In order to increase the efficiency of the construction industry development and improvement of procurement procedures is vital. The purpose of this investigation is to increase the understanding of how procurement procedures affect project performance. A procurement model including eight hypotheses is first developed on the basis of a literature review and then tested through multivariate statistical techniques based on empirical data collected through a survey investigation of 106 Swedish construction clients. The results of hierarchical regression analyses show that cooperative procurement procedures positively affect collaboration among project actors and that collaboration in turn have positive effects on project performance. In general, however, cooperative procurement procedures do not have direct effects on project performance.

**KEYWORDS:** procurement, project performance, collaboration.

**INTRODUCTION**

Traditional competitive procurement procedures cause adversarial relationships and many problems in all stages of the buying process (Cheung et al., 2003, Eriksson and Laan, 2007). Although procurement procedures need to be tailored to enhance the fulfilment of different project objectives (Cox and Thompson, 1997, 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, Eriksson, 2008a). In order to enhance change, an increased understanding of how different procurement procedures affect different aspects of project performance in different types of projects is therefore vital. In spite of procurement procedures’ importance for project success, earlier research on this topic is limited to a few investigations focusing on how only one or a few procurement aspects affect a few project outcomes. Examples are bid evaluation effects on cost and schedule growth (Assaf and Al-Hejji, 2006, Wardani et al., 2006), and partnering tools’ effect on partnering success (Chan et al., 2004, Tang et al., 2006). In order to achieve successful governance of construction projects a holistic and systemic approach to procurement procedures is crucial (Cox and Thompson, 1997, Eriksson, 2008b). The purpose of this investigation is therefore to increase the understanding of how a broad range of procurement procedures affect various aspects of project performance. Through a comprehensive literature review a procurement model is first developed and then empirically tested.
PROCUREMENT EFFECTS ON PROJECT PERFORMANCE

Traditionally, researchers and practitioners have focused on the three project performance criteria of cost, time and quality. In this section cooperative procurement procedures’ effects on these three criteria and achieved collaboration are discussed and proposed.

Joint specification

Design-bid-build (DBB) involve a complete specification prior to contractor procurement, resulting in a divorce between design and construction (Pietroforte, 1997, Dubois and Gadde, 2002). This separation results in long project durations and decreased joint problem-solving (Korczynski, 1996), compared to design-build (DB) contracts. Other studies show that DBB ensure better quality (Cheung et al., 2001) and improved budget performance (Chua et al., 1997) than DB. Joint specification (Eriksson and Nilsson, 2008), or concurrent engineering, make parallel and integrated design and construction possible (Brown et al., 2001). 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 facilitates cost saving and shortened project duration due to increased buildability (Brown et al., 2001, Andi and Minato, 2003), increased client satisfaction since the client maintains the possibilities to influence and control the design work (Pietroforte, 1997, Eriksson, 2008b), and better joint problem-solving and collaboration (Korczynski, 1996, Rahman and Kumaraswamy, 2004). We therefore propose the following hypotheses for joint specification:

H1: The higher the level of collaboration between client and contractors in joint specification: (a) the better the economical performance, (b) the better the time performance, (c) the better the quality and (d) the better the collaboration.

Limited bid invitation

Compared to open invitations a limited number of invited bidders can decrease project duration due to shortened bidding stage. It also increases the chance for lasting relationships and a continuous workload for the selected contractors, which facilitate cooperation (Bresnen and Marshall, 2000a, Eriksson, 2007) and client satisfaction through increased knowledge about the client’s demands (Eriksson, 2009). For economical performance, the outcome is less certain. While an open bid is likely to result in a lower bid, 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 (Korczynski, 1996). Thus, we propose the following for bid invitation:

H2: The fewer the number of contractors that are invited in the bid invitation: (b) the better the time performance, (c) the better the quality, (d) the better the collaboration.

Soft evaluation parameters

By focusing on low bid price the client aims to select the contractor who performs the work to the lowest cost. However, it increases the risk for cost and schedule growth due to a higher amount of change orders (Assaf and Al-Hejji, 2006, Wardani et al., 2006). Soft parameters 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) and poor customer satisfaction (Maloney, 2002). Careful partner selection 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). Furthermore, appropriate attitudes and competence are very important for cooperation to emerge (Ng et al., 2002). Hence, bid evaluation based on suitable soft parameters improves cooperation (Rahman and Kumaraswamy, 2004). Accordingly, we propose the following relationships:

H3: The higher the focus on soft parameters in the bid evaluation: (a) the better the cost performance, (b) the better the time performance, (c) the better the quality, (d) the better the collaboration.

