EVALUATING THE MODUS OPERANDI OF CONSTRUCTION SUPPLY CHAINS USING ORGANISATION CONTROL THEORY

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ABSTRACT

Supply chains are omnipresent. However, the modus operandi of the construction supply chain is not clearly established in the literature. This might be attributable to the character of construction projects and the structure of the construction industry. Formal and informal control mechanisms are well established in retail and manufacturing supply chains which is evident in improved product performance. However, there is a paucity of research on the construction supply chain especially at identifying the interplay of control mechanisms and their relationship with project performance. In the case of large and complex construction projects, the client-contractor relationship requires input control, behaviour control and output control for successful project delivery. In the light of organisation control theory and the existing literature on construction supply chains, this study evaluates the modus operandi of the client-contractor relationship based on three control mechanisms: input control (project risk and reward power, and intra-project communication), behaviour control (opportunism) and output control (project performance) using a structural equation model. A survey data of 258 construction professionals working on construction projects in India was collected. The study findings reveal that input control, in terms of project risk and reward power, and intra-project communication, largely influence behaviour control in terms of opportunism. However, behaviour controls do not directly affect output control in terms of project performance; rather, a direct effect of the input control mechanism of output control is particularly evident.

KEYWORDS: Intra-project communication, Opportunism, Project performance, Project risk, Reward power.

INTRODUCTION

The construction industry is primarily a project-based industry. Because of its temporary and fragmented nature, it is predominantly recognised as an unorganised sector. It is also well known for its adversarial and fraudulent practices, which are often seen as congenital issues in the industry. Negotiations, litigations and disputes are commonplace, causing delays in project delivery. Supply-chain control problems can often arise throughout construction projects' lifecycle, potentially affecting the client-contractor relationship and the project performance (Eriksson & Laan 2007). The skew towards supply over demand in projects makes it difficult for contractors to be competitive and still earn a reasonable profit; however, clients want the project goals to be achieved at a reasonable cost and in a reasonable time, regardless of the contractor's preparedness. Corruption and opportunism represent another factor contributing to the deterioration of the client-contractor relationship. Corruption is a considerable issue in the Indian construction industry and presents a real barrier to India's growth potential; meanwhile, opportunism in a client-contractor working relationship can be detrimental to the project performance. Corruption, including bribery, often presents a major impediment to

projects in India, with many organisations eager to accept quick cash to sustain their businesses; promoters and builders often misstate their financial performance so it appears higher than average (Ernst & Young, 2012). Due to unreliable information, client organisations often need to conduct due diligence on contractors and subcontractors, meaning higher transaction costs. Further, corruption causes lack of trust and eventually attracts less capable and inefficient organisations to execute project works (KPMG, 2011).

These factors contribute to reducing GDP in India in terms of awarding and executing projects and securing financial closure; opportunity costs amount to USD 45 billion for contractors and USD 155 billion for owners (McKinsey & Company, 2009). How project stakeholders understand projects and construction procurement, and how they change their behaviour throughout the project lifecycle eventually affects project performance. There is a research gap in these areas. It is evident that client organisations often rely on the contract framework to control projects and contractors; eventually, however, both clients and contractors cut corners to optimise their gains. Such kinds of confrontations are quite common in construction projects and can generally be modelled as a game-theory problem. However, in real-life construction the outcome is not as straightforward as one party gains while the other loses. More than this, project performance is affected and the growth of the industry is retarded. Therefore, it is an important research study undertaken here, to identify and evaluate the modus operandi of the construction supply chain (CSC).

THEORETICAL FRAMEWORK

'Modus operandi' is a Latin phrase meaning 'method of operation'. It is used to describe someone's habits of working, particularly in the context of business or criminal investigations. Since the nature of supply-chain management in the construction industry has not been explored clearly, significant research avenues are open for evaluation of the modus operandi of the CSC.

Construction supply-chain management (CSCM) has been defined as the integration of key construction-business processes relating to key members of the construction supply chain, including client/owner, designer, contractor, subcontractor and supplier (Xue, Wang, Shen & Yu, 2007). This suggests the necessity for seeking integration within the CSC. However, according to Briscoe and Dainty (2005), it is difficult to achieve integration in the CSC due to the structure and the context of the construction industry. Integration forces are weaker in client-contractor relationships, given the temporal nature of construction projects. Majority of construction projects are unique and complex, within a competitive construction environment, engaged by a familiar or unfamiliar client-contractor dyad. The magnitude of outsourcing accompanied by competitive procurement makes the CSC more prone to opportunism and downgrading of the project performance. Therefore, the use of intrinsic control mechanisms can curb opportunism in the client-contractor relationship to deliver the project performance. It is important to know how the CSC seeks control in its operations while overcoming the contextual forces, in lieu of seeking integration.

