edler and Georghiou, 2007; Georghiou *et al.*, 2014; Obwegeser and Dueholm Müller, 2018). Uyarra and Flanagan (2010, p. 123)

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pinpoint that "the notion that public procurement can be used to promote innovation is high on the agenda of European policy-makers at all levels." Accordingly, both scholars and policymakers emphasize that public procurement can serve as a powerful demand-side innovation policy by encouraging innovation and/or speeding up the diffusion of innovation through increasing demand for innovation (Edler and Georghiou, 2007; Uyarra and Flanagan, 2010; Suhonen *et al.*, 2019).

Although public procurement occurs across a very wide range of sectors, it is especially prominent in construction, health and transport (Georghiou *et al.*, 2014), where large public clients play critical roles in shaping their markets. However, in the construction sector, public clients consider stimulating and objectively assessing innovation to be difficult, often because of a lack of knowledge and experience (Lenderink *et al.*, 2020). The client role in public procurements is important, as construction clients could function as catalysts for innovation and development (Aouad *et al.*, 2010). Clients are initiators and investors in most construction projects and consequently have a direct impact on construction actors' decisions to be innovative by being an "innovation supporter" (Lim and Ofori, 2007; Nam and Tatum, 1997).

There is, however, a complex situation in construction, where creating innovation is more than contractors "pushing" their innovations on the market, or clients "pulling" by telling the market their requirements (Ivory, 2005). Most development and improvements in projects are only possible due to joint capabilities within different organizations (Blayse and Manley, 2004), and a client needs to coordinate and steer numerous actors, with varying organizational practices and project expectations, to facilitate innovation (Eriksson *et al.*, 2017). Hence, inter-organizational relationships are important for innovation in construction in general (Harty, 2008). To manage these relationships, the most common approach applied by public clients involves competitive procurement strategies and subsequent control and oversight during execution (Eriksson and Laan, 2007; Karrbom Gustavsson and Hallin, 2014). Because the client's procurement strategies are strongly connected to organizational control (Eriksson and Laan, 2007), it seems relevant to adopt an organizational control perspective on public procurement of innovation.

However, although inter-organizational control heavily affects innovation (Lou *et al.*, 2022), the relationship between organizational control and innovation is somewhat neglected in prior research. Organizational control could be regarded as a process of monitoring and regulation for fulfillment of goals, objectives, or a desired state (Das and Teng, 2001), such as innovation. Cardinal *et al.* (2017) state:

> [. . .] [i]n an external environment with hyper competition, unrelenting change, fleeting competitive advantage, and environmental shocks, we would expect scholars to be more focused on understanding the links between control and outcomes associated with innovation [. . .]. (p. 580)

Regarding organizational control, there are some studies focusing on innovation in an intra-organizational relationship (Lill *et al.*, 2021), and covering other sectors such as a telecommunications company (Turner *et al.*, 2021), medicine (Wang *et al.*, 2021), IT and telecom industries, but there are fewer studies taking an inter-organizational perspective.

In the construction context, there are some studies on the effect of control on sustainability (Kivilä *et al.*, 2017), trust (Kadefors, 2004), coordination (Neves and Bugalho, 2008) and flexibility (Szentes, 2018). However, studying how a public construction client could both create innovation for the contractor, and, simultaneously, use organizational control systems to steer the contractor, has not received much attention. The purpose of this

paper, therefore, is to study how a public client's use of different types of control system affects contractors' innovation possibilities in construction projects. Two research questions have been formulated:

RQ1. How does different control systems affect a contractor's innovation possibilities?

RQ2. How can a public client use public procurement to promote innovation?

The findings are based upon an in-depth case study of six infrastructure projects involving the major public client for infrastructure in Sweden, the Swedish Transport Administration (STA), and six different contractors.

Theoretical background

Organizational control. The most influential theoretical framework within the field of organizational control is that of Ouchi (1979), which has increased in popularity in the past decade (Cardinal *et al.*, 2017). Ouchi (1979) identified three control systems: bureaucratic, market and clan. In the construction context, Ouchi's framework has been further developed by Aulakh *et al.* (1996), discussing how three corresponding control systems: *process* control (bureaucratic), *output* control (market) and *social* control (clan), relate to a client's procurement strategies. A control system is defined as consisting of a combination of control mechanisms (Sitkin *et al.*, 2010). Organizational control can be used in both intra- and inter-organizational relationships because the underlying logic is similar in internal and external principal–agent settings (Eisenhardt, 1985).

A *process* control system is achieved by mechanisms such as rules, where information for fulfillment of tasks appears in specific standards rather than in piecemeal forms with a foundation of following orders and directives from the principal (Aulakh *et al.*, 1996). This control system thus involves the *visible hand of management* (Anderson and Oliver, 1987; Gencturk and Aulakh, 1995) and uses formal rules and regulations (Cardinal *et al.*, 2017; Sihag and Rijsdijk, 2019; Sitkin *et al.*, 2020). In a principal–agent relationship between a client (principal) and a contractor (agent), a process control system could be used by monitoring whether the agent uses methods, materials or handbooks in the correct way. Process control can also be conducted through the principal's procurement and contracting strategies (Eriksson, 2006); it can be achieved if the principal produces a comprehensive and detailed specification of not only what should be performed, but also how the agent should perform it (Korczynski, 1996; Eriksson and Laan, 2007). Furthermore, when selecting agents, evaluating their inputs (e.g. different types of resources and capabilities) entails process control, as inputs will affect the agents' ability to perform the specified procedures (Anderson and Oliver, 1987). Process control can also be achieved with a reward system that covers the agent's costs, based on the time worked (e.g. salaried agents) and costs of input material (Eriksson and Laan, 2007; Gencturk and Aulakh, 1995).

