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Relationship-based determinants of building project performance in China

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The aim of this paper is to investigate the relationship-based factors that affect performance of general building projects in China. Eight performance metrics that may be used to measure the success level of construction projects are defined and categorized into two groups namely 'hard' and 'soft' performance. Eight indicators of risks inherent in relationships and seven indicators of tools expected to facilitate relationship building that may affect project success are identified. Data of different projects were collected in China via a self-administered postal survey. By using structural equation modelling techniques, a structural model is developed to help explain the relationship among different variables. It has been found that relational risk has negative influence on project performance. It is recommended that firms in the Chinese construction industry manage the relationship-based factors that are significant in the model so as to achieve project success.

Keywords: Relationship, risk, project performance, structural equation modelling, China

Introduction

China has witnessed rapid economic transformation since the open door policy was adopted in the early 1980s. China's construction industry currently ranks among the largest in the world. The gross output of the industry in 2002 soared to RMB1852.72 billion (approx. US$224.03 billion), which is about 65 times as much as it was in 1980 (National Bureau of Statistics of China (NBSC), 2003). In particular, the local construction market is undergoing an unprecedented expansion after China's accession to the World Trade Organization (WTO) in 2001. Notwithstanding the favourable conditions, problems of cost outrun and schedule delay are frequently reported in projects in China (Wang and Jiang, 1994). Among a series of initiatives sought to solve these problems, relationship building may be an effective one because it is emphasized as a central mechanism in business transactions among Chinese (Ang and Ofori, 2001; Jin and Ling, 2005a, b; Menkhoff, 1998).

The aim of this study is to investigate the relationship-based factors that affect performance of general building projects in China, such as cost, duration, quality and relationship building. The specific objective is to uncover key relationship-based determinants that could explain project performance. This is important because the relational model developed in this study would help owners, consultants and contractors predict the performance of their projects to some extent. In addition, they would know critical relationship-based variables that they must pay close attention to and manage in order to have harmonious relationships among project participants, by which project performance objectives are more likely to be achieved.

In the next section, literature relating to project performance, critical success factors and relationship is reviewed. The research methodology and procedures involved in structural equation modelling (SEM) are then explained. Afterwards, results are presented and discussed.

Literature review

Several studies have been conducted on how project success can be measured (Konchar and Sanvido, 1998; Molenaar and Songer, 1998). Baccarini's (1999)

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definition of project success includes meeting time, cost and quality objectives and satisfying project stakeholders. He defined product and process success as meeting quality output standards and meeting time and budget objectives respectively. Chua *et al.* (1997) identified eight key management factors that affect budget performance. They are: organizational levels between project manager and craftsmen; project manager experience; level of design completion at the start of the project; constructability programme; project team workmanship rate; frequency of control meetings; frequency of budget updates; and control system budget. Using the same set of data, five key factors affecting schedule performance, i.e. frequency of meetings; amount of time that project managers devote to the project; project manager's experience; monetary incentives to designers; and implementation of constructability programme, were found (Kog *et al.*, 1999).

Jaselskis and Ashley (1991) identified determinants for budget performance using logistic regression. They found that the most important variable is 'implementation of constructability programme'. Sanvido *et al.* (1992) examined the contribution of different factors to project success and found project team experience, contracts, resources and information available as important factors.

Pinto and Slevin (1988) found 10 critical success factors that are significantly related to project success using statistical regression analysis. These factors are: project mission; top management support; project schedule and plans; client consultation; personnel; technical expertise; client acceptance; monitoring and feedback; communication; and troubleshooting. Four external factors are found to significantly affect project success: characteristics of the team leader; power and politics; environmental events; and urgency of the project.

From the above review, it can be seen that most studies focused on organizational, management or technical factors and little research has been done to find out factors that have an impact on project performance in the context of relationship. Among the limited studies, Yasamis *et al.* (2002) proposed measuring leadership and employee empowerment. Jin and Ling (2006) investigated the relationship-based factors that affect performance of general building projects in China using multiple linear regression models.

Additionally, there has been little effort to examine whether relationship performance exerts any influence on general performance such as cost, duration and quality performance. As a result, this study aims to fill the gap in knowledge relating to key relationship-based determinants that affect different aspects of project performance.

A harmonious relationship based on trust is found to create advantages in conducting business (Menkhoff, 1998). Relationship building is a predominant feature and a central mechanism and lubricant in business transactions, especially those among Chinese people (Ang and Ofori, 2001; Jin and Ling, 2005a). Projects and companies emphasizing cordial relationships are more likely to experience success (Jin and Ling, 2005b).

