Received 17 January 2022
Revised 14 March 2022
29 April 2022
Accepted 17 May 2022

Public procurement of engineering services: the influence of task characteristics on organisational control

Klara Granheimer
Department of Real Estate and Construction Management, KTH Royal Institute of Technology, Stockholm, Sweden and Swedish Transport Administration, Borlange, Sweden, and
Tina Karrbom Gustavsson and Per Erik Eriksson
Department of Real Estate and Construction Management, KTH Royal Institute of Technology, Stockholm, Sweden

Abstract

Purpose – Prior research has emphasised the importance of the early phases of construction projects, as well as the difficulties of procuring engineering services – especially due to the uncertainties. Despite that, studies on the public procurement of engineering services are scarce. Although scholars have shown that uncertainty may affect the choice of control modes, the level of uncertainty that characterises services is not addressed by the two task characteristics: knowledge of the transformation process and output measurability. The purpose is to investigate organisational control in public procurement of engineering services.

Design/methodology/approach – The existing control model was adjusted in this study by conceptually adding uncertainty as a third aspect to the two task characteristics. A single case study of the Swedish Transport Administration was used. The empirical data, comprising 14 interviews with managers from the client and engineering consulting companies, were analysed using flexible pattern matching and visual mapping approaches and then illustrated using the model.

Findings – The public client did not base its choice of control modes on uncertainty, but rather on the other two task characteristics. Consequently, the service providers argued that the chosen control modes reduced their creativity, increased their financial risks and caused unclear responsibilities. This study therefore shows that uncertainty is an important factor to consider in the choice of control modes, both from a theoretical perspective and from the service providers' point of view. The developed model may therefore be useful for researchers as well as practitioners.

Originality/value – This study is the first attempt to add uncertainty as a task characteristic when choosing control modes. The results contribute to the scarce control literature regarding the procurement of engineering services for construction projects and the procurement of other services with high uncertainty.

Keywords Engineering services, Infrastructure projects, Organisational control, Public procurement, Task characteristics

Paper type Research paper

Introduction

Services are characterised as uncertain and complex (van der Valk and Rozemeijer, 2009; Wynstra *et al.*, 2018), which makes specification, evaluation, and procurement difficult for the

Funding: The research was funded by the Swedish Transport Administration (grant number: TRV 2019/40476).

Engineering, Construction and Architectural Management
Vol. 31 No. 13, 2024
pp. 208-222
Emerald Publishing Limited
0969-9988
DOI 10.1108/ECAM-01-2022-0055

client (Wynstra *et al.*, 2018). Since engineering services typically involve the development of creative solutions to emergent challenges (Pirzadeh *et al.*, 2021), these services are important for the public sector in the development of society (Benabdellah *et al.*, 2020). Furthermore, engineering services play an essential role in the success of construction projects (Kärnä and Junnonen, 2017) and they are typically performed in highly iterative and cyclical processes, which adds to the uncertainty (Mitchell *et al.*, 2011; Benabdellah *et al.*, 2020). Although more competence within public procurement of engineering services is argued to be crucial (Manu *et al.*, 2021), research on the topic remains scarce (Lines and Shalwani, 2019).

Organisational control is crucial for every organisation (Das and Teng, 2001). However, engineering services are especially challenging for the client to control, due to their uncertainty and non-linear processes (Benabdellah *et al.*, 2020). In their extensive literature review of empirical research on organisational control, Cardinal *et al.* (2017) find that the most dominant theoretical framework is based on the work of Ouchi (1979, 1980), who distinguishes three control modes (also called systems): *market*, *bureaucracy* and *clan*. These three modes of control are also referred to as *output*, *process*, and *social control*, respectively (Cardinal *et al.*, 2017; Sitkin *et al.*, 2020). According to Eisenhardt (1985), the main mechanisms that can be used to achieve organisational control concern how to specify, reward and evaluate performance. Because specification, reward system and performance evaluation are fundamental stages of construction procurement (Eriksson and Laan, 2007), these stages will be the focus of this paper.

The choice of control mode is traditionally based on the two task characteristics, i.e. output measurability and knowledge of the transformation process (Ouchi, 1979). Recent research, however, pinpoints the importance of another aspect: uncertainty. This is because organisational control is especially challenging when uncertainty is high (Schilke and Lumineau, 2018) and choosing control modes to manage uncertainty is one of the key differences between contracts with and without problems (Anderson and Dekker, 2005). Similarly, studies show that uncertainty should affect the choice of control modes (e.g. Gencturk and Aulakh, 1995; Schilke and Lumineau, 2018; Lin *et al.*, 2019; Yang *et al.*, 2022). However, these studies make no attempt to suggest how the control model by Ouchi (1979) can be further developed by addressing uncertainty. In response to the argument by Kirsch (1996) that the level of uncertainty characterising professional services is not addressed by the two task characteristics, as well as the call by Yang *et al.* (2022) and Lin *et al.* (2019) for more research on the combination of uncertainty and control modes, *uncertainty* will here be added as a third task characteristic.

The purpose is to investigate organisational control in public procurement of engineering services, and the research questions are:

(1) How may a public client choose control modes in the procurement of engineering services?

(2) How do the task characteristics of engineering services influence the public client's choice of control modes?

First, uncertainty will be added to the two task characteristics identified by Ouchi (1979). Secondly, by empirically applying the expanded model, the authors will illustrate how the three task characteristics influence the client's choice of control modes for the public procurement of engineering services. The findings will provide new insights into the design and implementation of procurement strategies for uncertain services – particularly for engineering.

