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General contractors' relationships with subcontractors: a strategic asset

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The general contractor–subcontractor relationship has been a focus of interest in the literature and yet its impact on a general contractor's economic performance remains a virtually unexplored area in the construction management literature. This research presents the findings of a questionnaire survey administered to 500 large US general contractors to explore this issue. The findings reveal that maintaining a relationship of high quality with subcontractors is positively and strongly associated with the perceived performance of general contractors responding to the survey.

Keywords: Transactions, general contractors, subcontractors, relationship quality, social embeddedness, and economic performance

Introduction

General contractors are continuously involved in a process of transforming inputs (i.e. materials, labour, capital) into outputs (i.e. constructed facility) but usually they are not alone in this long transformation process. They are accompanied by a number of other firms such as subcontractors, material vendors, equipment dealers, and financial institutions. General contractors' relationships with subcontractors have attracted overwhelming interest not only from mainstream organizational researchers (Eccles, 1981; Beardsworth *et al.*, 1988; Jones *et al.*, 1997) but also in the construction management literature (Hinze and Tracey, 1994; Shash, 1998). These research studies provided important insights into the unique nature of general contractor–subcontractor relationships. Yet the quality of the relationship between general contractors and their subcontractors, and the impact of this relationship on general contractors' economic performance has not been empirically explored in any of these research studies. The research presented here focuses on this unexplored area of construction management by building on newly emergent views of inter-firm relationships (Ring and Van de Ven, 1992; Mohr and Spekman, 1994; Dyer, 1996; Tan *et al.*, 1998; Johnson 1999). These research studies propose that the quality of a firm's relationship with other firms (e.g. subcontractors, material vendors, sureties, and banks) is a strategic asset that can have important implications on its operations and activities and, in turn, on its economic performance. The focus of the research is on the quality of the relationship from the general contractors' perspective and the implications of this relationship on general contractors' economic performance. The following section provides the conceptual foundations of the research.

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Conceptual foundations

One approach for studying a firm's relationships with other firms and the impact of these relationships on a firm's operations and activities is focusing on one of

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the fundamental blocks of the modern industrial system: transactions. The term transaction refers to transfer of resources (i.e. materials, services, etc.) between two or more firms. A firm conducts numerous transactions with other firms during the transformation of inputs into outputs, and in turn establishes numerous relationships with these firms. Different propositions prevail for explaining the coordination mechanisms of the transaction between two or more social actors (e.g. individuals, organizations and firms). Traditionally, price has been proposed as a primary mechanism for coordinating transactions between parties (e.g. Smith, 1776). More than half a century ago, Coase (1937) challenged this traditional proposition by arguing that in some cases price is not an effective mechanism for coordinating transactions. More recently, Granovetter (1985, 1992) argued that considering price to be the primary mechanism for the coordinating transactions ignores the social aspect of the industrial system. Granovetter (1985, 1992) introduced the concept of 'social embeddedness' for studying the social aspects of industrial systems and gaining insights into how these social aspects can influence the coordination of transactions between two or more firms.

The concept of social embeddedness proposes that a firm is socially embedded in ongoing transactions with other firms. Such social embeddedness has two important implications for the coordination of transactions between firms.

- First, social embeddedness promotes the diffusion of information about the qualities (i.e. character, trustfulness, ethicalness, reliability, conformity to societal expectations, skills, etc.) of prospective transaction partners. This information comes from parties with whom they were involved in the past. The diffusion of information regarding the probable behaviour of the parties acts as a safeguarding mechanism by providing guidance as to which parties should be avoided or preferred.
- Second, social embeddedness enhances the coordination between transacting parties because of inter-organizational learning that allows the firms to acquire experience from previous transactions. Organizational learning at inter-organizational boundaries enables parties to overcome liabilities of newness by developing trust, norms, values, roles, cooperation, skills, teamwork and communication, and by fostering the ability to coordinate smoothly, establish routines, decrease the variance in parties' expectations and goals, and decrease the amount of monitoring required over each other's activities.

It is the subtle operation of social embeddedness that makes establishing and sustaining relationships of high quality with other firms a strategic factor, which can influence a firm's economic performance. Commonly the quality of a firm's relationship with other firms has been conceptualized as a multi-dimensional construct including level of conflict, trust, coordination, communication, and longevity in relationship (e.g. Mohr and Spekman, 1994; Kumar *et al.*, 1995). Integrating these most commonly used dimensions of relationship quality, it can be stated that a higher quality relationship is obtained with a lower level of conflict together with the existence of mutual trust, effective coordination, open communication, and an emphasis on the longevity of the relationship.

