

EFFECTS OF PROCUREMENT ON CONSTRUCTION PROJECT PERFORMANCE

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Abstract

The processes and products of the construction industry affect all people in the industrialized world. It is also a backbone of many countries' economies, often constituting about 7-10% of the GNP. Hence, the efficiency of the construction industry is of great interest and relevance. In many countries, however, the construction industry frequently receives criticism regarding poor quality and customer satisfaction, frequent conflicts and disputes among different actors, and cost and schedule overruns in projects. Construction projects are mostly characterized by high complexity, customization and uncertainty coupled with long duration. Such characteristics require collaboration and coordination among many different actors. However, both practitioners and academics argue that many of the problems in construction projects are linked to inadequate procurement procedures where the focus is on short-term individual sub-optimization rather than on long-term project team performance. In order to increase the efficiency of the construction industry development and improvement of procurement procedures is therefore vital.

Earlier research efforts in the field of construction management have been limited to the investigation of how a single or a few specific procurement alternatives affect one or two project objectives. In order to achieve efficient governance of construction projects a systemic and holistic approach to procurement procedures is however crucial. Hence, investigations of a wide range of procurement procedures and their effects on different aspects of project performance are called for. The purpose of this paper is to increase the understanding of how chosen procurement procedures affect project performance. The paper develops a testable procurement model that on the general level proposes that collaborative procurement procedures influence project outcomes in a positive way. The influence is proposed to be moderated by the use of collaborative tools and the collaborative climate of the project. The method involves a comprehensive literature review including both procurement related factors and criteria of construction project performance.

The procurement related factors identified in this paper are related to aspects during the whole buying process: design stage, bid invitation, bid evaluation, subcontractor selection, compensation forms, and performance evaluation. The criteria for evaluating project performance are: economic performance, time performance, quality, environmental performance, work environment, and innovation. The outcome

of the paper is eight general propositions that propose certain direct and moderating relationships between success factors and success criteria. The theoretical contribution of the paper is high, since the model development is a unique effort to adopt a more systemic and holistic perspective on the effect of procurement procedures on project performance. Practically, the model can indicate how various procurement procedures affect different aspects of project performance. Thereby the model can increase our understanding of how to use different procurement procedures in order to facilitate different project objectives. The model can in a subsequent stage (outside the scope of this paper) be tested empirically through a large scale quantitative investigation. The practical contribution of such an empirical test is potentially very high.

Introduction

The construction industry is an important part of the economical backbone in many countries (Ngai *et al.*, 2002), often accounting for between 7-10 percent of the Gross Domestic Product (Winch, 1996, Voordijk *et al.*, 2000). Furthermore, construction products and processes have a large impact on safety, health and environmental aspects (Bayliss *et al.*, 2004). Since all human beings in modern societies are directly affected by its processes and/or products, the importance of a well-functioning construction industry is beyond doubt (Cheung *et al.*, 2001, Ngai *et al.*, 2002, Eriksson, 2007).

In many countries the construction industry has, however, attracted criticism for inefficiencies in outcomes such as time and cost overruns, low productivity, poor quality and inadequate customer satisfaction (Latham, 1994, Egan, 1998, Ericsson, 2002, Chan *et al.*, 2003). Practitioners, researchers and society at large have, therefore, called for a change in attitudes, behaviour and procedures in order to increase the chances for construction projects to be successful and result in improved end products (Love *et al.*, 2000, Dubois and Gadde, 2002).

Increased complexity, uncertainty, and time pressure in construction projects have increased the need for cooperation among different project actors (Anvuur and Kumaraswamy, 2007). Traditionally, relationships are, however, very competitive and adversarial in the construction industry (Cheung *et al.*, 2003), which to a large extent is due to the customary procurement procedures potentially causing many problems in all stages of the buying process (Eriksson and Laan, 2007). Therefore, in order to take advantage of collaboration, procurement procedures is one key improvement area and can contribute substantially to project success (Cheung *et al.*, 2003, Eriksson, 2007). A change of procurement procedures is, however, impeded by clients' habitual behaviour (Laedre *et al.*, 2006). Although procurement procedures need to be tailored to enhance the fulfilment of different project objectives (Cox and Thompson, 1997, Love *et al.*, 1998, Wardani *et al.*, 2006), clients tend to choose those procurement procedures they have a habit of using, regardless of any differences between projects (Laedre *et al.*, 2006). In order to enhance change, an increased understanding of how different procurement procedures affect different aspects of project performance is vital. Earlier research efforts in this area have been limited to the investigation of how a single or a few specific procurement alternatives affect one or two project objectives. In order to achieve successful governance of construction projects a holistic and systemic approach to procurement procedures is crucial (Cox and

Thompson, 1997, Eriksson and Pesämaa, 2007, Eriksson, 2008b). Since a systemic perspective on the effect of procurement procedures on different aspects of project performance is lacking in the construction management literature, this research effort aims to fill this theoretical gap that has potential to bring important practical implications.

