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Enhancing supply chain outcomes through Information Technology and Trust

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ABSTRACT

Challenged by competitive pressures, and enabled by information technologies (IT), organizations are forming strategic partnerships that share, collaborate, and make collective decisions across the supply chain (SC). To study this phenomenon, researchers have focused on one or some of these five salient factors: Information Technology Integration (IT), Inter-organizational Trust (TR), Relational Governance (RG), Transaction Cost (TC), and Supply Chain Performance (PE). In this study, we develop a research model that includes all these five factors by synthesizing and integrating theoretical perspectives: transaction cost economics, and relational governance. Our theoretical model clarifies the intricate relationships between the five factors by positioning two common resources for the supply chain: Inter-organizational Trust and IT, as the independent variables that influence outcome measures: performance, and reduction in transaction costs. Relational governance, which facilitates joint decision making, is theorized as playing a central role between the resources and the outcome measures. Data collected from 167 purchasing and supply chain managers provides strong support to our research model. Our findings should help researchers as well as practitioners to develop a more complete and transparent understanding of the relevant mechanisms with which the partnership resources, exert their beneficial effects on supply chain outcomes.

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1. Introduction

The two joint partnership resources: Trust and IT (Information Technology), may be viewed as two principle levers helping to promote sharing and collaborative decision making among partners. A number of research studies have focused on these two important factors in supply chain (SC) performance (Ganesan, 1994; Rai, Patnayakuni, & Seth, 2006). Researchers have shown that governance structures may work in conjunction with IT and trust and contribute to the overall success of the chain through outcome measures: Performance and reduction in Transaction Cost (TC) (Dehning, Richardson, & Zmud, 2007; Grover, Teng, & Fiedler, 2002) This governance structure, known as relational governance (RG), refers to the extent that the relationship between SC partners is not strictly limited to hierarchy or market structure, but rather a flexible, implicit "relational contract" based on trust and mutual expectation of continued cooperation (Pilling, Crosby, & Jackson, 1994).

Previous studies, explore only fragmented parts of the whole phenomenon thereby missing crucial links in the presence of other influential factors. We seek to develop and validate a more integrated model that captures the intricate relationships among a set of three factors: IT integration, trust, RG, and their relationship with SC outcome measures: SC Performance and reduction in TC (Fig. 1).

We have two broad research objectives. First, we examine the direct influence of IT integration, trust, RG on SC dyad outcomes: Performance and reduction in TC. Second, and more importantly, we seek to validate an intricate web of theoretical relationships through which IT integration and trust exert their influence on SC outcomes. These interlocking relationships, prominently featuring the role of RG, are based on theories and previous studies (Fig. 1).

2. Theoretical bases

In this study, we synthesize and integrate the diverse research literature on SCs as it relates to these five salient factors:

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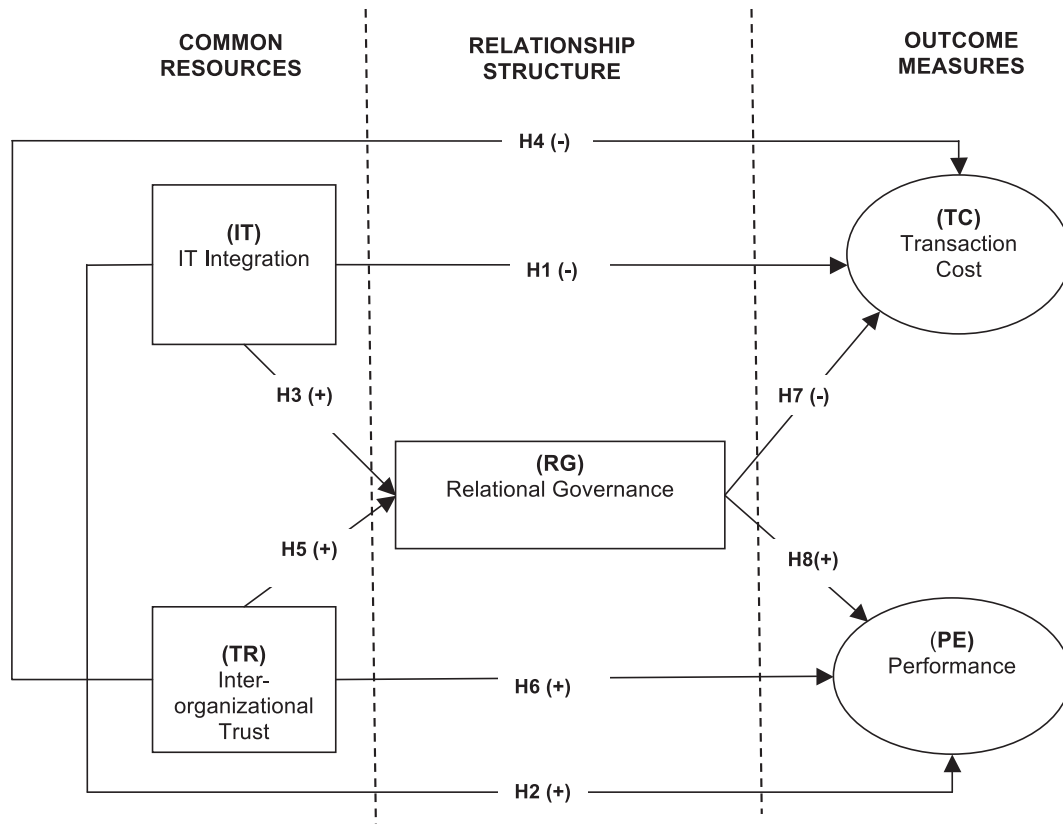
Fig. 1. Conceptual and research model.

Information Technology Integration (IT), Inter-organizational Trust (TR), Relational Governance (RG), Transaction Cost (TC), and SC Performance (PE). The research model (see Fig. 1) is developed to elucidate the intricate relationships between these factors.