On this basis, the scope of this research is confined to the client and the contractor i.e. the major stakeholders within the CSC. The mechanism of contract administration is useful to exercise the mediated power; power mechanisms employed by the client can avoid conflicts and confrontations, curb opportunism and control project performance (Lu, & Hao 2013). The

higher degree of outsourcing in construction projects, means that the dyad members are particularly vulnerable to project risks.

This study tests this most pertinent scenario of the CSC in the light of organisational control theory (Liu, Borman, & Guo, 2014). The theory utilises either single or multiple control mechanisms to evaluate the modus operandi of buyer-supplier relationships. Control theory focuses on input control, output control and behaviour control to assess dyadic performance (Jaworski, 1988; Long, Burton & Cardinal, 2002). Organisation control theory can throw light upon the operations of the CSC and project performance. According to the theory (Cardinal, Laura, Sitkin, Long & Chris, 2004; Eisenhardt, 1985; Ouchi, 1979), the objectives of organisations can be achieved by employing input, output and behavioural control mechanisms. In this regard, Ouchi's (1979) framework is often used in empirical studies on organisational control. The framework measures task programmability (i.e. the ability to specify the tasks to be followed) and outcome measurability. In the client-contractor dyad of construction projects, the outcome can be measured by project performance. The initiation of a client-contractor relationship on a project is largely influenced by the input control mechanisms. The input control mechanisms of the CSC include project risk and reward power mechanisms of the client organisation, and intra-project communication. Opportunism is detrimental to CSC operations, and therefore behavioural control mechanisms are of paramount importance. How do CSC operations influence the output control in terms of project performance? This research aims to identify how the input control mechanism influences the behavioural control (opportunism) and output control (project performance) mechanisms.

Input Control in the Construction Supply Chain

Reward power

The use of reward power in CSC operations can be used as a reactive input control to repair client-contractor relationships. Power in this context is defined as the ability to influence (Emerson, 1953). The two dichotomous sources of power - mediated power and non-mediated power - are widely used as control mechanisms in buyer-supplier relationships (French & Raven, 1959). Reward power of a client organisation is defined as the ability to promise something of value to the contractor in exchange for compliance (Handley & Benton, 2012). Although the premise of partnership is based on collaboration and joint working, it is also evident in literature that partnerships can flourish in the dyad, particularly where the buyer is dominant over the supplier (Handley& Benton, 2012). However, the notion of power is different in the Indian construction industry. With regard to relational contracts, Eriksson and Villeval's (2013) study reveal that long-term relationships are generally initiated with symbolic rewards. The use of reward power is exercised at the project award stage of drafting incentive contracts; during the execution stage, contractors often need to accommodate new requests from clients. The client can revert to the use of reward power by proposing incentives to overcome supply-side risks and the complexity involved in construction projects.

Perceived project risk

The management of risks in the CSC requires the proactive control of perceived project risk. Risk is defined as the potential for unwarranted or negative consequences of an event or activity (Rowe, 1977). Risk is a complex and dynamic concept, and consequently calls for an integrated approach to demystify it. According to Das and Teng (2009), project risk consists of the two

components of relational risk and performance risk. Therefore, studying project risk in isolation may not be worthwhile, since the concept of risk is directly linked to performance outcome, whether favourable or unfavourable to project stakeholders In a temporary construction project setting, project outcomes primarily affect the relational exchange of the client-contractor dyad. The risk perceived by the client-contractor dyad is process-oriented, longitudinal and dynamic. It is often manifested in the client-contractor operational behaviour of the project. It is also perceived in the shortcomings of project performance: cost, time, quality, appropriateness of the procurement mechanism, and the contractual arrangements to deliver the project. Risk can emerge from project characteristics e.g. complexity and size, or from procurement mechanisms and the ambiguity of contractual arrangements to mitigate dyadic risk. The risk is to be measured differently in different contexts. Zhou, Zhang, and Wang (2007) revealed that risk in a project is related to the specific supply-chain member. Supply risks are the major source of uncertainty in the engineering, procurement and construction sector (Micheli, Cagno & Zorzini, 2008).

Intra-project communication

The management of intra-project communication in the CSC can work as an active input control mechanism for prompt reciprocal response in the client-contractor relationship. Information is the crucial strategic resource of the CSC (Edum-Fotwe, Thorpe & McCaffer, 2001) and affects its competitiveness. Information is considered as an asset in managing coordination in the CSC. Thus, intra-project communication facilitates coordination between clients and contractors, and encourages an interactive working environment for faster decision making. According to Bankvall, Bygballe, Dubois and Jahre (2010), in the CSC, the client and contractor demonstrate reciprocal interdependence, which calls for frequent reciprocal information flow in the dyad before arriving at final decisions. However, the mechanism of coordination between the dyad members is dependent on the quality and availability of prompt and accurate information (Holweg & Pil, 2008). Intra- project communication is the precursor of high task interdependence in projects (Crook & Comb, 2007); therefore, timely, accurate, and active information sharing becomes an important proposition.