The impact of establishing and sustaining relationships of high quality on the coordination of transactions becomes more evident for transactions that involve high 'uncertainty' and high 'asset specificity', due mainly to two major aspects of human behaviour, 'opportunism' and 'bounded rationality' (e.g. Jones *et al.*, 1997; DiMaggio and Louch, 1998). Uncertainty refers to the degree of difficulty in evaluating and monitoring the performance of a transaction partner (Williamson, 1975, 1985). Asset specificity refers to the degree to which an asset is specific to a given transaction, to the extent that it cannot be re-deployed easily for use in another context without appreciable loss in its productive value (Williamson, 1975, 1985). Three major types of asset specificity can be identified: (1) site specificity is obtained when an asset is useful only in its current location, as when it is immobile or dependent on another specific asset; (2) physical asset specificity is obtained when an asset is less valuable when used in any other transaction than the one it was intended due to customized production; and (3) human asset specificity refers to transaction-specific know-how accumulated by transacting parties in previous transactions. Human asset specificity increases as transacting parties develop experience working together and accumulate specialized information, language and know-how that enables them to coordinate and communicate efficiently and effectively.

Opportunism is based on the assumption that individuals are in general self-interested; moreover, some individuals are prone to act opportunistically (e.g. lying, cheating, violating agreements, etc.), and it is not easy to separate these individuals from the rest (Williamson, 1975, 1985). Bounded rationality is based on the assumption that individuals intend to be rational but this intention is limited in their information processing capabilities (Williamson, 1975, 1985). It is well documented in the literature that all transactions among social actors are prone to the hazards of opportunism, due to the opportunistic nature of

human behaviour (Williamson, 1975, 1985). The fundamental challenge in organizing a transaction, therefore, is to safeguard it against the hazards of opportunism. High asset specificity in a transaction increases the potential danger of opportunism because high asset specificity leads to the high dependence of partners on each other and limits replacement alternatives available to each party. A transaction that is supported by high asset specificity can be safeguarded against the hazards of opportunism by writing a full legal contract, but writing a full contract becomes difficult and costly under conditions of uncertainty since every contingency that may arise during the course of the transaction cannot be foreseen and specified in a written contract in advance, because of the bounded rationality of human behaviour. Neither a price mechanism nor contract documents can satisfactorily safeguard transactions that are supported by high asset specificity and involve high uncertainty against the hazards of opportunism (Williamson, 1975, 1985). In these situations parties who have no direct or indirect close ties with a potential partner protect the transaction against the hazards of opportunism by identifying and assessing the behaviour of this potential transaction partner. They do this by referring to other parties' experiences with this transaction partner (DiMaggio and Louch, 1998). Furthermore, a party to a transaction cannot rely only on the price mechanism in its transactions with a potential partner under conditions of high uncertainty and high asset-specific investment. It should rely also on its previous experience with that prospective partner and on referrals regarding the potential partner's compliance with expectations of other parties. These experiences are noted and retained through learning. This way, firms can address the hazards of opportunism by developing trust (i.e. the belief that a party's word is reliable, that it will fulfil its obligations in a transaction), coordination routines, and effective communication processes. In sum, the impact of relationships of high quality on a firm's performance becomes more evident and emerges as an important strategic factor in coordinating transactions where parties cannot solely rely on a price mechanism and/or a contract.

Thus far, the concept of social embeddedness, the advantages of maintaining relationships of high quality with other firms, and the characteristics of transactions that promote establishing and sustaining good relationships have been presented. In the following section, these concepts are applied to relationships between general contractors and subcontractors. The objective is to gain deeper insights into the quality of general contractors' relationships with subcontractors and the potential impact of this relationship on the economic performance of general contractors.