2.1. Supply chain joint resource: Information Technology Integration (IT)

An Inter-organizational Information System (IOIS) is an application of enterprise level IT that helps restructure interactions with business partners (Sun & Teng, 2012). Inter-organizational Information Systems are assuming an increasing role in facilitating and enabling Inter-organizational collaboration as companies invest in joint resources to manage increasingly complex merged systems (Aleksić-Mirić, 2014; Chi & Holsapple, 2005; Konsynski & Tiwana, 2004; Talluri & Silberman, 2000). In a supply chain environment, the depth and breadth of IT integration between partners, covers computer mediated communications, processes, sharing, monitoring, coordination and joint decision making.

The level of integration in such computer mediated systems is capable of facilitating value added partnerships, reducing costs, and influencing partnership structures (Grover et al., 2002). Such depth facilitates collaborative decision making, automation of exchange procedures and documents, and the sharing of applications and databases, etc, between the partners. IT has long been theorized to reduce uncertainty and enhance organizations' information processing capability (Daft & Lengel, 1986). For the typical transactional environment in a Supply Chain that is laden with opportunism and the consequent TC, IT integration can be used to enhance collaborative inter-organizational information processing capabilities and improve the management of these TC. For example,

with higher efficiency and automation in routine exchange activities, managers may afford more attention to cooperative activities with SC partners (Bensaou, 1997).

2.2. Supply chain joint resource: inter-organizational trust (TR)

Trust is a key construct in Inter-organizational relationships (Talay & Akdeniz, 2014). Unlike IT integration, trust is a cognitive construct; an age old technique that influenced relationships long before the advent of technology. Trust (TR) is defined by: (1) confidence or predictability in one's expectations about another's behavior (Zaheer, McEvily, & Perrone, 1998), and (2) a common belief that another individual makes good-faith efforts to behave according to commitments, is honest and does not take excessive advantage of another even when the opportunity is available (Cummings & Bromiley, 1996). At the inter-organizational level, Inter-organizational trust can be defined as the extent of trust placed in the partner organization by the members of a focal organization (Zaheer et al., 1998).

For SCs, collective optimization, with sharing and cooperation is key to success. Therefore, trust between IOIS partners is essential. However, firms are wary of sharing information across organizational boundaries. Apart from the obvious conflict between participants, issues such as quests for dominance, clash of personalities, incompatibility of organizational culture and values, inadequate communication and betrayal can also underlie the demise of these alliances (Mentzer, Foggin, & Golicic, 2000). One solution to the above mentioned challenges, is to foster higher level of trust between partners, lack of which was found to be a barrier to good SC relationships (Moberg, Speh, & Freese, 2003).

2.3. Supply chain relationship structure: relational governance (RG)

While Transaction Cost Economics (TCE) attempts to explain inter-organizational relationships from the vantage points of economics, the exchange relationship often exhibits high levels of cooperation between partners that is difficult to account for by economic arguments alone (Connor & Prahalad, 1996; Islamoglu & Liebenau, 2007). To incorporate such long-term cooperation among partners, we use, Relational Governance (RG), which includes partners' appreciation of past transactions in anticipation of future ties (Pilling et al., 1994) and is a long-term-oriented, reciprocal social arrangement beyond mere formal contracts (Lado, Dant, & Tekleab, 2008). While contractual governance is considered as a control mechanism to address exchange hazards by specifying each parties roles in the relationship, RG addresses these risks through a social relationship between the parties (Cao & Lumineau, 2015). In other words, cooperation and trust may define a relationship above and beyond economic arguments and contractual obligations (Adler, 2001). The relationship is not just market exchange, but social and relational exchange (Joshi & Stump, 1999).

The RG concept, therefore, is based on implicit, flexible "relational contracts" under a variety of unforeseen environmental contingencies, and is not legally binding. It carries a reciprocal expectation and a long-term orientation, and helps to achieve some of the basic advantages of vertical integration without high financial costs and without substantial loss of operating autonomy as dependency rises (Provan & Gassenheimer, 1994). RG may reduce the risks that are targeted by formal contracts. In this paper, RG is conceptualized in the context of a buyer-supplier dyadic relationship, and encompasses dimensions of flexibility, shared problem solving, voluntary information exchange, and restraint in the use of power by the two parties (Grover et al., 2002).

2.4. Supply chain outcome: performance (PE)

Outcomes of an SC are important to practitioners, and deserve researchers' attention (Simon, 2006). The impact of SC relationship quality on its performance (PE) has not received sufficient attention in literature (Fynes, De Barca, & Voss, 2005). The ultimate goal being end results, our research will remain unfulfilled if an association with final outcomes is not examined. Performance is undoubtedly a good outcome measure of the SCs.

2.5. Supply chain outcome: reduction in transaction costs (TC)

The theory of transaction cost economics is often used to explain the type of relationship between the SC partners. This theory, pioneered by Coase (1937), predicted that a firm will tend to expand until the costs of organizing an extra transaction within the firm becomes equal to the costs of conducting the same transaction by means of exchange on the open market or the costs of organizing in another firm.

Partners in an SC dyad typically have limited understanding or information of each other, leading to opportunistic behaviors (Kumar & van Dissel, 1996). Such behaviors may be exacerbated by the complexity of the product or asymmetry in unilateral relationship-specific investments (e.g., technology, people, facilities). The cost in guarding against opportunism is a part of the TC, which also includes the cost of developing and maintaining an exchange relationship, and monitoring exchange behaviors (Williamson, 1993). According to TC economics, partners may assess TC and choose a governance structure. If TC is high, a structure akin to hierarchy with high degree of control and monitoring by one party on the other may be adopted. For low TC, a market-based governance structure is viable (Heide & John, 1988).

As reduction in TC is the primary objective for forming partnerships, it becomes a relevant outcome measure worth studying. One of the primary reasons to form SC partnerships is to reduce TC by getting the best of both extremes: markets and hierarchies.