Fiske (1990) established that communal sharing, authority ranking, equality matching and market pricing are four fundamentals in human relationships. He suggested that these forms are fundamental and universal due to their pervasiveness and importance. Based on Fiske's findings, Sheppard and Sherman (1998) conceptualized relational form as either dependent or interdependent, and relational depth as either shallow or deep. More importantly, they discovered that different relationships entail distinct risks. They emphasized that building relationships could mitigate relational risks.

Model construction

The abovementioned studies formed the theoretical basis for the empirical work of this study. It is assumed that relationship-based factors include relational risks (RRs) and relationship-building tools (RBTs). Relational risks (RRs) are defined as factors involving uncertain danger and having the possibility of harming mutual dealings or connections of business persons and groups in projects. Relationship-building tools (RBTs) are instruments necessary to improving mutual dealings or connections of business persons and groups in a project. It is hypothesized that RRs and RBTs be able to impact on project performance including 'hard' performance (HP) such as cost, duration and quality performance; and 'soft' performance (SP) related to relationship building such as level of client's satisfaction and incidence of litigation. Furthermore, 'soft' performance may affect and/or be affected by 'hard' performance to some extent. A conceptual diagram of structural model is presented in Figure 1. The corresponding hypotheses are as follows:

> *Hypothesis 1*: The hard/soft performance of construction projects becomes better as the perceived severity of relational risks decreases.

> *Hypothesis 2*: The hard/soft performance of construction projects becomes better as the perceived effectiveness of relationship-building tools increases.

> *Hypothesis 3*: The hard performance of construction projects becomes better as their soft performance becomes better, and vice versa.

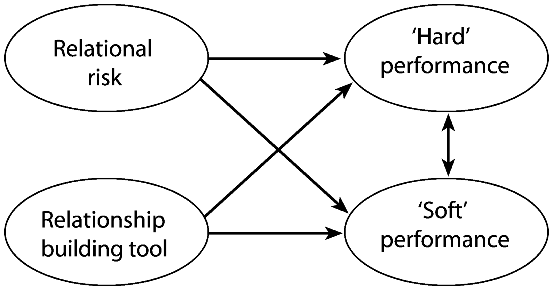

Figure 1 Conceptual diagram of structural model

Based on the literature review, eight performance indicators were identified and grouped into 'hard' and 'soft' performance (see Table 1). Eight indicators of relational risk and seven indicators of relationship-building tool were also identified (see Table 1).

Research methodology

The survey method was used to test the proposed research model. A questionnaire comprised of tailored measurement scales was designed and asked respondents to assess the performance of a project they had participated in and to evaluate the seriousness of relational risks and the effectiveness of relationship-building tools in that project. A sample question is 'Do you think that the short-term focus is a serious risk to harmonious relationship in a project?' Where possible, measures were adapted from previous studies to enhance validity. Respondents were also required to provide general information about the project and themselves.

Before the industry-wide one, a pilot survey was administrated in Shanghai Tongji University to check the questionnaire to ensure the face and content validity in terms of assessing the degree to which a construct has been accurately translated into an operationalization. The questionnaire was refined according to the feedback, which was followed by an industry-wide postal survey in China that constituted the primary data collection method in this study.

The target population of the survey in this study was clients, consultants and contractors who operate in the Chinese construction industry. However, random sampling in such a huge population was difficult. Therefore, judgmental or purposive sampling was used, in which a sample was drawn using judgmental selection procedures. In order to ensure the translation equivalency between the Chinese and English versions of the questionnaire, backward translation (Singh, 1995; Mullen, 1995) was adopted.