General contractor–subcontractor transactions

General contractors conduct transactions with subcontractors for a number of reasons (see Oliver, 1991) but it is commonly argued that unstable market conditions are the overriding reason (McWilliams and Gray, 1995; Jones *et al.*, 1997), since subcontracting out work packages enables general contractors to be flexible in responding to potential market ups and downs. The construction industry hosts an unstable and seasonal demand (i.e. market volatility) which does not justify the emergence of large construction firms that have the capability of carrying out the entire construction process with their own workforce and equipment. Unstable demand and seasonality cause construction firms to split into autonomous units and to rely on subcontractors to undertake some of the work packages. Construction firms prefer to be flexible rather than maintain a large organization to undertake the entire construction process (Beardsworth *et al.*, 1991). Therefore the general contractor–subcontractor relationship emerges as a rational response to the instability of demand in construction markets and to problems caused by seasonality (Jones *et al.*, 1997). Understanding general contractor–subcontractor transactions and exploring the impact on a general contractor's economic performance of establishing and sustaining relationships of high quality with subcontractors call for a close look at the two dimensions of transactions: (1) uncertainty and (2) asset specificity.

General contractor–subcontractor transactions involve a significant amount of uncertainty. Some of these uncertainties stem from the nature of the construction process and others from the uncertainty of a potential partner's performance during the course of the construction process. The construction process involves uncertainty that stems from a number of sources: (1) construction operations are carried out on sites which present uncertainties regarding weather and soil conditions; (2) each project requires a new design and generates new production problems regarding the coordination and integration of the outputs of specialized task groups which carry out interdependent tasks; and (3) the contracting system itself is a recipe for uncertainty since cost estimation is not an exact science (Winch, 1989). In addition to these uncertainties, general contractors and subcontractors also face difficulties in assessing each other's performance in advance. Poor performance on the part of either party, general contractor or subcontractor, can have profound effects on the other one.

General contractor–subcontractor transactions involve a 'high human asset specific investment' (Jones *et al.*, 1997). High human asset specificity is a direct

result of the production technology used in the construction process, which commonly is classified as craft technology (Powell, 1990). In craft based production, each output is relatively unique, the search for outputs is non-routine, and the work process depends upon a considerable amount of intuition and experimentation (Perrow, 1967). In addition to this, in the construction process, interdependence among work groups is high, and the workplace of a group is defined by its predecessors (Groák, 1992). Such production technology involves developing a significant amount of experience by working together.

The characteristics of the transactions between general contractors and subcontractors indicate that social embeddedness can have significant implications in the coordination of these transactions. Furthermore, research studies that explore general contractor–subcontractor transactions (Macneil, 1978; Eccles, 1981; Beardsworth *et al.*, 1988; Hinze and Tracey, 1994; Shash, 1998) also provide strong evidence that social embeddedness is in charge in these transactions. For example, Macneil's (1978) pioneering research on general contractor–subcontractor transactions reveals the subtle operation of embeddedness in these transactions, and shows that price is not the only governing mechanism on which parties rely. The research study reported by Eccles (1981) reveals that general contractors and subcontractors jointly restrict access to these transactions: general contractors tend to rely on a few subcontractors in each trade and tend to establish long term relationships with them, and similarly subcontractors mostly prefer to work with a rather small set of general contractors with whom they establish long term and flexible relationships. Restricting access to transaction relationships increases the frequency of transactions between existing parties and enables them to learn from one another to overcome problems caused by newness (i.e. learning new roles, coordination problems, developing trust and communication routes, etc.). Organizational learning at inter-organizational boundaries enables organizations to overcome liabilities of newness, and hence facilitates the coordination and integration of complex construction operations. The importance of inter-organizational learning becomes more apparent because of the fact that construction projects are carried out under intense time constraints, and because timeliness in construction operations can be achieved by the coordination and integration of the many autonomous organizations' efforts. Such inter-organizational learning that grows over the course of frequent relationships makes the transaction between the general contractor and the subcontractor highly asset specific, since the liability of newness clock is set to zero every time a new subcontractor is engaged for a different project.

Hinze and Tracey's (1994) research study reveals a number important issues surrounding general contractor–subcontractor transactions that can be attributed to the concept of social embeddedness. Hinze and Tracey (1994) report that some subcontractors refuse to submit quotes to those general contractors who have the reputation of bid shopping. In a subsequent inquiry of general contractor–subcontractor transactions, Shash (1998) reports that subcontractors are selective in getting involved in transactions with general contractors, and that they consider fairness on the part of the construction firm in its past dealings and particularly its compliance with common professional ethics to be of importance in this selection. Shash (1998) also reports that subcontractors quote similar prices for general contractors with whom they have done work in the past, and that they increase the price of their quotations submitted to contractors with whom they have limited work experience by 5–10%. Past transactions provide subcontractors information on general contractors' fairness in terms of prompt payment of amount due, representing the subcontractor's interest during the course of construction operations, and coordination and communication behaviour (Hinze and Tracey, 1994; Shash, 1998). This information in turn influences a subcontractor's decision for getting into a transaction with a general contractor.