The purpose of this paper is to increase the understanding of how chosen procurement procedures affect project performance. The paper aims to develop a testable procurement model that proposes certain relationships between specific procurement procedures (treated as success factors) and project results (treated as success criteria). The conceptual model will be based on a systemic and holistic approach. It will include a wide range of procurement related success factors, from the design stage to performance evaluation, and a wide range of success criteria. This will make it possible to analyse if and how different factors and criteria interact and affect each other. The method involves a comprehensive literature review of procurement related success factors and success criteria reflecting construction project performance.

Success Criteria Reflecting Project Performance

Traditionally, researchers and organisations have focused on the three project performance criteria of cost, time and quality (Dainty *et al.*, 2003, Chan and Chan, 2004, Swan and Khalfan, 2007). Recently, many studies have, however, included also other performance aspects, such as health and safety (Chan and Chan, 2004), environmental performance (Chan and Chan, 2004, Swan and Khalfan, 2007), customer satisfaction (Chan and Chan, 2004, Collins and Baccarini, 2004), and innovation (Harty, 2008). Next, we will briefly outline six areas in which construction projects are evaluated and consequently can be seen as success criteria.

Economic performance

This has traditionally been seen as one of the most important areas – if the economy of the project is off, the project can seldom be seen as a success. *Overall project cost*, i.e. the overall cost that a project incurs from inception to completion, is of major interest as it shows the resource usage in economical terms. Another important aspect regards cost predictability, that is, whether the final overall cost is in line with the initial cost estimate (Swan and Khalfan, 2007). *Cost overruns* can be a source for problems for an otherwise successful project as contractors are frequently criticised for the common occurrence of cost overruns (sometimes labelled cost growth) in construction projects (Chan and Chan, 2004).

Time performance

The increasing importance of time in our globalised society has affected the construction industry in form of shortened project schedules. *Project duration* is simply the number of days/weeks/months from start to completion of the project. Since time can be a critical issue for many clients, project duration is often of prime interest. However, *schedule overruns* may be an even more important issue.

Completing projects in a predictable manner on time (within schedule) is an important indicator of project success and the construction industry is frequently criticised for project delays (Chan and Kumaraswamy, 1997, Odeh and Battaineh, 2002, Faridi and El-Sayegh, 2006, Swan and Khalfan, 2007). Schedule overruns (sometimes labelled time growth) are often very negative since they hinder the client to start using the end product as planned.

Quality

Satisfactory time and cost performance is of little value if the project delivers inferior quality. The concept of quality is closely related to customer satisfaction, which has gradually been elevated in importance in the construction industry (Latham, 1994, Egan, 1998, Forsythe, 2007). Customer satisfaction is commonly described as a comparison between the customer's pre-purchase expectations and their post-purchase perceptions. Hence, it involves the customer's final feelings about whether the outcome provided a satisfying or dissatisfying experience (Forsythe, 2007). Since construction industry products are highly customised and co-created during the construction process, the concept of quality regards both the final product and the process during which is created. Therefore, we see two main aspects of quality. First, *quality of end product* has to do with the users' satisfaction with the finished construction and it is a critical success factor (Collins and Baccarini, 2004, Forsythe, 2007). It is also related to how the final product and its function meets the specification (Chan and Chan, 2004, Collins and Baccarini, 2004). The second aspect of quality is the *service quality during the construction process*, which reflects the client's perception of the process during which project participants interact to create the end product (Maloney, 2002, Forsythe, 2007).