3. Research model and hypothesis

3.1. Role of IT integration (IT)

We will first look at Hypothesis 1 in Fig. 1 that negatively links IT integration to TC. This link is evident from studies that found patterns of IT usage as significant determinants of relationship-specific investments (Subramani, 2004). Information systems, by keeping principals informed of agents' action, can reduce agent opportunism and effect participants' bounded rationality due to the resulting reduction in contracting and monitoring costs (Bakos & Treacy, 1986). IT can reduce coordination costs and reduce transaction risk (Clemons, Reddi, & Row, 1993). IT serves to create a less risky relationship between the parties either by promoting information exchange or by replacing the investment in assets with a high degree of specificity with an investment in IT/IS (Birnbirg, 1998). Imperfect information, an essential facet of TCE, leaves open the risk of opportunistic behavior by the suppliers. With transparent systems, IT has the capability of reducing imperfect information as well as uncertainty, and functions as a safeguard by reducing information asymmetries and by developing group norms among the partners (Gierl & Bambauer, 2002). Empirical evidence of the above mentioned arguments about the role of IT integration in reducing transaction costs found support in a study by Shi (2007) where Inter-organizational system enabled B2B e-commerce systems were found to reduce TCs. Thus.

Hypothesis 1. *In a supply-chain dyad, IT integration is negatively related to TC.*

Meta-analysis by Leuschner, Rogers, and Charvet (2013) identified numerous research papers that reveal a positive and significant correlation between integration and firm performance. IT integration leads to improved SC performance through elevated levels of process and information integration (Prajogo & Olhager, 2012; Wang & Wei, 2007). Existing studies have demonstrated that inter-organizational systems initiated by the buyer firm, is positively related to process efficiency (Saeed et al., 2005). Consequently, there is a relationship between eBusiness technologies and supplier integration that leads to better performance (Devaraj, Krajewski, & Wei, 2007). Studies have found empirical evidence of performance effects of inter-organizational information systems (Da Silveira & Cagliano, 2006; Devaraj et al., 2007; Sambamurthy, Bharadwaj, & Grover, 2003), and that the scope of the SC implementation have significant effects on the overall financial performance (Dehning et al., 2007; Saraf, Langdon, & Gosain, 2007) and operations performance. Prajogo and Olhager (2012) found that, by enabling IS integration with partner firms, IS flexibility becomes a capability that contributes to value creation in inter-firm relationships, while Klein, Rai, and Straub (2007) found that performance gains accrue when parties share strategic information, which can be facilitated by IT integration. Thus.

Hypothesis 2. *In a supply-chain dyad, IT integration is positively associated with performance.*

IT deployments in SCs lead to closer buyer-supplier relationships (Stump & Sriram, 1997; Subramani, 2004) and enable collaboration between partners. With the adoption of established protocols such as common data standards, electronic data interchange (EDI) or extensible markup language (XML)-based

standards, IT has changed the way SC relationships are coordinated (Dedrick, Xu, & Zhu, 2008). An empirical study by Grover et al. (2002) revealed that IT use has a significant positive relationship with RG in supply-chain dyads. Computer mediated communication systems such as IS integration across partners, are involved in the subtle shaping of relational effects between people (Walther, 1995). Thus.

Hypothesis 3. *In a supply-chain dyad, IT integration is positively related to relational governance.*

3.2. Role of inter-organizational trust (TR)

Consistent theoretical arguments and empirical works have been put forth to support the negative link from trust to TC (Delbufalo, 2012). In fact, mechanisms related to TCE such as formal contracts, economic hostages are necessary costs incurred to prevent opportunistic behavior, but do not create value beyond TC minimization (Dyer & Chu, 2003). In contrast, trust is a positive force that can reduce perceived risk and opportunism through intrinsic motivation, which in turn reduces monitoring costs, both important components of TC. There is evidence that TC associated with asset specificity, small numbers bargaining, and imperfect information can be reduced by trust (New, 1996). Thus.

Hypothesis 4. *In a supply-chain dyad, inter-organizational trust is negatively associated with Transaction Costs.*

As discussed earlier, TCE has difficulty in explaining the high levels of cooperation between partners (Connor & Prahalad, 1996), and this led to the conceptualization of RG that is based on non-economic social component evolving from a long-term relationship reflecting partners' appreciation of the past exchange in anticipation of future transactions (Pilling et al., 1994). Without good faith and trust, such "relational contracts" cannot survive the trials and tribulations in intensively interdependent relationships over the long-run (Maloni & Benton, 2000). Such relationships, according to the social exchange theory, is essentially based on trust, and is indeed a good predictor of a lasting relationship (Ybarra-Young and Margarethe, 1999). The role of trust, as a pre-condition for RG (McEvily, Perrone, & Zaheer, 2003) is established by existing studies (Chen, Lin, & Yen, 2014; Delbufalo, 2012). Thus.

Hypothesis 5. *In a supply-chain dyad, inter-organizational trust is positively related to relational governance.*

Intuitively, one would expect a direct beneficial effect of trust on SCs, which involves separate but interdependent entities, and trust would help to align and orchestrate their activities and facilitate collaboration. While the presence of trust positively influences partnership performance (Capaldo & Giannoccaro, 2015; Langerak, 2001; Zaheer et al., 1998), lack of trust is found to be one of the primary reasons for failure in SCs (Moberg et al., 2003). Various versions of trust in SCs were found to be positively correlated to outcomes such as performance, satisfaction, expectation of continuity, future purchase intentions and willingness to invest (Delbufalo, 2012). Thus.

Hypothesis 6. *In a supply-chain dyad, inter-organizational trust is positively associated with performance.*

3.3. Role of relational governance (RG)

Scholars of the operations management field have found major applications of TCE theory in studying inter-firm relationships (Grover & Malhotra, 2003), and elements of TC have been incorporated in a framework to analyze uncertainties and risks related to

SC relationships. While TC is incurred by economic control mechanisms in the absence of good will and enduring trust among the partners, RG involves stable long-term and trusting relationships, such as the sharing of knowledge among partners, that may render opportunism ultimately unnecessary. RG therefore makes the economic control mechanisms redundant, thereby reducing TC. Thus, self-regulation and cooperative behaviors, which are hallmarks of RG, are related to lower opportunism and lower need to monitor, i.e., lower TC (Parkhe, 1993). Indeed, empirical findings by Grover et al. (2002) revealed a strongly negative relationship between RG and TC. Thus.

