The Influences of Transaction and Partnership Characteristics on Inter-organization System Integration in Manufacturer-Supplier Dyads

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Abstract

Nowadays, given the high pressure caused by severe competition, establishing a more efficient supply-chain management has become an essential competitive strategy for many manufacturing firms. The inter-organizational systems (IOS) are considered to be the most important instrument that can link manufacturers and suppliers in the supply chain. Thus, supply chain management has become more valuable as more and more people realize that it is the supply chain that is critical when analyzing a company’s advantage competence.

Recently, business to business (B2B) commerce is the new subject in e-commerce: IOS are the systems that link several different organizations. In the past, the researchers not only discuss IOS adoption and use from the perspectives of technology, organization and environment. Now, however, they also evaluate factors which impact on the adoption of electronic data interchange (EDI) systems. When the internet expands, the role of IOS moves from being merely an operational tool to becoming a collaborative commercial instrument. Thus, integration has become a critical issue. On the other hand, firms have to address the variable environment more than ever, because they not only maintain the fixed supply chain components but also link up with the global market. The role of IOS has progressed from being concerned only with operational efficiency to becoming a collaborative tactical tool. This study emphasizes two major dimensions: transaction and partnership, as the main factors which affect IOS integration in manufacturer-supplier dyads.

Based on a survey of Taiwanese electronics firms, our results show that based on the context of transactions and partnerships, there are five critical factors that have a positive significant effect on IOS integration, that is, the complexity of components, component criticality, trust, supplier dependence and supplier investments. Market variables have negative significant effects on IOS integration. The uncertainty of demand is the only factor that has an insignificant effect on IOS integration. In this study, partnership characteristics are more important than transaction ones. Keeping collaborative relationship will improve the depth of IOS integration.

Keywords: IOS, Collaborative Commerce, Integration, Transaction, Partnership

1. Introduction

In the early years, inter-organizational systems (IOS) were closed systems. They only allowed firms in the supply chain to exchange information. Since the advent of internet technology, organizations have realized that there is value in implementing such systems with business partners. IOS can not only bring an organization some competitive advantage but can also change the transaction method and the relationship among organizations. It can even affect the role of the firm in the supply chain [25].

Research background and motivation

Many firms are confronted with severe competition on all fronts. They used to compete only against other rival firms. Nowadays, however, they need to consider the whole supply chain in order to gain some competitive advantage. Inter-organizational systems (IOS) are information systems (IS) that link two or more organizations and facilitate the exchange of products, services and information.

Over the years, supply chain management has attracted significant attention, as it has become the next frontier through information systems deployment. The related terminology include: network
sourcing, supply pipeline management, value chain management and value stream management [38]. Especially since the 1980s, with increased global portage, inter-organizational system technology has improved, businesses globalized, products customized, and faster market responsiveness have become main stream concerns. The activities of purchasing, marketing, logistics and transportation have crossed the borders of organizations and have become components of the whole supply chain. In order to manage these activities effectively, firms must enhance the cooperation among different departments and improve the coordination between two organizations [2].

Inspired by the concepts of supply chain management, many firms have made great progress in the purchase, logistics, R&D and planning processes, such as strategic purchase, supplier segmentation, early supplier involvement, supplier improvement, partnership, synchronous systems, lean and agile organizations [11][16][28][30]. Innovations and improvements in the business models show that it is, in fact, difficult and complex to manage the process across firms and different organizations. At the same time, integration and coordination are two core problems when managing the supply chain [2].

A transaction is defined as an exchange of products and services between two separate entities [40]. Past researches that concentrated on examining the transactional context brought forward contingencies such as the nature of the component to be purchased, the nature of the demand for the component, the characteristics of the market source for the component and the nature of the transactional relationship [9][23][29][36]. Grover and Saeed [19] are of the opinion that the factors pertaining to the dyadic transactional context are likely to influence the choice of coordination mechanisms that the firm makes. They also held the position that IOS usage is a coordination mechanism that represents one such choice. Prior research has not clearly examined how the transactional context shapes IOS deployment. Thus, a systematic analysis of this relationship is required.

2. Literature review

IOS integration is different from IT adoption or use. The most important factor in IOS integration is the depth of IOS between the partners. The major reason for facilitating the coordination-intensive configuration is the mutual benefit to be derived from the cooperation. From adoption to integration, one has to pass through three steps: adaptation, acceptance and routinization (Figure 1) [39]. Although setting up the hardware and developing the software may not be complicated, the IOS integration would require a lot of work to get through the alliance process, mapping data cell, investments and resource sharing. These are logistics coordination jobs. Thus, behind the integrating actions, there are the sharing of the cost of the plan and the acquisition of knowledge. It will expose the firm’s internal information to the other party. If there are no additional advantages, the firms will not proceed with this course of action.