**Joint subcontractor selection**

Cooperative relationships between client and main contractor do not automatically spread to subcontractors, which are often traditionally procured by main contractors (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 (Eriksson et al., 2007), which in turn may have many positive effects on project performance. Earlier research have found that increased subcontractor integration may facilitate improved economical performance (Errasti et al., 2007), time performance (Gil et al., 2004, Elfving et al., 2005), and quality (Errasti et al., 2007). Thus, we propose the following relationships:

H4: The higher the extent both client and contractors are jointly involved in subcontractor selection and integration: (a) the better the economical performance, (b) the better the time performance, (c) the better the quality, (d) the better the collaboration.

**Incentives**

Fixed price provides the client with a more or less accurate estimation of the total project cost already in the bid evaluation stage. However, due to increased amount of change orders, the risks for cost and schedule overruns are higher (Assaf and Al-Hejji, 2006, Wardani et al., 2006). Compensation based on incentives connected to different aspects of project objectives facilitates economical performance (Tang et al., 2006), time performance (Chua et al., 1999, Eriksson, 2009), quality (Eriksson, 2009), and a good project performance in total (Olsen et al., 2005). Reimbursement coupled with incentives also facilitates cooperation (Korczynski, 1996, Bayliss et al., 2004, Kadefors, 2005, Eriksson, 2008b). Based on the abovementioned arguments we propose the following hypotheses:

H5: 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 collaboration.

**Collaborative tools**

Since client and contractors have to interact in the construction process, it may be suitable to use various collaborative tools such as: joint objectives, joint office building, teambuilding activities, partnering facilitator, joint IT-tools, and joint risk management (Bresnen and Marshall, 2000b, 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). 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). A joint project office on site in which all members of the partnering team is located facilitates face-to-face encounters which are important for joint problem-solving (Olsen et al., 2005, Alderman and Ivory, 2007). Hence, the following hypotheses are formulated:

H6: The higher the use of collaborative tools in the project: (d) the better the collaboration.

**Contractor self-control**

Traditionally, construction clients perform most of the control, of both work in progress and the final product, instead of leaving it up to the contractor (Eriksson, 2008a). Such 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 project performance in the following ways:

H7: 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) the better the collaboration.

**Collaboration**

For collaborative relationships, such as partnering, to function well a good collaborative climate is needed. Earlier research have shown that collaboration facilitates: economical performance in terms of decreased cost overruns (Iyer and Jha, 2005), time performance (Chan et al., 2003), quality and customer satisfaction (Eriksson, 2009). We therefore propose that collaboration can work as a mediator, enhancing project performance:

H8: The better the collaboration among project actors: (a) the better the economical performance, (b) the better the time performance, (c) the better the quality.

**Model of hypotheses**

The developed model presented in Figure 1 proposes positive relationships (H1a-c - H7a-c) between cooperative procurement procedures and construction project performance. H1d - H7d propose that cooperative procurement procedures facilitate collaboration among project actors, and H8 propose that achieved collaboration enhance project performance.
METHOD

Sample

The empirical data were collected through a questionnaire to a population of 140 construction client organizations that are members of The Swedish Construction Client Forum (SCCF). The population consists of regional, national or international industrial and property companies, municipalities and regional authorities, and also government services and agencies. Hence, this population provides a suitable representation of Swedish construction clients. The organizations where initially approached by the CEO of SCCF through a letter describing the purpose of the investigation and its importance for SCCF and its members. In a second step the registered contact persons were telephoned, in order to inquire theirs or other more suitable person’s willingness to participate in the study. Consequently, it was up to the contact person to choose the most suitable persons, given that the survey involved procurement, project management processes and project performance. At this stage six respondents declined participation due to lack of time. In a third stage, questionnaires were posted to the 134 potential respondents that had agreed to participate in the investigation. After two reminders a total of 111 responses were received. In a fourth stage respondents who had not answered all questions were telephoned and asked to respond to these questions. This resulted in minimization of the amount of missing values. Nevertheless, in five responses there were a lot of missing values, for which reason they were discarded. Accordingly, 106 usable responses were received, resulting in a response rate of 76%.