Hypothesis 7. *In a supply-chain dyad, relational governance is negatively associated with TC.*

As a governance structure, RG offers practical mechanisms for collaborative activities of the participating partners, such as flexibility, shared problem solving, voluntary information exchange, and restraint in the use of power, and these can be expected to improve performance of the chain. Study by Johnston, McCutcheon, Stuart, and Kerwood (2004) shows that increased cooperative behavior lead to higher perceived performance and satisfaction among the buyer firms. Extant literature has suggests that in order to have a successful SC, firms should build and develop cultural elements of relations, such as trust, commitment and cooperative norms with their SC partners (Fynes et al., 2005; Min & Mentzer, 2004). In general, quality and depth of the various aspects of the buyer-supplier relationships have been found to have positive effects on performance outcomes (Benton & Maloni, 2005; Lado et al., 2008). Straub, Rai, and Klein (2004) provided strong evidence that greater information sharing and greater dependence within a dyad yield higher dyadic performance. Further, a stronger buyer-supplier relationship was found to enhance performance throughout the chain (Maloni & Benton, 2000). Thus, we propose:

Hypothesis 8. *In a supply-chain dyad, relational governance is positively associated with performance.*

To discount extraneous factors, we include two variables in the model: Organization Size and Supplier Share. We selected these variables because of their likely impact on the outcome measures. In line with related studies, we use number of employees as the measures of organizational size. A large organization is expected to have more streamlined dealings with its suppliers than its smaller counterparts. Subramani (2004) used size as a control variable in a study on supplier benefits from IT use in an SC while Chen et al., (2014) used annual sales and number of employees. Supplier share pertains to the percentage of total supplies (in dollars) handled by the most important supplier designated by the respondent.

4. Research method and data

Survey method was chosen to test the research model empirically. The unit of analysis is the SC dyad and the respondents are buyers in the dyad. The research model is designed to capture perceptions in the form of measurable research constructs from respondents who form the interface between the organization and its SC partners.

4.1. Construct measurement

The survey instrument was developed by adopting instruments successfully tested in the past, as well as adapting these instruments to fit our specific needs without distorting the purpose it was meant to serve (Appendix A). Items for inter-organizational

trust were adapted from scales developed by Cummings and Bromiley (1996) involving conceptual, empirical development and validation of organizational trust. The items were found to have an item-to-factor correlation of more than 0.85. The inter-organizational trust measure, in line with works by Ganesan (1994) and Ybarra-Young and Margarethe (1999), captures the aggregate aspects of faith in the relationship as perceived by the buying partner. The questions on IT integration, based on the extent of IT use in various aspects of the SC activities, were adapted from Grover et al. (2002). TC consists of three dimensions: monitoring the performance, addressing problems in the relationship, and the likelihood of suppliers taking advantage of the relationship. The measurements items were adapted from Grover et al. (2002) where, all first order constructs of TC were found to have good convergent validity (>0.70). Items for the four dimensions of RG (RG): flexibility in the relationship, voluntary exchange of useful information, shared problem solving, and restraint in the use of power, were adapted from Grover et al. (2002). In their survey, all second order constructs of RG were found to have good convergent validity (>0.70). For performance, the items were selected from scales used by Benton and Maloni (2005) and Premkumar and Ramamurthy (1995).

4.2. Data source and sample characteristics

Before starting the survey, pre-tests were done on the survey to check for face validity of the instrument. The survey instrument was first tested and discussed face-to-face with 9 volunteer respondents who fit the respondent profile. Later an online web-survey was tested and refined with the help of 29 volunteers from APICS (The Association for Operations Management) and APS (The American Purchasing Society).

Respondents for the main survey were made available from the Small Business Administration, an independent agency of the federal government to aid, counsel, assist and protect the interests of small business concerns. Local entities of large companies too, were among the target respondents: for example: The Ritz-Carlton hotel company, United Parcel Service (Ohio), Sun Microsystems, Adobe systems. The survey was conducted online, where the URL containing the survey was sent to respondents via email along with the introductory letter. The respondents, with designation such as purchase and chief operating manager, were typically involved in making decisions or were aware of decisions regarding policies with respect to the suppliers. They were asked to select one of their important suppliers, referred to as "Supplier S", in answering all questions. After checking for outliers and missing values and data cleaning, a total of 167 good responses out of were identified.

Although the response rate was calculated as 3.7% (167/4500), we estimate the true response rate to be upwards of 9% due to the following reasons: 1) e-mail systems of many respondents (503) treated it as spam and returned the email with messages against anti spamming and a request to unsubscribe 2) 1084 "Out of office" replies were received from respondents who may or may not have made it during the required survey period 3) the presence of automatic spam-guard and intelligent agent embedded in computers may have put the survey mail into either bulk or spam 4) Some respondents may have left the company and 5) Confidentiality and Internet security is a concern with many respondents who may decide to refrain from participating.

Response bias was tested by comparing item responses of late and early respondents. T-tests for comparing responses from 52 early and 115 late respondents were conducted for 3 randomly selected items: trust1, sat1, and rs8, and the results showed no significant difference. Comparing years of experience data between early and late groups also yielded no significant difference.

Sample Characteristics are provided in Table 1. Of the 167 respondents, the median age was between 50 and 59. The median number of years worked in the organization was 10, indicating that respondents have considerable seniority and are familiar with the firm's SC operation. More than half of the respondents were from manufacturing, retail or wholesale. This is similar to the sample used in other similar studies (e.g., Klein et al. 2007; Straub et al., 2004). Most respondents (73%) are from smaller firms with less than 1000 employees, as expected from this sample made available from the Small Business Administration. However, 10% are from large firms with over 30,000 employees. A majority (78%) of respondents reported a supplier share up to 50%.

