

THE EFFECTS OF PROCUREMENT PROCEDURES ON JOINT RISK MANAGEMENT

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Over the last decade, researchers and practitioners have recognised that the relationships between the client and the contractor play a significant role for successful project implementation. The interest in joint risk management (JRM) has increased as it strengthens collaboration between project actors and contributes to a more effective risk management process. The lack of an iterative and cooperative approach to risk management is a weakness in current procurement practice; although several empirical studies show that the project actors are positive about implementation of JRM. The purpose of this research is to investigate how common the use of JRM is in Sweden and if the occurrence is affected by the chosen procurement procedures. Empirical data was collected through a questionnaire survey of 106 members of the Swedish Construction Clients Forum. The results show limited use of JRM in construction projects. Clients that work on a national/international level use JRM to a greater extent than those on the local/regional market. The analysis also indicates that the use of JRM is positively affected by cooperative procurement procedures. In particular, the most significant relationship is found between collaborative tools and JRM - the higher the use of collaborative tools, the higher the use of JRM.

Keywords: client, joint risk management, procurement, risk, statistical analysis.

INTRODUCTION

Many various risks are involved in construction projects. If risk is not managed it may have a negative impact on the project in terms of cost overruns, time delays and quality problems. Thus an effective risk management (RM) process is an important part of project management that safeguards main project objectives. If risks are to be properly managed, it is evident that the RM process must be systematic and based on the efficient collaboration between the project actors. However, research in the field of construction management indicates that RM is not carried out systematically throughout projects (Akintoye and MacLeod 1997, Lyons and Skitmore 2004, Osipova 2008, Simu 2006, Tang *et al.* 2007, Uher and Toakley 1999, Wood and Ellis 2003). Moreover, adversarial behaviour is common in the construction industry (Cox and Thompson 1997, Zaghloul and Hartman 2003), whilst the use of collaborative tools and joint activities (e.g. joint project office, workshops, partnering facilitator) is very limited (Eriksson and Laan 2007).

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For many years, construction projects have been procured through traditional routes with lump sum payment mechanisms and standardised conditions of contract. These contracts assign responsibilities and liabilities of each party and formalise allocation of project risks. However, during the project implementation the identified risks may change and new risks may appear. Very often these unplanned changes and unforeseen risks may require joint efforts to be managed effectively. The concept of joint risk management (JRM) has been introduced by Rahman and Kumaraswamy (2002) and is based on the principles of collaborative relationships between the project actors. Despite the fact that JRM is argued to be the best option for managing unforeseen risks in projects, the use of this collaborative tool is limited. No studies have been conducted in Sweden in order to investigate to what extent JRM is used in projects and how different procurement procedures affect JRM. Thus the purpose of this research is twofold:

19. To explore the extent of JRM in construction projects.

20. To examine procurement procedures' effects on the use of JRM.

The study is based on the results of a questionnaire survey of Swedish construction clients. Through the literature review seven hypotheses about impact of different procurement procedures on JRM were formulated. The hypotheses were then statistically tested in order to find out what procedures play the most significant role for JRM implementation.

LITERATURE REVIEW AND HYPOTHESES

Joint risk management

The most extensive research on JRM has been conducted in Hong Kong by Rahman and Kumaraswamy (Kumaraswamy *et al.* 2004, Rahman 2003, Rahman and Kumaraswamy 2005, Rahman and Kumaraswamy 2008, Rahman and Kumaraswamy 2002). The main findings of their research are outlined below. The results of a survey of construction industry practitioners show their positive attitude towards the JRM concept. The majority of listed risk items were suggested to be managed through JRM to some degree. Both “hard/technical” (e.g. technical capabilities, similar previous work experience, adequate resources, price, and quality of performance) and “soft/relational” factors (e.g. an approach to joint problem solving, attitude towards collaboration, creativity/innovation, attitude to continuous improvement etc.) play an important role in forming a project team for JRM. Among the factors which create a successful collaborative environment, mutual trust, open communication among the actors, understanding each other’s objectives and equitable and clear allocation of foreseeable risks were identified as the most important. Early involvement of subcontractors and main suppliers is vital as their competence helps in effective risk identification and risk assessment. A project team involving clients, contractors and consultants should thus be formed before the final contract award. This helps in facilitating an effective project briefing that, in turn, leads to better understanding of the project’s objectives by the actors. JRM was identified by practitioners as the best strategy for managing unforeseen risks and risks that change during the project implementation.