Table 1 Constructs and measurements

Variable	Indicator	Scale for measurement
'Hard' performance (HP)	Service quality (HP1)	7=exceed expectation; 1=not satisfactory
	Cost growth (HP2)	7=exceed expected profit (cost savings); 1=not satisfactory (cost exceeded budget)
	Product quality (HP3)	7=exceed expectation; 1=not satisfactory
	Safety level (HP4)	ditto
	Schedule growth (HP5)	7=exceed expectation (early completion); 1=not satisfactory (delays)
'Soft' performance (SP)	Claims/litigation (SP1)	7=zero incidence; 1=high incidence
	Mutual understanding (SP2)	7=exceed expectation; 1=not satisfactory
	Client's satisfaction (SP3)	ditto
Relational risk (RR)	Exploitation (R1)	7=most serious; 1=least serious
	Short-term focus (R2)	ditto
	Poor interpersonal skills (R3)	ditto
	Distrust (R4)	ditto
	Poor communication (R5)	ditto
	Breach of contract (R6)	ditto
	Improper contract (R7)	ditto
	Disputes (R8)	ditto
Relationship-building tool (RBT)	Top management support (T1)	7=most effective; 1=least effective
	Following mutual goals (T2)	ditto
	Following defined rules (T3)	ditto
	Workshops for relationship building (T4)	ditto
	Empowering staff (T5)	ditto
	Solving problem jointly (T6)	ditto
	Efficient communication (T7)	ditto

Xuhui District Commission of Construction and Administration (a government department) was approached and it helped to select 150 companies to fill out the questionnaires. This list comprised 50 client companies, 50 consultant companies and 50 contracting companies. In addition, 150 copies of the questionnaire were sent to randomly selected companies listed under 'Property developer', 'Professional consultant' and 'Contractor' in the Shanghai Yellow Pages. In total, 300 questionnaires were distributed. The returned questionnaires were checked and edited to ensure completeness and consistency. The data were then input into the computer and analysed using software of Statistical Package for Social Sciences (SPSS) and Linear Structural Relationships (LISREL) (Byrne, 1998).

Results and analysis

Survey packages were sent out in China and recipients were invited to respond within two months. In total, 116 responses were received from the 300 companies surveyed. The response rate of 38% was rather good for a survey of this nature. The respondents comprised 34 clients (29%), 46 consultants (40%) and 36 main contractors (31%). A comparative interpretation of different parties' response was reported by Jin and Ling (2005b). The majority of the respondents have had tertiary education (96.6%) and hold management positions in their firms (60.3%). About 75% of the respondents had practised in the construction industry for more than five years. This information made the ratings dependable, and the views expressed by the respondents noteworthy.

Structural equation modelling (SEM) technique was used in this study to test the proposed model; this technique was considered more appropriate when interrelationships were to be considered in a holistic manner (Wong and Cheung, 2005). SEM grows out of and serves purposes similar to multiple regression, but in a more powerful way which takes into account the modelling of interactions, non-linearities, correlated independents, measurement error, correlated error terms, and multiple latent independents and one or more latent dependents each measured by multiple indicators. According to Trochim (2000), advantages of SEM include more flexible assumptions, use of confirmatory factor analysis to reduce measurement error by having multiple indicators per latent variable, the desirability of testing models overall, the ability to test models with multiple dependents, to model mediating variables, to model error terms, and to handle difficult data (e.g. incomplete data). SEM technique was adopted in similar research to the current study (e.g. Islam and Faniran, 2005; Wong and Cheung, 2005).

Table 2 Total variance explained

Component	Initial eigenvalues		
	Total	% of Variance	Cumulative %
1	**6.460**	28.087	28.087
2	**4.742**	20.618	48.705
3	**3.241**	14.093	62.799
4	**2.162**	9.401	72.200
5	0.945	4.110	76.310

Note: Extraction method: principal component analysis.

Both the eigenvalue >1 rule (Kaiser, 1960) and the scree test (Cattell, 1966) propose four factors in total (see Table 2 and Figure 2 respectively), which account for 72.2% of the total variance (see Table 2), suggesting the exploratory procedure is appropriate. Since components with at least four loadings above 0.6 in absolute value and with at least three loadings above 0.8 in absolute value are deemed reliable, regardless of sample size (Stevens, 2002), the confirmatory factor analysis results are acceptable as shown by the rotated component matrix (see Table 3).

The strength of the measurement model could be established through reliability, convergent and discriminant validity (Hair *et al.*, 1998). Three tests are used to assess reliability and convergent validity: Cronbach's alpha, composite factor reliability (CFR) and average variance extracted (AVE). For Cronbach's alpha, a cut-off value of 0.7 is used to indicate the acceptable level of internal consistency (Nunnally, 1978). Nunnally (1978) also recommended the threshold value of 0.7 as an indicator of adequate CFR. As for AVE, Fornell and Larcker (1981) suggested a score of 0.5 as an acceptable level.

