The Effect of Information Technology on Arms-Length Buyer-Supplier Relationship

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Abstract

This paper posits that arm's length buyer-supplier relationship as the intermediate type between market exchange relations and strategic partnership might be advisable, and information technology may have a role as a mechanism actualizing the effects of such arm's length relationship by strategic supply-line diversification.

Based on the theoretical analysis on interactive feedback relationships among IT level, buyer-supplier relationships, and supply chain structure, we suggest a set of advisable buyer-supplier relationship type for efficient supply chain management. Also, doing so would be helpful in suggesting a dynamic IT investment and adoption model appropriate for the establishment of productive buyer-supplier relationship, and further in providing theoretical foundations and practical guidelines on the role and function of B-to-B E-commerce for efficient SC integration.

Key Words: IT Investment, Arm's Length Buyer-Supplier Relationship, Supply Chain Structure, Feedback Relationship, System Dynamics

1. Introduction

In response to intense global competition and shrinking product life cycles, organizations have downsized to focus on core competencies and have attempted to achieve a competitive advantage by forming mutually beneficial relationships with suppliers to capitalize on their capabilities and technology. SCM also evolved when firms entered into strategic buyer-supplier alliances, and integrated their distribution and transportation activities in conjunction with logistics providers. In such a perspective, during the last decade, buying companies have increasingly emphasized the importance of strategic cooperation and supply-network construction with suppliers, and systematic supply chain management as a critical success factor for sustainable competitive advantage. In particular, recently, due to the development

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of computer and telecommunication technology, firms have been attempting to improve the efficiency of transaction between buyer and supplier by information sharing and communication through advanced information technology. In the light of such current change and trend, the establishment of strategic cooperation and supply-network construction between buyer and supplier has been highlighted as not only a fresh opportunity to obtain competitive advantage, but also a facing task both buyer and supplier should challenge and overcome together.

However, such establishment of collaborative strategic partnership structure with key suppliers is not an easy work. Also, we cannot guarantee that the establishment of collaborative strategic partnership necessarily leads to performance improvement and competitiveness. The reckless pursuit of strategic alignment or integration without the capability of controlling consistently and monitoring completely entire supply chain has considerably high risks on the loss of bargaining power to SC partners, because captive firms might fully accept even their SC partner's unreasonable demands due to the concern that the investments on site, physical, human specific assets for transaction with specific SC partners become sunk cost, thus probably being dominated by partners. Actually, Bensaou (1999) asserts that strategic partnerships are costly to develop, nurture, and maintain, and also risky, given the specialized investments they require, even though they create new value. As a proof of such assertion, he shows empirically that even Japanese firms emphasizing close relationship like a family between business partners do not manage primarily their partners by collaborative strategic partnerships.

The above argument means that the approach for deriving the benefits of collaborative strategic partnerships from supply chain partners with retaining bargaining power should be considered. As such an approach, we can think strategic supply-line diversification. That is, buying firms, which are dominated by powerful key suppliers, may consider additional potential suppliers except the existing key supplier as new SC partners, or actually transact with them on a few works as an example. From the above supply-line diversification, buying firms can expect two effects. First is to derive more progressive cooperation from key suppliers with high level of strain by showing the possibility that buying firms may change transaction line with them into others. Second, even if strategic partnerships with the key suppliers become aggravated due to supply-line diversification and eventually transaction line with the key supplier is broken, buying firms can reduce damage because they can shift to prepared new supply line even though it is not the best. Actually, Wal-Mart had trouble with the inefficiency in distribution process by bargaining power game with P&G not responding smoothly Wal-Mart's demands. So, in order to resolve such inefficiency, Wal-Mart attempted Mead-Johnson Co. to participate in its VMI (vendor managed inventory) program. As a result, Wal-Mart could strengthen strategic partnership with P&G, and derive more progressive cooperation from them. Conclusively, the above argument suggests that arm's length relationship as the intermediate type between market exchange relations, in which the techni-

cal and economical dependence of both buyer and supplier on each other is relatively low, and strategic partnership, in which buyer-supplier relationship is strongly connected by considerable transaction-specific assets of both buyer and supplier, might be advisable.

