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Organizational motivation and inter-organizational interaction in construction innovation in Singapore

MOHAMMED FADHIL DULAIMI[1], FLORENCE Y. Y. LING[2] and ARUN BAJRACHARYA*[2]

[1]*Faculty of the Built Environment, The University of the West of England, Frenchay, Bristol BS16 1QY, UK.*
[2]*Department of Building, National University of Singapore, 4 Architecture Drive, Singapore 117566*

This paper examines the individual firm's motivation to adopt innovation in a construction project, and the inter-organizational interactions of relevant parties involved in innovation. Based on the theory of organizational motivation and inter-organizational relationships, seven hypotheses are set out. These hypotheses are tested using a structured questionnaire, and data were collected via a postal survey.

From the results, it is concluded that an innovative proposal may be successfully implemented in the project if *effort* is put into carrying the innovation through, and there are high expected *goals*, favourable *results* and high *commitment*. Firms need to be motivated to adopt the innovation, be optimistic about the results and exert additional effort. Incentives for the supporting parties need to be substantial to persuade them to participate in the innovation. In addition, the innovation should be designed such that it could draw all upstream and downstream parties together, and all their interests are looked after in the project.

Keywords: Construction innovation, organizational motivation, inter-organizational interaction, origin organization, support organization

Introduction

Construction is a project-based activity that needs to be carried out by multiple parties. Each party is a separate organizational entity that possesses its own interests and expected end rewards out of the project. The project is a temporary inter-organizational venture that lasts only for the project duration. Inter-organizational coordination of these different organizations is a challenge in any construction project. These features make innovation initiation and implementation difficult and challenging. For the innovation to be successful, favourable relationships between the relevant parties must exist. Coordinated information and resource exchange between the organizations must also exist.

The separate specialized parties jointly working for one single project, often at different points in time and for different durations, may not be motivated to propose, initiate and implement innovation in that particular project. Rather, most likely, they would be more concerned about completing the project to fulfil their individual interests. This variation in interests gives rise to fragmentation that makes innovation in construction more difficult than in other industries (Tatum, 1986; Winch, 1998). One reason for the fragmentation is the lack of understanding of the common project objective and each other's individual interests. Each entity therefore acts on the basis of short term individual rationality which often creates conflicting tension among the parties (Borys and Jemison, 1989).

The objective of this paper is to investigate (1) the individual firm's motivation to adopt innovation in a construction project, and (2) the inter-organizational interactions of relevant parties involved in innovation. Relevant research hypotheses were developed based on the theory of organizational motivation and inter-organizational relationships. The hypotheses were tested using a structured questionnaire, and data were collected through postal survey. The results were used to explain how an individual organization behaves, what the likely

*Author for correspondence. E-mail: bdgarunb@nus.edu.sg

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behaviour of other parties is, and how such behaviour may affect the success of the innovation. This paper is based on a part of a research project that investigated the enabling and inhibiting factors of innovation in Singapore's construction industry.

Background on construction innovation

Pioneering works in construction innovation at the organizational level were conducted by, among others, Tatum (1986, 1989) and Gerwick (1998). Winch (1998) explained the role of the integration of innovation superstructure and infrastructure at the institutional level, and the role of implementation and learning processes at the firm level in improving innovation in construction. Gann and Salter (2000) differentiated construction innovation at the project and business levels. They emphasized the need for integrating project and business processes within the firm to effectively manage technological capabilities. Slaughter (2000) proposed six distinct stages for the implementation of construction innovation. She proceeded to recommend different strategies for each of these stages. She also laid down the roles of clients, contractors, suppliers and manufacturers in the implementation of construction innovation. Mitropolous and Tatum (1999) modelled the decision making process in technology adoption, and the risk-management issues. Mitropolous and Tatum (2000) stated that innovative behaviour of organizations depends on external forces (demand pull and technology push), and organizational characteristics. However, they pointed that in the literature, no such consistent characteristics have been identified, nor were there are any causal explanations as to how external factors affect innovative behaviour of organizations. They identified four forces that drive innovation: competitive advantage; process problems; technological opportunity; and institutional requirements.

The past works in construction innovation at the organizational level mainly focused on a single individual organization, its possible roles at different levels and the factors that affect the organization in playing the roles. There is a gap in research in construction innovation in the context of project organization where more than one organization is involved. This paper therefore attempts to fill this gap by investigating the motivation of different organizations and consequent interactions between them when construction innovation is introduced.

The concept of individual organizational motivation

Innovation carries the paradoxical meaning of uncertainties in benefit and associated risks (Janszen, 2000; Quinn, 1985). This concept has the underlying meaning of creative tension and entrepreneurship. Klein and Sorra (1996) stated that the success of innovation is the success of effective implementation. However, effective implementation does not guarantee that the innovation will, in fact, prove beneficial for the organization. Innovation is mainly a goal orientated process at the initiation and adoption stage, and it is mainly a result/performance driven process at the implementation and continuation stage. Therefore when there is a question of finding appropriate theories to explain the motivation behind innovation, two main threads of theories need to be considered (Repenning, 2002).

The first thread of theories explains the concept of goal orientation or expectancy behind motivation in innovation. Van de Ven and Poole (1995) formulated the teleological motor of change as one of the modes of organizational changes. Teleological motor of change is based on the philosophy that goal or intended target is the cause that guides the movement of an entity. This concept of goal fulfilment or expectancy of achievement is reflected in most of the induced-change frameworks, including decision making (March and Simon, 1958), adaptive learning and strategic planning.