Building upon the preceding arguments, it could be suggested that the existence of social embeddedness is apparent in general contractor–subcontractor transactions. Therefore, it could be proposed that having relationships of high quality with subcontractors is positively associated with a general contractor's economic performance. The following section presents the research methodology used in this study for empirically exploring this proposition.

Research methodology

Sampling and data collection

A questionnaire was designed to solicit information about general contractors' demographics (i.e. firm size and age), general contractors' perceptions of the quality of their relationship with their subcontractors, and general contractors' economic performance. Collecting data from both general contractors and subcontractors would have been desirable but resource considerations (i.e. limited time and funds) necessitated focusing only on general contractors.

The sample used in the research was drawn from the population of construction firms based in the USA. Construction firms that are classified by the Standard

Industry Classification (SIC) code as general contractors constitute the population used in the research presented, and the construction firms that constitute the sample of the research were drawn from *Engineering News Record Contractor Source book and Directory 1997–98* (*ENR*, 1997), which provides the mailing, addresses and names of key executives of construction firms that undertake projects larger than $10 billion. The Standard Industry Classification information of the sample was obtained from a number of business information sources such as *Million Dollar Business Directory* and *American Big Business Directory* (ABD, 1998). During the review process, the addresses and names of the key respondents were re-checked and updated for possible changes in individuals and mailing addresses. The key informant used in this study was the chief executive officer or a senior executive of each construction firm, since these individuals are expected to be able to assess the quality of their firm's relationship with their subcontractors, and to benchmark the economic performance of their firm relative to competitors.

A cover letter, a questionnaire form and a prepaid return envelope were sent to the 500 American general contractors that are listed in *Contractor Source book and Directory 1997–98* (*ENR*, 1997). The copies of the questionnaire were not coded, and anonymity was assured in the cover letter for avoiding potential bias in responses and increasing the rate of return, since the questionnaire involves solicitation of confidential information.

Research variables

The quality of general contractors' relationships with their subcontractors is formulated as a multi-dimensional concept including conflicts, longevity, coordination, communication, and trust. Respondents were asked six questions. In the first question, respondents were asked to indicate the overall quality of their relationship with subcontractors on a five-point Likert scale ranging from 1 = extremely poor to 5 = excellent. In the second question, respondents were asked to indicate on a five-point scale, ranging from 1 = very often to 5 = very rarely, how frequently their firm experiences major disputes and problems with subcontractors. In the third, fourth, fifth and sixth questions, respondents were asked to rate on a five-point scale, ranging from 1 = not at all to 5 = to a great extent, the extent to which their relationship with subcontractors is marked by a strong emphasis on longevity of relationships, open communication, effective coordination and strong mutual trust, respectively. An index of the quality of general contractors' relationship with their subcontractors was derived by summing up all corresponding values and calculating the mean. A high score represents a high relationship quality.

General contractors' performance is measured by using a subjective reporting approach developed by Dess and Robinson (1984). The subjective reporting approach is adopted here for two major reasons. First, generally the objective sources of performance data are unavailable for privately held companies. Furthermore, mostly these companies are reluctant to release their hard financial data. Second, goals and performance criteria of companies differ from one company to another. These difficulties have been pointed out in the construction management literature, and commonly subjective measurement approaches have been used for exploring the influence of some organizational factors on construction companies' performance (Kabasakal *et al.*, 1989; Hampson and Tatum, 1997). The use of the subjective method is widespread in the literature and its validity has been justified by numerous research studies (Dess and Robinson, 1984; Covin and Slevin, 1988).