Behaviour Control in the Construction Supply Chain

Opportunism

Opportunism has been defined as ‘seeking self-interest with guile’ (Williamson, 1975). Opportunistic behaviour emanates from the single motive of the maximisation of one’s own profits, and distorts the dyadic trust. It is evident in dyadic behaviour that is marked by lying, stealing, cheating, withholding or distorting information, or failing to keep promises. Opportunism is a key mediator in shaping the nature of working relationships of buyers and suppliers (Hawkins, Wittman, & Beyerlein, 2008). A contractor’s reluctance to accommodate design changes, suspension of work due to lack of incentives, delaying of projects’ execution, or failures in dispute resolution and negotiation also represent opportunistic behaviour. Opportunistic behaviour in a project emanates from the lack of trust between project partners (Carson, Madhok & Wu, 2006). It may be induced through misalignment of rewards, incompetence and lack of appreciation for a system and integrity of failure (Lau, 2011). Other examples include delaying payment to contractors and exploiting contract conditions.

Output Control in the Construction Supply Chain

Project performance

Project performance monitoring is the decisive control mechanism of the client and contractor dyad to achieve project objectives even despite failure to update input control. Project performance measures might differ considerably, but the classic measures in the form of the iron triangle – time, cost, quality – are appropriate for the client-contractor dyad. Project success is a subjective proposition, but project performance is an objectively measurable proposition in terms of cost, time and quality (Wai, Yusof, Ismail & Ng, 2012). Numerous other measures of project performance are cited in project management literature. For instance safety, environmental performance and functionality of projects are other key performance indicators (Chan & Chan, 2004). In a heterogeneous project environment, good performance monitoring needs improved collaboration, integration, communication and coordination in the dyad (Wickramatillake, Koh, Gunasekaran & Subramanian, 2007). Butcher and Sheehan (2010) argued that understanding a client's business needs is a key performance indicator in relation to past performance of a contractor on similar projects. More often, the contractor's performance on cost depends on the client-initiated design variations; it has been established that the contractor's own performance on similar projects and the commitment of the relationship towards the downstream affects the contractor's performance on projects (Xiao & Proverbs, 2003). In the Indian context, it has been found that commitment, coordination and competence can improve the performance of construction projects on cost, quality, schedule, dispute and safety (Jha & Iyer, 2007). The project manager's competence, coordination among participants and owner's competence can positively influence cost performance (Iyer & Jha, 2005). Contractors should seek to initiate a good relationship with their clients, to respond to clients' needs, in a manner that enhances project performance (Ahmed & Kangari, 1995).

DEVELOPMENT OF HYPOTHESES

Perceived project risk and project performance

In the construction project business, contractors often have difficulty in decision-making due to lack of accurate and timely information. Project complexity in terms of size and novelty necessitates competitive procurement to enable the contractor to deliver the project (Khalfan, McDermott & Swan, 2007). A client's knowhow in project procurement is often inadequate and often passes on risks to the contractor. A contractor can anticipate project risk, for instance ambiguity in construction contracts, lack of involvement of subcontractor and supplier at design stage, or delay in payments (Rahman & Kumaraswamy, 2004). The risk primarily comprises two components – relational risks and performance risks (Das & Teng, 2001). Risk is a potential contextual variable in project execution, which influences project performance (Zwikael & Smyrk, 2015). On the other hand, clients' wariness of opportunistic behaviour of contractors in project execution may bring about the risks of project costs and time overrun (Zou et al., 2007). According to Hartono, Sulistyo, Praftiwi and Hasmoro (2014), project risk affects the decision making of project stakeholders (client and contractors) on projects. On the contrary, it can be argued that the higher the risk the higher the return. Nevertheless, we propose that the higher the levels of project risk, the more the client/contractor perceives the likelihood of poor project performance. Based on this discussion, the study hypothesises that:

H1: Perceived project risk negatively influences project performance.

Perceived project risk and opportunism

The lack of clarity on project deliverables, inappropriate construction contracts and unbalanced risk allocation can cause both the client and the contractor to resort to opportunistic practices. Risks can shrink opportunities in business (Jaafari, 2001). It is often evident through reluctance to share accurate and timely information, withholding payments or suspension of project work. Opportunism in the client-contractor dyad is the plausible effect of perceived project risk. Uncertainty in project delivery affects the accuracy and quality of information sharing. The lack of risk allocation fails to comprehend the mechanism of loss sharing. Therefore, the more project risk is perceived, the greater the tendency towards opportunistic practices (Caniels & Gelderman, 2010; Lui & Ngo, 2004; Williamson, 1985). Therefore, the study proposes that:

H2: Perceived project risk positively influences opportunism.