5. Data analysis

PLS, an SEM (Structural Equation Modeling) technique was used to simultaneously do factor analysis with hypotheses testing. While there are cases where PLS has been considered a good technique for small sample size, others suggest practicing caution with small sample size and have suggested a ratio of 15 respondents to one parameter to minimize problems with deviations from normality (Marcoulides & Saunders, 2006). The sample of 167 cases in this study is significantly more than the required: $7 \times 15 = 105$ responses to satisfy the above criteria.

To decide on the relationship between measurement items and constructs, we adhere to specific guidelines in IS research by Petter, Straub, and Rai (2007) and separate the constructs into reflective or formative constructs as the tests conducted on formative constructs are different. While Trust and Performance were treated as reflective latent constructs, we make the following arguments in the treatment of IT integration, TC and RG. As is evident from the questions for IT integration, the context here was to find breadth of IT usage across partners in various areas of the partnership. Thus, we treat IT integration as a formative construct, in line with works by Rai et al. (2006). TC consists of monitoring the performance of Supplier S (3 items), addressing problems (4 items), and likelihood of Supplier S taking advantage (3 items). RG consists of flexibility (3 items), information exchange (4 items), shared problem solving (4 items) and restraint in the use of power (3 items). The items loaded heavily on their own sub-constructs and not on the other sub-constructs of the same second order construct. Their loadings on their higher-order construct were low. Therefore, both the TC and

Table 1
Characteristics of respondents.

No. of employees	%	Supplier share	%
1–499	63%	Up to 20%	48%
500–999	10%	21%–50%	30%
1000–4999	8%	51%–80%	17%
5000–9999	1%	81% and above	4%
10,000–19,999	5%	**Primary Business**	**%**
20,000–29,999	2%	Consultant/Professional	3%
30,000 and up	10%	Educational	1%
Age	**%**	Financial	1%
Less than 20	1%	Hospitality	1%
20 to 29	4%	Information Technology	2%
30 to 39	12%	Legal	0%
40 to 49	32%	Manufacturing	49%
50 to 59	38%	Media/Marketing/Advertisement	4%
60 and above	13%	Medical	3%
Years worked	**%**	Retail/Wholesale	10%
1 to 4	25%	Service Provider	8%
5 to 10	22%	Telecommunications	2%
11 to 15	19%	Transportation	2%
16 to 25	25%	Utility	1%
More than 25	10%	Others	13%

RG constructs were treated as second order formative constructs made up of reflective first order constructs.

5.1. Analysis methods

To analyze the study results, we use two statistical techniques: the individual pair-wise correlations as well as the path coefficients from the PLS modeling. With the conventional correlation coefficients, we may gauge the strength of the relationships between two variables as hypothesized, but without other variables entering the picture. With PLS, the strength of individual paths will then be examined further in the context of other variables making up the overall model. The differences of results from PLS in comparison to pair-wise correlations are due to the presence of other variables, and we will interpret the results accordingly to gain further insight.

To prevent common method bias, both preventive and post-hoc testing approaches were used. In the preventive approach, we maintained and assured anonymity. To reduce the effect of anxiety, social desirability and acquiescence, some questions were reverse scored, and item complexity and ambiguity were also reduced (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). In the post-hoc testing we used the Harman one factor test on the six constructs where exploratory factor analysis was conducted on all multiple-item measures. Most covariance explained by a factor was 29.86% and the remaining factors explained less than 10%, indicating that common method bias was minimal. The results of PLS approach suggested by Podsakoff et al. (2003), also confirmed the unlikely chance of common method bias.

5.2. Measurement model

Before testing the hypotheses, we will first asses the measurement model using two types of validities: convergent validity and discriminant validity (Chin, 1998).

Convergent validity. We used two methods to test for convergent validity. In the first method, we used PLS bootstrapping procedure and generated loadings, composite reliabilities, average variance extracted (AVE) for each measurement item in relation to its theorized construct. Composite Reliability (CR) and Average Variance Extracted (AVE) for all reflective constructs are summarized in Table 2. The Composite Reliability and AVE are not relevant for formative constructs (Chin, 1998). All reflective constructs showed a CR of 0.80 or more. In the second method, we looked at the item loadings where the factor loadings of indicators with their respective constructs are provided. We dropped one item (tm4) from the TC construct due to low loading of −0.2718 on the first order construct. Here too, since internal consistency or reliability is unimportant for formative constructs, such constructs are not

included. Factors loadings showed loadings of more than 0.67. While a loading threshold of at least 0.70 is recommended, in case of early stages of the research reliability coefficients between 0.5 and 0.6 are deemed adequate (Nunnally, 1967).

Discriminant validity. Two procedures are used to assess discriminant validity (Chin, 1998). First, we looked at AVE values as seen in Table 2. For discriminant validities, the construct's AVE should not be below 0.50 or the square root of the AVE should not be less than the correlation of the construct with other constructs. Discriminant validity is established since AVE for each construct is more than 0.50 and also the square root of the AVE is significantly larger than any correlations involving the construct, indicating that all constructs share greater variance with their own measures than with other constructs. Second, we examine the item to construct loadings and cross loadings. The results indicate that all the measurement items load highly on their own latent construct than on other constructs.

Multicollinearity. Unlike reflective indicators, where multi-collinearity between construct items is desirable, excessive multi-collinearity in formative constructs can destabilize the model (Petter et al., 2007). In testing for multicollinearity, the items of the IT integration construct did not pose a problem as we found that the average of variance inflation factors is 2.27 with the maximum of 3.38, much below the cut-off of 10 (Diamantopoulos & Winklhofer, 2001). Fig. 2 depicts the measurement properties of second order formative constructs: Transaction Costs and Relational Governance.

5.3. Hypothesis testing

With an adequate measurement model and an acceptable level of multicollinearity, the proposed hypotheses were tested. Table 3 displays all pair-wise correlations. Fig. 3 presents PLS results with all path coefficients. Pair-wise correlation coefficients are also included in parentheses.