The *output* control system involves a hands-off approach based on the rules of competition (Sihag and Rijsdijk, 2019; Sitkin *et al.*, 2020), and Ouchi (1979) points out that this control system is an effective method if the market is frictionless; the prices then contain all information necessary for correct decision-making and the price provides the means for solving any problems with inconsistent goals. Output control systems involve the *invisible hand of the market* (Anderson and Oliver, 1987; Gencturk and Aulakh, 1995). Translated into a contractual situation, if the agent has the required information to fulfill the order in the contract, the principal only needs to ensure that the terms and conditions of the contract are met before rewarding the agent (Aulakh *et al.*, 1996; Eriksson, 2006). Hence, the principal

focuses on the outcome instead of detailed demands, by using functional demands (Aulakh *et al.*, 1996) and a reward system based on a fixed price. The principal could also use incentive-based rewards and pay-for-performance to influence the outcome positively through output control (Cardinal *et al.*, 2017).

Social control could comprise social requirements consisting of a set of agreements within a specific group, which could be described as values, integrity, beliefs or a socialization process within a culture (Aulakh *et al.*, 1996; Eriksson, 2006; Lou *et al.*, 2022). Social control, therefore, involves social observation to check if the right objectives are fulfilled (Kirsch *et al.*, 2010). In addition, considerations of the relationship, such as collaborative ability and shared values, are aspects of social control (Aulakh and Gencturk, 2000; Sitkin *et al.*, 2020). Using social control can be resource intense, as the monitoring is done through formulating joint objectives, meetings and co-location of offices (Das and Teng, 1998; Sihag and Rijsdijk, 2019). Partner selection is an important basis of social control because the principal can then select an agent with objectives and values that overlap with their own (Fryxell *et al.*, 2002). Furthermore, considerations regarding the collaboration and nurturing of the relationship (e.g. criteria related to collaborative ability, shared values, prior experience, etc). indicate social control (Aulakh and Gencturk, 2000). In terms of specification, social control can be achieved when the principal and the agent jointly create the specification, agreeing on how to perform the work processes to achieve the contract objectives (Eriksson and Laan, 2007). In addition, a reward system based on profit-sharing indicates social control (Das and Teng, 1998), for example, through cost reimbursement together with a target cost and incentives (Eriksson and Laan, 2007).

Role of the client in creating innovation possibilities. Previous research on influential factors for achieving innovation in construction projects highlight different client procedures and mechanisms, e.g. procurement strategies, regulations, requirements, organizational setup and project resources (Blayse and Manley, 2004; Gambatese and Hallowell, 2011; Larsson *et al.*, 2022), that arguably could be connected to the client's control systems. Client control systems span the entire supply chain, from early tendering processes to the effectiveness of the procurement strategy and project management. Applied control systems may, in fact, either facilitate or hinder collaboration. Managing the inter-organizational relationship through strict procurement strategies, including technical requirements, has been mentioned as a barrier to introducing large-scale product innovations in public infrastructure projects (Rose *et al.*, 2019). However, many studies have shown that collaboration may encourage product innovation in construction projects (Blayse and Manley, 2004; Eriksson and Szentes, 2017). Furthermore, collaborative relationships may serve as engagement platforms for innovative co-creation practices (Jacobsson and Roth, 2014; Eriksson *et al.*, 2017). There are, however, some recent indications that opportunities for supplier-led innovation focusing on sustainable outcomes are also facilitated by other mechanisms, such as long-term maintenance responsibilities that extend contractor involvement (Larsson *et al.*, 2022). Furthermore, Sariola (2018) found that early involvement of contractors, tendering with incomplete designs, and requesting alternative solutions are procedures that also increase possibilities for contractors to use their innovation potential actively. This type of procedure may be connected to all three control systems (Eriksson and Laan, 2007) depending on when and how they are applied and used throughout the project.

Innovation in construction projects can be achieved through regulations and standards (Gann *et al.*, 1998). Strict regulations that force organizations to innovate according to detailed specifications are most common but inhibit creativity (Gann *et al.*, 1998; Bröchner and Silfwerbrand, 2019), meaning that the freedom for a contractor to find alternative solutions is limited. Instead, performance-based building regulations, which stimulate contractors to innovate in a certain direction, are progressive and can be an effective driver of innovation

(Gann *et al.*, 1998). Therefore, active use of regulations as part of a selection of policies can encourage improved project performance (Bossink, 2004; Gann *et al.*, 1998), and function as part of the applied process control system. Strict standards that are set higher than current practices have been shown to be another possible way of inducing market demand for high-performance technologies, and can be incorporated into the output control system. Performance standards that only contain minimum requirements for the intended solution, and not the components of production, may be appropriate when extensive technological change is required (Gann *et al.*, 1998).