Intra-project communication and opportunism

Communication is the critical determinant of relational governance in the CSC, since it moderates the effect of opportunism arising out of exchange hazards (transaction specific assets, and uncertainty) on relational governance (Sheng, Brown, Nicholson, Poppo, 2006). Further, because of reciprocal interdependence within the dyad, the quality, accuracy and timing of information sharing can hold back vital project decisions (Bankvall et. al. 2010). Lack of information sharing or withholding of information can lead to distrust and suspicion in client-contractor relationships. Such poor communications between the dyad members can obscure vital project information in key construction contracts and give rise to disputes in the dyad. On the other hand, timely and accurate information sharing regarding project milestones and payment delivery, inculcates dyadic confidence. Accurate and up-to-date information reduces opportunistic behaviour. Information sharing ensures the dyad members are aware of the magnitude of project risk so that corrective actions can be taken immediately. Communication directly deters manipulation of records and curbs opportunistic practices (Crosno & Dahlstrom, 2008). Therefore, the higher the intra-project communication, the smaller will be the scope for opportunistic behaviour. Hence the study hypothesises that:

H3: Intra-project communication negatively relates to opportunism.

Reward power and opportunism

Reward power is a reactive input control mechanism of the CSC used to motivate the client-contractor dyadic relationship. The use of mediated power is often seen as a mechanism to control the behaviour of project partners in construction project business. Power is manifested through mutual formal contract agreement within the dyad in order to pay incentives and share gains in the course of well-defined project delivery. On occasion the mediated source of power is exercised as a safeguard to control opportunism in the client-contractor dyadic relationship. The two sources of mediated power, reward power and coercive power are the two extreme poles of power mechanisms (French & Raven, 1959). However, the exclusive use of either or both is often found in the literature to control opportunism. For example, Laan, Voordijk and Dewulf (2011) found that opportunistic behaviour is less if the incentive structure is agreed in an alliance contract. Mediated power can thus achieve better control over opportunism in a dyadic relationship (Tangpong, Hung & Ro, 2010; Williamson, 1985). The greater the rewards power of the client, the smaller is the opportunism of the contractor in the dyadic relationship. Therefore the study hypothesises that:

H4: Reward power negatively relates to opportunism.

Opportunism and project performance

Opportunistic behaviour is reactive behaviour in the anticipation of impending loss, often manifested in the self-interest behaviour of cheating, misstating, carelessness, etc. The commitment of the project partners to the project objectives is not active in the presence of likely opportunistic behaviour. Subsequently, project needs can be compromised and project performance fail to meet expected performance levels. However, the client organisation's role is decisive not only in delivering and controlling project performance, but also in building trustworthy working relationships in projects (Anderson, 2012). Collusive bidding behaviour can further compromise project performance in terms of cost overrun and time overrun (Jap & Anderson, 2003). Opportunism also compromises the quality standards expected for project completion and safety standards may also be overlooked (Crosno & Dahlstrom, 2008). Thus, it is predicted that:

H5: Opportunism negatively influences project performance.

Intra-project communication and project performance

Communication may facilitate the realisation of project goals through clear information being shared. Moreover, intra-communication is a decisive input control mechanism in project planning, scheduling, monitoring and controlling of projects. The client-contractor dyad can demonstrate reciprocal interdependence (Bankvall et al., 2010); timely and accurate information sharing can keep track of the cost and time performance of the project. According to Cheung, Yiu & Lam (2013), communication in construction projects plays a mediating role in the trusts-performance relationship. Updates on a client's needs on project quality measures and safety records are dynamic activities and evolve over a project's lifecycle. Consequently, achieving performance standards with up-to-date and accurate information reduces rework and transaction costs. In order to reduce disputes stemming from the parties' low quality of information, communication facilitates prompt decision-making and avoids misunderstandings and opportunistic behaviour. Mahaney and Lederer (2010) argued that project monitoring reduces shirking behaviour and can yield project success. More recently Ananatamula (2015) asserted that communication depends on the project size and it facilitates faster decision making. Therefore it is hypothesised that:

H6: Intra-project communication positively relates to project performance.

Reward power and project performance

Mediated power control mechanisms in the form of reward power and coercive power are useful governance mechanisms to attain project objectives. Reward power in the form of gain sharing and profit sharing offers incentives to meet project goals (Khalfan et al., 2007). Reward power can instil commitment in the relational competence to attain cost reduction and reduce project delays. The provision of contractual incentives of the client organisation is associated with positive outcomes in project delivery in a cost and time measures (Caniels, Gelderman & Vermeulen, 2012; Lu, Guo, Quin, He & Xu, 2015). The provision of incentive contracts by the client can improve cost and time performance in projects (Eriksson & Westerberg, 2011). Relational attributes such as trust and commitment of a contractor also improves project performance (Meng, 2012). Therefore this study hypothesise that:

H7: Reward power positively influences project performance.