Environmental performance

Environmental management in construction has become a critical issue in recent decades since the actors start to acknowledge that the construction industry is one of the major contributors to environmental problems (Crawley and Aho, 1999, Tam *et al.*, 2006a, Tam *et al.*, 2006b). Environmental impact is affected by both the activities performed during the construction process and the material and technical solutions incorporated in the end product (Crawley and Aho, 1999). Furthermore, the environmental performance depends not only of choices made but also how these choices are executed. Hence, two main aspects can be identified within this area. First, it is in what degree the construction actors make *environmentally friendly choices of material and processes*, i.e. in the planning and procurement choose those material and those methods that will leave the least environmental "footprint" over the construction's life span (not only the construction period). Second, it is about how the material and processes are used during construction, i.e. *environmentally friendly use of material and processes*. With little concern over environmental impacts, excess loss of material and improper waste treatment are always common in the construction industry (Tam *et al.*, 2006b).

Work environment

Having a safe and healthy work environment for those involved in the construction process is another important indicator for a successful project performance. Construction has a poor record in this area and is still today generally a dangerous work place (Ai Lin Teo *et al.*, 2005). However, this does not mean that a project can allow the work environment to continue to cause project participants to become ill or even die. Rather, it is the opposite. A construction project must not harm those involved, if it can be helped. A failure to succeed with this may cause long-term problems as it reduces the legitimacy of those responsible. A risk-free work environment is today seen as necessary for achieving other goals linked to cost, time and quality (Koehn and Datta, 2003). The most important sub-facets of work environment are health and safety. *Health* is concerning the physical and mental well-being of those who are involved in a construction project. Physical health issues (such as back injuries are more likely to concern those working at the construction site, while mental health issues (such as stress) are more likely to be common among off-site workers. *Safety* is about avoiding accidents of any kind that can cause injuries or even fatalities for those involved in the construction process. A safe project have few accidents in relation to the total man-hours worked on the specific project (Chan and Chan, 2004).

Innovation

Traditionally, the construction sector has been seen as a low tech industry, with little innovation compared to other industries (Reichstein *et al.*, 2005, Harty, 2008). Actually, many of the problems outlined in the introduction can be seen as symptoms of a lack of new thinking and innovative action. During recent years, innovation in construction has received increasing interest in an explicit manner, both among practitioners and academics. Innovation thus seems to be a success criterion to be reckoned with. There are two aspects of innovation. First, *product innovation* implies innovation in the final construction, for instance in terms of innovative architecture or innovative features in other aspects of the building. Second, *process innovation*, is about novel ways to work with the actual construction phase. It can comprise new ways to organize the work, new construction methods, etc.

Procurement Related Success Factors' effect on project performance

Eriksson (2008a, b) and Eriksson and Nilsson (2008) have developed a systemic and holistic frame of reference regarding the clients' choices during all the stages of the buying process. In this paper these different alternatives are treated as independent variables concerning procurement related success factors. As illustrated in Table 1, all procurement related choices will affect the governance form's focus of competition and cooperation. A cooperative governance form is established by choosing the cooperative procurement procedures in the right column, whereas the alternatives in the competition column will result in a governance form focusing on competition. In between of these opposing standpoints are cooperative choices which result in a governance form that balances competition and cooperation.

Table 1. Procurement procedures' relation to competition and cooperation

Buying stage	Procedures related to competition	Procedures related to coepetition	Procedures related to cooperation
Design	By the contractor (or by the client)	Joint specification with one party responsible	Joint specification with shared responsibilities
Bid invitation	Open bid procedure (multiple bids)	Limited bid invitation (a few bids)	Direct negotiation with one bidder
Bid evaluation	High weight on price	Equal weight on price and soft parameters	High weight on soft parameters
Subcontractor selection	By the contractor (or by the client)	Joint selection with one party responsible	Joint selection with shared responsibilities
Compensation	Fixed price	Fixed price and shared profits	Including incentives (shared profits)
Performance evaluation	By the client	Divided between client and contractor	By the contractor

As discussed in the introduction, the traditional competitive procurement procedures cause many problems (Eriksson and Laan, 2007). The procurement model developed in this paper therefore proposes that more cooperative procurement procedures will have positive effects on many aspects of project performance. Next, the choices during the buying process and their effects on project performance are discussed and proposed.