However, for buying firms to actualize successfully the effects of such arm's length relationship by strategic supply-line diversification, they should make key suppliers to believe that buying firms have a capability of changing supply-line from key suppliers, and thus to feel a sense of crisis due to such capability. In other words, if key suppliers do not believe the possibility of buying firms' shift to other supply-line because of considerable transaction -specific assets of both buyer and supplier, which are sunk costs that will have little value outside the particular relationship, buying firms cannot effectively take away bargaining power from key suppliers. If so, how can buying firms make key suppliers to feel a sense of crisis due to supply-line diversification? This paper posits that information technology may have a role as a mechanism actualizing the effects of such supply-line diversification. That is, viewed in the perspective of transaction cost theory which will be noted again in literature review part, information technology and inter-organizational information systems can reduce the dependency on physical specific asset for transaction with key suppliers and the cost of achieving information about prices and product characteristics. Such reduction should lead to an increase in the number of potential suppliers considered by buyers because buyers can reduce sunk cost for specific key suppliers and switching cost for changing supply-line, thus consequently connected to the increase of buyer's bargaining power.

This paper investigates the validity of the above proposition through the analysis on interactive feedback relationships among IT level, buyer-supplier relationships, and supply chain structure by *System Dynamics*, one of dynamic simulation tools. Based on the successful accomplishment of this objective, we can suggest a set of advisable buyer-supplier relationship type for efficient supply chain management. Also, doing so would be helpful in suggesting a dynamic IT investment and adoption model appropriate for the establishment of productive buyer-supplier relationship, and further in providing theoretical foundations and practical guidelines on the role and function of B-to-B E-commerce for efficient SC integration.

2. System Dynamics and Causal Loop Diagram

2.1 Conceptual Framework

Viewed in this perspective, strategic alignment among key SCM strategic and structural issues, and advanced IT deployment, should be regarded as the most significant and urgent research theme for the construction of an effective SCM strategy. This study attempts to suggest the shape of such effective SCM strategy through the development and testing of a

framework for investigating the relationships among information technology, product customization level, buyer-supplier relationship, and supply chain structural issues. Figure 1 indicates the conceptual framework based on the selected arguments discussed above.

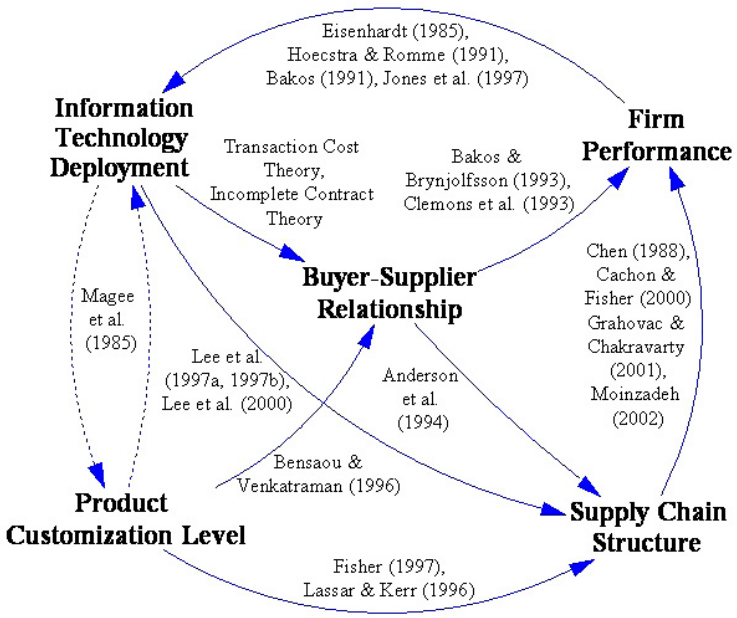

Figure 1. Conceptual Framework

One thing to be noted is that, as can be seen in the above figure, the relationship between information technology deployment and product customization level is indicated not by a solid, but by a dotted line. This is because it was relatively difficult to find related previous research supporting the relationship. However, this relationship also deserves further investigation.