Organisational control literature and frameworks

By organisational control, Ouchi means a "focus on the problems of achieving cooperation among individuals who hold partially divergent objectives" (1979, p. 845). Consequently, he suggests that either the behaviour (i.e. the process) or the output should be measured, but if

neither can be measured, socialisation (clan control) is appropriate. Even though Ouchi (1979) develops the control modes in an intraorganisational setting, they are argued to also be applicable (Celly and Frazier, 1996) and used (e.g. Das and Teng, 2001; Lou *et al.*, 2022) in interorganisational contexts.

Some scholars discuss whether control modes should be seen as complements or substitutes (Cardinal *et al.*, 2017; Sihag and Rijsdik, 2019). While some conclude that control modes have a negative effect on performance (e.g. Tiwana and Keil, 2007), others observe a positive effect (e.g. Maqsoom *et al.*, 2020). Early studies of control modes perceive them as *substitutes,* hence the use of one control mode reduce the effect of another (e.g. Ouchi, 1979; Eisenhardt, 1985). Later studies, however, see control modes as *complements*, hence one mode making the other more effective (e.g. Sihag and Rijsdik, 2019; Yang *et al.*, 2022). Similarly, Cardinal *et al.* (2017) advocate a holistic view by assuming that a mix of control modes makes up the client's control, instead of arguing that a single control mode is optimal.

Three modes of organisational control

The three control modes (output, process and social control) are usually categorised as formal or informal (Sitkin *et al.*, 2020). Both output and process control include formal control methods such as rules, policies and procedures that specify, evaluate and reward desirable performance. In output control, the client relies on the service provider to reach the result (Joslin and Müller, 2016) and it thus only specifies and evaluates output. Accordingly, output control relies on a hands-off approach, assuming that the service provider knows best how to perform the tasks (Aulakh and Gencturk, 2000; Sihag and Rijsdik, 2019). In process control, the client first specifies the behaviour and processes that the service provider should perform, and then monitors and directs the execution of those processes (Aulakh and Gencturk, 2000), which makes this mode of control very resource intensive (Aulakh and Gencturk, 2000; Joslin and Müller, 2016).

In contrast, social control is an informal control method that relies on the creation of organisational norms, common goals, culture and values to encourage desirable output and behaviour (Ouchi, 1980; Das and Teng, 2001; Cardinal *et al.*, 2017). In social control, the intention is to establish an organisational context where the client usually relies on self-control by the service provider (Das and Teng, 2001) and thus builds a common organisational culture – a "clan" (Ouchi, 1979) that orients the service provider toward mutual goals (Sitkin *et al.*, 2020).

Task characteristics influencing the choice of control modes

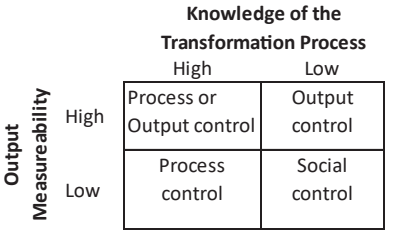
In prior research on organisational control, the choice of control modes depends on the measurability of the task characteristics' output and on knowledge of the transformation process (Ouchi, 1979, 1980; Das and Teng, 2001; Cardinal *et al.*, 2017). As mentioned above, a third task characteristic (i.e. uncertainty) will be added in this paper. The three characteristics and how they influence the choice of control modes are described below.

Output measurability refers to the ability to set goals (Ouchi, 1979) and measure goal attainment (i.e. the output) in an objective and precise way (Das and Teng, 2001). Measurements are critical in order to write contracts and tie rewards to performance – especially in an interorganisational context (Wuyts and Geykens, 2005). If outputs are unreliable and unobservable, the ability to predict their quality is not good; thus, output measurability is considered low (Ouchi, 1979).

The definition of knowledge of the transformation process is more ambiguous (Kreutzer *et al.*, 2016). In the empirical context of parts distribution within a major company, Ouchi (1979) enquires as to whether a task can be specified in steps beforehand. However, Kirsch (1996) argues that knowledge of the transformation process in the sense Ouchi (1979) means is not applicable when studying complex services (e.g. information systems development)

since the tasks are non-routine and the uncertainty is high. Therefore, Kirsch (1996) argues that knowledge of the transformation process should be defined as "how well the client understands the tasks" (p. 4). In line with other studies on various complex services (e.g. Tiwana and Keil, 2007; Kirsch *et al.*, 2010; Lin *et al.*, 2019), Kirsch's definition of knowledge of the transformation process will be used. In the context of organisational control of complex services, clients have to understand the service in order to carry out process control, but it is difficult not to impose detailed process control when clients understand the service (Tiwana and Keil, 2007). Furthermore, if clients lack understanding of the service, they are forced to use social control (Kirsch *et al.*, 2010).

The existing framework on the choice of control modes predicts that output control is most suitable when the output measurability is high and the knowledge of the transformation process is low, whereas the opposite applies to process control (Das and Teng, 2001; Cardinal *et al.*, 2017). In addition, when both output measurability and knowledge of the transformation process are low, social control is suggested (Cardinal *et al.*, 2017) (see Figure 1).



Soruce(s): Adapted from Ouchi, 1979

Figure 1. Control modes and their suitability

Several studies note that the control model by Ouchi (1979, 1980) does not include uncertainty (e.g. Eisenhardt, 1985; Gencturk and Aulakh, 1995; Lin *et al.*, 2019; Yang *et al.*, 2022). Yang *et al.* (2022) and Lin *et al.* (2019) study which control modes to choose when environmental and project uncertainty are high, while Eisenhardt (1985) studies how outcome uncertainty affects the choice of control modes. Further, Gencturk and Aulakh (1995) examine internal/external uncertainty in relation to the alliance/company when choosing control modes. However, because no study (to our knowledge) has explored the role of uncertainty together with output measurability and knowledge of the transformation process, or focused on uncertainty in relation to the characteristic of a service procured, uncertainty will be added as a third task characteristic to the framework.