As can be seen in Table 3, all the correlations are highly significant ($p < 0.01$) and in the theorized direction, providing strong support to all hypothesis. For example, IT is found to be significantly and negatively correlated to TC (−0.23), PE (0.42) and RG (0.30), consistent with the theoretical arguments leading to Hypotheses H1, H2 and H3. Trust is positively correlated with RG (0.63), PE (0.64), and negatively correlated with TC (−0.55), strongly supporting hypotheses H4, H5 and H6. Finally, as hypothesized in H7 and H8, RG is significantly related to TC (−0.35) and PE (0.58).

Fig. 3 depicts the path coefficients, pair-wise correlations along with the R-square of each endogenous variable. Most of the PLS path coefficients are consistent with correlations. It should be noted that, while correlations consider just 2 variables, the path

Table 2
Correlations, CR and AVE Values of reflective first order constructs (N = 167).

Construct	CR	AVE	1	2	3	4	5	6	7	8	9
Trust (1)	0.98	0.87	0.93								
Flexibility (2)	0.86	0.66	0.38	0.81							
Inform. (3)	0.86	0.62	0.54	0.47	0.78						
Shared (4)	0.90	0.69	0.54	0.45	0.55	0.83					
Restraint (5)	0.85	0.65	0.47	0.38	0.38	0.54	0.81				
Monitoring (6)	0.94	0.84	−0.38	−0.11	−0.27	−0.17	−0.10	0.92			
Address (7)	0.82	0.53	−0.45	−0.29	−0.17	−0.14	−0.18	0.53	0.73		
Likelihood (8)	0.90	0.75	−0.49	−0.30	−0.33	−0.26	−0.25	0.57	0.54	0.87	
Performance (9)	0.89	0.58	0.65	0.34	0.46	0.51	0.48	−0.24	−0.22	−0.26	0.76

Note: Boldface numbers on the diagonal are the square roots of the AVE values. Higher order construct: RG involves (1) flexibility: rf1,rf2,rf3 (2) voluntary information exchange: ri4, ri5, ri6,ri7 (3) shared problem solving: rs8, rs9,rs10,rs11, (4) restraint in the use of power: rr12,rr13, rr14; Higher order construct: TC involves (1) Monitoring the performance of Supplier S: tm2, tm3, tm4, (2) Addressing problems that might arise in the relationship: ta5, ta6,ta7,ta8 (3) likelihood of Supplier S taking advantage of its relationship: tl9, tl10, tl11.
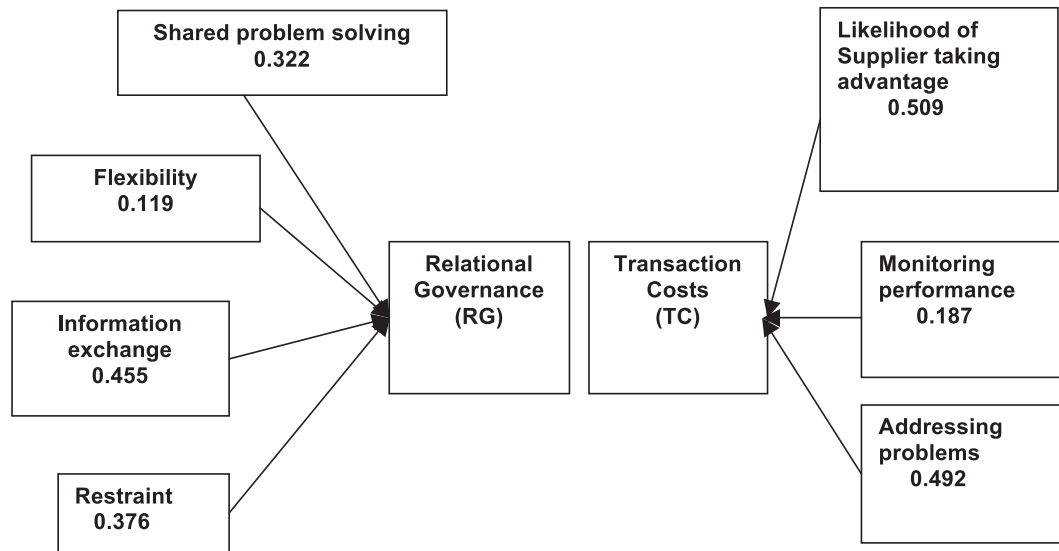
Fig. 2. Measurement properties of second order formative constructs.

coefficients represent the strength of the links in the context of all variables and links for the overall model.

As shown in Fig. 3, of the eight hypothesized paths, two hypotheses (H1, H7) did not show any significance, H3 showed significance at 0.1 level and the remaining five hypothesis (H2, H4, H5, H6, and H8) showed significance at the 0.01 level. In H1, although the pair-wise correlation between IT and TC shows a significant negative correlation, the relationship between IT and TC in the contextual presence of trust and relational governance shows no significance. In H2, IT integration was found to be significantly associated with PE. This result further reinforces the validity of earlier research findings regarding the beneficial effects of IT use in SCs (Da Silveira & Cagliano, 2006; Dehning et al., 2007). However, the path coefficient (0.27) is much lower than the correlation (0.42), indicating that this association is partially mediated by RG, as the effect of IT on RG (0.14) and RG on PE (0.23) are both significant. In testing H3, IT integration was found to be associated with RG (b = 0.14, p < 0.1). However, this is much less than the pair-wise correlation (0.3, p < 0.01). Again, one can see that this association is substantially reduced due to the strong presence of trust (H5). For H4, trust was found to be highly negatively related to TC (b = −0.53), strongly supporting the contention that trust can mitigate TC. As the magnitude of the path coefficient is close to the pair-wise correlation (0.55), the result attests to the central role of trust even within the presence of IT and RG in the model. The relationship between Trust and RG in H5 was found to be strong (0.6) and highly significant (p < 0.01), which indicates that more trust among partners leads to a better and smoother relationships between the participants of an SC dyad. The relationship between Trust and Performance in H6, was also found to be substantial (0.58) and highly significant (p < 0.01). The magnitude of the path,

being one of the highest among all eight path coefficients, is a bit lower than the pair-wise correlation (0.64), and this suggests that the association is slightly mediated by RG, as there is a strong link from Trust to RG (b = 0.6), which, in turn, has a strong link to Performance (b = 0.23). In Hypothesis 7, RG failed to show a negative influence on TC in the contextual presence of other factors, although the negative pair-wise correlation between RG and TC (−0.35) provides fresh new evidence to corroborate with previous studies (Grover et al., 2002). This occurs since the model includes Trust, which has strong influence on RG (b = 0.60), has already taken up the burden of absorbing TC. Hypothesis 8, which relates RG to Performance, was found to be significantly positive. This finding strengthens past study results linking buyer-supplier relationship to performance (Maloni & Benton, 2000). Again, due to the dominating influence of Trust on Performance (0.58), the path from RG to Performance (0.23) is much lower than the pair-wise correlation (0.58).