The second thread of theories explains the concept of performance-effort reinforcing process behind motivation in innovation. Performance induced effort, and effort induced performance in turn, is self-reinforcing motivation mechanism such as evolutionary motor of change formulated by Van de Ven and Poole (1995). Other similar theories that explain result-driven motivation mechanisms are valence-instrumentality-expectancy concept (Vroom, 1964), self-reinforcing relationship between performance and the perceived effort-reward probability (Porter and Lawler, 1968), and performance success and self capacity strengthening concept (Wood and Bandura, 1989).

Repenning (2002) termed the second thread of motivation theories as 'instrumental motivation' implying that the result/performance is *instrumental* in stimulating effort for the performance. Likewise he termed the first thread of motivation theories as 'non-instrumental motivation' or 'normative pressure' implying that the external goal induced subjective norm would be the stimulating force behind innovation effort. Sterman *et al.* (1997) defined the non-instrumental motivation as the force behind management's 'push' to implement a new idea and the instrumental motivation as the force behind the 'pull' effect generated by the successful results out of the new idea.

Concept of inter-organizational interaction

Construction is a complex system industry (Nam and Tatum, 1988; Winch, 1998). As such, a construction

project organization is very complex in the sense that it possesses both intra- and inter-organization interactions. Intra-organizational motivation is explained by the theories of organizational motivation as explained in the previous section. However, such theories are inadequate to explain inter-organizational interaction. It is suggested that alignment of motivation of different entities within the construction project organization is one of the necessary conditions for implementing innovation. Alignment of motivation may be made possible through alliances. Therefore the concepts related to alliances are reviewed to understand the inter-organizational interaction.

In the manufacturing and service sectors, forming an alliance to exploit the resources and expertise of accompanying firms is a pre-requisite for facilitating an innovative venture (Dunning, 1998). In the construction sector, the project environment offers a short-term quasi-alliance structure (Dulaimi *et al.*, 1996). However, the struggle between 'mutual interest' and 'individual interest' of the accompanying parties shapes the collective effort towards innovation. Based on these two types of interests, inter-organizational relationship could be in the form of cooperation, competition, regulating and conflictive during an innovative process (Van de Ven *et al.*, 1999). Dominance of competitive, regulating or conflictive relationship among the parties indicates motivation misalignment in a construction project. Thompson and Sanders (1998) argued that because traditional owner/contractor relationship tends to be mainly competitive in nature, the degree of *objective alignment* tends to suffer. In addition to the dyadic relationship between owner/contractor, if adversity dominates the relationships between the different parties involved in construction innovation, then misaligned motivation is more certain to occur within the project.

Knoke (2000) explained that the motive behind organizational relationships can be explained by three theories: institutional, transaction cost and dependency theories. The institutional theory states that an organization seeks alliance with other suitable ones because of normative institutional requirement to maintain socio-political legitimacy in the operating area. The transaction cost theory explains the decision on whether to make or buy a particular function of organization. Hence an alliance is necessary if the organization decides to buy a particular function from another party. The dependency theory suggests that the motive behind an alliance is to acquire deficit resources from other organizations by establishing a relationship with them.

For a construction project, the dependency theory can explain appropriately why the different parties relate with each other to execute a construction project. The resources in terms of finance, materials, equipment, skills and expertise are the means to bind the client, consultants, contractors and suppliers together. In spite of this, there is every right for each party to pursue their own interests, sometimes even at the expense of others (Buckley and Casson, 1998). This implies that the behaviour of each party involved in a venture is motivated primarily by its own expectation of a positive outcome. Complex interaction of the instrumental and noninstrumental motivation of different parties gives rise to inter-organizational interaction. Therefore, it is hypothesized that the degree of motivation alignment between different parties determines the level of success in construction innovation.

Research hypothesis

When discussing construction innovation, the parties in a project organization which are implementing an innovative idea may be divided into two major blocks. The first block is the party that comes up with the innovative idea and proposes it. This party is referred to as the 'Origin Organization' (OO), meaning the originator of the innovative idea. The other block contains all other relevant parties in the project whose support is needed for the OO to implement the proposed innovation. This supporting block of separate organizations is referred to as 'Supporting Organizations' (SOs).

Hypothesis set 1 (Figure 1) explains the organizational motivation for construction innovation within each firm, using organizational motivation theory described in the earlier section. Here, *organizational motivation* is operationalized as *commitment*. 'Commitment' is an important driving force in innovative projects (Nam and Tatum, 1997). Based on the expectancy driven non-instrumental motivation theory, it is hypothesized that there is a positive relationship between the expected goals and the level of commitment (H1-1). Based on instrumental motivation theory, it is hypothesized that there is a positive relationship between the favourable result and commitment (H1-2).

Hypothesis set 2 (Figure 1) explains the inter-organizational relationships for construction innovation. Both the OO and the SOs would be willing to put more effort if they are committed in the construction innovation. Therefore, it is hypothesized that the commitment of individual OO and SOs to achieve the goal encourages them to put concerted effort in an innovative idea (H2-1 and H2-3).