Design Stage

Possible choices regarding the design stage

The design stage is very important for many aspects of project performance, such as life cycle costs, project costs and schedule (Andi and Minato, 2003, Faridi and El-Sayegh, 2006). In fact, defective design has been found to cause 30% of cost and time overruns in construction projects (Andi and Minato, 2003). Adequacy of plans and specifications and a design with high constructability have been identified to improve overall project performance (Chua *et al.*, 1999). The client can choose varying degrees of detail in the design work. The extremities are to specify the technology in detail (i.e. design-bid-build contracts) or merely the performance and functions of the product (i.e. design-build contracts). In design-bid-build contracts the client performs detailed design work together with consultants before contractors are procured, in order to develop a solid base for competitive bidding. In design-build contracts, contractors are procured very early based on the project brief or sketchy drawings, after which the contractor performs detailed design. This facilitates solutions with high constructability, due to contractor focused design (Tam, 2000). The drawback is diminished client influence in the design work. Between these extremes, where design relies heavily either on the client or the contractor, there are alternatives in which the client and the contractors together with consultants cooperate in developing the detailed design. As for design-build, the contractors need to be involved early in the design process. This approach is often called joint specification (Eriksson and Nilsson, 2008) or concurrent engineering, since it make parallel and integrated design and construction possible (Brown *et al.*, 2001).

Relationships between design stage choices and project performance

A high degree of specification prior to contractor procurement results in a divorce between design and construction, since construction planning cannot affect design (Pietroforte, 1997, Dubois and Gadde, 2002, Eriksson and Laan, 2007). This separation results in long project durations (Pietroforte, 1997, Love *et al.*, 1998) and decreased innovation due to lack of joint problem-solving (Korczynski, 1996). The literature shows some positive results for both design-build and for design-bid-build. Looking at design-build contracts, these have shown to provide better value for money and reduced project duration, compared to design-bid-build contracts (Tam, 2000). Other studies show that design-bid-build contracts have ensured quality better than design-build contracts (Cheung *et al.*, 2001). A complete design before construction also improves budget performance (Chua *et al.*, 1997).

In order to decrease the risk for defective design increased coordination between designer and contractors is suitable (Andi and Minato, 2003). Early involvement of contractors in concurrent engineering facilitates cost saving and shortened project duration due to increased buildability (Bresnen and Marshall, 2000c, Bresnen and Marshall, 2000a, Brown *et al.*, 2001, Andi and Minato, 2003, Rahman and Kumaraswamy, 2004) and reduced rework (Love *et al.*, 2004), increased client satisfaction since the client maintains the possibilities to influence and control the design work (Pietroforte, 1997, Eriksson, 2008b) and improved environmental performance (Cole, 2000), work environment (Cameron and Duff, 2007), and innovation (Ling, 2003). Based on the above, we propose the following propositions for the design stage:

- P₁: The higher the level of collaboration between client and contractors in the design stage,
- a: the better the economical performance.
 - b: the better the time performance.
 - c: the better the quality.
 - d: the better the environmental performance.
 - e: the better the work environment
 - f: the better the innovation

Bid invitation

Possible choices regarding the bid invitation

Laws regarding public procurement restrict public sector clients' bid invitations to open invitations in which all contractors are welcome to submit bids. The purpose is of course to enhance competition and transparency. The drawback is that it hampers long-term development in lasting relationships since actor constellations are changed in every project (Dubois and Gadde, 2000). Hence, private sector clients often utilize the possibility to invite a limited amount of trustworthy contractors, or even negotiate directly with only one selected contractor (Lam *et al.*, 2001, Eriksson, 2008a).

Relationships between bid invitation choices and project performance

Invitation of a limited number of bidders decrease project duration due to shortened bidding stage (Lam *et al.*, 2001). Invitation of a limited number of bidders also increases the chance for lasting relationships and a continuous workload over time for

the selected contractors, which facilitate improved innovation (Barlow, 2000, Dubois and Gadde, 2002, Manley, 2008) and the development of knowledge about the clients and their demands, which is important for client satisfaction (Eriksson, 2009). Since one key factor of keeping a safe and healthy work environment is continuity (Wilson, 1989), a smaller set of trusted invited bidders is likely to lead to a better project work environment. Also environmental management and sustainable development require continuity and a long-term perspective, which should be facilitated by long-term relationships. For economical performance, the outcome is less certain. While an open bid is likely to result in a lower bid (and potentially a lower overall project cost), a closed bid may be better in terms of avoiding cost overruns as there is less reason for underestimating costs for bidders in this situation. Thus, we propose the following for bid invitation:

