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# Evaluating eCollaboration: Toward A Positioning Map For Supply Chain Integration

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## Abstract

*E-business systems have the potential to transform supply chain relationships into integrated collaborative networks. However many firms are hesitant to adopt e-business systems, and in particular collaborative supply chain initiatives, as the benefits often fail to fulfill the promise. To reduce this anomaly, firms need to realize the successful creation and implementation of a collaborative supply chain system is more complex than other inter-organizational systems (IOS). Decision makers need to evaluate the different options for integrating the supply chain and determine the most appropriate partners. Although previous studies have assessed e-business and IOS, few offer a predictive model that can assist decision makers with the selective deployment of an integrated supply chain system. Based upon previous research and empirical data, the authors have devised a positioning framework for prospective adopters to illustrate the potential impact of a collaborative supply chain system. This framework enables a positioning of current supply chain partners, based upon pre-adoption factors, to identify the potential level of impact achievable. An EU-Funded project, Co-Improve, provided the empirical setting to test this framework. With e-business evaluation still in its infancy, this new framework can assist managers with the complex task of instigating and implementing e-supply chain initiatives.*

## 1 Introduction

Today many firms are increasingly drawn to the competitive opportunities available through a more effective and efficient supply chain network. One such opportunity is to develop technologies that transcend traditional boundaries to automate and integrate supply chain functions between trading partners. Historically, Electronic Data Interchange (EDI) had attracted attention because of its potential to provide information sharing benefits in an inter-organizational setting. However, in practice, the adoption rate

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of EDI by business communities has remained low. One estimate suggests that EDI accounts for only two to three percent of the total data exchanged between businesses in the US (Rockwell, 1999). In contrast, Internet and web technologies have created numerous alternatives to EDI for fostering inter-organizational coordination (den Hengst and Sol, 2002). One particular alternative, *collaborative supply chain systems,* have steadily gained momentum for their potential to enable efficient supply chains. Volkswagen Group, for instance, have claimed to recoup their outlay costs for a supplier network portal within a year through "reduction in administrative tasks, acceleration of processes, improved planning accuracy and improved transparency in the collaboration with suppliers" (Neumann, 2001).

However the promise of collaborative technologies in the supply chain, as advertised by vendors, has often fallen short of expectations. Firms are discovering that real world problems and solutions are complex and unique in collaborative inter-organizational environments (SymbiusCorporation, 2002). Many firms often overlook that adoption and implementation of an electronically integrated supply chain requires "tremendous resources, a great deal of management time and energy, large organization-wide changes, huge commitment from suppliers/partners, and sophisticated technical infrastructure" (Pant et al., 2003,201).

There is very little literature that can help decision makers devise an approach for creating e-enabled supply chains that is suitable for their context (Pant et al., 2003). In this article, we propose an approach to assist decision makers by synergizing the contributing factors thus enabling them to evaluate the potential impact of collaborative supply chain systems. Our framework categorizes the current supply chain partners to predict the potential impact of a collaborative system in the pre-adoption stage. The flexibility in this tool makes it adaptable to the fluidity of supply chain environments and its wide spectrum of trading partner relationships. This exploratory framework was developed and tested in conjunction with an EU-funded project, Collaborative Improvement for the Extended Manufacturing Enterprise.

## 2 Background

A plethora of studies have investigated the factors involved in the adoption of IOS and e-commerce systems. Although many authors have studied IOS and its relationship with e-commerce, very few (Icasati-Johanson and Fleck, 2003; Pant et al., 2003; Subramani, 2004) have investigated collaboration in an e-enabled supply chain. An area deficient in published studies is the evaluation of these new collaborative supply chain systems. Hence, this study puts forth a unique approach to investigate these new category of integrated systems.

Recent developments have facilitated the evolution of supply chain systems into truly collaborative 'open' systems utilising the Internet as an enabler. Historically, the origins of supply chain technological linkages can be traced to EDI as one of the earliest inter-organizational systems to be scrutinized academically (McNichols and Brennan, 2004). As shown in Figure 1, the darker arrow signifies an increasingly collaborative orientation in the desired impact of the inter-organizational system. Recent trading exchanges have opened the door for Internet-based supply chain systems to emerge. Supply chain management systems can be described as inter-organizational systems that serve to mediate customer-supplier transactions (Subramani, 2004). Web-enabled SCMS utilize the open TCP/IP protocols and often surpass its predecessors in the depth of applications such as information sharing, communication and collaboration (Icasati-Johanson and Fleck, 2003).

