

## IMPACTS OF IT CAPABILITY AND TRUST ON SUPPLY CHAIN COLLABORATION

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### ABSTRACT

To deal with the turbulent environments, firms have endeavored to achieve greater supply chain collaboration. To collaborate well with their supply chain partners, firms have invested in IT capabilities including IT expertise and IT infrastructure flexibility. The objective of the study is to explore the impact of IT capabilities and trust on supply chain collaboration. Data was collected through a Web survey of U.S. manufacturing firms. Structural equation modeling (LISREL) was used to analyze the data. The results indicate that IT capability and trust enhance supply chain collaboration directly and additively. The moderation effect of trust on the relationship between IT capability and supply chain collaboration is not supported.

**Keywords:** IT Capability, Trust, Supply Chain Collaboration, Structural Equation Modeling, Survey Research.

### INTRODUCTION

Customers have become increasingly demanding. As the environment becomes ever more dynamic, firms have endeavored to attain greater supply chain collaboration (Nyaga et al., 2010; Verdecho et al., 2012). Supply chain collaboration denotes two or more independent firms working together to design and arrange supply chain operations (Simatupang and Sridharan, 2005; Cao and Zhang, 2011). It can produce significant benefits to its partners, e.g., reducing risks, accessing complementary resources, and decreasing transaction costs (Verdecho et al., 2012).

Information technologies further extend firms' opportunities to strengthen their supply chain partnerships (Teo et al., 2011; Rai et al., 2012). Using IT, supply chain partners develop close relationships in a chain structure, which enables them to access each other's data and information (Rai et al., 2012). Such electronic hierarchies allow firms to achieve the effect of vertical integration without ownership through the use of IT to tie-in partners and lock out competitors, and thus achieve sustainable competitive advantage.

In spite of the wide recognition and advantages of supply chain collaboration, not many firms have indeed capitalized on its potential (Min et al., 2005). In addition, many existing researches have focused entirely on studying the performance implications of supply chain collaborations (Allred et al., 2011; Cao and Zhang, 2011). Thus, further research is needed to study what factors

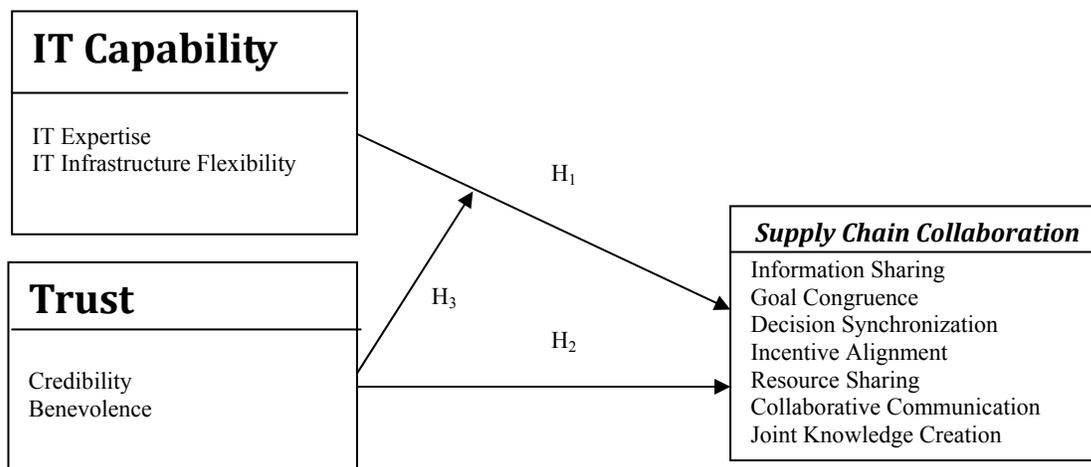
or antecedents help attain the value of the collaboration.

First, in investigating IT to facilitate supply chain collaboration, prior studies have no unified conceptualization of IT capability. Second, in researching the antecedents or the conditions that affect supply chain collaboration, prior studies focus more on IT capability and less on its contextual variable, e.g., trust (Rai et al., 2012).

The objective of the study is to explore the impact of IT capability and trust on supply chain collaboration. By pooling a set of factors, the research extends our understanding of the attributes of IT capability, trust, and supply chain collaboration. Through a large-scale Web survey with manufacturers across the US, the research also intends to develop reliable and valid instruments and to empirically test the relationships among IT capability, trust and supply chain collaboration using structural equation modeling.