Uncertainty can be referred to as a "lack of information" (Wynstra *et al.*, 2018, p. 85). Uncertainty is sometimes used synonymous with risk (Das and Teng, 2001). However, risk is argued having a known probability, whereas uncertainty is argued having an unknown probability (ibid). In addition, risk has been used as a moderator between control modes and performance (Maqsoom *et al.*, Das and Teng, 2001; Liu, 2015; Maqsoom *et al.*, 2020), whereas it is argued that uncertainty should affect the choice of control modes (e.g. Gencturk and Aulakh, 1995; Schilke and Lumineau, 2018; Lin *et al.*, 2019; Yang *et al.*, 2022), thus a task characteristic (antecedent) and not a moderator. Therefore, in this study only uncertainty will be covered.

Uncertainty within procurement of services especially reflects the difficulty of defining and evaluating the service (Axelsson and Wynstra, 2002; Andersson and Dekker, 2005; van der Valk and Rozemeijer, 2009). When uncertainty is high, it is challenging to specify the output beforehand (Axelsson and Wynstra, 2002) and measure compliance to the output afterwards (Kreutzer *et al.*, 2016), which makes output control impractical (Eisenhardt, 1985). Even though process control is argued to be more efficient than output control when uncertainty is high, there will still be many exceptions to the specified rules and procedures

(Ouchi, 1980), which makes evaluation of the process difficult (Kreutzer *et al.*, 2016). In contrast, social control relies on implicit rather than explicit rules, and thus is more flexible (Aulakh and Gencturk, 2000). Therefore, high uncertainty is closely related to the importance of social control (Kirsch *et al.*, 2010; Kreutzer *et al.*, 2016; Maqsoom *et al.*, 2020) and it is thus reasonable to argue that social control is suitable in situations characterised by high uncertainty. Thus, there seems to be a need for expanding the control model to handle high levels of uncertainty. In Table 1, uncertainty is added as a third task characteristic to the control model.

Table 1. Task characteristics influencing the choice of control modes (expanded model)

	High	Low
Output measurability	Output or process control	Process or social control
Knowledge of the transformation process	Process or output control	Output or social control
Uncertainty	Social control	Process or output control

Control modes in the procurement of engineering services

Eriksson (2006) and Eriksson and Laan (2007) develop a conceptual procurement model to illustrate how various procurement strategies relate to the three control modes. Since their model was originally developed for procurement of contractors, the framework is here adapted to engineering services. Thus, instead of referring to which party specifies the tasks (Eriksson and Laan, 2007), the type of specification method is used (Axelsson and Wynstra, 2002). For reward systems, time-and-materials is used instead of cost-plus contracts (Bajari and Tadelis, 2001). Due to this paper's focus on specifying, rewarding and evaluating performance in engineering service contracts, these three stages of the procurement model will be used. In Table 2, the adapted procurement model is visualised and, in the three sections below, the procurement strategies based on each control mode will be outlined.

Table 2. The procurement model

Procurement stages	Output control	Process control	Social control
Specification	Output-oriented	Process-oriented	Value-oriented
Reward system	Fixed price	Time-and-materials	Including incentives
Performance evaluation	Output control by client	Process control by client	Self-control by service provider

Source(s): adapted from Eriksson and Laan (2007)

Procurement strategies based on output control

In output-oriented service specifications, the client specifies the function and the service provider translates these into activities (Axelsson and Wynstra, 2002), which means that the service provider is responsible for the quality of the service (Eriksson, 2006). The responsibilities between the parties are regulated in the specification and the reward system (Eriksson and Laan, 2007). Concerning output control, the service provider is typically rewarded for the output in a fixed-price contract (Eriksson, 2006). Fixed-price contracts increase the incentive for the service provider to reduce costs but make changes costly (Bajari and Tadelis, 2001), which means they are usually used for simple services and require the client to clearly specify the output. In output control, the service provider is evaluated through inspection of the output, which is measured against predefined criteria (Sitkin *et al.*, 2020).

Procurement strategies based on process control

In process-oriented service specification, the process (i.e. what the client wants the service provider to do) is specified (Axelsson and Wynstra, 2002) and the client is responsible for the quality of the service (Eriksson, 2006). Typically, the service provider is rewarded for the costs related to the time worked in a time-and-materials contract (Eriksson, 2006). Time-and-materials contracts are usually used for complex services as they require less precise specifications (compared to fixed-price contracts) and are more flexible when changes are needed (Bajari and Tadelis, 2001). In process control, performance evaluation is conducted by the client, who monitors the performance of the service provider (Eriksson, 2006) against specified methods and procedures (Sitkin *et al.*, 2020).

Procurement strategies based on social control

If the client knows neither the output nor the process, they can specify their needs using value-oriented (also called outcome-oriented) specification, which describes what value/need the service should fulfil (Axelsson and Wynstra, 2002). The detailed activities are then developed jointly (joint specification) and the responsibility is shared (Eriksson, 2006). The service provider is typically rewarded for the costs they incur, combined with an incentive such as using a two-stage contract starting with time-and-materials and then a second stage where the parties jointly decide on a target cost including incentives (Eriksson, 2006). Since the level of trust is high, the service provider is evaluated based on self-control and the shared values of the parties (Das and Teng, 2001).

Method

When studying complex issues, in-depth (single) case studies are preferred over multiple case studies (Eisenhardt, 1989) and can serve as "a very powerful example" (Siggelkow, 2007, p. 20). Case studies can be used to generalise to other circumstances by using in-depth analytic investigations, i.e. "analytic generalization" (Yin, 2012, p. 18), and thus the findings build theoretical premises that work as assertions for other situations than the one studied (ibid).