Method

Research approach and case selection

A qualitative case study of inter-organizational construction contracts was conducted to achieve our aims. Such a study is suitable for in-depth investigation of a phenomenon (Eisenhardt, 1989), and the use of a single-case study was deemed suitable to allow deep exploration and a rich explanation of the respondents' views on the phenomena.

The STA, which is the largest client in the Swedish construction sector, was chosen for the case study. STA has, during the past decade, made organizational changes in an attempt to stimulate innovation through its client role. One change is to increase the procured Design-Build (DB) contracts, in which the contractor is responsible for design. DB contracts transfer more responsibility to contractors and provide them with increased freedom to choose technical solutions and production methods. Consequently, DB contracts arguably increase the opportunity for innovation for the contractors, compared to Design-Bid-Build contracts (Eriksson and Szentes, 2017), and are therefore interesting to investigate from an organizational control perspective.

Data were collected from six infrastructure projects, all procured and managed by the STA and based on DB contracts underpinning the principal–agent relationships. The client has a central organization for procurement, which develops and applies standardized documents, forms and collaboration models during the process. The standardization and use of the same resources during procurement supports the creation of contracts with similar formats for all studied projects. However, the researchers selected projects with some differences to increase representability and generalizability. Accordingly, the studied projects varied in characteristics such as size, content, duration, complexity and different contractors. The following projects were examined in this study:

- Project A entails 40 kilometers of road reconstruction in a rural area lasting three years.
- Project B entails new road and a bridge in the south of Sweden. A rather small infrastructure project lasting one year.
- Project C consists of a new tunnel under a large river in Sweden. This tunnel is a sub-project within a mega project.
- Project D aims to increase the commuter capacity in a larger city in Sweden; it consists of a second railway track next to an existing track.
- Project E entails construction of a new, 8-kilometer road between two highways, including a 120-meter long bridge over a small river.
- Project F could be considered a conventional road project as its entails reconstruction of an existing road junction, including a new bridge over a larger road and a new roundabout.

Data collection

The empirical data comprised 35 semi-structured interviews with respondents representing both the client (21) and the contractors (14). The interviews were conducted with individuals representing different roles in each project (see Table 1), and none of the respondents overlaps. Interviews generally lasted approximately one hour. However, the length of interviews differ somewhat as some of the respondents did not participate during the entire project duration (e.g. the site inspector), for which reason all questions did not apply for all respondents. By using semi-structured interviews, the respondents were free to express their views and give meaning to the topics raised by the authors (Galletta, 2013). The interview guide contained questions regarding the client role, procurement strategy, collaboration, innovation, project outcomes and organization. Explicit questions regarding the three organizational control systems were not asked, to avoid leading the respondent in any direction and thus potentially narrowing descriptions of the topics of study. In terms of innovation, however, respondents were explicitly asked to describe and elaborate on created innovations in their projects. All interviews were recorded and later transcribed verbatim to aid the analysis.

Table 1.
List of respondents

No.	Project	Actor	Role
1	A	Client	Project manager
2	A	Client	Procurement officer
3	A	Client	Project engineer
4	A	Contractor	Project director
5	A	Contractor	Project engineer
6	A	Contractor	Design manager
7	A	Contractor	Project support
8	A	Client	Project manager
9	A	Client	Construction site inspector
10	A	Client	Contract manager
11	B	Client	Project manager
12	B	Client	Procurement officer
13	B	Contractor	Project director
14	B	Contractor	Warranty manager
15	B	Contractor	Project engineer
16	C	Client	Project manager
17	C	Client	Procurement officer
18	C	Contractor	Project director
19	C	Client	Project director
20	C	Contractor	Site manager
21	D	Client	Project manager
22	D	Client	Sub-project manager
23	D	Contractor	Project manager
24	D	Contractor	Design manager
25	D	Client	Construction site inspector
26	E	Client	Project manager
27	E	Client	Procurement officer
28	E	Client	Project engineer
29	E	Contractor	Project manager
30	E	Contractor	Design manager
31	E	Client	Construction site inspector
32	F	Client	Project manager
33	F	Client	Procurement officer
34	F	Contractor	Project manager
35	F	Client	Project director

Data analysis

The empirical material consisted of a rich data set, from which the authors extracted descriptions given by the respondents regarding innovation possibilities from an organizational control perspective. The software Nvivo was used to sort and organize data to enable easier classification and, thus, help to draw conclusions.

The first step of the data analysis was extracting the data that the authors interpreted as containing descriptions of what could represent innovation possibilities created by the client. The next step was to identify and classify these innovation descriptions from a control system perspective, using the model proposed by Aulakh *et al.* (1996) consisting of the three control systems: process, output and social. Descriptions of innovation possibilities that could not be connected to any of the control systems or mechanisms were excluded from the analysis. As the interview guide did not directly focus on control systems, the respondents' answers and descriptions are at the control mechanism level. This means that the respondents described, for example, detailed rules and regulations, which the authors interpret as control mechanisms connected to the process control system. These steps of analysis resulted in many descriptions of innovation possibilities that are mostly affected by process and output control mechanisms. The initial lack of links between innovation possibilities and social control led the authors to re-visit the transcribed interviews to make sure that descriptions of this link were not overlooked. This iteration did not, however, result in a distinct link between these two aspects being found. It is, therefore, added empirical data that are interpreted as social control, but without a clear connection to innovation possibilities.