![Figure 1. From adoption to integration (revised from [58])](image)

IOS integration can be compared to the trigger mechanism of organizational reconstruction. The meaning behind IOS integration is the mutual coordination of organizations [14]. Purvis et al.[35] think that this is the main factor behind process re-engineering. The post-adoption stage will move the two parties towards the adaptation of new technology and its context. Kim and Umanath [26] mention that through electronic integration information technology can facilitate the integration of business processes between organizations. However, implementing IOS between two firms is not the final
purpose of any IOS project. The real purpose of IOS is to facilitate the transfer of data and information flow. Inevitably, the success of IOS efforts will depend on two systems, at least. One is for inputting information, the other is for using the information. that IOS can transfer for the purpose of data utilization. Only the internal information system can bring about business value when the data is utilized. Thus, when the internal information systems are integrated, the potential value of IOS would be realized.

IOS integration is similar to the concept of assimilation, which is defined as that aspect of information technology that has increasingly become part of the whole organizational process. Purvis et al., [35] argue that the assimilation or usage is related to post-adoption. Organizations have to address the mutual adaptation of technology and context. IOS integration which in the purview of this study can be equated with electronic integration. Kim and Umanath [26] mention that the electronic integration has caught the IT-enabled integration of business processes between organizations in mid-stream. Choudhury [9] thought that electronic dyads and electronic monopolies were IOS-enabled governance mechanisms. They are high level electronic integration. Researchers also emphasized the penetration of the systems [8][31]. The databases can provide each party with quick access to relevant information. In this study, we use the definition of Grover and Saeed [19]. IOS integration is taken to mean the extent to which systems are shared by two or more firms. The systems are integrated to facilitate access to information residing in either firm.

Information processing theory (IPT) identifies three important concepts—information processing needs, information processing capabilities, and the fit between the two to obtain optimal performance [17]. We have revised these three concepts into: information needs, the depth of integration and the IOS configuration. The information needs affect the depth of IOS and finally shape the configuration of IOS with suppliers. IPT deems that the best way to eliminate uncertainty is to deeply process information interchanges and openings based on efficiency. The most important thing is to eliminate uncertainty and ensure a smooth information sharing system. Bensaou and Venkatraman [4] suggest that the uncertainty could arise from three aspects: the environment, organizational relationships and task uncertainties. When the level of uncertainty is low, the standard operation process needed is quite simple. When the level of uncertainty is high, more coordination mechanisms are needed to accomplish the task.

Researches in organizational theory identify two major dimensions for uncertainty—complexity and dynamism [15][32]. In component characteristics, component complexity and criticality determine the complexity dimension, while demand uncertainty and market variability determine the dynamic dimension.

Another uncertainty comes from the relationship between and among partners. The uncertainty factor between major trading partners can cause two risks: operational risks and opportunity risks [13]. When firms are confronted with the operational risk, the major action taken is usually to avoid having the partner reneging from the contract. When addressing opportunity risks, firms have to reinforce the relationship-specific investments in order to avoid the other partner from doing anything detrimental in the relationship. This study highlights trust, supplier dependence and supplier investments to evaluate the uncertainty level of the relationship.

3. Research model

Based on the literature review, we define IOS integration as the depth of the system on the other partner’s side. In this research model, there are two dimensions: the component and the partnership characteristics. They have positive effects on IOS integration. The research model is shown in figure 2.

Each characteristic is comprised of several variables. The component characteristics consider the aspects of component complexity, demand uncertainties, component criticality and market variability. The partnership characteristics are concerned with trust, supplier dependence and supplier investments.
The definition of each research variable is described in Table 1.
Table 1. Definition of Research Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component complexity</td>
<td>The description of component complexity.</td>
<td>[19] [24][27]</td>
</tr>
<tr>
<td>Demand uncertainty</td>
<td>The unpredictability of the volume and time of demand.</td>
<td>[6][27][34]</td>
</tr>
<tr>
<td>Component criticality</td>
<td>The importance of the component in the end product.</td>
<td>[7][34]</td>
</tr>
<tr>
<td>Market variability</td>
<td>The variability of a single component market</td>
<td>[9][19]</td>
</tr>
<tr>
<td>Trust</td>
<td>Level of trust with supplier.</td>
<td>[18][21][34]</td>
</tr>
<tr>
<td>Supplier dependence</td>
<td>Level of partner’s dependence on the manufacturer.</td>
<td>[19][21]</td>
</tr>
<tr>
<td>Supplier investments</td>
<td>Level of partner’s investments on manufacturing capacity, facilities and staff.</td>
<td>[5][6][34]</td>
</tr>
<tr>
<td>IOS integration</td>
<td>Depth of information system reach to supplier’s side.</td>
<td>[19]</td>
</tr>
</tbody>
</table>