An explanatory and qualitative approach was adopted for this study, drawing upon one case study of The Swedish Transport Administration (STA). The STA is the governmental agency that is responsible for the long-term planning and procurement of construction and maintenance works on the road and railway infrastructure. The STA was selected based on theoretical sampling (Eisenhardt, 1989). Since the STA is the largest client of infrastructure projects in Sweden, it is reasonable to think it has high level of knowledge of procurement and organisational control from a public client perspective. Therefore, STA may arguably be viewed as a favourable case (Flyvbjerg, 2006), appropriate to illustrate how a public client can purposefully choose control modes based on task characteristics.

Empirical context

The STA procures engineering services from engineering consultancy companies (ECC). This study focuses on clients' and service providers' perceptions of engineering service contracts, which contain documents relating to physical planning and preparation of tender documents for the construction phase.

The physical planning phase takes place at the very beginning of a construction project and results in either a road or railway plan. The plan is the legal document that gives the STA permission to acquire the land needed for the construction works. The physical planning takes place in one cohesive, continuous process that starts by focusing on general planning conditions, restrictions and environmental aspects. After that, the level of planning detail gradually increases as alternatives of location and construction design proposals are investigated. The planning process is regulated and results in a final plan that needs to be

approved by the Country Administrative Board (The Transport Infrastructure Committee, 2010).

When the plan is approved, the tender document phase begins, in which the ECCs prepare tender documents for the procurement of the contractor. The output of the tender document phase depends on whether the construction phase will be based on a design-bid, design-bid-build or an early contractor involvement contract, so the final construction design is sometimes part of the engineering contract.

Data collection

Within qualitative research, interviews are one of the main ways to seek new knowledge (Alvesson, 2011). In order to document the client's and service provider's perceptions of the procurement of engineering service contracts, 14 respondents from three parts of the client organisation and six ECCs were selected for interview (see Table 3). Towards the end of the 14 interviews, it was clear that no new information was being added (i.e. saturation was reached), so there was no need to do any more interviews (Eisenhardt, 1989).

Since managers within the organisations were responsible for multiple engineering contracts, they were chosen as respondents to add more breadth to this single case. The respondents from the STA were regional managers, unit managers and programme managers working in three different business areas. The respondents from the ECCs were chosen to represent both Tier A (larger) and Tier B (smaller) suppliers to the STA. The engineering service managers were division managers, business area managers and development managers. For ethical reasons, the respondents are kept anonymous.

All the interviews were semi-structured to enable a dialogue between the researcher and the respondent, and lasted for 45–90 minutes. The interview questions were inspired by the control model by Ouchi (1979) and the procurement model by Eriksson (2006) and Eriksson and Laan (2007). Due to Covid-19, most of the interviews were carried out online. The interviews were all recorded with the consent of the respondents and transcribed. Notes were also taken by the interviewer to capture their own reflections.

Table 3.
Interview respondents

Respondents	Organisation
Client manager *A*	Investments
Client manager *B*	Investments
Client manager *C*	Major Projects
Client manager *D*	Investments
Client manager *E*	Investments
Client manager *F*	Purchasing and Logistics
Client manager *G*	Major Projects
Client manager *H*	Purchasing and Logistics
Engineering manager *I*	Larger
Engineering manager *J*	Larger
Engineering manager *K*	Smaller
Engineering manager *L*	Larger
Engineering manager *M*	Larger
Engineering manager *N*	Smaller

Data analysis

According to Siggelkow (2007), case studies are useful in three ways: illustration, inspiration and motivation. By this, the researcher means that purely conceptual contributions have shortcomings, so case studies can be useful to illustrate concepts in a real life context. In this study, the empirical data serve as an *illustration* of the usefulness of adding uncertainty as a

third task characteristic, and thus why expanding the control model by Ouchi (1979) was important. In the analysis of the transcribed interviews and notes, a flexible pattern matching approach was applied to test and expand existing theories (Bounchen *et al.*, 2021). In order to make sense of the data, visual mapping (i.e. formed figures) was used, as it is useful for tracing patterns (Langley, 1999). In order to build validity (Eisenhardt, 1989) and robustness (Siggelkow, 2007), the researchers kept asking "why" when differences and similarities were found in the empirical data and theoretical patterns. In addition, the analysis was also discussed by the authors and with other practitioners.

As illustrated in Figure 2, the analysis was carried out in four steps. First, the empirically identified task characteristics were interpreted and visualised. Secondly, the empirical data were compared against the procurement model (Table 2) to form the empirically identified control modes being used. Thirdly, the empirically identified task characteristics (Table 4) were applied to the expanded model (Table 1) and the procurement model (Table 2) to identify the conceptually suggested control modes. Lastly, the empirically identified control modes (Table 5) were matched with the conceptually suggested control modes (Table 6).

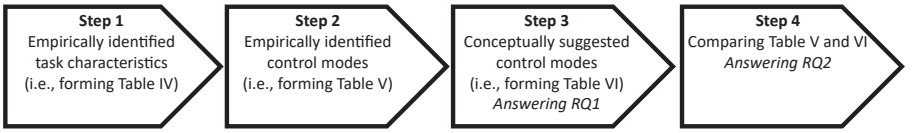


Figure 2.
The four steps of the analysis

Findings

Task characteristics

Output measurability

The respondents perceived measuring the output to be rather easy, since it had to be approved according to the regulations. Many of the client managers saw the final output as "a product", though they also felt they were procuring "a process", since the regulations also determined the overall planning process. Client Manager C said: "We get a product in the end, but in fact we procure the entire process from the consultant [ECC]".