As mentioned previously, previous literature comments that there exists the trade-offs among supply chain structural issues (Magee *et al*., 1985; Pine *et al*., 1993). For example, as mentioned previously, if lead-time is reduced and distribution occasions are frequent, overall inventory level is decreased, while transportation is increased. However, the deployment of advanced information technology may change traditional concept on such trade-off relationships. That is, the deployment of advanced IT may enable buying firms to accept a little longer lead-time relative to the existing lead-time in terms of minimum total cost. Accordingly, if a firm's IT adoption level is relatively high, the firm's effort for reducing the lead time of supply chain may be less required even in customized/differentiation focused product. This suggests the existence probability of the relationship between information technology deployment and product customization level. This research will investigate such probability.

2.2 Causal Loop Diagram

In order to fully address the research questions and objectives above mentioned, more sophisticated models must be constructed and more comprehensive simulations must be carried out. Thus, this paper will develop a dynamic simulation model of advanced IT deployment considering interactive feedback relationships with product customization level, buyer-supplier relationship, and supply chain structure. The simulation modeling process by the *System Dynamics* method can be largely classified into three stages; establishing a causal loop diagram, designing a system dynamics diagram, and formulating an equation.

A causal loop diagram is the map identifying the feedback structure of a system and organizes the cause and effect that may be produced in a system by indicating the feedback structure on a two-dimensional diagram. A causal loop diagram is established by a set of causal propositions or hypotheses on the shape of relationships among selected construct variables. Before introducing the causal loop diagram of this paper, we should note two important assumptions for understanding properly causal loop diagram. First, the +/- notations on the arrows indicated in causal loop diagram mean the direction of the relationship between constructs in the model. Second, ceteris paribus condition is applied. That is, under the assumption that all other variables are constant, we should consider just direct relationship between two constructs.

3. IT Effect on Buyer-Supplier Relationship

The explanation on the causal loop diagram in this paper starts from the introduction of the following two contradictory theories on the impact of IT on buyer-supplier relationships.

In the perspective of transaction cost theory, Malone *et al*. (1987) and Bakos (1987) insist that IT will facilitate a move from single-supplier arrangements within the firm (“hierarchies”) to multiple supplier arrangements (“markets”) because it reduces transaction costs with suppliers. According to this logic, technological developments lowering the cost of acquiring information about prices and product characteristics in a given market may reduce the excessive dependence on few key suppliers by reducing physical assets specified to transaction with key supplier and subsequently entire transaction costs, and this should lead to an increase in the number of potential suppliers selected by buyer.

Such a shift to multiple supplier arrangements can provide greater *ex post* bargaining power to a buyer, because a buyer can have many alternative suppliers. Also, such a buyer’s increasing bargaining power can deduce the decrease of material price, thus leading to the increase of a buyer’s profit. If a buyer’s profit is increased, the buyer can increase investment capability for advanced IT deployment, thus making a connection to the increase of IT level.

Figure 2 indicates a feedback loop reflecting the above argument. The feedback loop in Figure 2 shows that there is a mutual positive feedback relationship among IT level, the number of suppliers and buyer's bargaining power in the perspective of transaction cost theory. In other words, continuous advanced IT deployment ultimately can derive complete competition in the electronic market among numerous suppliers, and such an electronic market structure can provide the capability enabling pursuit of the deployment of more advanced IT to the buyer.