It is also hypothesized that the OO's effort would be partly devoted to getting the support and commitment of the relevant SOs to successfully implement an innovative idea (H2-2). The effectiveness of this effort, however, depends on the power of the OO, and the perceived attractiveness of the innovative proposal to the SOs. If the SOs do not perceive the innovative idea to be effective,

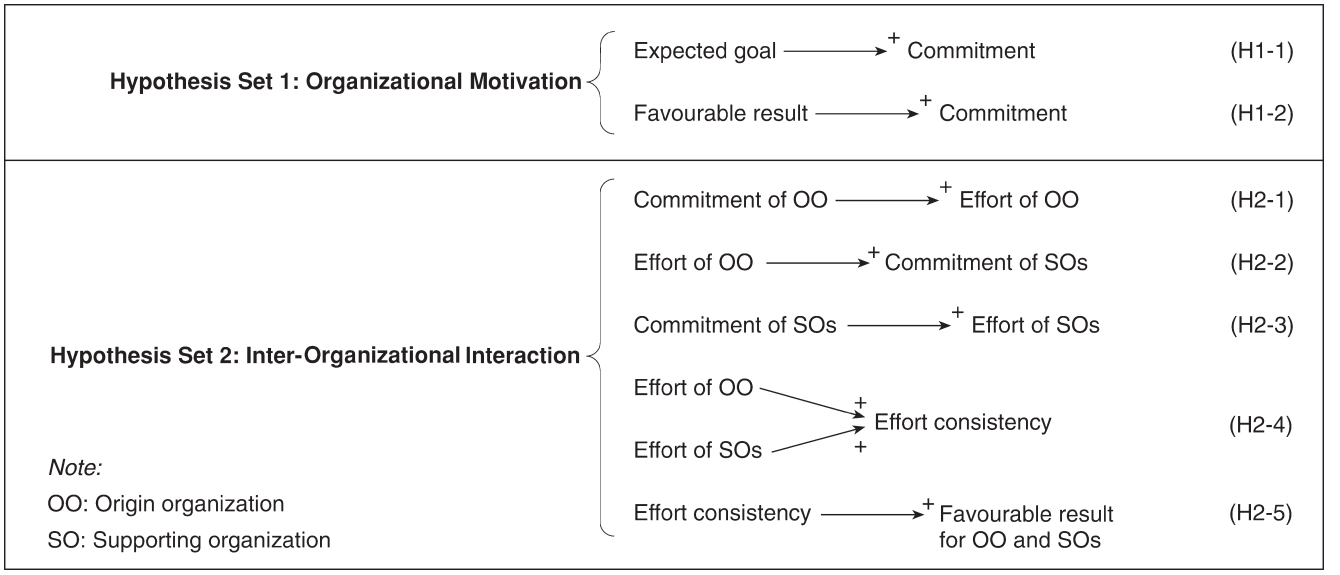

Figure 1 Research hypotheses

or desirable, in ensuring their individual goal fulfilment, they may not be as committed to the innovation. This hypothesis, therefore, tests the motivation alignment of different parties involved in innovation.

The effort of the OO and SOs should be consistent in order to obtain favourable results from the innovative proposal. However, there are many factors, like the level of managerial and operational commitment, conflict in goal, coordination of the effort, knowledge and information exchange between the OO and SOs, which may affect the consistency of their effort. This concept of consensus and coordination in the effort of the parties is termed as *effort consistency*. It is hypothesized that there would be a positive relationship between the efforts of the OO and SOs with effort consistency (H2-4), which would significantly influence the effectiveness of the effort itself. It is also hypothesized that the more effective the effort, the more favourable would be the result of the innovation for both the OO and SOs (H2-5).

In overall term, hypothesis set 1 represents the motivation of individual organizations whether they are the OO or different SOs. Hypothesis set 2 represents the interaction of the OO and relevant SOs. It also represents the motivation alignment among different parties in terms of commitment, effort consistency, and result of innovation.

Operation of research hypothesis

The hypotheses as shown in Figure 1 were operationalized so that they can be tested in the fieldwork. This section presents the operationalized hypotheses.

Expected goal

'Expected goal' is referred to in H1-1 (Figure 1). This is operationalized as the main objectives that each company has in initiating or supporting the innovative idea as shown in Table 1.

Commitment

As discussed earlier, 'commitment' is a vicarious measurement of 'motivation'. 'Commitment' is used in H1-1, H1-2, H2-1, H2-2 and H2-3 (see Figure 1). The commitment level of both the OO and SO management was quantified as the perceived level of interest shown by the different parties at the proposal stage of innovative idea (Table 2).

Effort

The level and nature of the effort exerted at the managerial level by both the OO and SOs in order to implement the innovative idea are operationalized in Table 3. The respondents were asked to rate the level of emphasis which the relevant parties gave.

Effort consistency

Respondents were asked to rate the interest level of their own company and the perceived interest level of the other relevant parties during the implementation stage of the innovation. It can be deduced that if an organization consistently works with high interest level at the implementation stage and perceives that other relevant parties are also working with similarly high interest level, then

Table 1 Operationalization of expected goal (EG)

Question: What were the main objectives of your company in initiating or supporting the new idea?	
Variable code	Main objectives
OO-EG1 or SO-EG1	To enhance the quality of company's own work
OO-EG2 or SO-EG2	To minimize the cost of particular work
OO-EG3 or SO-EG3	To reduce the normal time required for completing an item of work
OO-EG4 or SO-EG4	To overcome technical difficulties in the project
OO-EG5 or SO-EG5	To maximize your company's overall profit out of the project
OO-EG6 or SO-EG6	To strengthen your company's stake or influence in the project
OO-EG7 or SO-EG7	To enhance the performance of the whole project
OO-EG8 or SO-EG8	To fulfill a market demand
OO-EG9 or SO-EG9	To secure the good business relationships with other parties
OO-EG10 or SO-EG10	To secure good market reputation in the construction industry

Note: OO-EG refers to Origin Organization's expected goal; SO-EG refers to Support Organization's expected goal.