The conceptual model as shown in Figure 1, was developed to reveal the modus operandi of CSC with relevant hypothesised relationships.

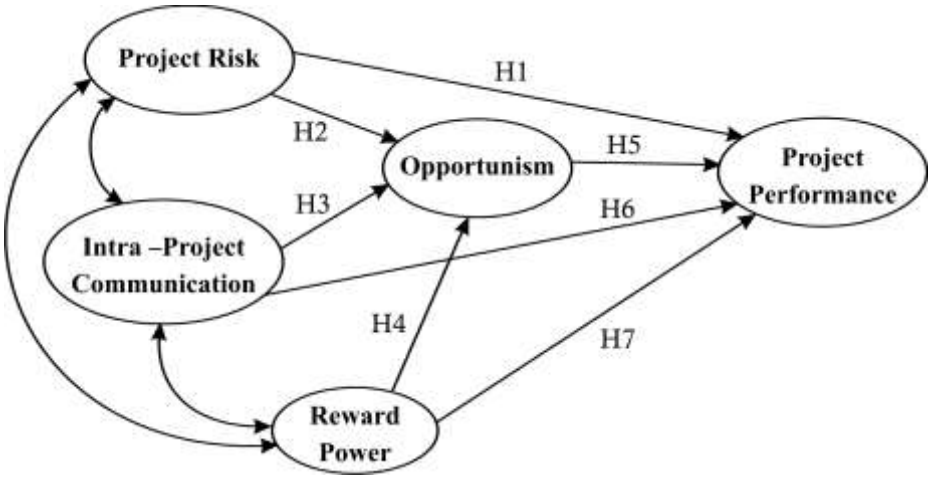

Figure 1: Conceptual model

METHODOLOGY

The research employs a positivist approach: the results are compiled using deductive logic of theory development (Trochim, 2000). Since this study aims at identifying the socially rooted control mechanisms of construction supply chain members, survey study is considered an appropriate choice of research methodology. The survey research approach adopted, captures the attitudinal nature of variables and enhances the generalisability of the results (Kerlinger, 1986).

In order to test the hypotheses, the survey study involved three phases. The first phase involved developing the preliminary questionnaire based on the constructs identified in the literature reviewed. The preliminary questionnaire is checked for content validity using structured interviews with construction industry professionals (Nunnally, 1978) and then the proposed model is developed based on constructs identified in the study. In the second phase, a pilot study is conducted on 50 respondents to assess the questionnaire for convergent validity (Campbell & Fiske, 1959) and discriminant validity. In this phase, the preliminary questionnaire is modified by omitting items with factor loadings less than 0.5 while other items were modified to gain clarity and simplicity. Reliability and validity of the questionnaire was assessed by employing exploratory factor analysis and the final questionnaire is confirmed. In the third phase, the finalised questionnaire is administered using purposive sampling methods. The respondents were provided information on the purpose of the study and given enough time to complete the questionnaire. The questionnaire administered in the study, largely used seven-point Likert scales where 7 = Strongly agree and 1 = Strongly disagree. The third phase of the study involved testing of the measurement model using confirmatory factor analysis and testing the structural model. Further elaboration of the research methodology is provided in the subsequent section.

Sampling and data collection

Data for the study was collected using random, convenient, purposive sampling of construction-project professionals located in five different cities of India - Delhi, Mumbai, Kolkata, Pune and Hyderabad - through a self-administered questionnaire. The target population includes working professionals registered at the National Institute of Construction Management and Research India, at the five city centres. The selection of this sampling frame fulfils the objective of this study in a numbers of ways. Firstly, the five cities comprise reputed construction companies with ongoing large-sized construction projects in real estate and Infrastructure sectors of the Indian economy. Secondly, these large construction clients and contracting organisations sponsor their working professionals for Executive programmes at the institute. Thirdly, the working professionals enrolled in the Executive programmes are knowledgeable of client-contractor working relationships in large scale projects.

Table 1: Demographic Profile

Descriptors	Number	Percentages
Experience		
Less than 5 years	85	33
6 - 10 years	67	26
11 - 15 years	52	20
16 - 20 years	54	21
Qualifications		
Diploma	41	16
Degree	201	78
Postgraduate	16	6
Work Profile		
Planning	28	11
Executions	150	58
Quantity Surveying	31	12
Contracts, Tendering and Bidding	49	19
Organisational Sector		
Private	180	70
Public	78	30
Construction Party		
Client	142	55
Contractor	108	42
Consultant	08	3
Project Type		
Road projects	39	15
Residential/Commercial building projects	77	30
Industrial buildings	39	15
Power and process plant	39	15
Telecommunications and Electricity distribution	64	25

A total of 600 questionnaires were distributed. There were 258 usable responses (representing 45% response rate) obtained after checking the completed questionnaires for omissions, including error in multiple answers. The location of construction projects covered by the study mainly represented five metro cities of India: Delhi (30%), Mumbai (25%), Kolkata (20%),

Pune (15%), Hyderabad (10%). 40 % of the respondents were sponsored by their employers, while 60% were self-sponsored. The demographic profile of the respondents are presented in Table 1.