General contractors' performance was measured by means of three performance indicators: growth in contract awards, profitability, and overall performance. Growth in contract awards and profitability were measured by asking respondents to indicate on a five-point scale, ranging from 1 = very poor to 5 = very good, how well their company did along these two performance indicators vis-à-vis their principal competitors over the last three years. Overall performance, which is a composite indicator, was derived by asking respondents to rate the importance attached by their company to these two performance criteria (i.e. growth in contract awards and profitability indicators) on a five-point scale ranging from 1 = not at all to 5 = extremely and by multiplying the achievement level in the two performance criteria (i.e. growth in contract awards and profitability) with the corresponding importance weightings. The corresponding importance weighting of each performance criterion (i.e. growth in contract awards and profitability) was calculated by dividing the importance of each item by the total importance given to both items for a given company. A high score on a performance variable indicates a construction company's performance is high on that dimension with respect to its competitors.

Control variables

Two contextual factors, namely the size and age of general contractors, were used as control variables since they can influence the firms' relationships with other parties (Kale and Arditi, 1998). The size of the construction companies was measured by asking respondents to indicate the total number of their full-time

employees. The age of the construction companies was measured by asking respondents to indicate the number of years the company had been in existence.

Results and discussion

The questionnaire was returned by 107 general contractors within four weeks following the mailing. Eight questionnaires were undelivered and returned. Four questionnaires were unusable due to missing information on some parts of the questionnaire. The effective rate of return for the survey was 21% (103/492). The mean size and age of responding general contractors are 237 employees and 46 years, respectively (Table 1).

The data collection procedure adopted in this research is a self-reporting procedure. It is reported in the literature that the self-reporting procedure of data collection can create problems associated with the common method of variance that can inflate or suppress the magnitude of the relationships being investigated (Campbell and Fiske, 1959). The issue of the problem with the common method of variance was addressed by using Harman's (1967) one-factor test (Podsakoff and Organ, 1986), which indicated that research findings were not affected by this problem.

The internal consistency of the relationship quality index (i.e. the reliability of the construct) was assessed by the Cronbach alpha method. The computed Cronbach alpha value of the relationship quality index is 0.84. It exceeds Nunnally's (1978) minimum criterion of 0.70 and as such indicates that the construct reliably measures the quality of the relationship between general contractors and subcontractors.

The impact on a general contractor's economic performance of the quality of its relationship with subcontractors is explored by using two complementary statistical analyses.

- The results of the bivariate correlation analysis are presented in Table 1. These statistically significant results at 1% highlight that the quality of the relationship with subcontractors is strongly correlated with overall performance ($r = 0.43$, $p \leq 0.01$) and profitability ($r = 0.42$, $p \leq 0.01$) but not with growth in contract awards ($r = 0.16$, $p \leq 0.01$).
- Partial correlation analysis is conducted to control the effects of the contextual factors, namely size and age of general contractors. It has been pointed out in the literature that not only can these contextual factors influence a firm's relationship with other parties in its operating environment but also they can mask the link between relationship quality and economic performance. Therefore a proper statistical analysis calls for partialling out contextual factors from the analysis. The results are similar to those obtained from bivarite correlation analyses, and imply that contextual factors, namely size and age, do not influence the relationship between economic performance and the quality of the general contractor–subcontractor relationship. Indeed, these results point out that the quality of the relationship between general contractors and subcontractors is significantly correlated with overall performance (pr = 0.43, $p \leq 0.01$) and profitability (pr = 0.41, $p \leq 0.01$) but not growth in contract awards (pr = 0.14).

These research findings that are based on both bivarate and partial correlation analyses provide strong support for the research proposition that establishing and sustaining relationships of high quality with subcontractors is positively related with general contractors' profitability and overall performance. These levels of correlation compare reasonably well and are consistent with recent research findings that explore inter-firm relationships and performance (Oliver, 1997; Tan *et al.*, 1998). Furthermore, these research findings provide empirical support to the research studies that promote the concept of 'partnering', where adver-

Table 1 Descriptive statistics and correlation matrix[a]

Research variables	Mean	S.D.	1	2	3	4	5	6
1. Size of construction firms (employees)	237.19	239.87	1.00					
2. Age of construction firms (years)	46.48	28.85	0.26[b]	1.00				
3. Relationships with subcontractors	4.21	0.69	−0.18	−0.17	1.00			
4. Growth in contract awards	4.06	0.88	−0.16	0.03	0.16	1.00		
5. Profitability	4.15	0.92	−0.07	−0.02	0.42[b]	0.58[b]	1.00	
6. Overall performance	4.14	0.74	−0.11	−0.13	0.43[b]	0.23[c]	0.89[b]	1.00

[a] All tests are two-tailed.
[b] $p \leq 0.01$.
[c] $p \leq 0.05$.

sarial relationships are avoided by establishing and maintaining long term collaborative relationships in order to meet the challenges presented by competitive conditions (Cook and Hancher, 1990; Thompson and Sanders, 1998).