Measure: procurement, collaboration and project performance

The respondents were asked to what extent they use different procurement procedures in their construction projects, and how satisfied they are with the collaboration among project actors, and various aspects of project performance. The questions were measured using seven-point Likert scales anchored by 1 = very seldom/very dissatisfied and 7 = very often/very satisfied. The questions did not measure these aspects in a particular project but involved firm-level behavior and project performances in the clients’ portfolios of procured and finished projects. Furthermore, three control variables were measured through a nominal scale: if the organization follows public procurement regulations or not, if the construction activities involve new construction/rebuilding projects or continuous maintenance work, and if the client is active on a local/regional or national/international market.
EMPIRICAL RESULTS

The ten items measuring project performance and collaboration are theoretically related to the four aspects of cost, time, quality and collaboration. In order to investigate if the empirical data supports such a classification the ten items were subjected to a principal component factor analysis (PCFA) with Oblimin rotation, which was forced into four solutions (Table 1).

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function according specification</td>
<td>5.75</td>
<td>0.91</td>
<td>0.04</td>
<td>0.13</td>
<td>-0.14</td>
</tr>
<tr>
<td>Expected quality is achieved</td>
<td>5.70</td>
<td>0.90</td>
<td>0.01</td>
<td>-0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>High customer satisfaction</td>
<td>5.90</td>
<td>0.77</td>
<td>-0.04</td>
<td>-0.06</td>
<td>0.20</td>
</tr>
<tr>
<td>Time schedule is minimized</td>
<td>4.70</td>
<td>-0.09</td>
<td>0.92</td>
<td>-0.02</td>
<td>0.07</td>
</tr>
<tr>
<td>Within time schedule</td>
<td>5.61</td>
<td>0.25</td>
<td>0.60</td>
<td>0.30</td>
<td>-0.06</td>
</tr>
<tr>
<td>Within project budget</td>
<td>5.51</td>
<td>0.01</td>
<td>0.05</td>
<td>0.94</td>
<td>-0.07</td>
</tr>
<tr>
<td>Project cost is minimized</td>
<td>4.95</td>
<td>-0.06</td>
<td>0.14</td>
<td>0.77</td>
<td>0.16</td>
</tr>
<tr>
<td>Life cycle costs are minimized</td>
<td>4.87</td>
<td>0.32</td>
<td>-0.24</td>
<td>0.48</td>
<td>0.20</td>
</tr>
<tr>
<td>Negotiations are solved</td>
<td>5.18</td>
<td>-0.10</td>
<td>-0.05</td>
<td>0.18</td>
<td>0.87</td>
</tr>
<tr>
<td>Good cooperation</td>
<td>5.41</td>
<td>0.30</td>
<td>0.19</td>
<td>-0.12</td>
<td>0.67</td>
</tr>
<tr>
<td>Percentage of variance</td>
<td>42.16</td>
<td>14.76</td>
<td>9.70</td>
<td>8.74</td>
<td></td>
</tr>
<tr>
<td>Cronbach alpha (CA)</td>
<td>0.87</td>
<td>0.60</td>
<td>0.73</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>Factor mean value (MV)</td>
<td>5.76</td>
<td>5.17</td>
<td>5.09</td>
<td>5.73</td>
<td></td>
</tr>
</tbody>
</table>

The Kaiser-Meyer-Oklin (KMO) value was 0.76 and the Bartlett Test of Sphericity reached statistical significance (0.00), supporting the expected four factor solution, explaining 42.2%, 14.8%, 9.7% and 8.7% of the variance respectively. The identified factors are; 1) Quality (CA = 0.87, MV = 5.76), 2) Time (CA = 0.60, MV = 5.17), 3) Cost (CA = 0.73, MV = 5.09) and 4) Collaboration (CA = 0.59, MV = 5.73). The factor mean values (5.09-5.76) indicate that the clients are rather satisfied with project performance. To be able to address H8 the collaboration factor will be computed into a separate construct and also used as an independent variable potentially affecting the performance factors quality, time and cost.

Procurement procedures’ impact on project performance

The constructs formed in the PCFA were then used (as average summated scores) to test any significant relationships between the procedures and the performance criteria by hierarchical multiple regression. In Table 2, the statistically significant values are highlighted.