In addition, when analyzing the data, the authors found that the time aspect seems to have an impact on innovation possibilities, in terms of when different control mechanisms manifest themselves. The empirical findings section below is, therefore, presented in chronological order, with the ex ante (procurement phase, before signing the contract) descriptions first, followed by the ex post (after the procurement, during the execution phase) perspective, within each section describing the three control systems. Steering ex ante means that the mechanisms manifest before the contract is signed with the contractor, for example, detailed requirements in the procurement documents. Steering ex post means that the steering mechanisms manifest during the execution of the project, such as monitoring to see if a bonus or incentive is to be paid to the contractor. Table 2 illustrates a summary of the data analysis, sorted from the empirical level to the aggregated level that consists of the three different control systems.

Empirical findings

Process control. The respondents (both client and contractors) were clear in their descriptions of the limitations that the process control system has on innovation possibilities for contractors. Many aspects of the process control system are decided by the client in the tendering documents. The requirements and details that are decided by the client in the procurement phase, e.g. in the road plan and preliminary design, affect the design of the road. This action limits the choice of construction processes for the contractor. One client respondent stated:

> You are a little constrained due to the road plan, you decide early on how to build. You cannot lower or raise the road profile, and you constrain, there and then, the opportunities for innovation. (Respondent 8)

One contractor respondent described the lack of innovation possibilities in a similar way and connected this to the procurement strategy:

Empirical level	Themes (analysis level)	Time aspect	Aggregated level
you are a little constrained due to the road plan, you decide early on how to build	Negative impact on innovation possibilities	Ex ante	Process control
there's very little freedom due to the way they tender			
We do have a lot of requirements			
submit a tender based on our tendering documents. And we have not given any room for innovation			
well, if you look really close, there is not much freedom			
Their hands are tied by all the demands			
the contractors are even forced to buy materials from [our own] material service			
they wanted us to deliver according to their 25 pages of requirements			
no, we are not actually allowed to depart [from the requirements]			
but regulations put a stop to that		Ex post	
we need to start an approval process, and this could take up to three years			
They say how it should look/../ they will not approve, and then you conform			
all these requirements have resulted in them developing/. . ./ beyond our demands	Positive impact on innovation possibilities	Ex ante	
there are tough demands for constructing a tunnel	Negative impact on innovation possibilities	Ex ante	Output control
Then they wanted to be compensated for the more complex solution they used instead of our suggestion		Ex post	
the innovation was to plan ahead when they wrote their tender	Positive impact on innovation possibilities	Ex ante	
we have a goal to halve the disturbance or halve the execution time			
we let the contractor decide how to solve the problems		Ex post	
they could, later in the project, present any solution that is suitable			
One example is the new noise reduction paling			
You have the same function, but you remove some parts here and there			
When the tendering documents were written . . . we added collaboration level 1 according to the old system we had	No impact on innovation possibilities	Ex ante	Social control
you need to build trust between the client and contractor, so that [smaller] changes we propose will be received positively by the client		Ex post	
we were involved in the discussions, and it is part of our control process			
we don't demand anything, just make suggestions			
there were innovation opportunities, we used incentives connected to our evaluation system			

Table 2.
Overview of the data analysis

> There's very little freedom due to the way they tender [. . .] when you can't move the height of the road, for example, you can't change the cross-section of the road. That doesn't allow us to get creative and use any good ideas. (Respondent 13)

Another respondent also confirmed this, but clarified the client's reliance on process control, describing it as follows:

> Well, if you look really close, there is not much freedom. The contractor should be responsible for the work and we should just monitor and check the quality. That is not the case, we need to steer, otherwise, it will not work. (Respondent 25)

The client feels compelled to control the process to be assured that project execution is as required.

The level of detail in the procurement documents was brought up by several respondents. One client respondent stated:

> It's technical requirements and perhaps we need to ease these up to get innovation [. . .] We do have a lot of requirements, and this could be an obstacle in a DB contract. (Respondent 3)

The level of detail as well as the number of requirements prescribed in the tendering documents seem to affect innovation possibilities in a negative way, even though the respondent is aware of the freedom that the DB contract is supposed to give to the contractor. The connection between the client's procurement strategies and limiting innovation possibilities was explained by one client respondent as follows:

> This could be in direct conflict with the innovation possibilities, but we ask them to submit a tender based on our tendering documents. And we have not given any room for innovation. (Respondent 33)

One contractor respondent confirmed this by stating:

> It is specified exactly, the requirements, it is not easy for the project team to develop anything. Their hands are tied by all the demands. So we always return to the same conclusion, there is not anything to be innovative about. (Respondent 30)

Even though most respondents emphasized the lack of freedom, some respondents also gave some indications that a DB contract offers potential for being innovative, as functionality is in focus and not detailed requirements. One contractor respondent stated: "we like this contract type [. . .] there is enough freedom [. . .] for me as design manager" (Respondent 24). However, even though functional requirements may offer innovation possibilities to some extent, the strict rules and regulations that are decided by the central organization and used by the client during execution to steer the project inhibit opportunities. This was described by one contractor respondent: "we don't have any freedom, it sounds like we have opportunities when it comes to fulfilling functionality, but regulations put a stop to that" (Respondent 5). In railway contracts, the requirements also, in some cases, include restrictions about using certain components and materials, as one client respondent noted: "how to build railways is highly regulated [. . .] the contractors are even forced to buy materials from [our own] material service" (Respondent 21). The quote indicates process control, as materials cannot be chosen freely by the contractor, instead the contractor is forced to buy the railway switches via the client. This control inhibits opportunities for the contractor to develop or introduce alternative solutions regarding materials.