Measurement

In order to measure the latent construct of the study, the scales established from literature are reviewed and modified after a pilot study. Reward power, perceived project risk and intra-project communication were presented as the exogenous constructs, while opportunism and project performance were the endogenous constructs of the study. The reward power scales were adopted from Benton and Maloni (2005). The construct of intra-project communication were measured using an abridged version of Goldhaber and Rogers' (1979) communication audit survey. Project risk and project performance scales were developed from the review of literature. The measurement scales of Heide, Wathne and Rokkan (2007) were used to measure opportunism.

DATA ANALYSIS AND RESULTS

Exploratory factor analysis

The study employed exploratory factor analysis to check the uni-dimensionality of the constructs, as the objective of the study is to confirm, not to explore the factors. Exploratory factor analysis is an efficient technique to examine the factor structure of data. The study established the appropriateness of the data (Kaiser, 1958) using the measure of sampling adequacy known as the Kaiser-Melin-Olkin (KMO) measure and Bartlett's test of sphericity. Further, the principal component analysis analysis using varimax rotation revealed five factors, explaining 65.34% of the the total variance (Kaiser, 1958). The reliability and validity of the constructs were examined using Cronbach's Alpha values, which were greater than the cut-off value of 0.7 (Hair, Black, Babbin & Anderson, 2010), as shown in Table 2.

Table 2: CFA Statistics

Latent constructs	IPC	RWP	RSK	PP	OP
Intra-Project Communication (IPC)	0.50	0.39	0.35	0.56	-0.05
Reward Power (RWP)		0.50	0.14	0.34	0.16
Project Risk (RSK)			0.50	0.49	0.29
Project Performance (PP)				0.50	0.23
Opportunism (OP)					0.50
Cronbach's alpha	0.782	0.815	0.812	0.837	0.80
Composite Reliability	0.831	0.749	0.855	0.831	0.83

(The diagonal element indicates the values of AVE.)

Confirmatory factor analysis

Confirmatory factor analysis (CFA) was employed to confirm the factor structure of the items. The confirmatory factor analysis of each of the five constructs yielded satisfactory fit to the data. The convergent validity of the latent construct was established using average variance extracted and composite reliability. The cut-off values of the average variance extracted (AVE) and composite reliability were greater than 0.5 and 0.7 respectively. The construct validity was

confirmed since the indicator loading of each of the items was greater than 0.5. Further, the discriminant validity of the construct was confirmed, since the AVE value of each construct is greater than the square of the inter-construct correlation (Fornell & Larcker, 1981). These relevant statistics are summarised in Table 2.

Further, the CFA of each construct revealed satisfactory goodness of fit. Subsequently the goodness of fit of the overall model was examined: Chi-square ($\chi 2$) is the fundamental measure used in structural equation modelling (SEM) to account for the difference between the observed and estimated covariance matrices. The SEM involve determining the absolute fit measures and incremental fit measures. The absolute fit measures included $\chi 2$ statistics, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), and Root Mean Square Error of Approximation (RMSEA). The incremental fit indices included Comparative Fit Index (CFI) and Tucker Lewis Index (TLI). The measurement model revealed satisfactory goodness of fit with the fit indices of the baseline model: $\chi 2$ /DF = 2.357; CFI = 0.805, TLI = 0.78, GFI = 0.77, AGFI = 0.72, RMSEA = 0.052 (Bentler, 1990).

Structural Equation Model

Structural equation modelling (SEM) is a flexible approach to identifying the causal relationships of the latent constructs of the research study (Anderson & Gerbing, 1988). Based on theoretical support from literature reviewed, the seven causal relationships are presented in the structural model shown in Figure 2. The structural model utilised three exogenous variables (perceived project risk, reward power and intra-project communication) and two endogenous variables (project performance and opportunism) in the project dyad. The structural model was tested using data set of 258 samples using AMOS software 14 (Byrne, 2001). The fit indices of the baseline model were: $\chi 2$ /DF = 2.357; CFI = 0.80; TLI = 0.78; GFI = 0.77; AGFI = 0.72; RMSEA = 0.052 (Bentler, 1990). All the seven hypotheses of the structural model were supported. Figure 2 shows the path coefficients and the significance levels of the structural relationships within the model.