Regarding the tender document preparations, a few of the client managers said it could be difficult to evaluate the quality just by looking at the outputs, such as drawings and technical descriptions. However, the quality of the output would be shown in the production phase, when the contractor started to build according to the tender documents. Therefore, the client could set goals and measure output objectively and precisely in both phases.

Knowledge of the transformation process

The STA is the largest public infrastructure client in Sweden, and all the engineering managers perceived it as professional, knowledgeable and with high technical expertise in physical planning and tender document contracts. Engineering Manager *J* said that "one part of the professionalism is all the skilled [technical] specialists within the STA are able to guide" the contract execution. All the engineering managers also argued that the STA was experienced in procuring and managing engineering service contracts. One of the engineering managers explained that they usually discussed the solutions and functions with the STA, whereas other less knowledgeable clients focused more on costs. In addition, the engineering managers said that the tender documents and tendering procedures at the STA were clearer and more thorough compared to those of other clients. The client managers also perceived their internal project organisations as knowledgeable in relation to uncertainties, complexities, solutions and the processes of the consultants. In short, the client understood the tasks performed by the service providers in both phases well.

Uncertainty

All respondents argued that, in general, it was difficult to describe the output as well as the process of physical planning beforehand, since the question of what to build and where cannot be known. As Engineering Manager I said: "We have fewer facts in the early phase". According to most of the managers, as the preconditions were not yet set, the uncertainties were high in the physical planning phase. Because the investigations and analyses carried out in the physical planning process would serve as input to the physical planning and design, as well as the fact that prioritising values and opinions was difficult, the physical planning process was perceived as uncertain and complex. Some of the client managers said that the working process was iterative and thus could not be described beforehand: "We cannot predict exactly how the process will look and what steps we need to take" (Client Manager C).

Most of the respondents said that the output of the tender document phase was easy to define beforehand, since both parties knew what to construct and where. In the procurement of the tender document phase, "you buy a much more defined product" (Client Manager D). Most of the respondents said that, in the tender document preparation, the information was more comprehensive and the uncertainties were reduced through the investigations that had been carried out in the previous phase. Therefore, defining the output and process beforehand was easier. Accordingly, the client had limited information about the service in the physical planning phase, whereas in the tender document phase the information had grown. Thus, the physical planning is about *"defining what you should do"* whereas in the tender document phase it is already *"defined what should be done"* (Client manager A).

In Table 4, the findings related to task characteristics are summarised (the first step of the data analysis). The interviews indicated that output measurability, as well as the client's knowledge of the transformation process, were high for both phases. However, the respondents clearly indicated that the uncertainties were much higher in physical planning than in preparation of tender documents.

Table 4. Empirically identified task characteristics of engineering services

	Physical planning	Tender documents
Output measurability	High	High
Knowledge of the transformation process	High	High
Uncertainty	High	Low

Control modes

Specification

The physical planning and tender document phases are often procured in the same contract, meaning that the control modes for specification, reward system and performance evaluation are the same. Respondents from both parties said that the physical planning and tender document contracts were usually specified as several documents that should be delivered throughout the process. These documents resulted in two final outputs (a physical plan and a tender document) and were thus examples of output control. In addition, several respondents from both sides said that the specifications usually contained gaps, as the level of detail and quality of the outputs were not defined.

One of the client managers reflected on the internal preparation work by saying that: *"in some cases we tend to do a bit too much ourselves before we procure the engineering services"* (Client manager B). In addition, some of the client managers said they sometimes specified too many details and used calculable assumptions (i.e. details and fictive numbers) to increase the

calculability for the bidders. Some of the engineering managers said that in procuring something clearly defined and specified, the STA did not utilise the advisory competence of the ECCs and reduced its ability to provide innovative solutions. Hence, the client combined output and process control in the specifications of physical planning and the tender document.

Reward system

All respondents argued that time-and-materials compensation (hourly price per consultant) was the most suitable reward system for the physical planning contracts due to the many uncertainties, the process, and the problem-solving characteristics of that phase. It was argued by respondents from both sides that it was possible to use fixed-price compensation for simple tender document contracts due to the reduced uncertainties and clearer scope. In addition, several respondents from both sides argued that, apart from the level of uncertainty, the client's ability to write clear and calculable specifications was of great importance in fixed-price contracts. Engineering manager N exemplified by saying that *"you have to be pretty clear about what exactly should be done"*. Despite this, most respondents said the STA had recently procured several fixed-price contracts (i.e. output control) including both physical planning and tender document phases. Some engineering managers were frustrated about this, as they believed the high uncertainty increased their financial risk. Hence, the client and the service providers perceived that a reward system entailing process control was preferable for the physical planning, whereas one entailing process or output control was preferable for the tender document phase.

Performance evaluation

A few respondents from the client side said that the ECC was responsible for the quality of the documents/output it produced and thus should internally control the quality before sending them to the STA. Then, the STA could rely on the quality and just carry out a few spot checks. However, the same respondents said that the STA often found the quality to be poor and that the ECC often had to make changes, which was an example of output control.

One of the client managers described another performance evaluation method where the STA inspected the ECC's time schedule for contracts to make sure the amount of resources per activity was reasonable. One of the engineering managers said they sometimes got different and contradictory input from various technical specialists at the STA, resulting in the consultant organisation "going back and forth, based on opinions" (Engineering Manager E). Client Manager *G* agreed, saying: "Our technical specialists are usually very good and they like to tell us how it should be done". One of the engineering managers explained that, according to the contract, they were required to deliver one solution/output of the entirety, but they often spent time discussing details with different technical specialists at the STA. In addition, several of the respondents from both sides said that the STA controlled the technical solutions in detail throughout the contract. These are all examples of process control.

The findings relating to the client's choice of control mode are summarised in Table 5 (the second step of the data analysis). Since the client frequently procured the physical planning and tender document phases in the same contract, the findings are merged into one column.