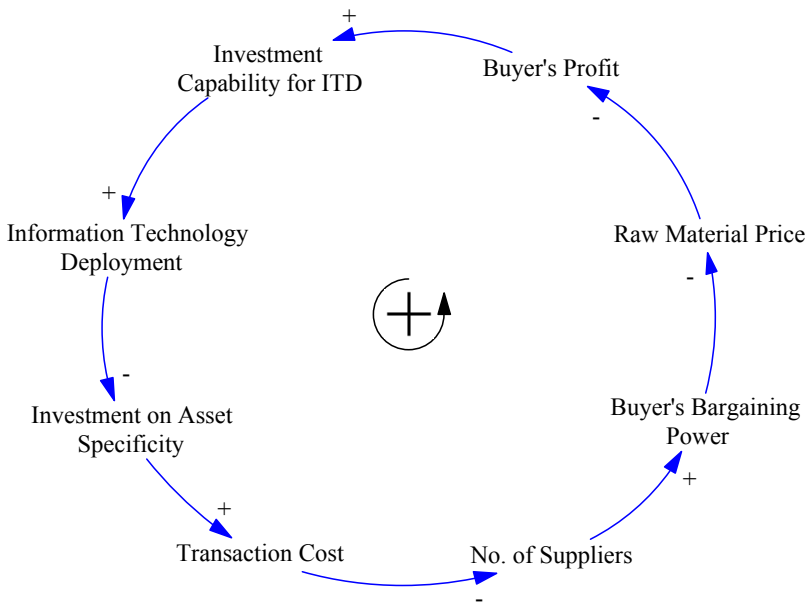

Figure 2. Causal Loop Diagram for IT effect on Buyer-Supplier Relationship in the perspective of Transaction Cost Theory

However, the perspective of incomplete contract theory suggests a paradox of such positive feedback relationship among IT level, the number of suppliers, and buyer's bargaining power under the viewpoint of transaction cost theory. That is, the decrease of material price induced by the increase of buyer's bargaining power obviously leads to the increase in buyer's profit, but simultaneously drives a decrease in supplier's profit. If a supplier's profit is decreased continuously, supplier may pursue the reduction of making non-contractible investments in areas such as quality, innovation, speed, responsiveness, and flexibility in order to make up such profit decrease. Such reduction of supplier's non-contractible investments increases the burden of buyer to make non-contractible investments. As a result, transaction costs may actually increase in spite of the decline of investment on transaction-specific assets due to IT development. Accordingly, buyers must depend on close relationships with

suppliers to reduce the burden of transaction cost increase, and this should lead to a decrease in the number of suppliers considered. Also, such shift to fewer key supplier arrangements provides great bargaining power to suppliers, and this increase can induce an increase in material price, subsequently followed by a decrease in buyer's profit, the decrease of investment capability for IT deployment, and ultimately the reduction of desired IT level. Conclusively, the above argument means that there is a negative feedback relationship among IT level, the number of suppliers, and buyer's bargaining power in the perspective of incomplete contract theory unlike in the perspective of transaction cost theory. In other words, continuous IT deployment cannot lead to a persistent increase in the number of suppliers, and inversely, such stagnation in the number of suppliers prevents the continuous improvement of IT level, and thus each factor consisting of feedback loop is self-regulated and stabilized. Actually, Bakos and Brynjolfsson (1993) assert that IT is likely to increase the importance of non-contractible factors, and Clemons *et al.* (1993) note that the relationship between IT level and non-contractible investment shifts the structure of buyer-supplier relationship to the middle ground between market and hierarchical structures, thus supporting the above argument (See Figure 3).