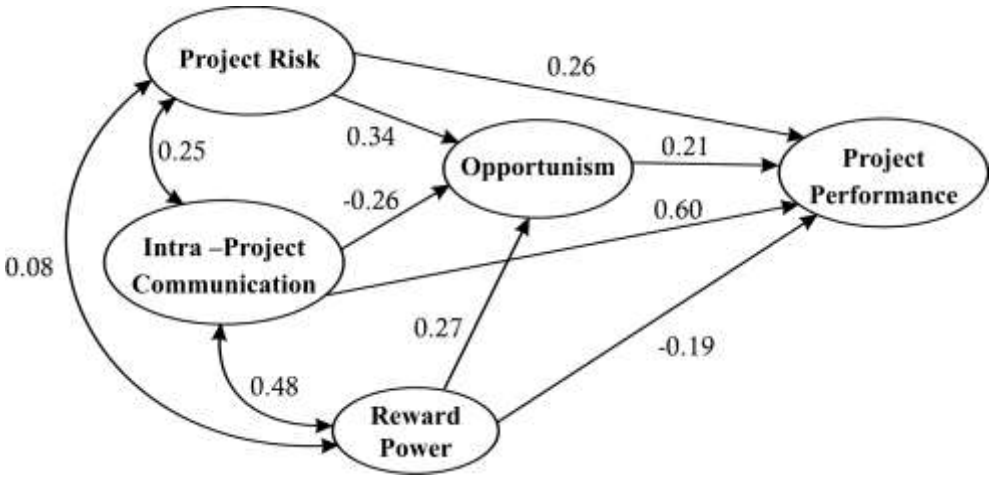

Figure 2: Structural relationships

The data analysis of the structural model revealed that all the seven hypotheses are supported at the desirable significance level. Hypothesis H1, relating project risk to project performance, is supported with path coefficient 0.26 significant at 0.01. However, the unexpected positive path coefficients suggest that perceived project risk increases project performance. This result

is not consistent with the theoretical perspectives, implying that mutual understanding of project risk on the part of project owners and contractors can better control project performance in terms of cost and time. This result suggests that awareness of project risk between the client-contractor dyad could facilitate tracking and control of project performance. Further the study revealed that project risk reduces complacent behaviour in the dyad, and explicit notification of risks helps to control project performance. Likely disputes are settled and negotiated in the light of direct communication.

Hypothesis H2, relating project risk to opportunism is also supported, with path coefficient 0.34 significant at 0.001.The positive coefficient suggests that perceived project risk gives rise to opportunistic behaviour in the supply-chain dyad. Ambiguity in contracts, project complexity, delay in payment, and lack of fulfilment of project milestones make room for opportunistic behaviour. These finding are consistent with theoretical perspectives in literature.

Hypothesis H3, relating intra-project communication to opportunism is also supported, with the coefficient -0.26 significant at 0.01. The negative coefficient implies that intra-project communication reduces opportunistic behaviour. The scope of corrupt and opportunistic behaviour is reduced with prudent and open communication between the project partners. Project's needs are explicitly addressed with faster decisions. These findings are consistent with theoretical deductions.

Hypothesis H4, relating reward power to opportunism is supported, with coefficient 0.27 significant at 0.01. Surprisingly, this relationship is in the opposite direction to that of theoretical deductions, implying a new insight into the modus operandi of the client-contractor dyad. The use of reward power might make dyad members more vulnerable to opportunistic behaviour of the respective counterpart. This might suggest that informal rewards in the form of personal favours or gifts from either side could reveal the immediate dependence of the partner.

Hypothesis H5, relating opportunism and project performance is supported, with coefficient 0.21 significant at 0.01. This finding is surprising as it suggests that opportunism increase project performance. This might be due to the fact that in order to achieve the requirements of project performance in terms of cost and time, along with safety and quality, corrupt and opportunistic practices often crop up in the construction supply chain.

Hypothesis H6, relating intra-project communication to project performance is supported, with path coefficients at a high level of significance of 0.001. This suggests a strong correspondence between intra-project communication and project performance in the construction supply chain. The result has pragmatic relevance for practising project managers, who should extend communication between project owners and contractors to enhance project performance. The communication mechanism is a single input control, which significantly influences project performance (output control).

Hypothesis H7, relating reward power to project performance is supported, with path coefficient of -0.19 significant at 0.05. However the direction of the finding is opposite to directions offered by theoretical deductions, as it reveals that the use of reward power reduces project performance. The provision of unexpected incentives on a project might shift the focus of project partners onto other project business opportunities or challenging assignments, which

could compromise project performance. The results of the structural equation modelling are summarised in Table 3.