Table 2 Operationalization of commitment (C)

Question: What was the response of the parties in the project when the new idea was first proposed?	
Variable code	Interest level at the proposal stage
OO-C	Respondent OO's interest level
SO-C1	Respondent SO's interest level
SO-C2	The supporting client's interest level
SO-C3	The supporting main consultant's interest level
SO-C4	The supporting main contractor's interest level
SO-C5	The supporting sub-contractor's interest level
SO-C6	The supporting supplier's interest level

Note: OO-C refers to Origin Organization's Commitment; SO-C refers to Support Organization's Commitment.

Table 3 Operationalization of effort (EFT)

Question: What effort did your company put at senior management level to attain the objectives for initiating or supporting the new idea?	
Variable code	Emphasis on effort
OO-EFT1 or SO-EFT1	Additional resource investment
OO-EFT2 or SO-EFT2	Formation of separate task group within the company
OO-EFT3 or SO-EFT3	Formulation of incentive plans for the involving staffs of the company
OO-EFT4 or SO-EFT4	Formulation of monitoring plan to track the progress
OO-EFT5 or SO-EFT5	Formulation of coordination plan with the involving parties
OO-EFT6 or SO-EFT6	Formulation of incentive plans for the involving parties

Note: OO-EFT refers to Origin Organization's Effort; SO-EFT refers to Support Organization's Effort.

effort consistency is relatively high. This is expressed mathematically in Eq. 1:

$$EC = \sum \frac{ILR}{MPR} \quad (1)$$

where,

EC = Effort Consistency

ILR = Interest Level Rating of all the involved parties during the implementation stage

MPR = Maximum Possible Rating of all the involved parties, given by 7* Number of involved parties.

Favourable result

Favourable result (FR) was quantified as the realized benefit and satisfaction of all the parties involved in innovation (Table 4). The respondents were asked to rate the benefit and satisfaction of their own company and the perceived benefit and satisfaction of the other relevant parties during the implementation stage of the innovative idea. They were also asked to rate the benefit accrued to the whole project due to the innovative idea.

Table 4 Operationalization of favourable result (FR)

Question: Please rate the following success factors of the new idea perceived after the implementation in the project.	
Variable code	Realized benefit and satisfaction
OO-FR	Respondent OO's benefit level
SO-FR1	Respondent SO's benefit level
SO-FR2	The supporting client's benefit level
SO-FR3	The supporting main consultant's benefit level
SO-FR4	The supporting main contractor's benefit level
SO-FR5	Other relevant supporting parties' benefit level
FR6	Benefit for the project as a whole

Note: OO-FR refers to Origin Organization's benefit; SO-FR refers to Support Organization's benefit.

Fieldwork

This paper presents a part of the findings of a major research project which investigated the enabling and inhibiting factors of innovation in Singapore's construction industry. Structured questionnaire research technique was used in the study, and data were collected through postal survey. Respondents were required to rate each question on a seven-point Likert scale where 1 represented 'strongly disagree' or 'not interested' or 'least emphasized' and 7 represented 'strongly agree' or 'highly interested' or 'highly emphasized', as the case may be.

Target population

In this study, there were five population frames comprising clients, consultants, contractors, subcontractors and suppliers. The different groups were targeted because they occupy the different positions in the construction value chain and their perspectives were needed or this research.

Two groups of clients were identified: public sector clients and private sector property developers. The public sector clients were identified from the Singapore Government Telephone Directory. The private sector property developers where based on the members of the Real Estate Developers Association of Singapore (REDAS). For the two groups, samples were randomly selected.

The consultants who were surveyed comprised architects, structural engineers, mechanical and electrical (M&E) engineers and quantity surveyors. Samples were randomly selected from the listings provided by their respective professional institutions.

The target populations for contractors, subcontractors and suppliers were based on companies that are registered with the Building and Construction Authority (BCA) of Singapore under the relevant work-heads. Samples were randomly selected from all the categories of contractors and suppliers.

The survey package comprised a cover letter, the questionnaire, and a pre-stamped and self-addressed envelope. A pilot study was conducted prior to the full-scale industry-wide survey to ensure clarity and relevance of the questions.

Response rate

As shown in Table 1, a total of 1286 questionnaires were sent to the different target groups in the Singapore construction industry. Seventy-six questionnaires were returned within one month of sending out (response rate of 5.91%). Out of these, 18 questionnaires were not substantially completed and the usual reason given was that the companies do not have relevant experience in innovation. Sixty were returned because the companies have changed their addresses. Data from the 58 usable returned questionnaires were checked, edited, coded and analysed. Out of the 58 usable responses, 41 were OO and the remaining 17 were SO (Table 5).

Table 5 Response data

Population group	Sample size	Number of satisfactory responses		Number of unsatisfactory responses	Response rate (%)
		Usable responses	Unusable responses		
Client	341	10	5	10	4.40
Consultant	444	21	4	39	5.63
Contractor	501	27	9	11	7.19
Total	1286	58	18	60	5.91

Table 6 Profile of respondents and role in innovation

Sample	Designation		Experience in the construction industry (years)			Organizational role in innovation	
	CEO, MD, GM, senior manager	Architect, engineer, QS, project manager	Maximum	Average	Minimum	As origin organization	As supporting organization
Client	5	5	25	16.57	3	7	3
Consultant	18	3	35	15.89	4	11	10
Contractor	22	5	38	16.85	2	23	4
Total	45	13	–	–	–	41	17

Profile of respondents

The profile of respondents is summarized in Table 2. The respondents have an average construction experience of approximately 16 years. The majority of them are in senior positions in their firms.