	Physical planning and tender document
Specification	Output and process
Reward system	Output and process
Performance evaluation	Output and process

Table 5. Empirically identified control modes in use

Discussion

Conceptually suggested control modes

This section will answer the first research question by comparing the empirically identified task characteristics (see Table 4) with the expanded model (see Table 1) and the procurement model (see Table 2), i.e. the third step of the data analysis.

In accordance with the expanded model, social control is the conceptually suggested control mode for physical planning. Even if the client and the service providers perceive high levels of output measurability and knowledge of the transformation process, the high uncertainty means that it is difficult to define both the output and the process beforehand. Hence, according to the procurement model (Eriksson, 2006; Eriksson and Laan, 2007), it is appropriate to use value-oriented specifications (Axelsson and Wynstra, 2002) or joint specification (Eriksson and Laan, 2007) in the specification stage.

According to the expanded model, only specification and performance evaluation need to be handled with social control. Time-and-materials (process control) is suggested for the reward system stage, since it is most suitable when uncertainty is high and changes are likely (Bajari and Tadelis, 2001). In addition, when the knowledge of the transformation process is high, the client is likely to be able to manage the service provider's lack of cost-minimising focus, which is a con of the reward system. In fact, a two-stage contract including incentives (i.e. social control) (Eriksson, 2006) does not seem appropriate because the empirical data indicated that uncertainty was high throughout the entire physical planning phase. Therefore, getting to a stage suitable for fixed-price contracts did not seem possible.

As the performance in the physical planning phase cannot be evaluated according to any predefined specifications, output and process control is not achievable (Sitkin *et al.*, 2020). Thus, the procurement model (Eriksson, 2006; Eriksson and Laan, 2007) suggests performance evaluation, including self-control and shared values of the parties (Das and Teng, 2001).

According to the expanded model, output or process control is appropriate for the tender document phase because the data showed that the uncertainty was perceived as low, since more information had been gathered (Wynstra *et al.*, 2018). In addition, the output measurability was perceived as high (Das and Teng, 2001), as was the knowledge of the transformation process (Kirsch, 1996).

Based on the suggested control modes and procurement actions (Eriksson, 2006; Eriksson and Laan, 2007), either process- or output-oriented specifications (Axelsson and Wynstra, 2002) are preferable. The suggested reward system is fixed-price (i.e. output control (Eriksson, 2006; Eriksson and Laan, 2007)) because changes are less likely, so precise specifications are possible (Bajari and Tadelis, 2001) and output is measurable afterwards (Kirsch, 1996). As the choice of control modes and procurement actions for the two stages have to be the same (Tiwana and Keil, 2007), performance evaluation should either be output or process control by the client.

In Table 6, the control modes for both phases suggested by the expanded model and the procurement model (Eriksson, 2006; Eriksson and Laan, 2007) are outlined. Thus, in accordance with Kirsch *et al.* (2010) and Maqsoom *et al.* (2020), applying the empirical data to the expanded model and the procurement model (Eriksson, 2006; Eriksson and Laan, 2007) illustrates that social control is optimal when uncertainty is perceived high.

Table 6.
Control modes suggested by the expanded model and the procurement model by Eriksson (2006) and Eriksson and Laan (2007)

	Physical planning	Tender documents
Specification	Social	Output or process
Reward system	Process	Output
Performance evaluation	Social	Output or process

Clients' choice of control modes

This section will answer the second research question by comparing the conceptually suggested control modes and actions from the previous section to the client's actual choice and use of control modes, i.e. the last step of the data analysis. This analysis will focus on the frequently combined contracts, including both phases which means that the client used the same control modes for both phases.

The data show that, when the client procured an engineering service with high uncertainty, their choice of control modes (see Table 5) was different from the conceptually suggested control modes and actions (see Table 6). On the other hand, the client's choice of control modes when uncertainty is low was similar to the suggested control modes and actions. Hence, the expanded model and the procurement model (Eriksson, 2006; Eriksson and Laan, 2007) illustrate that the client did not perceive the level of uncertainty as a decisive factor when choosing control modes in the procurement of engineering services. Since the other two task characteristics (output measurability and knowledge of the transformation process) were considered high for both phases, it is difficult to say how the characteristics may have influenced the decisions. Below, there is a discussion of the differences between a client's choice and use of control modes compared to the conceptually suggested control modes when uncertainty is high, in each of the three procurement stages.

The data show that, when procuring a service including high levels of uncertainty in the specification stage, neither process nor output control were possible without resulting in gaps and different possible interpretations. Therefore, it was notable that the client still chose output and process control, which is different compared to the expanded model and previous research (Axelsson and Wynstra, 2002; Eriksson and Laan, 2007). In addition, the perceptions of both the client and the service provider indicated that this choice reduced the service provider's creativity.

The client's choice of control mode for different reward systems seemed partly in line with previous research (Bajari and Tadelis, 2001; Eriksson, 2006) as there were both fixed-price and time-and-materials contracts for physical planning. However, the service providers were frustrated about the financial risks they needed to take in fixed-price contracts.

The data suggest that the client's choice of control modes for performance evaluation was not influenced by the high levels of uncertainty, as social control was not used. Hence, their choice was different from the expanded model and the procurement model (Eriksson, 2006; Eriksson and Laan, 2007). In addition, the data show that the client sometimes used different control modes in the specification (output control) and evaluation (process control), which is not suggested in previous research (Tiwana and Keil, 2007). This seemed to cause frustration among the service providers due to unclear responsibilities (Eriksson, 2006). In accordance with Tiwana and Keil (2007) the client's use of process control could be explained by it being perceived as understanding the service procured (Kirsch, 1996), and thus it might have been difficult not to monitor the service provider in detail.