An example where the detailed process control inhibited a contractor from being innovative was when the contractor delivered 3D models that were beyond client demands, but instead of welcoming this, the client insisted that they deliver according to initial specifications. A contractor respondent describes it as follows:

> The client wants 3D-models and that could be innovative. But they wanted to control all of the details of the 3D-model [. . .] even if ours was much better; they wanted us to deliver according to their 25 pages of requirements. (Respondent 15)

This can be considered a procedure that reduces innovation possibilities, since it seems that the client is not interested in accepting solutions that differ from initial requirements. In some cases, the contractors expressed a desire to depart from initial requirements; however, this was not allowed by the client even if the suggestion would have enhanced the project outcome for the client. One contractor respondent explained:

> No, we are not actually allowed to depart [from the requirements]. If we think it [the specification] is too narrow, they say that we cannot change, even if it would mean that the road duct would last 30 years instead of 10. (Respondent 4)

However, although most examples concern how process control has a negative impact on innovation possibilities, there was one example of how process control in terms of detailed requirements stipulated in the procurement phase inspired the contractor to develop a new solution to measure different parameters during the project execution. One client respondent stated:

> We have a large monitoring program to measure any movement of structures, we need to keep track of groundwater levels, of buildings [. . .] all these requirements have resulted in them [the contractor] developing a complex measurement program beyond our demands. (Respondent 16)

The detailed demands about how the contractor should monitor the surrounding environment during execution inspired them to develop a complex program exceeding the stipulated client demands.

There were examples of how the client used process control during the execution of projects and how this affected innovation possibilities during execution. One example mentioned related to the client's approval process for new, alternative solutions from the contractor. A new and untested solution could potentially cause delay, due to the internal approval process, which may cause reluctance to support change. One client respondent stated: "If any other solutions are to be used, we need to start an approval process, and this could take up to three years, affecting the entire project" (Respondent 33). The reason why the client chooses to procure by proven methods and standards is explained in the quote – the client wants to approve new and untested solutions suggested by the contractors. This reluctance to test new solutions was confirmed by a contractor respondent who stated:

> What should you do? Well, only as the client says. And they are not open to new ideas, new thinking. [. . .] They say how it should look, otherwise, they will not approve, and then you conform. (Respondent 18)

The above quotes highlight the problematic situation of suggesting new, innovative solutions from both a client and contractor perspective. The client finds it difficult to approve a new solution due to time constraints, whilst the contractor feels restricted by the proposed solution stipulated by the client. The reason for this process control is, according to the client, primarily due to long internal approval processes that are needed to secure the functionality of innovative solutions. This approach taken by the client limits innovation possibilities as only solutions derived from the client's knowledge can be accommodated within individual projects.

Output control. Some of the client respondents described that they have adopted a more hands-off approach and control based on functional requirements, in accordance with an output control system. They have a positive view of this approach and indicated that

contractors have opportunities to choose methods and materials, and that the client supports new ideas and solutions. There are examples when the client takes a step back and tries to open up the situation for the contractors, exemplified by one client respondent as follows:

> We let the contractor decide how to solve the problems, the best way possible. To take advantage of their knowledge [. . .] we have the opinion that the contractor is best suited to find solutions, we didn't have so many requirements in the procurement. (Respondent 17)

This is an example of limiting the detailed requirements in the procurement documents and thus allowing the potential for new solutions.

Another example of the client trying to focus on functionality instead of detailed specifications regarded procuring a new type of asphalt with both noise reduction and a longer life span (10 years), as described by a client respondent: "we demanded a noise reducing coating, a double drain asphalt [. . .] This is a functional demand, but it has become a technical challenge for the contractor" (Respondent 32). The combination of the two functional demands including both noise reduction and longer life span proved to be very challenging. However, the situation was made even more challenging for the contractor due to the client's specific demand of a double drain asphalt with certain requirements on parameters regarding the voids, binder content, and highly modified bitumen with extra high adhesion. By specifying certain requirements for these parameters the client restricted the contractor's possibilities for innovation. The contractor's project manager argued that the specification of certain parameters made it impossible to achieve the challenging functional demands: "this is not possible, the decibel yes but not the voids. If you want a noise reduction, then please tell only the noise reduction, and not parameters" (Respondent 34). This example shows that the client's combination of using both output and process control may severely reduce contractors' opportunities for innovation.

If the client focuses on end results, the contractor could have more freedom to choose a suitable construction process. However, even if the client chooses not to prescribe how the contractor should execute the project, there may be other reasons for limitations, according to one client respondent: "there are tough demands for constructing a tunnel [. . .] how they fulfil the requirements are up to them. But there is not much space [for innovations], maybe using new materials" (Respondent 25).