The research findings also provide some empirical support for the subtle operation of social embeddedness in general contractor–subcontractor transactions. The concept of social embeddedness has important implications on general contractors' and subcontractors' operations and activities and on their economic performance. The implications on general contractors (as mentioned in the Introduction, the focus of this paper is on general contractors) are explained by means of two social factors. (1) Establishing and sustaining relationships of high quality with subcontractors reveals that the general contractor in question is reliable, trustworthy, legitimate, ethical and conforms to societal expectations. Such information is vital not only for subcontractors but also for clients, material vendors, equipment dealers, financial institutions, and sureties. When initiating transactions with general contractors, this information allows them to safeguard their vital interests against the hazards of opportunism on the part of general contractors since price or contract clauses alone are not sufficient mechanisms for this purpose. When clients and sureties consider initiating a transaction with a general contractor, generally they review this company's prior relationships since rational parties avoid parties that have a history of problematic relationships. The negative information about a general contractor's behaviour spreads quickly among the other parties because of the temporary nature of the construction process, where members of the temporary alliance go their own way upon completion of the project (Provan, 1993). The negative information about the behaviour of a general contractor reaches other parties, including subcontractors, sureties, material vendors, and even prospective clients, in very little time. Negative information about the relationships of a general contractor is a liability and creates a competitive handicap. On the other hand, positive information about a general contractor's behaviour distinguishes it from other potential competitors and acts like a catalyst for the formation of transactions in the future. Therefore establishing and maintaining relationships of high quality with subcontractors can facilitate subsequent repeat transactions with these parties and new transactions with other previously unconnected parties. (2) Maintaining relationships of high quality with subcontractors enables a general contractor to address coordination problems it faces in construction processes by capturing the benefits of inter-organizational learning. The characteristics of general contractor–subcontractor transactions (i.e. high asset specificity and high uncertainty) coupled with specific quality objectives, budget limitations, and time constraints present challenges to the parties involved in construction. A general contractor can partly address these challenges by establishing and maintaining good relationships with subcontractors, since relationships of high quality facilitate the formation of subsequent transactions; in their subsequent transactions, parties can rely on the experiences acquired in previous transactions to overcome problems of coordination, communication and integration.

The research findings highlight the subtle operation of social embeddedness in general contractor–subcontractor transactions, and reveal that not only price mechanisms but also social mechanisms have important implications for general contractors' operation and activities, and consequently for their performance. These findings should not be interpreted as a rejection of the argument that adversarial relationships (i.e. bid shopping, delay in payments to subcontractors) prevail in general contractor–subcontractor transactions; adversarial relationships do exist and could harm a general contractor's economic performance.

Conclusion

The research presented in this paper addresses one of the important research areas of the organizational studies literature, namely the impact of inter-firm relationships on firms' economic performance in the context of the construction industry. The research builds on the premise that every firm is socially embedded in ongoing transactions with other firms and that such social embeddedness presents two types of gain to firms: (1) diffusion of positive information regarding a firm's behaviour, such as reliability, trustfulness, ethical conduct, conformity to societal expectations; and (2) capturing the benefits of inter-organizational learning. Research findings reveal that maintaining relationships of high quality with subcontractors is positively and strongly associated with general contractors' economic performance.

The study made use of the perceptions of higher executives employed by general contractors to assess the quality of their relationship with subcontractors. Incorporating subcontractors' views would have provided deeper insights into the matter. Of particular interest would have been to see whether general contractors and subcontractors symmetrically share the benefits of maintaining relationships of high quality. A survey administered to subcontractors is recommended for future study.

Research findings presented in this paper should be interpreted and considered within the limitations of the

study. Like most survey-based research studies, this one establishes association but not causality. It is possible that general contractors that display a higher economic performance can afford to establish and maintain relationships of high quality with their subcontractors. The task remains for further research to address this issue by controlling first-order factors such as firms' choices regarding competitive positioning alternatives.

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