Hartman *et al.* (1997) use the term “dynamic risk management” for the similar approach for proactive and joint management of risks. The study highlights the importance of project actors’ beliefs in team efforts. Otherwise, it is impossible to achieve a win-win scenario.

JRM and current procurement procedures

Empirical studies on RM practices in different countries (Akintoye and MacLeod 1997, Lyons and Skitmore 2004, Osipova 2008, Simu 2006, Tang *et al.* 2007, Wood and Ellis 2003, Zou *et al.* 2008) show that RM is not carried out systematically in many projects. While open discussion of risks in the early phases as well as their collaborative management throughout the project are found to be important drivers of effective RM, the communication of risks between the actors does not work. Despite of the visible advantages of collaborative work it is often the case that each actor is focused on his own part of the project and management of associated risks. Traditional procurement procedures based on formal contracts are often seen as a main barrier to effective collaboration in construction projects (Kadefors 2004). Moreover, in traditional procurement there is more focus on price and short-term result than on collaboration and long-term relationships (Eriksson *et al.* 2008).

To overcome the insufficiencies of traditional procurement procedures, the concept of relational contracting (RC) has been explored extensively in the research literature and in practice (Carson *et al.* 2006). RC is a concept that focuses on the relationship between the contract parties and recognises mutual benefits and win-win scenarios through cooperation in the project. RC supports such cooperative agreements as partnering and alliancing, and facilitates teamworking and JRM (Rahman 2003).

Over the last decade, collaboration through partnering has been widely applied in many countries (Bayliss *et al.* 2004). Partnering is argued to be a means to overcome adversarial relationships and create collaborative project environment. Several studies show that industry practitioners are positive about collaborative relationships and believe they lead to cost and risk reduction (Akintoye and Main 2007, Black *et al.* 2000). The results of the other study (Drexler and Larson 2000) show that relationships in partnering projects are much more stable than in other types of projects. As JRM requires collaborative effort of project participants, partnering can be considered as a procurement strategy that facilitates JRM:

Hypothesis 1. Collaboration through partnering is positively related to the use of JRM.

From the perspective of dealing with risks, early involvement of contractors and consultants in joint specification is considered to be advantageous. It allows utilisation of their competence and expertise from the very beginning that, in turn, leads to better understanding of project risk. Cooperative work of the architects and contractors is argued to result in better technical solutions and help in avoiding many design and technical risks. Moreover, significant savings are possible in the beginning of project, since changes in the early phase cost less money than in the production phase (Uher and Toakley 1999). Thus, the second hypothesis assumes that:

Hypothesis 2. Joint technical specification by client, contractor and consultants is positively related to the use of JRM.

Open bid invitation is widely used in the construction industry. It creates competition between contractors and puts more focus on price and short-term results (Eriksson and Laan 2007). On the contrary, limited bid invitation, i.e. direct negotiations with one or two contractors, is argued to facilitate long-term relationships and, in turn, better collaborative environment (Eriksson *et al.* 2008). Thus, hypothesis 3 states:

Hypothesis 3. Limited bid invitation is positively related to the use of JRM.

The focus on price when evaluating project bids is a common approach in the construction industry (De la Cruz *et al.* 2006, Eriksson and Laan 2007, Rahman and

Kumaraswamy 2008). At the same time the soft evaluation parameters are often neglected. There are a lot of examples of poor contractor selection that led to significant cost overruns for clients as contractors always try to find ways to decrease their own cost (Branconi and Loch 2004). In order to create a successful collaborative environment that supports JRM, these soft/relational parameters must be taken into account. Some examples of such parameters are contractor's resources and competence, previous experience with the contractor, size and financial stability, attitudes towards changes and continuous improvement, references, and collaborative ability (Eriksson 2008). Thus, the next hypothesis is formulated:

Hypothesis 4. Consideration of soft parameters during bid evaluation process is positively related to the use of JRM.