Nonetheless, constructing a tunnel is complex, but one client respondent described using tendering to stimulate innovation. By not prescribing how the contractor should build, instead leaving these aspects to the contractor and having the contractor state a fixed price in their tender is one way of steering via fixed price. Another client respondent noted:

> The contractor stated that they could build for this price. Therefore, the innovation was to plan ahead when they wrote their tender. There is only one similar tunnel that has been built, I think it is in Shanghai, and they have easier conditions than what we have. (Respondent 17)

Even though it seems that client is reluctant to allow contractors to submit alternative tenders, there were some indications that they do have a general openness during the execution of the project, expressed by one client respondent as follows:

> We don't allow for alternative solutions during tendering, but they [the contractor] could, later in the project, present any solution that is suitable. The only constraint is that it must work. (Respondent 1)

The approval process as part of process control mentioned in the quote is, therefore, clearly present when the respondent states that it has to work. One contractor respondent described how they had used this opportunity to find other solutions during execution:

> Everywhere you could find good ideas or save money, we have tried to do so. One example is the new noise reduction paling that is now the same [throughout the project] instead of different kinds along the tracks. (Respondent 24)

In addition, a client respondent gave examples of how this open approach during execution could stimulate innovative solutions if combined with functional demands:

> We have a goal to halve the disturbance or halve the execution time. We put this as a demand, a challenge [. . .] if they had chosen a traditional concrete bridge then they would have to work shifts and weekends to be done on time. The contractor has chosen a solution that is new [. . .] and that could be built with minimal disturbance to traffic. (Respondent 32)

The quote indicates that the client does not have to demand a specific type of bridge; instead by adding particular goals (functional demands) they triggered the contractor to take the opportunity to be more innovative and find more efficient processes that saved time on site. Another example where the contractor seized the chance to be innovative due to functional demands was described by one contractor respondent: "Not any larger issues, but smaller things like changing curbs and such, this also helps maintenance. You have the same function, but you remove some parts here and there" (Respondent 29).

Procuring by fixed price may either stimulate innovation, as suggested earlier, or inhibit innovation and hence, has an impact on innovation potential. The fixed price may, in some cases, make the contractor reluctant to try innovative solutions since alternative solutions may or may not be more costly than planned. One client respondent stated:

> We have had discussions regarding the functional demands; the contractor says that they want more money because they could not include some aspects in their tender, whereas we think that we have described it sufficiently in the procurement documents. [. . .] Then they wanted to be compensated for the more complex solution they used instead of our suggestion [. . .] but taking the responsibility for the design is not our role. (Respondent 21)

Social control. The respondents (client and contractors) discussed many aspects of collaboration (i.e. social control), but they did not describe a link between social control and innovation possibilities in any of the contracts. The STA includes a clause regarding the use of a collaboration model in all contracts. The prescribed model requires that the project have to include a certain level of collaborative engagement between the client and the contractor. The formal collaboration includes different activities, as stated by one client project manager:

> When the tendering documents were written [. . .] we added collaboration level 1 according to the old system we had [. . .] and have the five activities included in this model [. . .] where joint risk management is one [. . .] we share offices and that results in much better collaboration. (Respondent 21)

None of the respondents stated that the formal collaboration model had increased innovation possibilities in their projects. One client respondent stated that "joint risk management has aided" in their project, even if some of the formal collaboration model activities felt "forced" (Respondent 21). However, the collaboration model could be regarded as social control by focusing on soft parameters such as shared values, collaborative activities and joint problem solving.

The STA's aim with the formal collaboration model is that it should lead to more trusting relationships, facilitating fruitful and open discussions. Indirectly, the formal collaboration model may therefore affect innovation possibilities by fostering such relationships. This is an important aspect that was noted by one contractor respondent:

> For railways, there are no freedoms [. . .] the same goes for bridges. [. . .] you need to build trust between the client and contractor, so that [smaller] changes we propose will be received positively by the client. Not the big things, those are all fixed, like height and profile. (Respondent 23)

This highlights the importance of functioning relationships built on trust, in which the contractor can openly inform and discuss with the client the ongoing execution of the project. The client has thus created a control system that allows them to steer the contractor to provide information. The quote also highlights the difference from other aspects of the project, such as technical demands and specifications, where there is no freedom (as noted in the process control section above), in comparison to smaller adjustments. That these discussions between the client and contractor are part of the control systems was confirmed by a client respondent who stated:

> We were involved in the discussions, and it is part of our control process to give opinions, and it has been useful that our experts were involved and give their opinions [to the contractor]. (Respondent 16)

This quote connects the client's control system to interactions between the actors, which the client regarded as having a positive impact on the project.

However, with the use of DB contracts, the client's view of their role seems to have changed regarding who should take responsibility for driving the innovation efforts. One client respondent stated:

> We are not builders anymore at the STA, this is what the contractor should be good at [. . .] when we look at their work from a distance [. . .] we don't demand anything, just make suggestions. (Respondent 21)

This quote indicates that the changed role of the client means that it is the responsibility of the contractor to be innovative, as the client is distant from the project execution. The introduction of DB contracts has, thus, made the client distance themselves from the project execution, as well as the innovation efforts, indicating that social control is not employed to promote joint innovation.

Some client respondents, however, connected innovation possibilities to a social control perspective, in terms of the reward system. There were examples given by a client respondent of how innovation possibilities may be affected by reward systems based on incentives: "there were innovation opportunities, we used incentives connected to our evaluation system [. . .] we evaluate at least twice a year" (Respondent 33). This quote indicates that the client considered that economic incentives strengthen contractors' innovation possibilities, but again they did not see that the client might play a role in the innovation effort together with the contractor. Instead, they are prepared to reward innovative solutions afterwards.

