Identifying Direction of Causality Between IT Investments
In Supply Chains and Buyer Supplier Relationships: A Meta-Analysis

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ABSTRACT
Various researchers have made an attempt to identify the antecedents to the successful implementation of inter-organizational IT systems. Relationship between buyers and sellers has been identified by researchers to be an important predictor of IT investments. However there have also been various other studies that have identified IT investments as an antecedent to buyer-supplier relations. This paper is a step towards ascertaining the strength and direction of relationship between the two factors by doing a meta-analysis on literature concerning both the directions. We use theoretical anchors to explain the relationship in both cases.

INTRODUCTION
Intense questions have been raised addressing the importance of Information Systems in sustaining competitive advantage (Carr 2003). Deployment of IT artifacts has been studied as both “antecedents of” and “consequence to” the relationship formation among supply chain partners. While it can be purported that Inter-organizational Information systems affect the relationship between supply chain partners, it is a possibility that the relationship between supply chain partners cause the investment in inter-organizational information systems.
Earlier studies have focused to study the role of information technology in social behavior. For example, using GDSS as an illustration DeSanctis (1994) explained the role of advanced Information Technology in organization change thereby proposing the Adaptive Structuration Theory. This paper is a step towards ascertaining the strength and direction of relationship between the investments on inter-organizational systems and their impact on relationship between the supply chain partners by doing a meta-analysis on literature concerning both the directions. It will contribute towards obtaining a better understanding of the two constructs: Information Technology and supply chain relationships.

**Research Question**

While there are many possible structures for good theory about the role of information technology in organizational change, only a few of these structures can be seen in current theorizing (Markus and Robey 1988). Robey and Boudreau (1999) used four theories to explain contradictory Organizational Consequences of Information Technology:

- Does Information Technology force a good relationship?
- Does a good relationship induce investments in Information Technology?
- Which force is more significant?

Using meta-analysis, these are the issues we plan to address in this study. Theoretical arguments have been examined to understand the directions of causality. The scope of the study is limited to B2B buyer – supplier relationships. It does not include B2C e-commerce systems where the role of IT investments has shown significant tendency to relate to customer relationships.

**LITERATURE REVIEW**

The society is increasingly becoming dependent on a multiplicity of pervasive and invasive technological artifacts (Orlikowski and Lacono 2001). Using the models of change within organizations and industry (Meyer, Brooks et al. 1990), we can place Information Technology as a revolution and Open Supply Chains as an evolution. Today, the most important and powerful Information Systems involve networks that transcend across organizations (Cash Jr. and Konsynski 1985) and the most successful examples of Information Technology systems are ones that link a company to its suppliers, distributors and customers (Johnston and Vitale 1988). An increase in investments in Information technology in the supply chain leads to the efficiency and effectiveness of the same. This results in a stronger relationship among the supply chain partners. This enhances the experience and confidence in the usefulness of IT in the supply chain, leading to increased investments in IT. Figure 1 represents the theoretical underpinnings explaining the direction of association between the investments in IT and the supply chain relationship.

**Inter-Organizational Information Systems → Relationships**

Information Technology induced organizational relationships has been a stream of research (Zaheer and Venkatraman 1994) and researchers have extensively studied various technological tools like bar codes, CAD and CAM which help create value added partnerships (Johnston and
Lawrence 1988). With regard to relationship management, intra- and inter-organizational information technology deployment has different effects on relationship atmosphere (Ryssel, Ritter et al. 2004). Information Technology deployments in supply chains lead to closer buyer-supplier relationships (Bakos and Brynjolfsson 1993). Patterns of information technology use are significant determinants of relationship-specific investments (Subramani 2004) and it has been argued that information systems, by keeping principals’ informed of agents’ action, can reduce agent opportunism (Eisenhardt 1989). Information Technology functionality plays an important role in defining interfirm relationship (Zaheer and Venkatraman 1994). Technologies with feedback mechanisms have been shown to be effective in trust building (Sulin and Paul 2002) and it has been found that it is impossible to achieve an effective supply chain without Information Technology (Gunasekaran and Ngai 2004). Finally, (Mouritsen, Hansen et al. 2001) found that information overcomes absence and creates closeness and trust relations (Mouritsen, Hansen et al. 2001). According to a study done by Stump and Sriram (1997), it was found that IT investments indirectly enhance buyer-supplier relationships.

Information Technology 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).