Limitations of the study

The response rate of 5.91% is low and could influence the result with sample bias effect. The reason behind the low response rate may be the practice of deliberate innovation is very low in the industry or the respondents were flooded with questionnaire surveys by too many researchers in Singapore's relatively small construction industry (Tan, 1995). Notwithstanding this, the authors approached personal contacts in the construction industry and made follow-up calls. Several responses were received through this effort.

The second limitation relates to the use of perception rating via a Likert scale. Although, this technique is particularly helpful in examining respondents' 'perception' of the innovation in a project, it might be associated with different types of information errors like leniency error, severity error, central tendency error or halo error (Schwab, 1999).

Results and discussions

The main statistical tool which was used to test the hypotheses was Spearman's correlation analysis. This tool was chosen because it is able to calculate correlation coefficients, without being susceptible to serious influence of extreme values, and there is no need to assume normal population distribution (Newbold, 1991). Correlation coefficients were calculated using the Statistical Package for Social Sciences (SPSS). The results are shown in Tables 7, 8 and 9.

H1-1 and H1-2: Correlation of expected goal and favourable result with commitment

Hypothesis H1-1 states that expectancy to fulfil a goal would enhance the commitment level. The hypothesis was tested both for the OO and SOs separately. Table 7 (column 2) shows some instances where the expected goal of the OO is positively correlated with commitment. In the first instance, the expected goal to enhance the company's quality of work (OO-EG1) is significantly and positively correlated to commitment of the OO (OO-C). Similarly, the OO's commitment is also significantly and positively correlated with the expected goals of streng-thening the company's stake in the project (OO-EG6), enhancing performance of the whole project (OO-EG7), and securing good market reputation (OO-EG10).

However, in the case of SOs, there is no significant positive correlation between expected goals (SO-EG) and commitment (SO-C1) (Table 7; column 4). Instead, in two instances, the expected goal and commitment are negatively correlated. The results show that when the goal of the SO is to reduce the normal time required to complete an item of work (SO-EG3), or to maximize the company's overall profit (SO-EG5), the SO's commitment level actually reduces.

The results further show that when the expected goal is to overcome technical difficulties in the project (OO-EG4 and SO-EG4), there is no significant increase in commitment. This observation implies that even a seemingly attractive goal may not have any effect on the commitment level. This may be due to the perception that the goal is very difficult to achieve out of the intended innovation. An unpleasant past experience or a difficult working environment may induce such scepticism towards innovation.

The overall result of testing H1-1 is that commitment of the OO is positively related to its expected goals in many instances, while SOs do not seem to be enthusiastic about using innovation to achieve their goals. This shows that there is a difference in motivation level between the OO and SOs.

According to hypothesis H1-2, favourable results would be instrumental in enhancing commitment level. Table 8 shows that in almost all instances, favourable results for both the OO (OO-FR) and SOs (SO-FR) are positively correlated with their commitment level (OO-C

Table 7 Correlation results between expected goal and commitment of OO

Origin organization's expected goals	Origin organization's commitment (OO-C) (correlation coefficient/ 2-tailed significance)	Support organization's expected goals	Support organization's commitment (SO-C1) (correlation coefficient/ 2-tailed significance)
OO-EG1	0.37*	SO-EG1	0.20
	0.027		0.468
OO-EG2	0.17	SO-EG2	–0.41
	0.328		0.125
OO-EG3	0.01	SO-EG3	–0.71**
	0.959		0.003
OO-EG4	–0.02	SO-EG4	–0.27
	0.906		0.921
OO-EG5	0.16	SO-EG5	–0.52*
	0.360		0.046
OO-EG6	0.42*	SO-EG6	0.003
	0.012		0.992
OO-EG7	0.43**	SO-EG7	0.29
	0.008		0.288
OO-EG8	0.25	SO-EG8	0.18
	0.151		0.498
OO-EG9	0.31	SO-EG9	0.23
	0.076		0.427
OO-EG10	0.34*	SO-EG10	0.32
	0.045		0.241

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Table 8 Correlation results between favourable result and commitment and effort consistency

Favourable Results	Commitment (correlation coefficient/2-tailed significance)							Effort consistency (EC) (correlation coefficient/ 2-tailed significance)
	OO-C	SO-C1	SO-C2	SO-C3	SO-C4	SO-C5	SO-C6	
OO-FR	0.50*	0.39	0.41**	0.30	0.42*	0.42*	0.36	0.46**
	0.000	0.261	0.008	0.098	0.016	0.032	0.064	0.001
SO-FR1	0.44	0.47	0.32	0.95*	0.89**	0.80	0.80	0.48
	0.158	0.103	0.313	0.051	0.008	0.102	0.102	0.094
SO-FR2	0.44**	0.44	0.56**	0.39*	0.64**	0.62**	0.62**	0.59**
	0.002	0.128	0.000	0.029	0.000	0.000	0.000	0.000
SO-FR3	0.18	0.83	0.89**	0.84**	0.87**	0.49**	0.47*	0.80**
	0.396	0.167	0.000	0.000	0.000	0.037	0.047	0.000
SO-FR4	0.58**	0.63	0.73**	0.79**	0.79**	0.62**	0.65**	0.78**
	0.001	0.127	0.000	0.000	0.000	0.004	0.002	0.000
SO-FR5	0.38*	0.59	0.74**	0.67**	0.78**	0.62**	0.61**	0.75**
	0.014	0.097	0.000	0.000	0.000	0.00	0.000	0.000
FR6	0.48*	0.57	0.50**	0.36*	0.53**	0.50**	0.37*	0.49**
	0.001	0.065	0.001	0.044	0.001	0.006	0.038	0.001

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

and SO-C) respectively. The benefit for the whole project (FR6) is significantly and positively correlated to the commitment level of almost all the major participants in the project team.