Discussion

Responding to *RQ1*, our findings show that creating opportunities for contractor innovation as a client (through the inter-organizational relationship) is rather complex when viewed from an organizational control system perspective. There are several ways in which different client control systems may affect construction innovation throughout the supply chain (Bossink, 2004; Gann *et al.*, 1998; Bröchner and Silfwerbrand, 2019; Blayse and Manley, 2004; Eriksson and Szentes, 2017), making it vital to understand how different control mechanisms on a detailed level may affect innovation possibilities. The empirical data suggest that the client not supporting innovation could be the result of a lack of time and/or resources, e.g. verifying a new solution could take years. Therefore, even if there is an

intention by the client to stimulate innovation, the empirical findings suggest many factors that inhibit innovation possibilities.

Detailed demands (*process* control) seem to reduce the potential for innovation, confirming the studies conducted by Gann *et al.* (1998) and Bröchner and Silfwerbrand (2019). The empirical data from both the client and the contractors indicates that process control has the most negative impact of the three control systems, on innovation possibilities. The empirical data from contractor respondents indicate that requirements and regulations that the client relies on are not something that the contractor can depart from, from a process control point of view. There are also indications that the client is not open to new solutions or ideas, and that client often has specific solutions in mind, and therefore is not willing to accept other solutions. Process control is a suitable tool for a client to ensure that the delivery will be in accordance with what they had in mind (Korczynski, 1996; Eriksson and Laan, 2007), often stipulated in technical requirements. However, there was one example when detailed requirements spurred the contractor to develop a monitoring system, supporting the suggestion that that certain aspects of process control could have a positive impact on innovation possibilities (Bossink, 2004; Gann *et al.*, 1998). The combination of requirements and regulations seems to hinder developments and new ideas according to the contractors. In general, many of the process control aspects seem to connect to formal rules and regulations in the procurement phase.

Output control seems to have the most positive impact on innovation possibilities, especially if relying on data from client respondents. There were, however, few contractor respondents who confirmed this view. Earlier studies have found that alternative solutions facilitate innovation (Sariola, 2018), a suggestion not confirmed in this study by contractor respondents. This is mainly due to the client's scarce use of pure functional requirements. According to the contractors, the tendering specifications often also included specific requirements related to process control. However, the contractor respondents' quotes indicate that the output control system has enabled them to deliver a product to the client that is in accordance with the demands, but different in details (e.g. noise reduction paling).

Social control seems to have a weak impact on innovation possibilities in the studied projects, which is not in accordance with earlier research that identified collaboration as a facilitator of innovation (Blayse and Manley, 2004; Harty, 2008; Ozorhon *et al.*, 2014). Social control, given the nature of the oversight, e.g. collaboration, trust and social interactions (Aulakh and Gencturk, 2000; Eriksson, 2006), could be the foundation of an innovative working environment involving the client and the contractor. However, the respondents seemed to regard aspects of collaboration as being connected to a well-functioning inter-organizational relationship in general, rather than enabling innovative discussions in particular. One reason for this could be that the client's social control mechanisms (e.g. shared value, beliefs) focus more on the inter-organizational relationship rather than innovative discussions *per se*. In fact, our findings related to output control, clearly indicate that client want contractors to bring new ideas and innovations into projects. Accordingly, the social control does not seem to be used to serve as a basis for joint innovation efforts, as discussed in earlier literature (Blayse and Manley, 2004; Harty, 2008; Ozorhon *et al.*, 2014), as the client in this study seems to have a more detached view of project execution, only making suggestions to the contractor. Therefore, the client does not seem to actively take part in innovation and, thereby, foregoes the opportunity to use the collaborative relationship as an engagement platform for innovative co-creation practices as suggested by Jacobsson and Roth (2014) and Eriksson *et al.* (2017).

Responding to the second research question our findings reveal challenges for public clients to stimulate innovation. In general, prior literature emphasize that public

procurement has potential to stimulate innovation (Edler and Georghiou, 2007; Georghiou *et al.*, 2014; Obwegeser and Dueholm Müller, 2018). However, being a public client adds another aspect of complexity, as the Public Procurement Act stipulates that significant changes from the procurement phase cannot be made because they may result in a different end product. Hence, significant changes (e.g., based on alternative solutions) may be considered to represent a different contract from that which was originally specified. The public client is legally bound to make sure that the procured contract is kept intact, and that the requirements and demands in the tendering documents form the basis for the contract, an aspect brought up by respondents. Any changes in the contract could be regarded as a breach of contract, and contrary to the intentions in the procurement. This aspect influenced the authors during the analysis to emphasize the time aspect, resulting in the ex ante and ex post aspects of the procurement and contract phase having an impact on a public client's monitoring and oversight in relation to innovation possibilities.