Today subcontractors carry out the largest part of construction work, which results in multiple points of responsibility as well as difficulties in risk communication (Loosemore and McCarthy 2008). In order to better control the whole supply chain, more attention should be paid to including subcontractors in the project team. The results of a survey conducted by Rahman and Kumaraswamy (2004) indicate positive attitudes towards bringing subcontractors and suppliers very early in the project, before the contract is awarded. This helps in facilitating an effective project briefing that, in turn, leads to better understanding of the project's objectives and JRM:

Hypothesis 5. Joint procurement of subcontractors by client and main contractor is positively related to the use of JRM.

The concept of RC highlights the importance of contract incentives in order to facilitate joint problem solving. Some payment mechanisms, for example, lump sum, shift all responsibility to one actor and do not underpin possibilities for performance improvement. A study by Muller and Turner (2005) indicates that lump sum contracts have adverse effects on communication between client and contractor. On the contrary, when incentives are used, rational decisions makers tend to put effort in minimising risk so they can get a reward (Knight *et al.* 2001). Moreover, they prefer to cooperate when tangible reward for problem solving is provided (Cheung *et al.* 2008). Turner and Simister (2001) argue that projects based on cooperation and not conflict require incentivisation of all involved actors. A survey conducted by Bubshait (2003) shows that incentive contracts are an effective instrument for promoting project actors' performance, however, their use is still limited in practice. Thus, it is predicted that:

Hypothesis 6. Cost-reimbursable payment mechanisms with incentives or bonuses are positively related to the use of JRM.

Finally, a number of collaborative tools are available for creating and supporting effective project environments (Bayliss *et al.* 2004, Black *et al.* 2000, Eriksson and Nilsson 2008). Some examples of such tools are: establishment of joint objectives, relational workshops, joint project database, team building activities, joint project office and partnering facilitator. Usually, the use of collaborative tools is limited in construction projects (Eriksson 2008) despite the fact that they are necessary for joint activities in general and JRM in particular:

Hypothesis 7. The use of collaborative tools in the project is positively related to the use of JRM.

RESEARCH APPROACH

Questionnaire survey

The main part of the study is a questionnaire survey of construction clients that are members of the Swedish Construction Clients Forum. The purpose of the survey was to analyse how different procurement related factors affect the project results. The questionnaire survey was developed consisting of three sections. The first section contained general questions about the respondent. The second section covered decision models during project procurement, e.g. payment mechanisms, choice of the main contractor, procurement of subcontractors, the use of collaborative tools etc. Finally, the third section discussed different aspects of the final project result. The questions were not focused on a particular project but on project performances in the clients' portfolios of procured and finished projects. Responses to the questions were rated on a seven-point Likert scale range: from 1 = very seldom/unimportant/very dissatisfied to 7 = very often/ important/satisfied.

The participants represented various types of construction clients: regional, national and international industrial and property companies, municipal and regional authorities, and government services and agencies. At the first stage, a letter with information about the survey, its purpose and importance for the construction clients, was sent by the CEO of the Forum to the 140 organisation members. Then, the registered contact person within each organisation was contacted by telephone and asked to provide the details of possible respondent. At this stage six organisations declined to participate due to lack of time. Finally 134 questionnaires were sent and 111 responses were received after two reminders. From obtained responses five questionnaires were excluded due to the significant amount of missing values. From the population of 140 organisations, 106 usable questionnaires were received resulting in a response rate of 76%.

Data analysis

When the completed questionnaires had been collected by mail, the data was entered into the Statistical Package for Social Science (SPSS). All questions were converted into variables and each answer alternative was coded using value labels. In order to test hypotheses, relationships between the dependent variable "use of JRM" and independent variables "procurement procedures" have been modelled using hierarchical regression analysis.

RESULTS

To fulfil the first purpose of this research - to measure the extent of JRM in the Swedish construction projects - the mean value was obtained. The results indicate a limited use of JRM, as the average score is 3.1 on the seven point scale.