Transaction Cost Economics

Resource Based View

**Figure 1: Theoretical Underpinnings**

**Transaction Cost Economics**

The Theory of Transaction Cost Economics (TCE) is most often used to explain the reasons of alliance formation by the companies and the type of relationship between the supply chain partners (Rindfleisch and Heide 1997). TCE looks at firms as avoiders of market costs by analyzing the relative efficiency of the market in comparison to internalization (Conner 1991).
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 become equal to the costs of carrying out the same transaction by means of exchange on the open market or the costs of organizing in another firm" (Conner 1991). All transactions in a market are associated with production costs, as well as additional costs due to incomplete contracts due to bounded rationality and the risk of opportunistic behavior.

Organizations have found a middle path between the two extremes by forming supply chain alliances. These have neither the characteristics of pure markets nor those of pure hierarchies (Grover, Teng et al. 2002). While markets and hierarchies are two extreme forms of governance mechanisms in response to the transaction environment, long term cooperative relationships between firms lie in the continuum between markets and hierarchies. Also called, Relationalism, this type of mechanism extends Transaction Cost Economics by considering the social context. These structures have the element of relationship as a deterrent to opportunism. Adler (2001) extends the TCE framework by adding a third structure based on opportunity/trust in addition to market/price and hierarchy/authority.

**Role of Information Technology in Transaction Cost Economics**

One aspect of TCE; Asset specificity, refers to the amount of dependence an asset has on an input or producer to which it is specific. This can arise in one or more of three ways; site specificity, physical asset specificity and human asset specificity. This puts the producer at a higher risk, as the assets are so specific that they cannot be easily transferred elsewhere. This can lead to a lesser number of suppliers, and a potential for opportunistic behavior by the suppliers. Petroleum refinery with its high asset specificity is a pertinent example.

There is evidence of Information Technology -infrastructure creating relationships across organizations, which in turn help reduce opportunism. However, by making investments of people knowledge and IS that are specific to a partnership, asset specificity adds up which makes the organization slip into a small numbers bargaining position. Hence, Investment in Supply Chains is double-edged with tradeoffs. According to (Ybarra-Young and Margarethe 1999), Specific assets have been found to have a detrimental impact on the strategic flexibility of alliance relationships.

Secondly, imperfect information, another facet of TCE, leaves open the risk of opportunistic behavior by the suppliers. IT has the capability of reducing imperfect information as well as uncertainty using transparent systems. It can also be an asset specific to a partnership. In many cases due to the small number of transactions, many partners are stuck with dealing with only one or few partners. For instance, Lockheed Martin can define the transaction specifics due to its unique position as the only buyer from its small vendors.

There is evidence that transaction costs associated with asset specificity, small numbers bargaining, and imperfect information (Williamson 81; Ruekert, Walker et al. 1985; Conner 1991) can be reduced by trust (Wright 1986; New 1996; Butler and Carney 1983). Table 1
provides a representative list of studies on the role of Information Systems in influencing relationships.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Objective</th>
<th>Theories used</th>
<th>Methodology / Sample size / Response Rate / Sample Frame</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Grover, Teng et al. 2002)</td>
<td>To investigate role of IT in buyer-supplier relationships</td>
<td>Uses concept of Relationalism as an extension of Transaction Cost Theory by considering trust and a long term perspective</td>
<td>Confirmatory factor analysis SS = 203 RR = 27 %</td>
<td>Positive role of IT in partially offsetting the negative relationship between transaction cost and Relationalism.</td>
</tr>
<tr>
<td>(Ybarra-Young and Margarethe 1999)</td>
<td>Strategic flexibility in information technology alliances</td>
<td>Transaction Cost economics, Social exchange theory</td>
<td>Structural equation model SS = 91 RR = 38 %</td>
<td>Trust was positively related to flexibility</td>
</tr>
<tr>
<td>(Wu, Chiag et al. 2004)</td>
<td>How to integrate supply chain business process</td>
<td>--</td>
<td>Canonical correlation analysis SS = 134 RR = 22.3</td>
<td>Idiosyncratic investments, dependence, product salability, Trust, power, continuity and communication enhances commitment and integration of supply chain management</td>
</tr>
<tr>
<td>(Ryssel, Ritter et al. 2004)</td>
<td>Impact of IT on buyer seller relationships</td>
<td>-</td>
<td>SS = 61 RR = 37 %</td>
<td>Trust and commitment have significant impact on value creation</td>
</tr>
<tr>
<td>(Bensaou 1997)</td>
<td>Role of IT in relationships</td>
<td>Transaction costs economics, organization theory</td>
<td>Multiple Regression Analysis SS = 447 RR = 43 %</td>
<td>Mixed results in Japan and America</td>
</tr>
</tbody>
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Table 1: Studies on Role of Information Systems in Influencing Relations