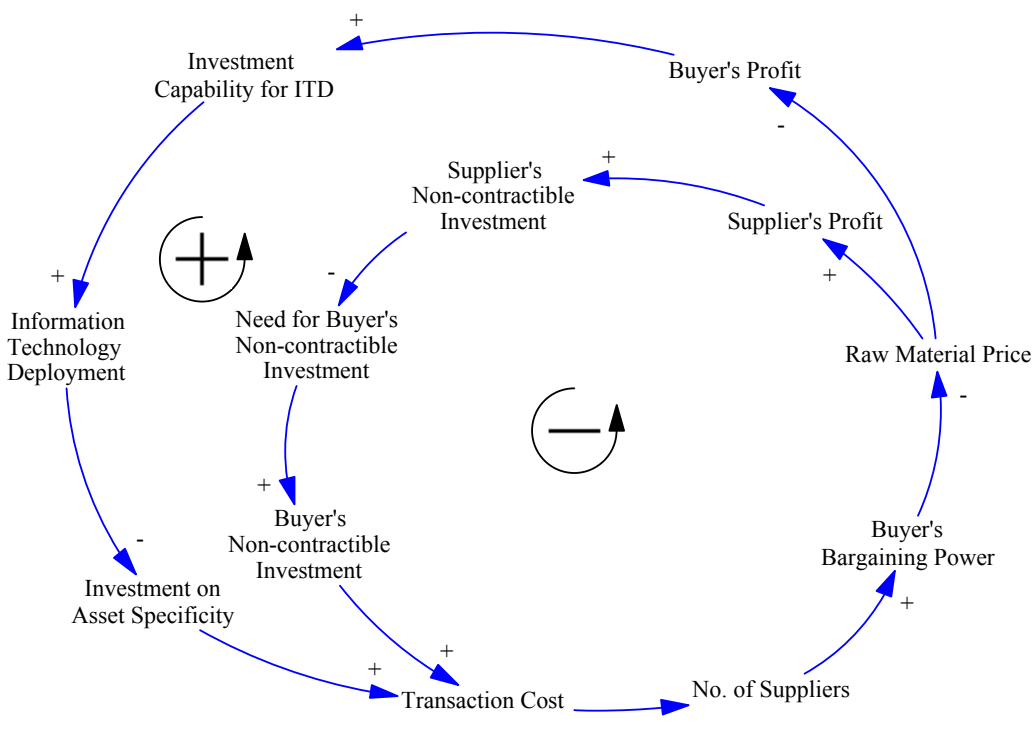

Figure 3. Causal Loop Diagram with IT effect on Buyer-Supplier Relationship in the perspective of Incomplete Contract Theory

4. IT Effect on Supply Chain Dynamics

In order to analyze more realistically the effect of IT on buyer-supplier relationship, we should consider the existence possibility of other factors which influence on buyer-supplier relationship except IT. First, we can think about demand-supply balance. If buyer has raw material inventories sufficient for making finished goods which can cover customer demands, buyer can have a certain level of slack in bargaining with suppliers. Otherwise, there is a high possibility that buyers might be dominated by powerful suppliers. This means that demand-supply balance may influence on buyer-supplier relationship.

Of course, such effect of demand-supply balance can be different depending on the characteristics of traded products. That is, in case of standardized/cost leader focused product, the level of product variety is not high (Hambrick, 1983), demand is stable (Miller, 1988), and demand area is generally wide (Porter, 1980; Miller, 1987). So, manufacturer can control demands with finished products already made. Also, the strength of buyer-supplier relationship may be relatively weak because market governance structure is expected to appear dominantly. But, in case of customized/ differentiation focused product, the level of product variety is high (Porter, 1980; Miller, 1987), and demand is unstable (Miller, 1988). So, manufacturer may hold inventory with the form of raw material and start making product at the time of receiving orders. Also, the level of support and cooperation among supply chain members for dealing with effectively demand uncertainty is relatively high (Anderson and Gatignon, 1986; Miller and Friesen, 1986; Ward *et al*., 1996; Lassar and Kerr, 1996), and thus it is expected that hierarchical governance structure by strategic partnership between buyer and supplier is more strongly shaped (Eisenhardt, 1989; Lassar and Kerr, 1996). Therefore, it may be difficult for buyers to expect the benefit from demand-supply balance. Both demand-supply balance and the characteristics of traded product above mentioned are the key issues for designing supply chain structure. This implies that buyer-supplier relationship might be significantly influenced by supply chain structure and supply chain dynamics. In such a perspective, it is necessary to analyze the effect of IT on supply chain dynamics, and also to investigate how such effect of IT on supply chain dynamics affects the relationship between IT level and buyer-supplier relationship.