6. Discussion

We examine and validate the intricate web of relationships through which IT integration and trust exert their influence on SC relationship governance structures and outcome measures.

### 6.1. Information Technology Integration

While all pair-wise correlations of IT with other constructs are significant, its influence on them in the context of other factors included in the model is mixed. For instance, IT integration, does enhance performance over and above the presence of Trust and RG. In addition, IT also directly enhances RG, over and above the strong presence of Trust. These findings attest to the idea that IT is not inert, and plays an active role in enhancing SC performance with a host of related factors.

With increase in coordination capabilities over the years, the role of IT too has shifted. It began with basic reduction of coordination costs, moved to improvement in performance and finally now has the capability of influencing structures. This paper finds evidence of these effects: IT to reduction in TC, Performance and RG, thereby revealing the growing influence of IT in the partnership governance structures.

Table 3
Correlations between principal constructs.

Construct	1	2	3	4	5
IT (1)	1.00				
Performance (2)	0.42[***]	1.00			
Relational Governance (3)	0.30[***]	0.58[***]	1.00		
TC(4)	−0.23[***]	−0.27[***]	−0.35[***]	1.00	
TR(5)	0.24[***]	0.64[***]	0.63[***]	−0.55[***]	1.00

[*] Significant at 0.1 level, [**]Significant at 0.05 level, [***]significant at 0.01.
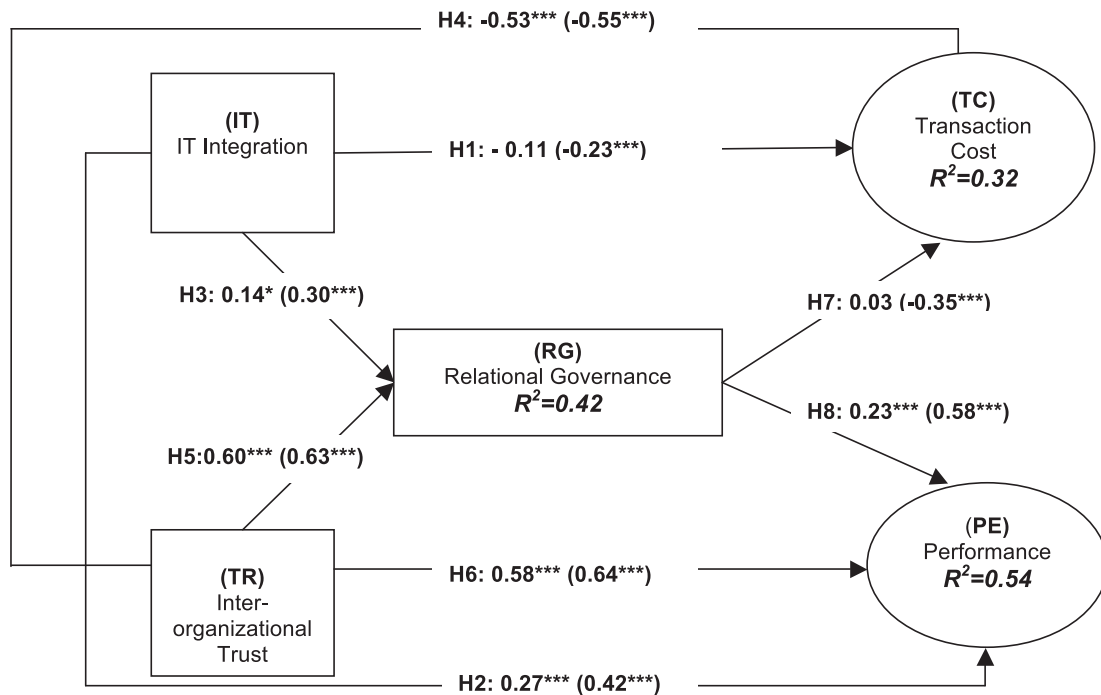
*** path coefficients and pair-wise correlations (in parenthesis): significant at 0.01 level
** path coefficients and pair-wise correlations (in parenthesis): significant at 0.05 level
* path coefficients and pair-wise correlations (in parenthesis): significant at 0.1 level

Fig. 3. PLS analysis results.

6.2. Inter-organizational trust

Our strongest and the most striking result centers on trust. In addition to its positive effect on performance, its power to reduce TC and foster RG is also demonstrated. Trust contributes to performance directly, but it also does this indirectly by enhancing RG (a positive factor). The pivotal and powerful role of trust in holding together and pushing forward an SC dyad relationship is now made crystal clear: it is a major source of social capital that adds value and reduces cost at the same time. We find evidence supporting the arguments put forward by Transaction Cost Economics. It shows the role of trust and IT as unique resources capable of competitive advantage and also finds evidence that organizations form partnerships to reduce TC.

6.3. Relational governance

The RG structure entails many friendly and flexible ways to do business in a dyad. Our model clearly demonstrated that RG is shaped by Trust and IT Integration to a great extent ($R^2 = 0.42$), and the influence from Trust (b = 0.60) appeared to be dominant. In addition, despite its strong pair-wise negative influence on TC, the path within the model becomes insignificant in the presence of Trust. Thus, our results have clearly demonstrated not only the direct contribution of RG, but also how it transmits the influence of Trust and IT Integration on Performance. We find evidence that IT and trust affect the underlying relational structure of the partnership.