## CONCEPTUAL DEVELOPMENT

By working together, supply chain partners can get into and assimilate each other's resources and benefit from their associated benefits. Such collaboration is enhanced by IT capability and trust. The degree of trust (i.e., high vs. low) might also moderates the relationship between IT capability and supply chain collaboration. These relationships are depicted in a framework shown in Figure 1.



**Figure 1: Impact of Collaborative Culture on IOS Appropriation and Supply Chain Collaboration**

## Hypotheses Development

*Hypothesis 1: IT capability has a significant positive effect on supply chain collaboration.*

*Hypothesis 2: Trust has a significant positive effect on supply chain collaboration.*

*Hypothesis 3: Trust moderates the relationship between IT capability and supply chain collaboration.*

## **INSTRUMENT DEVELOPMENT**

The three steps were carried out in developing instruments for IT capability, trust, and supply chain collaboration: (1) item generation, (2) structured interview and Q-sort, and (3) large-scale analysis. First, to ensure the content validity of the constructs, a literature review was conducted to define each construct and generate the initial items for measuring the constructs. Then, a structured interview and Q-sort were conducted to provide a preliminary assessment of the reliability and validity of the scales. The third step was a large-scale survey to validate the instruments.

### **Item Generation**

The goal of item generation is to achieve the content validity of constructs by reviewing literature and consulting with academic and industrial experts. The measurement items for a scale should cover the content domain of a construct (Churchill, 1979). To generate measurement items for each construct, prior research was extensively reviewed and an initial list of potential items was compiled. A five-point Likert scale was used to indicate the extent to which managers agree or disagree with each statement where 1=strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

### **Structured Interview and Q-Sort**

After the measurement items were created, the pool of items were reviewed and evaluated by practitioners from four different manufacturing firms to pre-assess the reliability and validity of the scales. First, structured interviews were conducted to check the relevance and clarity of each sub-construct's definition and the wording of question items. Then, interviewees were asked to sort out the questionnaire items into corresponding sub-constructs. Based on the feedback from the experts, redundant and ambiguous items were eliminated or modified. New items were added when necessary. After two rounds of Q-sort, items were distributed to six academicians who reviewed each item and indicated to keep, drop, modify, or add items to the constructs. Based on the feedback from the reviewers, items were further modified. Then the questionnaire items were sent out for a large-scale survey.

### **Sampling Design and Large-Scale Data Collection**

The sample respondents were expected to have knowledge or experience in supply chain management. The target respondents were CEOs, presidents, vice presidents, directors, or managers in the manufacturing firms across the U.S. The respondents were expected to cover the following seven SIC codes: Furniture and Fixtures (SIC 25), Rubber and Plastic Products (SIC

30), Fabricated Metal Products (SIC 34), Industrial Machinery and Equipment (SIC 35), Electric and Electronic Equipment (SIC 36), Transportation Equipment (SIC 37), and Instruments and Related Products (SIC 38).

An email list of 5,000 target respondents was purchased from the Council of Supply Chain Management Professionals (CSCMP), a prominent association of professionals in the area of supply chain management, and lead411.com, a professional list company which is specialized at providing executive level email lists. A Web survey was conducted. Excluding multiple names from the same organization, undelivered emails, and returned emails stating that target respondents were no longer with the company, the actual mailing list contained 3,538 names.

To enhance the response rate, three waves of emails were sent once a week. Out of the 227 responses received, 211 are usable resulting in a response rate of 6.0%. A chi-square test is conducted to check non-response bias. The results show that there is no significant difference between the first-wave and second/third-wave respondents by all three categories (i.e., SIC code, firm size, and job title) at the level of 0.1. It exhibits that received questionnaires from respondents represent an unbiased sample.

### **Large-Scale Data Analysis Methods**

With confirmatory factor analysis in LISREL, steps were undertaken to check (1) unidimensionality and convergent validity, (2) reliability, (3) discriminant validity, and (4) second-order construct validity. The assessment for each construct was conducted in one all-factor first-order correlated model so related multi-items measures are grouped together. Iterative modifications were undertaken by dropping items with loadings less than 0.7 and items with high correlated errors thus improving the model fit to acceptable levels (Hair et al., 2006). In the cases where refinement was indicated, items were deleted if such action was theoretically sound and the deletions were done one at a time (Hair et al., 2006). Model modifications were continued until all parameter estimates and model fits were satisfactory.