Analysing the correlation coefficients pertaining to hypotheses H1-1 (correlation between expected goal and commitment) and H1-2 (correlation between favourable result and commitment), one distinct pattern is observed: there are fewer significant correlations and even negative correlations pertaining to hypothesis H1-1, whereas, most of the correlation coefficients in H1-2 are significant and positive. This indicates that the parties involved in construction innovation are more motivated by the *actual* favourable results derived from the innovation,

Table 9 Correlation results between effort and commitment and effort consistency

Organizational efforts	Commitment (correlation coefficient/2-tailed significance)							Effort consistency (EC) (correlation coefficient/ 2-tailed significance)
	OO-C	SO-C1	SO-C2	SO-C3	SO-C4	SO-C5	SO-C6	
OO-EFT1	0.13		0.26	0.24	0.34	0.41*	0.38*	0.23
	0.436		0.166	0.266	0.081	0.032	0.049	0.148
OO-EFT2	0.24		0.12	0.24	0.37*	0.39*	0.27	0.32*
	0.161		0.520	0.276	0.059	0.046	0.162	0.043
OO-EFT3	0.14		–0.14	–0.12	–0.13	0.30	0.06	0.03
	0.410		0.481	0.570	0.517	0.130	0.775	0.867
OO-EFT4	0.18		0.005	0.11	0.00	0.16	0.25	0.17
	0.292		0.980	0.620	0.998	0.419	0.200	0.305
OO-EFT5	0.31		0.11	0.26	0.18	0.36	0.52**	0.31**
	0.063		0.562	0.234	0.376	0.063	0.004	0.052
OO-EFT6	0.27		–0.05	0.02	–0.16	0.37*	0.08	0.16
	0.108		0.813	0.926	0.430	0.059	0.686	0.316
SO-EFT1		0.08	0.14	0.29	–0.03	0.65	0.51	0.33
		0.779	0.642	0.640	0.931	0.116	0.242	0.229
SO-EFT2		0.43	0.70**	0.46	0.66**	0.51	0.35	0.69**
		0.111	0.008	0.436	0.039	0.237	0.437	0.006
SO-EFT3		–0.14	0.13	–0.80	0.22	0.28	0.11	0.38
		0.629	0.676	0.102	0.547	0.542	0.808	0.186
SO-EFT4		0.63*	0.42	0.63	0.24	0.40	0.29	0.57*
		0.013	0.158	0.254	0.509	0.379	0.526	0.032
SO-EFT5		0.65**	0.63*	0.55	0.39	0.62	0.52	0.76**
		0.008	0.021	0.334	0.271	0.140	0.232	0.002
SO-EFT6		–0.32	0.35	–0.80	0.03	0.28	0.11	0.33
		0.240	0.246	0.102	0.930	0.542	0.808	0.249

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

than by some lofty goals that they *expect* out of the innovative idea.

H2-1: correlation of commitment of OO with its effort

Hypothesis H2-1 states that the commitment of the OO drives it to put more effort in the innovation. Table 9 shows that the correlation coefficients between the OO's commitment (OO-C) and their effort (OO-EFT) are weakly positive. This may be because the commitment level is more result-induced rather than expectancy-driven. Without a strong expectancy induced commitment, the OO may prefer to undertake innovation only as a part of its regular business without the need to invest extra effort. This is consistent with Mitropoulos and Tatum's (2000) finding that resources for implementing a new technology are allocated from the project budget, and not head office overheads.

H2-2: correlation of OO's effort with SOs' commitment

Hypothesis H2-2 states that the effort of the OO influences the commitment level of SOs positively. This hypothesis represents the influence of the OO in getting commitment and cooperation from SOs. Table 9 shows that there are some instances of significant positive correlation between effort of the OO (OO-EFT) and commitment of SOs (SO-C). The effort of additional resource investment (OO-EFT1) is found to be significantly correlated with the commitment of supporting-sub-contractors (SO-C5) and that of supporting-suppliers (SO-C6). This indicates that the downstream supporting players like sub-contractors and suppliers are more motivated if the OO is investing additional resources in innovation. This inference is in accord with Tatum's (1989) finding that innovation will increase if there is commitment of money.

Likewise, the effort of the OO in forming a separate task group within its company to deal with innovation (OO-EFT2) and in emplacing incentive schemes for parties that are involved in the innovation (OO-EFT6) are significantly and positively correlated to the commitment of supporting-sub-contractors (SO-C5). Further, the effort of the OO in coordinating (OO-EFT5) with, and in providing incentives (OO-EFT6) for the involving parties, are significantly and positively correlated with the commitment of supporting-suppliers (SO-C6). These observations imply that the deliberate intra- and

inter-organizational cooperative effort of the OO seems to be important in motivating the downstream supporting players. This is consistent with Nam and Tatum's (1997) finding that effective leadership is essential for technological innovation.

It is also observed that there are instances of adverse relationships (though not statistically significant) between the OO's effort and the commitment of SOs. The OO's effort in providing incentive to its own staff (OO-EFT3) is negatively correlated with the commitment of clients (SO-C2), main consultants (SO-C3) and the main contractor (SO-C4). The commitment of supporting clients (SO-C2) and the main contractor (SO-C4) is also negatively correlated with the OO's effort of formulating incentive plans for the involving parties (OO-EFT6). This may be because SOs are worried that they may be expected to contribute to such an incentive scheme.