- P₂: The fewer the number of contractors that are invited in the bid invitation,
- a: -
 - b: the better the time performance.
 - c: the better the quality.
 - d: the better the environmental performance.
 - e: the better the work environment
 - f: the better the innovation

Bid evaluation

Possible choices regarding the bid evaluation

Selecting a capable contractor is one of the most important tasks faced by clients who wishes to achieve project success (Fong and Choi, 2000, Kumaraswamy and Anvuur, 2008). Bid evaluations can include many different parameters, such as bid price, technical competence, management capability, earlier experience, reference objects, environmental and quality management systems, financial stability and collaborative skills (Lam *et al.*, 2001, Eriksson and Laan, 2007, Malmberg, 2007). Traditionally, clients set a very high weight on price and lower weight on soft parameters, especially among public clients (Fong and Choi, 2000, Eriksson, 2008a). Recently, there has, however, been growing interest for a shift from lowest price selections to multi-criteria selection also considering soft parameters (Kumaraswamy and Anvuur, 2008). While bid price is related to competition, all other aspects can be seen as aspects determining the potential for collaboration in the project (Eriksson, 2008a). For instance, suitable competencies and capabilities will provide a basis for better integration between client and contractor. Likewise, earlier experience (especially if it shared) provides a path for how collaboration can be organized.

Relationships between bid evaluation choices and project performance

High weight on lowest bid price increase the risk for opportunism and conflicts and hampers cooperation since contractors often bid low to get the job and then search for “extras” to achieve profitability (Korczyński, 1996, Ng *et al.*, 2002, Kadefors, 2005, Alderman and Ivory, 2007). Focus on low bid price also increase the risk for cost and schedule growth due to several change orders (Assaf and Al-Hejji, 2006, Wardani *et al.*, 2006).

Factors related to competence and experience, such as poor site management, supervision and planning on behalf of the contractor, are common causes of cost and time overruns (Chan and Kumaraswamy, 1997, Odeh and Battaineh, 2002, Assaf and Al-Hejji, 2006, Sambasivan and Soon, 2007) and poor customer satisfaction (Maloney, 2002). Careful partner selection (through bid evaluation based on suitable soft parameters) considering desired competences, experiences and attitudes can therefore reduce cost growth (Chua *et al.*, 1997, Iyer and Jha, 2005, Wardani *et al.*, 2006) and time overruns (Chan and Kumaraswamy, 1997), and improve quality performance (Yasamis *et al.*, 2002), work environment (Ai Lin Teo *et al.*, 2005), and innovation (Manley, 2008, Bosch-Sijtsema and Postma, 2009).

Environmental management systems (EMS) may not guarantee improved environmental performance (Tam *et al.*, 2006a). Instead, relevant training, expertise and commitment among management staff is the most important success factor for improvements in this area (Shen and Tam, 2002, Tam *et al.*, 2006b). Most clients are, however, not committed to environmental performance, but for those who are, the inclusion of environmental management aspects in tendering requirements is important (Shen and Tam, 2002). Hence, bid evaluation based on suitable soft parameters that consider various environmental aspects can improve environmental performance.

Thus, as for bid invitation we see links to all success criteria, but the relation to economic performance is uncertain. A strong focus on bidding price is certain to bring down the bidding price and likely also get a low overall project cost. However, cost overruns are more likely. Therefore, we refrain from putting forward a proposition for economic performance. For the other five criteria, we propose the following:

- P₃: The higher the focus on soft parameters in the bid evaluation,
- a: -
 - b: the better the time performance.
 - c: the better the quality.
 - d: the better the environmental performance.
 - e: the better the work environment
 - f: the better the innovation

Subcontractor selection

Possible choices regarding the subcontractor selection

As much as 70-80 % of the overall project cost regards purchased material and services from suppliers and subcontractors (Dubois and Gadde, 2000). Thus, subcontractor selection is very important for project success. The selection of subcontractors can be made by the main contractor (domestic contract), by the client (nominated contract) (Shoemith, 1996) or jointly by both parties in collaboration (Eriksson, 2007). In market relationships, main contractors have total freedom to select their subcontractors, leaving the client with no control of who performs specialist work (Shoemith, 1996). Domestic contracts therefore indicate a *laissez-faire* approach, while nominated contracts entail control and authority. The third alternative, careful joint subcontractor selection by both client and main contractor in collaboration, indicates a concern for both parties' interests (Eriksson, 2007).