4. Research methodology

At beginning of this research, the authors conducted enterprise interviews and questionnaire translations. Enterprise interviews involved discussions about the factors which affected IOS integration and provided the expert’s viewpoints, and ensured that the questionnaire is appropriate. These two steps were taken to make sure that the questionnaire had reliability and content validity. In July 2008, we start to collect data for pilot test. The Chinese version of the draft was pretested with 43 persons who has industrial experiences for content validity, resulting in modifications of the wording of some survey items. In January 2009, we randomly selected 600 electronic manufacturing firms from Taiwan’s stock market and then the final version of the survey was distributed to the procurement, depository and management information systems (MIS) members of the firms. Because the procurement, depository and MIS functions play a critical roles in any manufacturing firm and their members should also have good understanding of IOS and relation with the suppliers, we consider that these members should be the most knowledgeable and reliable informants within a company to answer our questionnaires.

After collecting the questionnaires, we started to organize and analyze the data. We followed the quantity research procedure. This research adopted the SPSS 10.0.7C for windows and Smart PLS (version: 2.0.M3) as the data analysis tools.

4.1 Questionnaire Collection

575 questionnaires were sent to respondents. A total of 181 responses were received after two rounds of solicitations. Out of these 181 respondents, 20 questionnaires were not included due to missing values. There were 161 valid questionnaires with a 31.5% response rate. Because the samples
came from the website (86) and from hard copy (95), we compared them using statistical analysis. There was no significant differences based on the amount of capital or the number of employees.

4.2 Reliability and validity

The purpose of the reliability and validity tests is to verify the credibility of the research model. In order to make sure that the instrument can measure the variables exactly in the construct, this research employed two tests on reliability and validity: item reliability and convergent validity.

4.2.1 Item reliability

Item reliability seeks to make sure that the factor loadings of every item are over the standard point. It represents the internal consistency of the observed object. Bagozzi and Yi [1] suggest that the factor loading should be greater than 0.5. This research is based on the standard of Bagozzi and Yi to eliminate the items below 0.5.

The constructs have a theoretical foundation and pass the exploratory factor analysis (EFA). They also contain the construct independence in every variable.

4.2.2 Convergent validity

The test indexes are composite reliability (CR>0.7) and the average variance extracted (AVE>0.5). On the test of CR, when the coefficient is higher, the item has more represented ability. Based on the literature, Nunnally [33] suggests that the CR should be higher than 0.6; Churchill [12] suggests that the CR should be higher than 0.7. If the CR is lower than 0.7, the items are eliminated. The results are shown as Table 2. It shows that the CRs are all above 0.7 and thus have good reliability.

The average variance extracted (AVE) shows the variance of variables. Hair et al. [20] suggest that the AVE should be higher than 0.5. This means that the variables of the model have good convergent validity. In this research, all the variables are higher than 0.7 and thus are better than the suggested score (Table 2).

<table>
<thead>
<tr>
<th>Variables</th>
<th>AVE</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component complexity</td>
<td>0.711</td>
<td>0.925</td>
</tr>
<tr>
<td>Demand uncertainty</td>
<td>0.817</td>
<td>0.930</td>
</tr>
<tr>
<td>Component criticality</td>
<td>0.793</td>
<td>0.920</td>
</tr>
<tr>
<td>Market variability</td>
<td>0.946</td>
<td>0.986</td>
</tr>
<tr>
<td>Trust</td>
<td>0.767</td>
<td>0.952</td>
</tr>
<tr>
<td>Supplier dependence</td>
<td>0.951</td>
<td>0.975</td>
</tr>
<tr>
<td>Supplier investments</td>
<td>0.748</td>
<td>0.899</td>
</tr>
<tr>
<td>IOS integration</td>
<td>0.876</td>
<td>0.955</td>
</tr>
</tbody>
</table>

4.2.3 Model test

The PLS software (Smart PLS) was used to examine the hypothesis. The variance of the dependent variable can be explained by using the independent variable and the result is quite significant (p<0.001). The hypotheses were tested using path coefficients whether they were significant or not. The method used to estimate the path coefficients is the bootstrapping process to randomly draw out 100 samples from the original data. The results are shown in Figure 3.

After going through the model test, only one out of all the hypotheses is shown to be insignificant. The results indicate that “demand uncertainty→IOS integration” is insignificant (T-value=0.228<1.96). The control variable “supplier firm size→IOS integration” is insignificant (T-value=0.493<1.96).