H2-3: correlation of SOs' commitment with their effort

Hypothesis H2-3 states that the commitment of SOs drives them to put more effort into the innovation. This hypothesis is similar to hypothesis H2-1, except that it is applied to SOs. Unlike in hypothesis H2-1, there exist significant and positive correlations between the commitment of SOs (SO-C1) and their effort (SO-EFT) (see Table 9). Commitment of SOs is found to be positively and significantly correlated to their effort of formulating monitoring plan to track progress (SO-EFT4) and formulating coordination plan with involving parties (SO-EFT5). These significant correlations imply that SOs are concerned about the process to achieve success of the innovative idea that they are supporting and willing to work closely with other parties.

The efforts of providing incentives for SOs' own staff (SO-EFT3) and other relevant parties (SO-EFT6) are found to be negatively correlated with SOs' commitment. Although these are statistically insignificant correlations, it indicates SOs' unwillingness to invest in incentive plans as this may give rise to additional expenditure and eat into their profits.

H2-4: correlation of OO and SOs' effort and effort consistency (EC)

Hypothesis H2-4 states that the effort of OO and SOs' would enhance the overall effort consistency in the innovation. Table 9 shows that the OO's effort in forming a separate task group within the company (OO-EFT2) and coordinating with the involving parties (OO-EFT5) are significantly and positively correlated with effort consistency. This implies that the formation of a separate team to coordinate and champion innovation with other relevant parties is seen as a projection of commitment of the OO in implementing innovative idea. This helps win the trust and interest of SOs and thus encourages them put on effort effectively.

Similarly as the OO, the SOs' efforts of formation of separate task group within the company (SO-EFT2) and formulation of coordination plan with the involving parties (SO-EFT5), are positively and significantly correlated with effort consistency. Besides these, formulation of monitoring plan to track the progress (SO-EFT4) is also positively and significantly correlated with effort consistency. These correlations imply that SOs' enthusiasm in terms of forming a task group that has coordinating and monitoring functions to support the innovative idea would enhance the overall effort consistency.

H2-5: correlation of effort consistency and favourable result

Hypothesis H2-5 states that effort consistency positively correlate with favourable results. Table 8 shows that in almost all instances, there are significant and positive correlations between effort consistency (EC) and favourable result for own party as perceived by the OO (OO-FR) and SOs (SO-FR). Likewise the perceived favourable result for the whole project (FR6) is also significantly and positively correlated with effort consistency (EC). This result indicates that the satisfaction with each other's effort in the innovation is crucial to achieving favourable result for individual parties and for the project as a whole.

Conclusion

This paper proposed two sets of hypotheses, comprising seven specific hypotheses (Figure 1) which were tested in the fieldwork. A structured questionnaire was designed to collect the necessary data from clients, consultants, contractors, sub-contractors and suppliers who had proposed and implemented construction innovation (OO), and those who had supported construction innovation (SO).

Hypothesis 1-1 states that when a firm's expected goal from the innovation is high, the commitment of the firm towards the innovation will also be high. This hypothesis is generally supported for the OO (see Table 7; OO-EG and OO-C). Expected goals from the innovation include to: enhance the quality of work within one's own firm; strengthen own firm's stake or influence in the project; enhance the performance of the whole project; and secure good reputation in the construction industry.

Hypothesis 1-2 states that when the result of the innovation is good, the commitment towards the innovation will be high. This hypothesis is supported in more instances than Hypothesis 1-1 (see Table 8; OO-FR and OO-C; SO-FR and SO-C). Therefore, the implication is

that the individual organizations involved in construction innovation are motivated by the realized (actual) benefit out of innovation during and after implementation, rather than the presumed (expected) benefit from the innovation. This indicates that instrumental motivation (Repenning, 2002) is more influential than non-instrumental motivation. It also shows that construction innovation is implemented with a risk-averse attitude, which may be translated to: 'show me the results, and I will be committed'. This is consistent with Mitropoulos and Tatum's (2000) finding that firms adopt a cautious attitude to innovation.

Hypothesis 2-1 states that when the OO is more committed, its effort in the innovation will increase. The results show that this hypothesis is not supported (see Table 9; OO-C and OO-EFT). The implication of this finding is that organizations may welcome innovation, and even be prepared to be committed to it, without putting in actual and concrete effort.

Hypothesis 2-2 states that when the OO puts in effort for the innovation, commitment of SO may increase. This hypothesis is supported (see Table 9; OO-EFT and SO-C). This interaction of the relevant parties also show that downstream parties like sub-contractors and suppliers who are supporting the innovation seem to be more willing to participate in the innovation if there is tangible and substantial efforts and cooperation shown by the OO.

Hypothesis 2-3 states that when commitment of SOs is high, they will put in more effort in the innovation. This hypothesis is supported (see Table 9; SO-C and SO-EFT). The SOs are found to be concerned about the implementation process to achieve innovation success, and they seek close coordination with other parties. Ironically they are found to be less willing to invest in incentive plans.

Hypothesis 2-4 states that more effort by the OO and SOs leads to higher effort consistency. This hypothesis is supported (see Table 9; OO-EFT, SO-EFT and EC). When effort consistency is high, it is hypothesized that result of the innovation will be favourable (hypothesis 2-5). This hypothesis is also supported. It is found that the effort of supporting parties appears to be more influential in comparison to that of originating parties, in producing synergistic output of the overall effort consistency in innovation. The effort consistency is found to be very crucial in achieving favourable results.