Relationships between subcontractor selection choices and project performance

Cooperative relationships between client and main contractor do not automatically spread to subcontractors, which are often traditionally procured by main contractors (Bresnen and Marshall, 2000c, Alderman and Ivory, 2007). Hence, clients who wish to integrate subcontractors in teamwork and joint problem-solving have to get involved in the procurement of subcontractors. Careful joint subcontractor selection by both client and main contractor in collaboration is therefore important in order to increase subcontractors' involvement and cooperation (Palaneeswaran *et al.*, 2003, Briscoe *et al.*, 2004, Eriksson *et al.*, 2007), which in turn may have many positive effects on project performance. Earlier research have found that increased subcontractor involvement may facilitate improved economical performance (Errasti *et al.*, 2007), time performance (Gil *et al.*, 2004, Elfving *et al.*, 2005), quality (Karim *et al.*, 2006, Errasti *et al.*, 2007), environmental performance (Shen and Tam, 2002), work environment (Debrah and Ofori, 2001), and innovation (Eriksson *et al.*, 2007, Manley, 2008). Thus, we propose the following relationships:

- P₄: The higher the extent both client and contractors are jointly involved in subcontractor selection,
- a: the better the economical performance.
 - b: the better the time performance.
 - c: the better the quality.
 - d: the better the environmental performance.
 - e: the better the work environment
 - f: the better the innovation

Compensation form

Possible choices regarding the compensation forms

Fixed price for a product delivered is the most common form of compensation (Eriksson and Laan, 2007). This compensation makes the bid evaluation easier since the client easily can compare the different contractors' bid prices. It will also provide the client with a more or less accurate estimation of the total project cost already in the bid evaluation stage. The opposite type of compensation is cost reimbursement, which means that the contractor receives payment for all costs arisen in the project, decreasing the financial risk for the contractor (Korczyński, 1996, Bajari and Tadelis, 2001). Between these extremities there are alternatives based on reimbursement payments including gain share/pain share agreements based on a target price (Bresnen and Marshall, 2000b, Bajari and Tadelis, 2001, Eriksson and Laan, 2007).

Relationships between compensation form choices and project performance

Fixed price compensation increase the risk for opportunism and conflicts and hampers cooperation (Korczyński, 1996, Kadefors, 2005, Eriksson, 2008b). Compensation based on incentives connected to different aspects of project objectives facilitates economical performance (Tang *et al.*, 2006), time performance (Eriksson, 2009), quality (Eriksson, 2009), innovation (Dulaimi *et al.*, 2003) and a good project performance in total (Olsen *et al.*, 2005). Furthermore, incentive-based compensation facilitate improved environmental performance (Tam and Tam, 2008) and work environment if the reward to project participants is connected to environmental aspects, such as reduced amount of waste and accidents.

Based on the abovementioned arguments we propose the following propositions including all six criteria:

- P₅: The more the compensation is based on incentives connected to joint objectives,
a: the better the economical performance.
b: the better the time performance.
c: the better the quality.
d: the better the environmental performance.
e: the better the work environment
f: the better the innovation

Performance evaluation

Possible choices regarding the performance evaluation

The control of work in progress and the final product can either be executed by the client or by the contractor. Traditionally, construction clients perform most of the control instead of leaving it up to the contractor. End inspections of the finished product are traditionally very comprehensive, consuming both time and money without adding any value.

Relationships between performance evaluation choices and project performance

Tight monitoring of contractors' behaviour and performance increase the risk for opportunism and hampers cooperation (Korczynski, 1996). Increased reliance on contractors' self control can instead save both money and time (Eriksson and Nilsson, 2008, Eriksson, 2009) due to earlier identification of defects and a less comprehensive end inspection. Self-control also has the potential to increase the contractors' concern for quality since they cannot rely on others to control the quality of their work (Eriksson, 2009). In line with this discussion we propose that performance evaluation affect economical performance, time performance, and quality in the following ways:

- P₆: The more the performance evaluation is based on contractors' self control,
a: the better the economical performance.
b: the better the time performance.
c: the better the quality.
d: -
e: -
f: -

Summary of propositions

In Table 2 below we summarize the propositions. The + signs indicates where we have been able to find logical relationships and therefore formulated propositions.