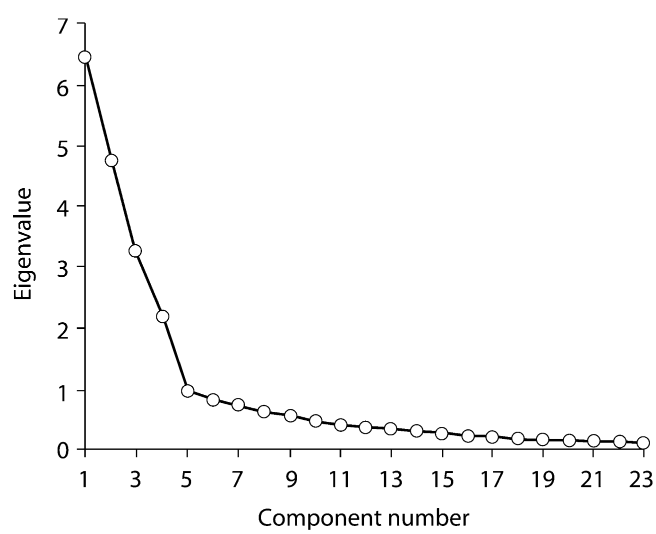

Figure 2 Scree plot

Table 3 Rotated component matrix

Variable	Code	Indicator	Component			
			1	2	3	4
'Hard' performance	HP1	Service quality	−0.155	0.185	**0.791**	0.201
	HP2	Cost growth	−0.063	−0.120	**0.894**	0.013
	HP3	Product quality	0.020	0.153	**0.808**	−0.019
	HP4	Safety level	−0.126	0.091	**0.714**	0.490
	HP5	Schedule growth	−0.124	−0.298	**0.729**	−0.044
'Soft' performance	SP1	Claims/litigation	−0.061	0.229	0.011	**0.830**
	SP2	Mutual understanding	−0.089	0.059	0.023	**0.946**
	SP3	Client's satisfaction	−0.116	−0.209	0.221	**0.805**
Relational risk	R1	Exploitation	**0.860**	−0.092	0.115	−0.081
	R2	Short-term focus	**0.674**	0.309	−0.059	−0.064
	R3	Poor interpersonal skills	**0.778**	0.154	−0.280	0.012
	R4	Distrust	**0.893**	−0.066	−0.143	−0.124
	R5	Poor communication	**0.800**	0.056	−0.274	−0.111
	R6	Breach of contract	**0.739**	−0.109	0.167	0.122
	R7	Improper contract	**0.858**	0.159	−0.017	−0.026
	R8	Disputes	**0.768**	0.270	−0.164	−0.226
Relationship-building tool	T1	Top management support	0.041	**0.754**	0.143	−0.084
	T2	Following mutual goals	0.104	**0.726**	0.068	0.207
	T3	Following defined rules	−0.102	**0.874**	0.030	0.100
	T4	Workshops for relationship building	0.104	**0.921**	−0.075	0.079
	T5	Empowering staff	0.005	**0.781**	−0.151	−0.183
	T6	Solving problem jointly	0.095	**0.706**	−0.001	−0.016
	T7	Efficient communication	0.241	**0.887**	−0.043	0.081

Notes: Extraction method: principal component analysis. Rotation method: Varimax with Kaiser normalization.

The standardized solution of the proposed model using LISREL is shown in Figure 3. The convergent validity is satisfactory based on all the prevailing criteria (see Table 4). As shown in Table 5, because there are big differences of chi-square between unconstrained and constrained models for each pair of constructs, discriminant validity has been evidenced. The correlation table also shows satisfactory results (see Table 6). Judging by the results of the aforementioned tests, overall the convergent and discriminant validity are acceptable and consequently the measurement model fitting is good.

The model fitting is however less than satisfactory (see Table 7). Although model chi-square=797.42 with 224 degrees of freedom is significant with a probability of 0.000, relative chi-square=797.42/224 is greater than 3. Besides, other indices such as root mean square error of approximation (RMSEA), goodness of fit index (GFI) and comparative fit index (CFI) failed to hit the lowest requirement. This may be because only relationship-based factors are considered in the current model and there exist other types of factors that exert an important influence on project performance.

As shown in Table 8, the hypotheses of causal relationships from relational risk (RR) to 'hard' performance (HP) and 'soft' performance (SP) are supported because $|t|$ related to is greater than critical value. However, the hypotheses of causal relationships from relationship-building tools (RBTs) to HP and SP and between HP and SP are rejected due to small $|t|$ values.