Table 3: Results of the study

Hypotheses	Hypothesised Relationship	Path coefficient	Result
H1	Perceived project risk negatively influences the project performance.	0.26 (P<0.01)	Supported
H2	Perceived project risk positively influences opportunism.	0.34(P<0.00 1)	Supported
H3	Intra-project communication negatively relates to opportunism.	-0.26 (p>0.01)	Supported
H4	Reward power negatively relates to opportunism.	0.27 (P<0.01)	Supported
H5	Opportunism negatively influences project performance.	0.21 (P<0.01)	Supported
H6	Intra-project communication positively relates to project performance.	0.60 (P<0.001)	Supported
H7	Reward power positively relates to project performance.	-0.19 (P<0.05)	Supported

DISCUSSION AND CONCLUSION

The analysis of results in the light of organisation control theory presents some important findings for managerial practice within the construction industry. As far as the role of input control is concerned in the CSC, interesting lessons are revealed. Project risks and rewards do not correlate (0.08) and hence need to be considered as the two independent input control mechanisms in the construction supply chain. Notably both risk as well as rewards can give rise to opportunistic behaviours in the CSC. The direct effect of risk on project performance is consistent with theoretical deductions. However the direct effect of reward power on project performance is not. The indirect effect, tested via opportunism as a mediating variable is also significant (Zhao, Lynch, & Chen, 2010). This suggests that project risk is an input control mechanism with behaviour control of opportunism as a mediator influencing project performance This input-behaviour-output control reveals complimentary mediation effects (Zhao et al. 2010), which suggests that all control mechanisms work in a sequential manner in the CSC. On the other hand, opportunism is also supported as a mediator with reward power, as input controls to influence project performance. However this input-behaviour-output control mechanism yields competitive mediation (Zhao *et al*. 2010), as the direct effect of reward power on project performance is negative, while that of opportunism as mediator is positive. Therefore, project managers should carefully initiate reward power mechanisms in projects in the likely presence of opportunistic behaviour in the CSC.

Similarly, the effect of the third input control of intra-project communication relating to opportunism as behaviour control on project performance reveal competitive mediation where one of the two paths (direct or indirect) is negative. Overall, this result suggests that opportunistic behaviour control is prominent in the CSC. However, input control of intra-project communication could maintain strong control of opportunism. Out of the three input controls, only intra-project communication strongly influenced project performance, while the other input control mechanisms proved susceptible to opportunistic behaviour in construction.

Implications and future scope of the study

This study outlines the common and socially rooted governance mechanism of the CSC applicable for all kinds of project. The study is useful to project owners, contractors, and policy makers. It enables the understanding of the interplay of control mechanisms to ease the procurement of large and complex construction projects. Future studies would benefit the domain of CSC by separating the client-led and contractor-led control mechanisms of CSC, and determine their relationship to project performance. These future studies would benefit by employing objective data to understand the CSC control mechanisms.

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APPENDIX: QUESTIONNAIRE

Input control mechanism of CSC

Reward power (α =0.81)

Our project partner offers incentives when we are initially reluctant to cooperate with his new request (new project). (0.79)

We feel that by going along with our project partner, we will be favoured on other occasions. (0.74)

Our project partners offer rewards so that we will go along with their wishes. (0.81)

Intra-project communication (α =0.78)

We are satisfied with the amount of information we receive from our project partner. (0.61)

We like the channels that we use to share information from my project partners. (0.75)

Informal communication amongst partners is usually active. (0.47)

New information is usually shared amongst project partners in due time. (0.72)

We frequently communicate on the progress of our project and project performance. (0.67)

Project risk (α =0.81)

We perceive project complexity and ambiguity in contract conditions as a risk to project business, the fear being that our project partner can take advantage of it. (0.56)

We perceive that lack of clear communication and understanding in the relationship with the project partner will mean more risk. (0.75)

We perceive lack of transparency and information sharing by the project partners as an impediment to faster project delivery. (0.66)

We perceive that lack of involvement of project partners at early stages of our project would carry the risk of the project getting delayed. (0.66)

We perceive that delay in claim processing and payment in the event of project glitches would cause financial problems for us. (0.77)

We perceive that limited supplier support and expertise in the later phase of the project (erection and commissioning) would not help the cause of faster project delivery. (0.57)

Behavioural control in CSC

Opportunism (α =0.80)

On occasion, this party lies about certain things in order to protect their interests. (0.61)

This party sometimes promises to do things without actually doing them later. (0.71)

This party sometimes tries to breach informal agreements between our companies to maximise their own benefit. (0.79)

This party will try to take advantage of holes in our contracts to fulfil their own interests. (0.84)

This party sometimes uses unexpected events to extract concessions from our firm. (0.84)

Output control in CSC

Project performance (α =0.83)

Due to our previous associations on earlier similar projects, we are able to reduce the cost overrun. (0.82)

Due to our previous associations and understanding, we are able to reduce the time overrun. (0.82)

Relationship commitment of project partners helps in meeting desired quality and safety standards in our project. (0.68)

Good communication between project participants helps to achieve the project goals. (0.64)

Relationship commitment of project partners helps in meeting the expectations of the project. (0.53)

Frequency of disputes with project partners is largely reduced due to the commitment of project partners. (0.60)