6.4. Implications for practice

Findings from this paper reveal that IT artifacts in the form of electronic connections linking supply chain partners are capable of

positively influencing relationship structure. Information technology, manifest in tools such as ERP, Groupware and Inter-Organizational Information Systems (IOIS), bring supply chain partners closer despite disparate time zones and physical distance from each other. Practitioners should view IT not only as a tool to improve performance but also as an enabler of relationships beyond the formal structures drawn out by the parties. This in turn eventually translates into better outcome measures.

The overall pattern of results provide these strategic guidelines to SC managers: 1) proactively and earnestly foster and build trust with suppliers, 2) evolve good practices in the area of RG which is intimately related to trust, and 3) enhance IT integration which has a significant influence on performance.

6.5. Limitations and future studies

With data collected at one point in time, it becomes a challenge to infer causality and therefore we suggest caution when interpreting the results. While we consider this a necessary but acceptable risk to infer associations between the various constructs, in order to bring out the longitudinal aspect, we inculcated aspects of past and present context by wording our questions to imply on-going past relationships. For example, "my firm has been allowing Supplier S to participate in strategic decisions" and "Supply operations for Component C, has improved due to our relationship with Supplier S". Another limitation: low response rate, may not be a serious problem, as the relevant tests did not show response rate bias. Additionally, we compared the demographics of our respondents with those from other studies with similar target respondents (Klein et al., 2007; Straub et al., 2004) and found no significant difference. A complementary study treating respondents as sellers and asking questions with respect to buyers can be conducted. This study focused on dyadic

relationships. We believe this approach has brought out a much more granular level of analysis and helps us analyze the factors in isolation. Future research, however, can extend this study to include multiple partners in the SC.

Appendix A. Research scales and items

Trust (1 = strongly disagree; 7 = strongly agree).
Please select one of your important suppliers, referred to as "Supplier S", in answering all questions.

(trust1) We think that Supplier S is dependable
(trust2) We think that Supplier S meets its negotiated obligations to us
(trust3) In our opinion Supplier S is reliable
(trust4) We think that the people in Supplier S keep their promises
(trust5) We think Supplier S keeps the spirit of an agreement.
(trust6) We think that people in Supplier S will honor the commitments made in our dealings

IT integration (1 = strongly disagree; 7 = strongly agree).
Please indicate the extent of use of Information Technology (IT) for each of the following activities with respect to your Supplier S.

(it1) Shipping, receiving and ordering raw materials or components
(it2) Inventory control for raw material or components
(it3) Exchanging information on finished goods inventory
(it4) Exchanging information on production schedules
(it5) Exchanging information on anticipated demand
(it6) Monitoring and coordinating performance and activities
(it7) Sharing databases, applications and files

Relational governance (1 = strongly disagree; 7 = strongly agree).
The following statements pertain to the relationship between your firm and supplier S.
Flexibility.

(rf1) Our relationship with supplier S permits flexibility in response to requests for changes
(rf2) The parties will be open to modifying their agreements if unexpected events occur
(rf3) If considered necessary, we may change previously agreed prices.

Information sharing.

(ri4) In our relationship with supplier S, it is expected that any information that might help the other party will be provided to them
(ri5) Exchange of information in our relationship with supplier S takes place frequently and informally and not only according to the pre-specified agreements
(ri6) It is expected that the parties will provide proprietary information if it can help the other party
(ri7) It is expected that parties keep each other informed about events or changes that may affect the other party

Shared problem solving.

(rs8) In general, we and supplier S are jointly responsible for getting things done

(rs9) Problems that arise are treated by both parties as joint rather than individual responsibilities
(rs10) In our relationship with Supplier S, we do not mind owing each other favors
(rs11) The responsibility for making sure that the relationship works for both parties is shared jointly

Restraint in the use of power.

(rr12) The parties feel it is important not to use any proprietary information to the other party's disadvantage
(rr13) In our relationship with supplier S, neither party is expected to make demands that may be damaging to the other
(rr14) Between us a supplier S, whoever has more power is expected to refrain from using this power in attempting to get its way

Transaction costs (1 = strongly disagree; 7 = strongly agree).
Developing an association with Supplier S.

(td1) Significant effort was required to gather the information necessary to outline the working relationship with Supplier S
(td2) There were many unspecified terms which had to be worked out as the relationship with supplier S developed
(td3) It required significant effort to determine individual roles to be performed by our firm and Supplier

Monitoring the performance of Supplier S.

(tm4) It was easy to tell if we were receiving fair treatment from Supplier S (Negatively worded) (dropped)
(tm5) It takes significant effort to determine whether or not Supplier S confirms to specifications and quality standards
(tm6) Accurately evaluating Supplier S requires a lot of effort
(tm7) It is costly in time and effort to clearly monitor the performance of Supplier S

Addressing problems that might arise in the relationship with Supplier S.

(ta8) The approach to solving problems in our relationship with Supplier S is clear-cut (negatively worded)
(ta9) There are standard solutions or approached to problems that might occur with supplier S (Negatively worded)
(ta10) Problem solving is often challenging due to the nature of components handled by supplier S
(ta11) Although solutions to problems with Supplier S can be achieved they often need to be highly customizable

Concerning the likelihood of Supplier S taking advantage of its relationship with our firm.

(tl12) It is easy for supplier S to alter the facts in order to get what they wanted
(tl13) There is strong temptation for Supplier S to withhold or distort information for their benefit
(tl14) Supplier S has the opportunity to take advantage of unspecified or unenforceable contract terms

Performance (1 = strongly disagree; 7 = strongly agree).
Component C refers to the collection of material supplied by suppliers S.

(per1) Supply operations for component C has improved due to our relationship with supplier S

(per2) Without Supplier S the supply operation for Component C would not perform as well

(per3) Inventory turnover of Component C has improved due to our relationship with Supplier S

(per4) Our relationship with Supplier S has improved the co-ordination activities related to Components C

(per5) Our relationship with Supplier S helped us get better prices on Component C.

(per6) Dealing with Supplier S benefits our company.

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