Conclusions

In relation to the first research question, the control model for choosing control modes originally developed by Ouchi (1979) was expanded in this study. By applying the empirical data to the expanded model (see Table 1) and the procurement model (see Table 2) (Eriksson, 2006; Eriksson and Laan, 2007), this study stresses the importance of considering the level of uncertainty when choosing control modes, due to the preference for social control when uncertainty is high (Kirsch *et al.*, 2010; Kreutzer *et al.*, 2016; Maqsoom *et al.*, 2020). In relation to the second research question, the study shows that the client based their choice of control modes on the level of output measurability and knowledge of the transformation process, but *not* on uncertainty.

Theoretical contributions

According to the control model developed by Ouchi (1979), the client should only choose social control when both output measurability and knowledge of the transformation process are perceived as low. Thus, the model contradicts other researchers, who argue that it is important to use social control (Kirsch *et al.*, 2010; Kreutzer *et al.*, 2016; Maqsoom *et al.*, 2020) when uncertainty is high. Therefore, the expanded model presented in this paper is an important contribution to previous control models (e.g. Ouchi, 1979) as it suggests the client's choice of control modes should also be based on the uncertainty of the service procured.

By analysing a case of procurement of engineering services with the expanded model, this study illustrates more clearly how task characteristics influence the client's choice of control modes. Although the expanded model shows that the choice of control modes should be based on the level of uncertainty, this study suggests that clients are more influenced by output measurability and knowledge of the transformation process. The service providers in this study argued that the chosen control modes reduced their creativity, increased their financial responsibility and caused unclear responsibilities of the quality. Thus, the expanded model is important from both theoretical and practical perspectives. This study contributes to the scarce control research on engineering services within construction management literature and to control research within other uncertain service contexts (e.g. Tiwana and Keil, 2007; Kirsch *et al.*, 2010).

Practical contributions

In conclusion, the phases of physical planning and tender documents have different uncertainty levels, so it is preferable to procure these phases using different contracts in order to use different control modes. Furthermore, in accordance with previous research (Tiwana and Keil, 2007), this study emphasises the importance of choosing the same control modes for specification and performance evaluation as they are perceived to be tied to each other. Due to the fact that engineering services play an essential role in the success of construction projects (Kärnä and Junnonen, 2017) and that the procurement of services is considered difficult (Wynstra *et al.*, 2018), this study offers important knowledge to public clients when procuring engineering services.

Limitations and further research

One limitation of this study is that the expanded model is only applied to engineering services. It would, therefore, be desirable for future research to test the model quantitatively and apply it to other empirical contexts. It is also encouraged to use other units of analysis in further studies, e.g. project level or different roles within a project.

References

Alvesson, M. (2011), *Interpreting Interviews*, SAGE, London.

Anderson, S.W. and Dekker, H.C. (2005), "Management control for market transactions: the relation between transaction characteristics, incomplete contract design, and subsequent performance", *Management Science*, Vol. 51 No. 12, pp. 1734-1752.

Aulakh, P.S. and Gencturk, E.F. (2000), "International principle-agent relationships: control, governance and performance", *Industrial Marketing Management*, Vol. 29 No. 3, pp. 521-538.

Axelsson, B. and Wynstra, F. (2002), *Buying Business Services*, Wiley, Chichester.

Bajari, P. and Tadelis, S. (2001), "Incentives versus transaction costs: a theory of procurement contracts", *The Rand Journal of Economics*, Vol. 32 No. 3, pp. 387-407.

Benabdellah, A.C., Benghabrit, A. and Bouhaddou, I. (2020), "Complexity drivers in engineering design", *Journal of Engineering, Design and Technology*, Vol. 18 No. 6, pp. 1663-1690.

Bouncken, R.B., Qiu, Y., Sinkovics, N. and Kürsten, W. (2021), "Qualitative research: extending the range with flexible pattern matching", *Review of Managerial Science*, Vol. 15 No. 2, pp. 251-273.

Cardinal, L.B., Kreutzer, M. and Miller, C.C. (2017), "An aspirational view of organizational control research: Re-invigorating empirical work to better meet the challenges of 21st century organizations", *Academy of Management Annals*, Vol. 11 No. 2, pp. 559-592.

Celly, K.S. and Frazier, G.L. (1996), "Outcome-based and behavior-based coordination efforts in channel relationships", *Journal of Marketing Research*, Vol. 33 No. 2, pp. 200-210.

Das, T.K. and Teng, B.S. (2001), "Trust, control, and risk in strategic alliances: an integrated framework", *Organization Studies*, Vol. 22 No. 2, pp. 251-283.

Eisenhardt, K.M. (1985), "Control: organizational and economic approaches", *Management Science*, Vol. 31 No. 2, pp. 134-149.

Eisenhardt, K.M. (1989), "Building theories from case study research", *The Academy of Management Review*, Vol. 14 No. 4, pp. 532-550.

Eriksson, P.E. (2006), "Procurement and governance management – development of a conceptual procurement model based on different types of control", *Management Revue*, Vol. 17 No. 1, pp. 30-49.

Eriksson, P.E. and Laan, A. (2007), "Procurement effects on trust and control in client-contractor relationships", *Engineering, Construction and Architectural Management*, Vol. 14 No. 4, pp. 387-399.

Flyvbjerg, B. (2006), "Five misunderstandings about case-study research", *Qualitative Inquirey*, Vol. 12 No. 2, pp. 219-245.

Gencturk, E.F. and Aulakh, P.S. (1995), "The use of process and output controls in foreign markets", *Journal of International Business Studies*, Vol. 26 No. 4, pp. 755-786.