The model fit indices are used to assess unidimensionality and the significance of t-values of each measurement indicator is used to assess convergent validity. The overall model fit indices include comparative fit index (CFI), non-normed fit index (NNFI), root mean square error of approximation (RMSEA), and normed chi-square (i.e.,  $\chi^2$  per degree of freedom). Values of CFI and NNFI between 0.80 and 0.89 show a reasonable fit and scores of 0.90 or higher are evidence of good fit (Joreskog & Sorbom, 1989; Papke-Shields et al., 2002). Values of RMSEA less than 0.10 are acceptable (Hair et al., 2006). The normed chi-square estimates the relative efficiency of competing models where a value less than 5.0 is preferred for this statistic.

The composite reliability ( $\rho_c$ ) and the average variance extracted (AVE) of multiple indicators of a construct can be used to assess reliability of a construct (Hair et al., 2006). When AVE is greater than 50% and  $\rho_c$  is greater than 0.70, it implies that the variance of the trait is more than that of error components (Hair et al., 2006).

To examine the discriminant validity, a pair-wise comparison was performed by comparing a model with correlation constrained to one with an unconstrained model. A difference between the  $\chi^2$  values of the two models that is significant at  $p < 0.05$  level would indicate support for the

discriminant validity criterion (Joreskog & Sorbom, 1989).

To validate the second-order constructs, T coefficient was used. T coefficient is calculated as the ratio of the chi-square of the first-order model to that of the second-order model and a T coefficient of higher than 0.80 indicates the existence of a second-order construct (Doll, Raghunathan, Lim, & Gupta, 1995).

Finally, a LISREL model is run to test the hypotheses developed in the framework. Following the steps and procedures for implementing the latent variable interaction, the proposed model was tested.

## RESULTS

To test the hypotheses proposed in the framework, structural equation modeling (LISREL) is used to assess the model fit with the data. The summed item scores for each dimension are used as indicators to measure each main-effect construct.

To test the moderation effect, the interactive product approach is used. The moderating construct, trust, has two indicators (CR, BN) and the moderated construct, IT capability, has two indicators (IF, IE). There are two ways to generate the product indicators to measure the interaction construct based on the literature. Ping (1995) suggested that the product of the sums of the relevant indicators  $[(CR+BN)*(IF+IE)]$  be used as the sole indicator of the latent interaction construct. Kenny and Judd (1984) suggested all possible cross products of the indicators of the latent variables (IF\*CR, IF\*BN, IE\*CR, IE\*BN) be used as indicators of the latent interaction construct.

The path diagram and the loadings for the LISREL model are shown in Figure 2a. In terms of overall fit, chi-square statistic is 107.74 with  $df = 49$  and the ratio of chi-square to degrees of freedom is 2.20, which indicates a good fit. The model fit indices NNFI = 0.96, CFI = 0.95, and RMSEA=0.076 are very good.  $H_1$  and  $H_2$  are supported but  $H_3$  is disconfirmed.

Shown in Table 8, the data best support Figure 2a of the three models discussed. The results in Figure 2a support Hypothesis 1. The LISREL path coefficient is 0.24 ( $t=2.69$ ), which is statistically significant at the level of 0.01. This supports the claim that IT capability has significant, positive, and direct impact on supply chain collaboration. Hypothesis 2 is also supported with the path coefficient 0.75 ( $t=8.60$ ), which is statistically significant at the level of 0.01. This confirms the claim that trust has significant, positive, and direct impact on supply chain collaboration. Hypothesis 3 is not supported. This means that the relationship between IT capability and supply chain collaboration is not stronger for firms with high trust than those with low trust.

## DISCUSSION AND IMPLICATIONS

The study has developed valid and reliable instruments for IT capability and trust. All the scales

have been examined through rigorous methodologies including Q-sort method, confirmatory factor analysis, reliability, and the validation of second-order construct. All the scales are shown to meet the requirements for reliability and validity and thus can be used to facilitate further empirical research efforts.

This research has linked IT capability, trust, and supply chain collaboration literatures by proposing a model to help understand the phenomenon at the dyadic, supply chain context. It has also examined the alternative models by using different approaches to measure the latent interaction construct. In doing so, we identify and explicate the importance of IT capability and trust as the two key antecedents of supply chain collaboration.

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