The empirical data suggest that much of a public client's control system is decided upon early in the process, before the contract is signed, and remains unchanged, affecting innovation possibilities throughout project execution. The ex ante steering identified in the empirical data has a direct effect on the innovation possibilities for contractors. If the client procures a DB contract with detailed demands (Bröchner and Silfwerbrand, 2019), there is not much room for change by the contractor during design and execution. However, functional demands could still be hindered by rules and regulations that are decided by the central organization, even if the client has chosen an output control system in the project (Eriksson, 2006). The client can use several economic incentives to spur contractors' innovative thinking during the ex post phase. However, the situation is more complex than simply being innovative and trying new methods and materials. The ex post steering through performance evaluation indicates an output control perspective, as the client has not prescribed the process to deliver the solution, rather the contractor receives monetary compensation for fulfilling the stated criteria. The reward system, although decided ex ante in the procurement documents, is connected to the client's monitoring during the execution of the project. Output control could be closely connected to the procurement phase, as the choice to procure with functional demands could be regarded as steering toward outcomes instead of processes. However, if the demands in the procurement documents are detailed, a public client is forced to steer the contractor toward these demands. The client, therefore, has an opportunity to encourage innovative solutions in the procurement phase by relying on early involvement of contractors, tendering with incomplete designs, and requesting alternative solutions (Sariola, 2018). This would direct the client's oversight to monitor the contractor's execution in action rather than to monitor from the client's detailed demands and requirements from the procurement phase. This would, however, not render the client's organizational control superfluous, as the innovation possibilities links to both the organizational control decided in the procurement phase and the time aspect.

Conclusion

Overall, our findings confirm that the control system that a public client chooses to rely on will affect the contractors' innovation possibilities and the time aspect is important. Our findings indicate that relying on process control could negatively affect innovation possibilities, whereas output control could have a positive influence. The effect of social control is more ambiguous, but is arguably influenced by the client's aim when implementing it.

Our first theoretical contribution concerns the ambiguous effect of social control on innovation. Indeed, our findings indicate that social control has a weak effect on innovation

possibilities, which is in contrast with findings from previous studies (Blayse and Manley, 2004; Harty, 2008; Ozorhon *et al.*, 2014), However, our findings are in line with Larsson *et al.*'s (2022) study of projects procured by the STA. Our findings indicate that the STA does not seem to use social control to facilitate joint innovation. Instead, the client perceives innovation to be the responsibility of the contractor, without major support from the client, which reduces the impact that social control has on innovation. Hence, the STA misses the valuable opportunity to utilize collaborative arrangements as engagement platforms that enable client and contractor to co-create value, as suggested by prior studies (Jacobsson and Roth, 2014; Eriksson *et al.*, 2017).

Furthermore, this paper contributes to the construction innovation literature by adopting an organizational control perspective to examine a public client's creation of innovation possibilities for their contractors – how the client steers the contractor affects the level of freedom when it comes to new methods, materials and innovative solutions. This aspect is important because a client's organizational control usually manifests at the same time as the client tries to create innovation possibilities for the contractor, even if much of the control has been decided upon earlier. Our second contribution is, therefore, related to the aspect of time and continuance in public procurement. In line with previous studies on public procurement (Edler and Georghiou, 2007; Uyarra and Flanagan, 2014; Suhonen *et al.*, 2019), the studied client, STA, strives to facilitate innovation through procurement. However, many of the ways a public client chooses to oversee projects are based on the ex ante decisions the client makes before (e.g. centrally decided norms and regulations) or during the preparation of tendering documents. These decisions subsequently reduce innovation possibilities in the execution phase. As a public client needs to adhere to the Public Procurement Act, requirements stated during procurement need to be followed and kept intact. A client wanting both to oversee and create innovation possibilities needs to balance the ex ante requirements, so that the contractor has opportunities to be innovative in design and execution. In contrast to private clients, who may rely on a more flexible approach to organizational control, public clients must keep control mechanisms decided ex ante during the ex post execution of projects.

The main practical contribution is related to the effect the client's choice of control system has on innovation possibilities and how these choices could limit opportunities for being innovative. Because much of the control is decided before the contract is procured, a public client should balance the ex ante and ex post monitoring aspects, to both make sure that a satisfactory outcome is delivered and that the contractor can utilize alternative solutions during execution. To facilitate innovation, a public client must, therefore, refrain from relying too much on process control through detailed tendering specifications, providing contractors with sufficient freedom based on output control.

Another practical contribution is related to the purpose and use of social control. Our findings illustrate that social control indeed can be used to improve collaboration in inter-organizational relationships. However, if social control is to be used to promote innovation, the client should take an active role in inter-organizational development processes, using the collaborative relationship as a platform for joint innovation and co-creation.

Limitations and further studies

This research has some limitations affecting its generalizability. First, it was conducted within a Swedish setting only including projects with one client (the STA) to reduce confounding factors associated with differences in country, industrial sector and organization. However, to strengthen generalizability six projects with varying project characteristics were selected. Nevertheless, it would be interesting in future studies to widen the scope to other geographical

areas, and other types of public clients. Another limitation is that the study did not address whether the contractor used the opportunities to be innovative, or how the client received the innovative solutions suggested by the contractors, instead our focus was on whether the client had created innovation possibilities for the contractors. The aspects of how a client regards suggested innovations and how contractors might use the created innovation possibilities could be of interest in future studies. Finally, the study only included one type of contract (delivery model), whereas a recent study suggested that the actual contract type is of vital importance for opportunities for and achievement of innovations (Larsson *et al.*, 2022). Therefore, it would be of interest to examine other contract types that, theoretically, should rely on other control systems than the studied DB contracts.

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