In all the factors which affect IOS integration, the path coefficient of supplier dependence is greatest (β=0.411), it shows that supplier dependence will seriously influence the level of IOS integration. The second important factor is trust (β=0.34), indicating that a manufacturer’s trust of its suppliers will influence the depth of IOS integration. The third higher coefficient is component complexity (β=0.292). It shows that when the component is complex; they need to transfer more
information through IOS. The information needs will facilitate the IOS integration. The fourth higher coefficient is component criticality ($\beta=0.256$), which implies that more control and monitor actions are necessary to reduce the inventory and extent of real-time reaction. Finally, supplier investment has an impact on IOS integration ($\beta=0.206$), which shows that a particular supplier has the willingness to maintain a long-term relationship with the manufacturers. In the overall hypotheses, there is a negative effect which is market variability.

5. Discussion

The integration through IOS is the best condition that can be arrived at for manufacturers and suppliers; that is, the integration between them that involves cooperation and compromise between the two parties. This integration is affected by transaction and partnership factors. With regards to IOS integration, this research has focused on the three levels just like Grover and Saeed’s [19]: file exchange, share of application software and share of a database. The data exchange which includes quotations, product specifications, shipping data and so on, can be conveyed by e-mail or group software.

This research made use of previous researches that emphasize the importance of transactions and partnership contexts and their impact on IOS integration. It was found that firms tend to implement an IOS when the component complexity is high, the market variability is low and the component criticality is high. This research offers a useful standardization model to indicate the IOS integration and its proper configuration.

Manufacturers and suppliers have actual needs of IOS sharing because of component complexity. For the manufacturers, suppliers have to share the compatibility and performance testing reports of components. In order to match the higher coordinative needs, deploying IOS to facilitate the processing and exchanging of information will effectively manage component complexity [27][34].

We expect demand uncertainty and IOS integration to have a positive relationship but IOS integration is not necessary in detecting demand uncertainty. The distribution safety can solve the problem of demand uncertainty. This theory is explained clearly in the Theory of Constrains (TOC)
According to this research, the electronics industry in Taiwan run a lesser risk of having shortage problems by purchasing buffer stocks from back-up suppliers. However, IOS integration is not an efficient way to solve the problem of demand uncertainty. The manufacturer can deal with demand uncertainty by linking more substitute suppliers.

There is a high correlation coefficient between component criticality and complexity ($r=0.75$). These important components have two characteristics at the same time. The component complexity emphasizes the amount of information needed. Although the two factors have high relativity, they are clearly represented in two different dimensions. They can have different impact on IOS integration.

Choudhury et al. [10] made a research on the airplane parts market and found out that the market system is more suitable in a fragmented market. The market system is the same as in the electronics market. Many companies have made its non-strategic component purchases through the internet. Thus, they can have more chances to compare the prices and to lower them.

Many researches have shown that only when the manufacturers have trust on their suppliers can cooperation work well. This trust can result from the accumulated confidence of previous business cooperation schemes. When suppliers keep their promise for product shipping, product quality and on time deliveries, then the manufacturer will have enough trust on the suppliers [4][5][22]. We all believe that mutual trust is the bedrock of partnership integration.

Because IOS integration has to be built on the basis of mutual cooperation, if the suppliers take into consideration the manufacturer’s needs, it will act as the trigger motivation for integration. The results of this research indicate that when the manufacturer constitute a big proportion of a supplier’s revenues or become the major benefit source, it will be advantageous to deploy IOS integration in this context [22].

Supplier investments represent the actual action of a long-term relationship [18]. In previous researches, it has been shown that asset specific investments have a positive effect on strengthening mutual relationships. Asset specific and supplier investments have high correlative connections.

Supplier firm size is not found to be significant to IOS integration in this study. This is different from the research results of Grover and Saeed [19]. When comparing IT costs with the capital of a firm, the IT investment has decreased in proportion to the total investment. We have used this survey to verify the theoretical model using the questionnaires filled up by the electronics employees.

6. Conclusion

We combine transaction and partnership viewpoints to present our contributions to the body of knowledge in this regard.

Eventually, there are five findings presented in this research.
1. The ordinary performance of the suppliers will reflect the trust of manufacturers. Trust is the foundation for IOS integration.
2. When the component complexity is high, IOS integration is appropriate. It increases the need for information and also extends the need for IOS integration.
3. When the market is variable, firms should consider the electronics market in place of IOS integration. Thus, companies can benefit from comparing prices.
4. The relation between demand uncertainty and IOS integration may be constrained by the production field. IOS integration can facilitate the information flow, but if firms can not benefit from the information provided, its value will be reduced.
5. Supplier dependence and supplier investments can trigger the motivation and actual behavior of the suppliers. These are the two factors that can push IOS to a deeper integration.

These findings suggest that we should not consider IOS integration as a panacea for managing all supply-chain relationships. It is not necessary to integrate all the suppliers. Firms have to consider their own strategies and contexts on how IOS can be best utilized.

7. Reference