Table 2. The proposed relationships between procurement procedures and project performance

Procurement Procedures	Success criteria					
	Economical performance	Time Performance	Quality	Environmental Performance	Work environment	Innovation
	1) Overall project cost 2) Cost overruns	1) Project duration 2) Schedule overruns	1) Quality of end product 2) Service quality during process	1) Environmentally friendly choices 2) Environmentally friendly use	1) Health 2) Safety	1) Product innovation 2) Process innovation
Design stage The higher the level of collaboration between client and contractors in the design stage	+	+	+	+	+	+
Bid invitation The fewer the number of contractors that are invited in the bid invitation		+	+	+	+	+
Bid Evaluation The higher the focus on soft parameters in the bid evaluation		+	+	+	+	+
Subcontractor selection The higher the extent both client and contractors are jointly involved in subcontractor selection	+	+	+	+	+	+
Compensation forms The more the compensation form is based on incentives connected to joint objectives	+	+	+	+	+	+
Performance evaluation The more the performance evaluation is based on contractors' self control	+	+	+			

Collaborative tools and collaborative climate as moderating factor

Above we have put forward a number of propositions stating that the more geared towards collaboration certain aspects of the procurement procedures are, the better the projects outcome will be. In this section, we will elaborate on two aspects that we propose will moderate these relationships, i.e. affect how strong the relationship will be. Both aspects deals with how well the project parties can handle collaboration, where the first aspect, collaborative tools, has to do with “hardware” for collaboration, and the second aspect, collaborative climate, has to do with “software” for collaboration. These two aspects will next be discussed in detail.

Collaborative tools

In construction transactions, the actual production takes place within the buying process, since there is no standardised ready-made product to buy. Since the client and the contractors have to interact to create the product, use of collaborative tools for

joint action may be suitable (Bayliss *et al.*, 2004, Olsen *et al.*, 2005, Eriksson, 2007). Examples of such collaborative tools are: joint objectives, joint office building, teambuilding activities, partnering facilitator, joint IT-tools, joint risk management, and relational norms based on a partnering contract (Barlow, 2000, Bresnen and Marshall, 2000a, Rahman and Kumaraswamy, 2002, Olsen *et al.*, 2005, Eriksson, 2009).

High usage of collaborative tools will improve cooperation (Cheng *et al.*, 2000, Cheng *et al.*, 2001, Cheung *et al.*, 2003, Eriksson, 2008b) and thereby facilitate the mechanisms in P₁-P₆. For instance, *joint objectives* facilitate the development of a win-win situation in which all actors are striving together towards the same goal (Eriksson, 2008b). *Joint IT-tools* enhance integration and communication among different project actors (Cheng *et al.*, 2001). *Joint risk management* (JRM) is a good way of dealing with risks that are unforeseen and unquantifiable during the planning stage (Rahman and Kumaraswamy, 2004). Since these kinds of risks are common in construction projects, JRM will provide a tool that solves problematic situations before they become disputes and thus paves the way for collaborative action. In most countries the construction industry relies heavily on standard forms of contracts, which hamper joint problem-solving and cooperation since they work as a wedge to drive distance between the actors (Pietroforte, 1997, Thompson *et al.*, 1998, Eriksson and Laan, 2007). Hence, it is important that formal contracts are coupled with *relational norms* in order to enhance cooperation (Eriksson, 2008b, Bosch-Sijtsema and Postma, 2009). Relational norms, which can be based on a mutually agreed partnering contract, give the actors a sense of acceptable and deviant behaviour, increasing the predictability and decreasing the need for controlling each other (Eriksson, 2008b, Eriksson, 2009). A *joint project office* on site in which all members of the partnering team is located facilitates increased face-to-face encounters which is important for solving problems together in early stages (Barlow, 2000, Olsen *et al.*, 2005, Alderman and Ivory, 2007).

P₇: The higher the use of collaborative tools in the project, the stronger the relationships in P₁-P₆ will be.