Negative feedback loop discussed in IT effect on buyer-supplier relationship is also found in the effect of IT on supply chain dynamics. Information sharing by the utilization of advanced IT can reduce distortion in demand information between buyer and supplier, which is referred to as the “bullwhip effect” (Lee *et al*., 1997; Christopher, 1994). Such decrease of demand variability enables accurate forecasting, and this can lead to the decrease of target raw material (RM) level. This lowering of target RM level can deduce the reduction of RM inventory level, subsequently followed by the decline of entire supply chain inventory level. This logic is consistent with the argument of previous researches (Lee *et al*., 1997a; Lee *et*

al., 1997b; Lee *et al*., 2000) asserting that information sharing can significantly minimize the problem of excessive inventory. However, as Grahovac and Chakravarty (2001) mentioned, decreasing overall inventory levels in the supply chain may not always be beneficial. In other words, in order to reduce overall costs and maximize profit, increasing inventory levels may be necessary. This is due to the fact that there is a probability that too low a level of inventory results in under-stocks of inventory in times of peak demand. Such probability increases the need for safety stock. Particularly, in the case of customized/differentiation focused product in which the level of product customization and variety is high (Porter, 1980; Miller, 1987), and demand is unstable (Miller, 1988), the need for safety stock may be higher, because high customer service and responsiveness is required. Such need for safety stock brings the increase of production quantity, and subsequently this should lead to the increase of RM backorder necessary for the production of required quantity. When considering that this sequence is initiated from a low inventory level, the increase of RM backorder means that demand for RM is greater than the supply capability of RM, thus leading to the increase in RM pricing. As mentioned in the feedback loop for IT effect on buyer-supplier