Joslin, R. and Müller, R. (2016), "The relationship between project governance and project success", *International Journal of Project Management*, Vol. 34 No. 4, pp. 613-626.

Kärnä, S. and Junnonen, J.M. (2017), "Designers' performance evaluation in construction projects", *Engineering, Construction and Architectural Management*, Vol. 24 No. 1, pp. 154-169.

Kirsch, L.J. (1996), "The management of complex tasks in organizations: controlling the systems development process", *Organization Science*, Vol. 7 No. 1, pp. 1-21.

Kirsch, L.J., Ko, D.G. and Haney, M.H. (2010), "Investigating the antecedents of team-based clan control: adding social capital as a predictor", *Organization Science*, Vol. 21 No. 2, pp. 469-489.

Kreutzer, M., Cardinal, L.B., Walter, J. and Lechner, C. (2016), "Formal and informal control as complement or substitute? The role of the task environment", *Strategy Science*, Vol. 1 No. 4, pp. 235-255.

Langley, A. (1999), "Strategies for theorizing from process data", *The Academy of Management Review*, Vol. 24 No. 4, pp. 691-710.

Lin, L., Müller, R., Zhu, F. and Liu, H. (2019), "Choosing suitable project control modes to improve the knowledge integration under different uncertainties", *International Journal of Project Management*, Vol. 37 No. 7, pp. 896-911.

Lines, B.C. and Shalwani, A. (2019), "Procurement of architecture and engineering services: influence of cost on selection outcomes and evaluation criteria that best differentiate consultant expertise", *Journal of Architectural Engineering*, Vol. 25 No. 1, 4019002.

Liu, S. (2015), "Effects of control on the performance of information systems projects: the moderating ole of complexity risk", *Journal of Operations Management*, Vol. 36, pp. 46-62.

Lou, Z., Ye, A., Mao, J. and Zhang, C. (2022), "Supplier selection, control mechanisms, and firm innovation: configuration analysis based on fsQCA", *Journal of Business Research*, Vol. 139, pp. 81-89.

Manu, P., Asiedu, R.O., Mahamadu, A.M., Olomolaiye, P.O., Booth, C., Manu, E., Ajayi, S. and Agyekum, K. (2021), "Contribution of procurement capacity of public agencies to attainment of procurement objectives in infrastructure procurement", *Engineering, Construction and Architectural Management*, Vol. 28 No. 10, pp. 3322-3345.

Maqsoom, A., Hamad, M., Ashraf, H., Thaheem, M.J. and Umer, M. (2020), "Managerial control mechanisms and their influence on project performance: an investigation of the moderating role of complexity risk", *Engineering, Construction and Architectural Management*, Vol. 27 No. 9, pp. 2451-2475.

Mitchell, A., Frame, I., Coday, A. and Hoxley, M. (2011), "A conceptual framework of the interface between the design and construction processes", *Engineering, Construction and Architectural Management*, Vol. 18 No. 3, pp. 297-311.

Ouchi, W.G. (1979), "A conceptual framework for the design of organizational control mechanisms", *Management Science*, Vol. 25 No. 9, pp. 833-848.

Ouchi, W.G. (1980), "Markets, bureaucracies, and clans", *Administrative Science Quarterly*, Vol. 25 No. 1, pp. 129-141.

Pirzadeh, P., Lingard, H. and Blismas, N. (2021), "Design decisions and interactions: a sociotechnical network perspective", *Journal of Construction Engineering and Management*, Vol. 147 No. 10, 4021110.

Schilke, O. and Lumineau, F. (2018), "The double-edged effect of contracts on alliance performance", *Journal of Management*, Vol. 44 No. 7, pp. 2827-2858.

Siggelkow, N. (2007), "Persuasion with sase studies", *The Academy of Management Journal*, Vol. 50 No. 1, pp. 20-24.

Sihag, V. and Rijsdik, S.A. (2019), "Organizational controls and performance outcomes: a meta-analytic assessment and extension", *Journal of Management Studies*, Vol. 56 No. 1, pp. 91-133, doi: 10.1111/joms.12342.

Sitkin, S.B., Long, C.P. and Cardinal, L.B. (2020), "Assessing the control literature: looking back and looking forward", *Annual Review of Organizational Psychology and Organizational Behavior*, Vol. 7 No. 1, pp. 339-368.

The Transport Infrastructure Committee (2010), *Effektivare Planering Av Vägar Och Järnvägar. [More Efficient Planning of Roads and railways.] SOU 2010:57*, Fritzes, Stockholm.

Tiwana, A. and Keil, M. (2007), "Does peripheral knowledge complement control? An empirical test in technology outsourcing alliances", *Strategic Management Journal*, Vol. 28 No. 6, pp. 623-634.

van der Valk, W. and Rozemeijer, F. (2009), "Buying business services: towards a structured service purchasing process", *Journal of Services Marketing*, Vol. 23 No. 1, pp. 3-10.

Wuyts, S. and Geykens, I. (2005), "The formation of buyer-supplier relationships: detailed contract drafting and close partner selection", *Journal of Marketing*, Vol. 69 No. 4, pp. 103-117.

Wynstra, F., Rooks, G. and Snijders, C. (2018), "How is service procurement different from goods procurement? Exploring ex ante costs and ex post problems in IT procurement", *Journal of Purchasing and Supply Management*, Vol. 24 No. 2, pp. 83-94.

Yang, F., Shinkle, G.A. and Goudsmit, M. (2022), "The efficacy of organizational control interactions: external environmental uncertainty as a critical contingency", *Journal of Business Research*, Vol. 139, pp. 855-868.

Yin, R.K. (2012), *Case Study Research: Design and Methods*, Sage, London.

Corresponding author
Tina Karrbom Gustavsson can be contacted at: karrbom@kth.se