Collaborative climate

For collaborative relationships, such as partnering, to function well a good collaborative climate is needed. In this study, the collaborative climate consists of trust and commitment. Many studies have shown that mutual trust (Black *et al.*, 2000, Ng *et al.*, 2002, Wong and Cheung, 2004, Laan, 2008) and commitment (Black *et al.*, 2000, Ng *et al.*, 2002, Chan *et al.*, 2006, Rahman and Kumaraswamy, 2008) among the project actors is needed for collaboration to work well. Even though trust and commitment are distinct concepts, they often tend to correlate strongly – where there is trust, there is commitment, and where trust is missing, so is commitment. Trust is a key component of collaboration (Wood *et al.*, 2002, Kadefors, 2004, Lui and Ngo, 2004, Anvuur and Kumaraswamy, 2007) and it works as a glue to bind the parties together. The more the parties trust each other, the less effort they need to exert to accomplish common tasks. The reason for this is that less effort is used for controlling the other party, which is needed when trust is low. If trust is the glue, commitment determines its strength. Where there is strong commitment, collaboration is likely to

be tight. Thus, in projects where trust and commitment are present and the collaborative climate is good, the collaborative procurement procedures are likely to bear more fruit and we therefore propose:

P₈: The better the collaborative climate in the project, the stronger the relationships in P₁-P₆ will be.

In Figure 1 below we present the overall framework developed in this paper. It shows that P₁-P₆ propose relationships between collaborative procurement procedures and construction project performance, and that P₇ and P₈ propose that collaborative tools and collaborative climate have moderating effects on the first six relationships.

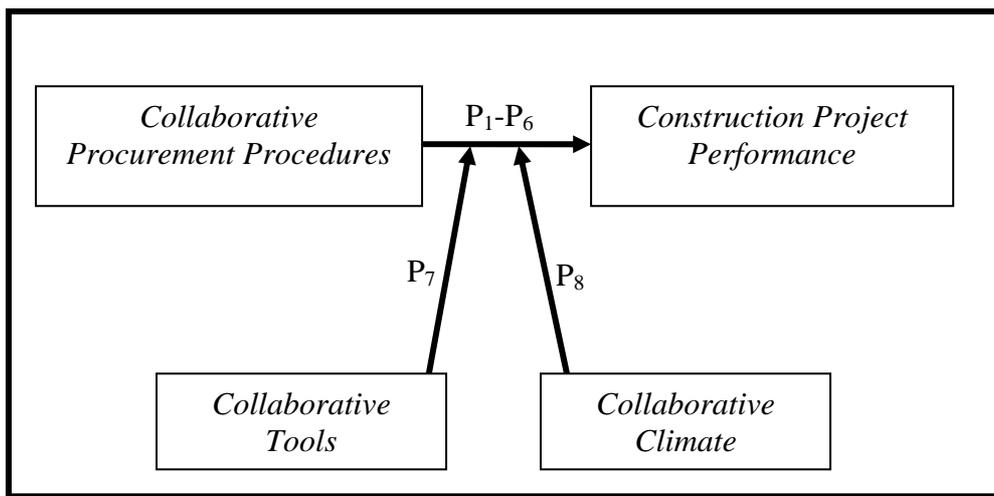


Figure 1. The proposed general framework for the study

Concluding discussion

In recent years there has been an increasing interest in the use of partnering in order to improve collaboration among construction project actors (Bresnen and Marshall, 2000a). Cox and Thompson (1997) mean that confusion exists between the means and the end in much of the partnering literature. There is a danger that collaboration becomes the objective rather than a vehicle for achieving successful project performance (Cox and Thompson, 1997, Bresnen and Marshall, 2000a). Our model proposes that collaboration works in two ways. First, as collaborative procurement procedures it acts as means to directly achieve better project performance. Second, as collaborative tools and collaborative climate, it acts as a moderator influencing the relationship between collaborative procurement procedures and project performance.

We encourage other scholars to put our proposed model to test in different contexts. Most of the concepts we discuss are easily operationalized as there exist scales (e.g. trust and commitment), or the concept can fairly easily be adequately measured (e.g. level of use of the different procurement procedures and of collaborative tools). The main challenge lies perhaps in collecting a large enough number of construction projects from a similar context. There need to be multiple respondents for each project (e.g. client, contractors, subcontractors, consultants) and to secure answers from all is a challenge. Another challenge is that data collection, at least to some extent, needs to

be retrospective. At least if the data should be available within reasonable time. Then the use of multiple respondents becomes even more important in order to be able to assess reliability. Thus, the data collection will be challenging in some areas, but rather straight-forward in others. We hope the challenges do not defer researchers to put the model to test. The value that lies in having this model tested is potentially great as the construction literature has many indications that cooperation and collaboration may be a good strategy for achieving project success, but empirical evidence delineating this in a more holistic way is lacking. We hope that this is just a temporary situation.

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