Relationship ——— Inter-Organizational Information Systems

By reversing the “causal direction”, many researchers have attempted to establish supply chain relationship as an antecedent to adoption of inter-organizational information systems. Prior investments in relationships develop economies of scale, familiarity, trust and a belief that ending such relationships would lead to waste of the applied investments in the technology. In order to salvage the existing investments with a hope that the new investments will help to break even and get the desired outcome, Organizations prefer to invest further in these “sunk costs”. Furthermore, it is also used by organizations to strengthen the relationship to mitigate the risk of opportunism. Investments in relation specific assets also provide a way to cope with a scarcity of qualified suppliers, particularly as part of the larger relationship between two firms. Information Technology artifacts are one such asset (Bensaou and Anderson 1999).

Resource based view

For a resource to be a source of competitive advantage, it should be valuable, rare, imperfectly imitable, and non-substitutable. An Information System deeply embedded in a firm’s informal and formal management decision making has the potential of sustained competitive advantage. Being socially complex, it makes this combination imperfectly imitable. (Barney 1991). The organization with an existing relationship with a supplier realizes the embedded-ness and unique nature of the relationship and its positive impact on efficiencies. In order to further strengthen this cooperation, deployment of Information Technology systems takes place. Table 2 provides a representative list of studies involving the effect of relationships on Information Systems.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Objective</th>
<th>Theories used</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Bensaou and Anderson 1999)</td>
<td>When do buyers risk making idiosyncratic investments</td>
<td>Transaction Cost economics, Institutional Theory Organization Theory, Role performance, Industrial organization</td>
<td>Specific investments increase coordination, buffer against technological uncertainty and build close relationships when supply market is thin</td>
</tr>
<tr>
<td>(Zaheer and Venkatraman 1994)</td>
<td>Determinants of Electronic integration in the insurance industry:</td>
<td>Transaction Cost model</td>
<td>Data supports the importance of Trust and Asset Specificity in explaining the degree of electronic integration</td>
</tr>
<tr>
<td>(Iskandar, Kurokawa et al. 2001)</td>
<td>Adoption of Electronic Data Interchange: The Role of Buyer-Supplier Relationships.</td>
<td></td>
<td>Length or relationship and likeliness to adopt EDI are significantly related.</td>
</tr>
</tbody>
</table>
Table 2: Effect of relationships on Information Systems

METHODOLOGY

We use meta-analysis to ascertain the strength and direction of relationship between the investments on inter-organizational systems and their impact on relationship between the supply chain partners. Meta-analytical techniques are useful because only summary statistics are typically available in the literature. If the raw data are available, then meta-analysis would not be appropriate since more powerful statistical techniques could be applied. There are two general approaches to Meta-Analysis. The First one concerns with dealing with relationships between variables. The second is related to differences between means. In this study we shall use the first method. Transaction Cost Theory plays a role in both directions. Both Information Technology systems and Relationships can play a role of specific assets. “An information processing system deeply embedded in a firm’s formal and informal management decision making process may hold the potential for sustained competitive advantage.” (Barney 1991). Currently, we are in the final stage of collecting the relevant articles for conducting the meta-analysis. Compiling the work done in Information Technology systems will guide us with respect to testing the claims made by theoretical explanation.

CONCLUSION AND FUTURE DIRECTIONS

A positive directional effect from both sides may project a time based circular relationship. Some researchers have developed models with circular relationships (Martinez and Perez 2005). A good relationship may prompt Information Technology adoption which once established may further strengthen relationships. One interesting question is: Did an investment in Inter-organizational information system further the relationship or does the study show a spurious relationship between an IT system and a relationship which was present even before the inter-organizational system was adopted. While a relationship might cause an investment in inter-organizational information system, the Information Technology systems thereby deployed may spuriously show a tendency to effect relationship. Perhaps the causality is multi-directional. However evidence leans more towards relationship being the independent variable. It brings out the ever present Information Technology paradox when dealing with justifying Information Technology investments. Additionally, investment in Information Technology is a decision whereas relationship is a mental state of mind. A study focusing just on the direction of causality will help to provide a better understanding of the phenomenon.

REFERENCES