In order to test relationships between the use of JRM and procurement procedures two models were constructed. In Model 1, the following characteristics of the client are included: area of the client's activity, i.e. local/regional or national/international market; type of work mostly performed by client, i.e. new construction/rebuilding or maintenance work; and if the client follows public procurement regulation or not. Model 2 summarises both client's characteristics and cooperative procurement procedures: local/regional or national/international market, new construction/rebuilding or maintenance work, public procurement regulation, extent of partnering, joint technical specification, limited bid invitation, soft parameters during

bid evaluation, joint subcontractor selection, payment mechanism with incentives/bonus, and use of collaborative tools. The results of regression analysis show significant correlations between the dependent and independent variables (Table 2). For Model 1, R square change is 0.105 and significant at the 0.01 level. For Model 2, R square change is 0.385, i.e. almost 40% of variation in the use of JRM can be explained by the combination of the cooperative procurement procedures.

Table 2: Regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.324	0.105	0.078	1.71	0.105	3.981	3	102	0.010
2	0.700	0.489	0.436	1.34	0.385	10.221	7	95	0.000

Table 3 presents detailed analysis of the hypotheses. In Model 1, the variable "area of the client's activity", i.e. if the client is active on local/regional market or national/international market, is significant at the level 0.05. The correlations between the use of JRM and individual procurement procedures are non-significant at the 0.05 level in six cases. This suggests that six hypotheses are rejected. The relationship between the use of JRM and use of collaborative tools is however positive and significant on the 0.01 level. Thus, Hypothesis 7 is confirmed: the higher the use of collaborative tools, the higher the use of JRM.

Table 3: Coefficients

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.538	0.820		1.877	0.063
	Public procurement regulation	0.328	0.410	0.091	0.801	0.425
	New construction/rebuilding or maintenance work	-0.185	0.545	-0.032	-0.340	0.735
	Local/regional or national/international market	0.993	0.429	0.262	2.313	0.023
2	(Constant)	-1.046	1.093		-0.957	0.341
	Public procurement regulation	0.327	0.494	0.090	0.662	0.510
	New construction/rebuilding or maintenance work	0.329	0.448	0.057	0.735	0.464
	Local/regional or national/international market	1.062	0.365	0.280	2.910	0.004
	Partnering	0.179	0.126	0.179	1.416	0.160
	Joint specification	0.103	0.092	0.126	1.118	0.266
	Limited bid invitation	-0.140	0.138	-0.150	-1.016	0.312
	Soft evaluation parameters	0.015	0.136	0.010	0.110	0.913
	Joint subcontractor selection	0.044	0.086	0.054	0.506	0.614
	Incentive-based compensation	-0.023	0.171	-0.017	-0.135	0.893
Collaborative tools	0.604	0.169	0.400	3.573	0.001	

As the regression analysis reveals, there is a significant correlation between the area of the client's activity and the use of JRM (R Square is 0.105). Hence, an additional analysis was conducted to further investigate this relationship. A compare means analysis (Table 4) shows that the clients working on national/international market use

JRM to a significantly larger extent (mean value = 3.9) than those who work locally/regionally (mean value = 2.7).

Table 4: Comparison of means

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Local/regional market	72	2.7222	1.63778	0.19301	2.3374	3.1071
National/international market	34	3.9118	1.81522	0.31131	3.2784	4.5451
Total	106	3.1038	1.77780	0.17267	2.7614	3.4462

DISCUSSION

During recent years, the Swedish construction industry has been trying to overcome the problems with increasing cost, project delays and quality problems. The actors have recognised the insufficiencies of traditional procurement and importance of relational contracting. However, the industry is still not efficient enough to expect rapid changes. There are a number of obstacles to increased collaboration (Eriksson *et al.* 2008). Some examples are conservative culture, adversarial attitudes, short-term perspective, traditional organisation of construction process and traditional procurement procedures. Despite the fact that collaboration through partnering has been introduced in Sweden, the use of partnering is still scarce and the use of collaborative tools is limited (Eriksson and Laan 2007). This study supports previous findings and shows the limited use of JRM in Sweden. It is also in line with a study by Tang *et al.* (2007) where the absence of JRM mechanisms was identified as the most important barrier to effective RM. One reason for the limited use of collaborative tools and JRM can be the lack of competence among the project actors. To involve a partnering facilitator that guides joint activities of a project team can be one solution to increase collaboration and promote the use of JRM.