Discussion

The test results support the relationship between relational risk and project performance, both hard and soft. This is because in the context of relationship, not all the risks are foreseeable and quantification of foreseeable risks at the outset may not always be either possible or correct (Rahman and Kumaraswamy, 2002). A deteriorating relationship will impair not only the relationship-related performance, but obliquely the general performance of cost, duration and quality. This finding further confirms that risk management should be an important and integral part of construction project management, which is widely recognized by leading project management institutions.

However, the results do not support the relationship between relationship-building tools and project

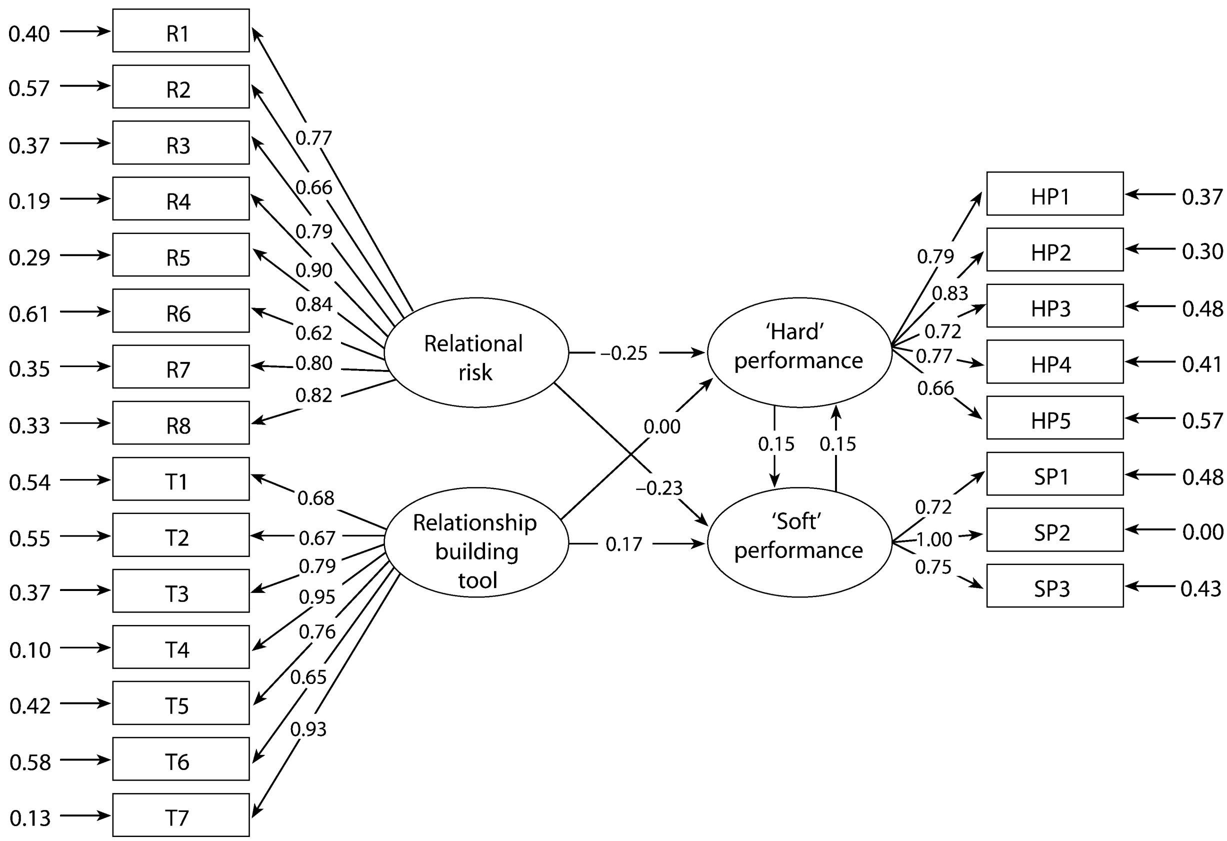

Figure 3 Standardized solution of the basic model

Table 4 Convergent validity

Latent variable	Indicator	t-value	Standard loading	Cronbach's alpha	CFR	AVE
'Hard' performance	HP1	9.65	0.79	0.8667	0.8691	0.5720
	HP2	10.34	0.83			
	HP3	8.45	0.72			
	HP4	9.23	0.77			
	HP5	7.49	0.66			
'Soft' performance	SP1	8.55	0.72	0.8527	0.8691	0.5720
	SP2	12.98	1.00			
	SP3	9.04	0.75			
Relational risk	R1	9.71	0.77	0.9222	0.9246	0.6081
	R2	7.74	0.66			
	R3	10.02	0.79			
	R4	12.35	0.90			
	R5	11.03	0.84			
	R6	7.22	0.62			
	R7	10.26	0.80			
	R8	10.55	0.82			
Relationship-building tool	T1	8.13	0.68	0.9116	0.9162	0.6147
	T2	8.02	0.67			
	T3	10.11	0.79			
	T4	13.57	0.95			
	T5	9.54	0.76			
	T6	7.67	0.65			
	T7	13.11	0.93			

Table 5 Constrained test of discriminant validity

Pair of constructs	Model	Chi-square	P-value
HP vs. SP	Original	146.60	0.00
	One-factor	355.31	0.00
HP vs. RR	Original	244.93	0.00
	One-factor	645.18	0.00
HP vs. RBT	Original	202.80	0.00
	One-factor	1372.92	0.00
SP vs. RR	Original	222.41	0.00
	One-factor	406.62	0.00
SP vs. RBT	Original	178.63	0.00
	One-factor	386.45	0.00
RR vs. RBT	Original	436.95	0.00
	One-factor	1582.28	0.00

performance, neither hard nor soft. In addition, the results reject the relationship between hard and soft performance too. It is probably because building a harmonious and cooperative relationship is less than enough to secure project success, especially in terms of 'hard' performance, which relies much more on organizational, managerial and technical factors. The findings suggest that although relationship building has been claimed as critical to project success, other aspects such as technical ones might deserve more attention and effort in order to secure better project performance. That is, selecting methods of construction such as a structural system or cladding that is within the capabilities of local contractors and subcontractors may lead to increased project harmony.