With only H2-1 not supported, it can be concluded that the research hypotheses set up in this paper are generally correct. This research extends the existing innovation literature by showing that from the organization point of view, success in innovation relies on two major aspects; high intra-organization motivation, and good inter-organizational interaction. An innovation may be successfully implemented in the project if *effort* is put into carrying the innovation through, and there are high expected *goals*, favourable *results* and high *commitment*.

The implication of the findings for practice is that an innovation is more likely to be successful if firms are motivated, optimistic about the results and exert additional effort. Incentives for the supporting parties need to be substantial so that they can participate in innovation with more commitment and effort. In addition, the innovation should be designed such that it could draw all upstream and downstream parties together, and all their interests are looked after in the project. The issue of generating a favourable environment in construction innovation could be investigated in further study.

References

Borys, B. and Jemison, D.B. (1989) Hybrid arrangements as strategic alliances: theoretical issues in organizational combinations. *Academy of Management Review*, **14**(2), 234–49.

Buckley, P.J. and Casson, M. (1998) A theory of cooperation in international business. In Beamish, P.W. (ed.), *Strategic Alliances*, pp. 91–110, Edward Elgar Publishing: Cheltenham, Glos and Northampton, Mass.

Dulaimi, M.F., Baxendale, A.T. and Langford, D.A. (1996) The construction process as a process of innovation. In *Proceedings of the CIB W65 The Organization and Management of Construction: Shaping theory and practice*, pp. 572–7, Glasgow, UK.

Dunning, J.H. (1998) Reappraising the Eclectic Paradigm in an Age of Alliance Capitalism. In Colombo, M.G. (ed.), *The Changing Boundaries of the Firm: Explaining Evolving Inter-Firm Relations*, pp. 29–59. Routledge: London and New York.

Gann, D.M. and Salter, A.J. (2000) Innovation in Project Based, Service Enhanced Firms: The Construction of Complex Products and Systems. *Research Policy*, **29**, 955–72.

Gerwick, Jr., B.C. (1998) Innovation's role under advanced type of construction contracting. In *Proceeding, Second International Conference on Construction Project Management: Critical Issues and Challenges into the Next Millennium*, pp. 15–18, 19–20 February, Singapore.

Janszen, F. (2000) *The Age of Innovation*, Financial Times/ Prentice Hall: London.

Klein, K. and Sorra, J. (1996) The challenge of innovation implementation, *Academy of Management Review*, **21**(4), 1055–80.

Knoke, D. (2000), *Changing Organizations*, Westview Press: Boulder, Colo.

March, J.G. and Simon, H.A. (1993), *Organizations*, 2nd Edition, Blackwell: Oxford.

Mitropoulos, P. and Tatum, C.B. (1999) Technology adoption decisions in construction organizations. *Journal of Construction Engineering and Management*, ASCE, **125**(5), 330–338.

Mitropolous, P. and Tatum, C.B. (2000) Forces driving adoption of new information technologies. *Journal of Construction Engineering and Management*, ASCE, **126**(5), 340–8.

Nam C.H., and Tatum, C.B. (1988) Major characteristics of constructed products and resulting limitations of construction technology, *Construction Management and Economics*, **6**, 133–48.

Newbold, P. (1991) *Statistics for Business and Economics*, Prentice Hall: Englewood Cliffs.

Porter, L. and Lawler, E. (1968) *Managerial Attitudes and Performance*, Dorsey Press: Honeywood, IL.

Quinn, J.B. (1985) Managing innovation: controlled chaos. *Harvard Business Review*, **May-June**, 73–84.

Repenning, N.P. (2002) A simulation based approach to understanding the dynamics of innovation implementation. *Organization Science*, **13**(2), 109–27.

Schwab, D.P. (1999) *Research Methods for Organizational Studies*, LEA Publishers: New Jersey and London.

Slaughter, E.S. (2000) Implementation of construction innovation, *Building Research and Information* **28**(1), 1–17.

Sterman, J., Repenning N. and Kofman, F. (1997) Unanticipated side effects of successful quality programs: exploring a paradox of organizational improvement. *Management Science*, **43**(4), 503–21.

Tan, W. (1995) *Research Methods in Real Estate and Construction*, National University of Singapore: Singapore.

Tatum, C.B. (1986), Potential mechanisms for construction innovation, *Journal of Construction Engineering and Management*, **112**(2), 178–91.

Tatum, C.B. (1989) Organizing to increase innovation in construction Firms. *Journal of Construction Engineering and Management*, **115**(4), 602–17.

Thompson, P.J. and Sanders, S.R. (1998) Partnering continuum, *Journal of Management in Engineering*, **Sep/ Oct**, 73–8.

van de Ven, A., Polley, D.E., Garud, R. and Venkataraman, S. (1999) *Innovation Journey*, Oxford University Press: New York.

van de Ven, A. and Poole, M. (1995) Explaining development and changes in organizations, *Academy of Management Review*, **20**(3), 510–40.

Vroom, V. (1964) *Work and Motivation*, Wiley: New York.

Winch, G. (1998) Zephyrs of creative destruction: understanding the management of innovation in construction, *Building Research and Information*, **26**(4), 268–79.

Wood, R. and Bandura, A. (1989), Social Cognitive Theory of Organizational Management. *Academy of Management Journal*, **14**(3), 361–83.