The hierarchical regression analysis shows that the use of JRM is positively affected by the use of cooperative procurement procedures. Together, the use of partnering agreements, joint specification, cost reimbursable payment mechanism with incentives/bonus, limited bid invitation, soft parameters during bid evaluation, joint procurement of subcontractors, and collaborative tools increase the use of JRM. However, looking at the individual procedures, only the use of collaborative tools has a statistically significant positive effect on JRM. A strong correlation between the use of JRM and the use of collaborative tools is in line with previous research which indicate that collaborative project environment is a necessary condition for an effective JRM process (Rahman and Kumaraswamy 2008).

Furthermore, the results show that clients working on a national/international level use JRM in a greater extent than those who are working on the local/regional markets. This can be explained by the fact that larger national companies allocate more resources in development and improvement activities and have a broader competence when it comes to project management practices.

The fact that six hypotheses were rejected indicates that further research on effects of other procurement procedures on the use of JRM is needed. In order to obtain more evidence, further investigation based on qualitative data (e.g. interviews with the project actors) will be conducted. The fact that the cooperative procurement

procedures together correlate significantly with the use of JRM gives an indication of their significance in practice. In this study, the use of JRM is discussed only from the client's perspective. Investigation into attitudes of contractors and consultants would contribute to the significance of the research. The study is a part of a research project, which aims at developing and testing a JRM model that can be used for guiding JRM activities at the different project stages in order to facilitate project success. In the future work two case studies will be performed with a main purpose to explore how JRM is working in practice. The literature review, questionnaire survey and case studies results will then form the basis for development of a JRM model.

CONCLUSIONS

Successful projects require stable relationships between the actors as well as collaborative environment for an effective management of project risks. The results of the study support previous research findings that the use of collaborative tools in general, and JRM in particular, is limited. Potential reasons for these limitations are discussed: traditional procurement procedures that are commonly used in the industry do not support collaboration. The other explanation can be that project actors experience a lack of competence in cooperative project management.

The following cooperative procurement procedures that facilitate collaboration and JRM are identified: joint technical specification by client, contractor and consultant; cost-reimbursable payment mechanism with incentives/bonuses; limited bid invitation, consideration of soft parameters during bid evaluation process; joint procurement of subcontractors by the client and main contractor; and the use of collaborative tools such as establishment of joint objectives, relational workshops, joint project database, team building activities, joint project office and partnering facilitator. Together these procedures have a significant impact on JRM, whilst the use of collaborative tools is the most important factor.

JRM is an important collaborative process aiming at safeguarding the project objectives and achieving a win-win scenario. The research results presented in this study are expected to increase awareness of construction clients about the importance of cooperative procurement procedures that support JRM.

REFERENCES

- Akintoye, A and Main, J (2007) Collaborative relationships in construction: The UK contractors' perception. *Engineering, Construction and Architectural Management*, 14(6), 597-617.
- Akintoye, A S and MacLeod, M J (1997) Risk analysis and management in construction. *International Journal of Project Management*, 15(1), 31-38.
- Bayliss, R, Cheung, S-O, Suen, H C H and Wong, S-P (2004) Effective partnering tools in construction: a case study on MTRC TKE contract 604 in Hong Kong. *International Journal of Project Management*, 22(3), 253-263.
- Black, C, Akintoye, A and Fitzgerald, E (2000) An analysis of success factors and benefits of partnering in construction. *International Journal of Project Management*, 18(6), 423-434.
- Branconi, C and Loch, C H (2004) Contracting for major projects: eight business levers for top management. *International Journal of Project Management*, 22(2), 119-130.
- Bubshait, A A (2003) Incentive/disincentive contracts and its effects on industrial projects. *International Journal of Project Management*, 21(1), 63-70.