However, the findings are at least subject to the following potential limitations. First, except for relationship-based factors, the model failed to include other factors that can influence project performance, such as technical factors as noted above. Future studies to integrate the relationship-based factors with other factors should be conducted to construct more robust models. Second, the survey was not taken by the random sample method and the current sample was limited to the practitioners of construction industry in Shanghai. Thus, the external validity may be violated. Third, internal validity (i.e. whether observed changes of project performance can be attributed to relationship-based factors) may be violated due to alternative explanations for the outcome not being eliminated.

Table 6 Construct correlation

	HP	SP	RR	RBT
HP	1.11	–	–	–
SP	0.22	1.07	–	–
RR	−0.29	−0.20	1.00	–
RBT	−0.03	0.12	0.21	1.00

Table 7 Goodness of fit statistics

Indices	Value
Chi-square (p-value)	797.42 (0.0)
d.o.f.	224
RMSEA	0.15
(NFI)	0.74
(NNFI)	0.76
(PNFI)	0.65
(CFI)	0.78
(IFI)	0.79
(RFI)	0.70
(RMR)	0.17
(GFI)	0.62
(AGFI)	0.54

Fourth, construct validity may not be evidenced in that it may not be generalized from the current measures to their concept. Finally, the current sample size (116) may be too small to make the SEM test results reliable as SEM generally requires a large sample size or a sound ratio of subjects to variables.

Conclusion

Relationship-based factors were rarely considered when trying to predict project performance. Nonetheless, relational risks and relationship-building tools are explored as relationship-based factors in this paper. The project performance is considered in terms of 'hard' and 'soft'. A relational model was developed based on literature review and tested using SEM techniques. Although the model was not fully verified, it was found that relational risks exert a negative influence on project performance. Furthermore, 'soft' performance does not influence 'hard' performance as hypothesized. However, the relationship-building tools do not have the positive influence on project performance as expected.

It is recommended that all local and non-local firms and consultants involved in the Chinese construction industry who wish to improve project performance give high priority to:

Table 8 Relationship between pairs of constructs

Construct	Antecedents	Coefficient	t-value
HP	RR	−0.25	−2.34
	RBT	0.00	0.04
	SP	0.20	1.52
SP	RR	−0.23	−2.30
	RBT	0.17	1.71
	HP	0.15	1.52

(1) focusing on relational risk management; and
(2) not concentrating on building relationships and overlook other aspects such as technical factors.

In addition, international firms that have entered or are going to enter the Chinese construction industry are advised to appreciate which relational risks to address when building relationships with Chinese partners in order to achieve satisfactory project performance.

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