If we first look at procurement procedures’ effect on performance we see that the only individual procedures that significantly affect performance are limited bid invitation and soft parameters. Limited bid invitations have a negative effect on cost performance, whereas soft evaluation parameters positively affect both time- and quality performance, supporting (H3b,c). However, testing of the overall model shows that cooperative procurement procedures as a group do not have a significant effect on project performance. Second, achieved collaboration is positively affected by both the overall model, including all cooperative procurement procedures, and by the individual procedures of soft evaluation parameters, joint subcontractor selection and collaborative tools, supporting hypotheses H3d,4d,6d. Incentives have, on the other hand, a negative effect, indicating that incentives are detrimental for collaboration. This may be due to that negotiations regarding change orders’ impact on the
target cost can lead to disputes that impair collaboration. Third, looking at collaboration’s effect on performance we see that hypothesis H8 is supported since collaboration positively affects all three performance criteria, especially cost and quality.

### Table 2: Hierarchical multiple regression

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Quality performance</th>
<th>Time Performance</th>
<th>Cost Performance</th>
<th>Collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Sig</td>
<td>B</td>
<td>Sig</td>
</tr>
<tr>
<td>H1 Joint spec</td>
<td>0.042</td>
<td>0.510</td>
<td>-0.058</td>
<td>0.351</td>
</tr>
<tr>
<td>H2 Limited bid</td>
<td>-0.052</td>
<td>0.572</td>
<td>0.084</td>
<td>0.364</td>
</tr>
<tr>
<td>H3 Soft parameter</td>
<td>0.219</td>
<td>0.019</td>
<td>0.231</td>
<td>0.013</td>
</tr>
<tr>
<td>H4 Joint SC-select</td>
<td>0.053</td>
<td>0.364</td>
<td>-0.077</td>
<td>0.185</td>
</tr>
<tr>
<td>H5 Incentives</td>
<td>-0.077</td>
<td>0.465</td>
<td>0.143</td>
<td>0.174</td>
</tr>
<tr>
<td>H6 Coll tools</td>
<td>0.006</td>
<td>0.952</td>
<td>0.091</td>
<td>0.396</td>
</tr>
<tr>
<td>H7 Self-control</td>
<td>0.013</td>
<td>0.877</td>
<td>-0.045</td>
<td>0.579</td>
</tr>
<tr>
<td>Overall model</td>
<td>ΔR²</td>
<td>Sig</td>
<td>ΔR²</td>
<td>Sig</td>
</tr>
<tr>
<td>Control variables</td>
<td>0.011</td>
<td>0.757</td>
<td>0.059</td>
<td>0.103</td>
</tr>
<tr>
<td>Procedures H1-H7</td>
<td>0.115</td>
<td>0.100</td>
<td>0.112</td>
<td>0.088</td>
</tr>
<tr>
<td>Collaboration H8</td>
<td>0.235</td>
<td>0.000</td>
<td>0.072</td>
<td>0.005</td>
</tr>
</tbody>
</table>

The overall model developed in this paper proposed that cooperative procurement procedures have positive effects on construction project performance (H1a-c - H7a-c) and collaboration among project actors (H1d - H7d), and that collaboration enhance project performance (H8). The results of this study show that cooperative procurement procedures are positively related to collaboration but not to construction project performance. Looking at these main relationships in the model the results suggest that only the relationship proposed by hypothesis H8 is fully supported by the empirical data, suggesting that collaboration is important for construction project performance. The overall relationship between cooperative procurement procedures and collaboration is also significant, although only the hypotheses H3d, H4d and H6d are strongly supported. This indicates that cooperative procurement procedures as a group have a positive impact on collaboration. It is especially important to choose the right partners and put effort in facilitating the collaboration. The overall relationship between cooperative procurement procedures and performance is not significant. The only individual procedure that has a positive effect on performance is soft parameters. Hypotheses H3b-c are supported, indicating that the use of soft parameters in bid evaluation have positive effects on time and quality.

### CONCLUSIONS

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, 2000b). However, 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, 2000b). The model developed and tested in this paper indicates that collaboration indeed is crucial for the achievement of project success. In fact, collaboration works as a mediating factor between cooperative procurement procedures and project performance. Cooperative procurement procedures do not automatically result in improved project performance. Instead they facilitate increased collaboration which in turn
enhances project performance. If increased collaboration is not obtained cooperative procurement procedures do not do any good. Due to the systemic and holistic perspective of this investigation and the comprehensive literature review the theoretical contribution of the model is high. The results contradict earlier performed case studies that argue for direct links between specific procedures and project performance. Our results show that cooperative procurement procedures need to result in increased cooperation in order to impact performance positively. From a practical perspective the model can serve as an alert for clients that the implementation of cooperative procurement procedures must be taken seriously and be executed in a purposeful way, otherwise better project performance will not be achieved.

REFERENCES