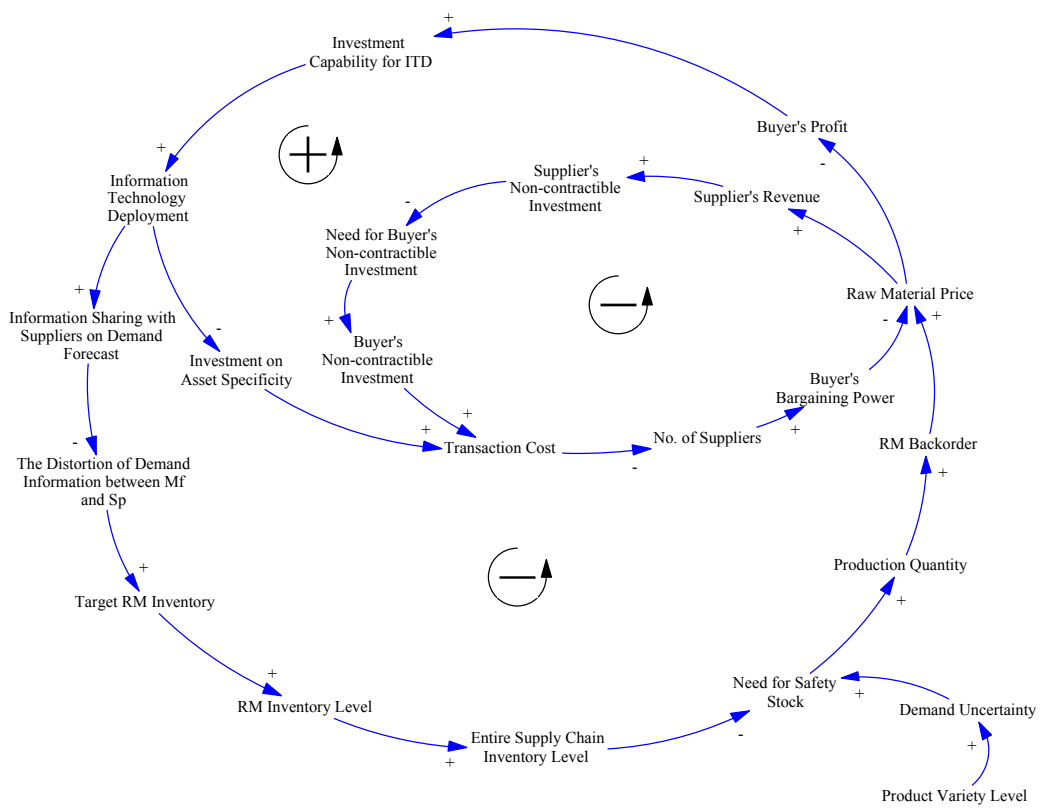

Figure 4. Causal Loop Diagram with IT effect on Supply Chain Dynamics (Full Model)

relationships, the increase of RM price subsequently leads to the decline in buyer's profit, the reduction of investment capability for IT development, and ultimately the reduction of desired IT level (See Figure 4).

Negative feedback loop representing IT effect on supply chain dynamics in Figure 4 indicates that information sharing by the utilization of advanced IT may not guarantee persistent cost reduction or profit increase through entire supply chain sequence. As mentioned previously, these opposing trends imply that the effect of information sharing can be different depending on the detailed characteristics of the SCM system. Chen (1998) observed that information sharing benefits decreased with an increase in demand variance, thus supporting the above argument.

5. Conclusion

Figure 4 indicates that the effect of IT investment in supply chain management can differ depending on the dynamic interactions among the three feedback loops representing the effect of IT on *buyer-supplier relationships* and *supply chain dynamics*. Depending on how these three feedback loops dynamically affect each other and which feedback loop is dominant, the effect of IT investment can vary. Therefore, in order to assess the validity of conclusions reached based on transaction cost theory or incomplete contract theory regarding the effect of IT deployment on buyer-supplier relationship, *it is necessary to consider the influence of supply chain dynamics on buyer-supplier relationship*.

The relevance and importance of supply chain dynamics becomes evident when demand -supply balance in a supply chain is considered. If the buyer has sufficient raw material inventories for making finished goods to meet customer demand, the buyer can have a certain level of "slack" in bargaining with suppliers. Otherwise, there is a high possibility that buyers might be dominated by powerful suppliers. This means that demand-supply balance may have an influence on the buyer-supplier relationship. The effect of demand-supply balance can be different depending on the characteristics of the product being sourced form the supplier. That is, in the case of a standardized product, the level of product variety is not high, demand is stable, and the market is generally wide. So, the manufacturer can control demand with finished products in stock. Also, the strength of buyer-supplier relationship in this situation may be relatively weak, because *market governance* structure is expected to be dominant. But, in the case of a customized product, the level of product variety is high, and demand is unstable. Therefore the manufacturer will hold inventory of raw material and start making the product after receiving firm orders. Also, the need for support and cooperation among supply chain members for dealing effectively with demand uncertainty is relatively high under these circumstances. Consequently, it is expected that *hierarchical governance*

structure through strategic partnership between the buyer and the supplier is more likely in the case of a customized product.

These arguments suggest that buyer-supplier relationship might be significantly influenced by supply chain dynamics. Therefore, it is necessary to analyze the effect of IT on supply chain dynamics and investigate how the effect of IT on supply chain dynamics in turn affects the relationship between IT level and buyer-supplier relationship. Accordingly, we address the following research questions:

1) In studying IT effects on buyer-supplier relationship, which of the two theories-Transaction cost theory or incomplete contract theory-is more useful?
2) How does the interaction between IT and supply chain dynamics help resolve the apparent contradiction between transaction cost theory and incomplete contract theory, regarding IT's effect on buyer-supplier relationship?

By answering these two research questions, we contribute to a fuller understanding of the role of information technology as a means for adopting arms-length inter-firm relationship. The paper makes a contribution by explicating the importance and relevance of supply chain dynamics in understanding IT effects on buyer-supplier relationship. These research issues have not been addressed in extant literature. The analysis on the research issues will contribute to theory building in buyer-supplier relationships. This should be addressed in future research

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