- Carson, S J, Madhok, A and Wu, T (2006) Uncertainty, opportunism, and governance: the effects of volatility and ambiguity on formal and relational contracting. *Academy of Management Journal*, 49(5), 1058-1077.
- Cheung, S O, Yiu, T W and Chiu, O K (2008) The aggressive-cooperative drivers of construction contracting. *International Journal of Project Management*, In Press, Corrected Proof.
- Cox, A and Thompson, I (1997) 'Fit for purpose' contractual relations: determining a theoretical framework for construction projects. *European Journal of Purchasing and Supply Management*, 3(3), 127-135.
- De la Cruz, M, Del Cano, A and De la Cruz, E (2006) Downside risks in construction projects developed by the civil service: the case of Spain. *Journal of Construction Engineering and Management*, 132(8), 844-852.
- Drexler, J and Larson, E (2000) Partnering: why project owner - contractor relationships change. *Journal of Construction Engineering and Management*, 126(4), 293-297.
- Eriksson, P E (2008) Procurement effects on competition in client-contractor relationships. *Journal of Construction Engineering and Management*, 134(2), 103-111.
- Eriksson, P E and Laan, A (2007) Procurement effects on trust and control in client-contractor relationships. *Engineering, Construction and Architectural Management*, 14(4), 387-399.
- Eriksson, P E and Nilsson, T (2008) Partnering the construction of a Swedish pharmaceutical plant: case study. *Journal of Management in Engineering*, 24(4), 227-233.
- Eriksson, P E, Nilsson, T and Atkin, B (2008) Client perceptions of barriers to partnering. *Engineering, Construction and Architectural Management*, 15(6), 527-539.
- Hartman, F, Snelgrove, P and Ashrafi, R (1997) Effective Wording to Improve Risk Allocation in Lump Sum Contracts. *Journal of Construction Engineering and Management*, 123(4), 379-387.
- Kadefors, A (2004) Trust in project relationships - inside the black box. *International Journal of Project Management*, 22(3), 175-182.
- Knight, D, Durham, C C and Locke, E A (2001) The relationship of team goals, incentives, and efficacy to strategic risk, tactical implementation, and performance. *Academy of Management Journal*, 44(2), 326-338.
- Kumaraswamy, M, Love, P, Dulaimi, M and Rahman, M (2004) Integrating procurement and operational innovations for construction industry development. *Engineering, Construction and Architectural Management*, 11(5), 323-334.
- Loosemore, M and McCarthy, C S (2008) Perceptions of Contractual Risk Allocation in Construction Supply Chains. *Journal of Professional Issues in Engineering Education and Practice*, 134(1), 95-105.
- Lyons, T and Skitmore, M (2004) Project risk management in the Queensland engineering construction industry: a survey. *International Journal of Project Management*, 22(1), 51-61.
- Muller, R and Turner, J R (2005) The impact of principal-agent relationship and contract type on communication between project owner and manager. *International Journal of Project Management*, 23(5), 398-403.
- Osipova, E (2008) Risk management in construction projects: a comparative study of the different procurement options in Sweden, Unpublished Licentiate Thesis, Department of Civil, Mining and Environmental Engineering, Luleå University of Technology.

- Rahman, M (2003) Revitalising construction project procurement through joint risk management, Unpublished PhD Thesis, The University of Hong Kong.
- Rahman, M and Kumaraswamy, M (2002) Risk management trends in the construction industry: moving towards joint risk management. *Engineering, Construction and Architectural Management*, 9(2), 131-151.
- Rahman, M and Kumaraswamy, M (2005) Assembling integrated project teams for joint risk management. *Construction Management and Economics*, 23(365-375).
- Rahman, M and Kumaraswamy, M (2008) Relational contracting and teambuilding: Assessing potential contractual and noncontractual incentives. *Journal of Management in Engineering*, 24(1), 48-63.
- Simu, K (2006) Risk management in small construction projects, Unpublished Licentiate Thesis, Department of Civil, Mining and Environmental Engineering, Luleå University of Technology.
- Tang, W, Qiang, M, Duffield, C, Young, D M and Lu, Y (2007) Risk management in the Chinese construction industry. *Journal of Construction Engineering and Management*, 133(12), 944-956.
- Turner, J R and Simister, S J (2001) Project contract management and a theory of organisation. *International Journal of Project Management*, 19(8), 457-464.
- Uher, T E and Toakley, A R (1999) Risk management in the conceptual phase of a project. *International Journal of Project Management*, 17(3), 161-169.
- Wood, G D and Ellis, R S T (2003) Risk management practices of leading UK cost consultants. *Engineering, Construction and Architectural Management*, 10(4), 254-62.
- Zaghloul, R and Hartman, F (2003) Construction contracts: the cost of mistrust. *International Journal of Project Management*, 21(6), 419-424.
- Zou, P X W, Wang, S and Fang, D (2008) A life-cycle risk management framework for PPP infrastructure projects. *Journal of Financial Management of Property and Construction*, 13(2), 123-142.