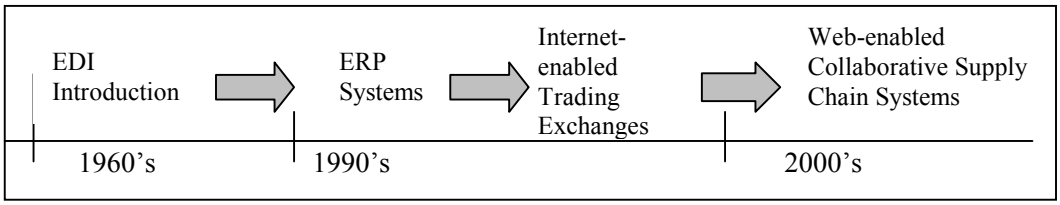


***Figure 1:*** *Evolution Of Inter-Organizational Systems (Mcnichols & Brennan 2003)*

### *2.1 Collaboration In Supply Chain Systems*

Collaboration is a vital ingredient in supporting Internet-based activities through the inter-company integration of processes and partnership by way of information exchange and joint supply chain management. Collaboration is defined as a process of decision making among independent organizations involving "joint ownership of decisions and collective responsibility for outcomes" (Gray, 1991,227). Important components of successful collaborative relationships include: a commitment to working together; goal congruency and benefit sharing. The success of collaboration depends upon the ability and willingness of managers to build meaningful relationships and create trust (Schrage, 1990). To promote collaborative behaviour requires an engaging partners in joint planning and processes beyond levels reached in less intense trading relationships (Spekman et al., 1998). Furthermore, Subramani (2004) found evidence that trading partner collaboration increases following e-supply chain management systems implementation.

### *2.2 Previous IOS Frameworks*

Various theoretical perspectives have been employed to evaluate the adoption effects and impact of IOS and EDI in particular. However, there lacks a standard, widely accepted typology to the evaluation of IOS in the literature (Choudhury, 1997). Research on IOS has been considerably influenced by the transaction cost analysis framework (Williamson, 1975; 1985). Initially, authors deployed this approach to examine inter-organizational linkages by either focusing on efficiency implications (e.g. Clemons and Row, 1992; 1993) or alternatively, the difference between electronic markets and hierarchies (e.g. Malone et al., 1987; Benjamin et al., 1990). In many early frameworks, the scope of interactions focused predominantly on the governing structures of the relationship and excluded other environmental factors (Chatfield and Bjorn-Andersen, 1997). On the other hand, a criticism of this approach is that it ignores the power-based criteria in explaining inter-organizational linkages (Heide and John, 1988). Hence, many recent frameworks have engaged a resource dependency approach (Pfeiffer and Salancik, 1978) by investigating the socio-political factors of interdependency, power and trust and its impact on EDI. Furthermore, few frameworks have ventured beyond one theoretical perspective, predominantly the transaction cost approach. Notable exceptions include: *Reekers and Smithson (1994); Iacovou et al. (1995); Bensaou (1997); Chatfield and Bjorn-Andersen (1997); Chatfield and Yetton (2000) and Subramani (2004)*.

A synthesis of various frameworks reveals the commonality of certain significant contributing factors to the adoption of IOS (refer to Appendix One). Almost all of the frameworks evaluated some elements of organizational and inter-organizational relationship factors. However, there was more divergence in the inclusion (or exclusion)

of factors relating to adopters' perceptions and environmental factors. For an in-depth review of the significant literature on IOS adoption and a compilation of their results, refer to McNichols and Brennan (2004).

Based upon a review of IOS frameworks and typologies, particularly EDI, existing models are insufficient as a prototype for evaluating the effects of adopting web-based collaborative systems. Earlier frameworks are limited in terms of comprehensively evaluating the dynamic factors involved with multiple trading partners fostering collaborative integration. Nevertheless, amalgamating some of the previously defined contributing factors into one flexible framework can enable a rich exploration into the complexities of collaborative supply chain systems.

## 3 Framework For Potential eCollaboration

It is proposed to build on extant research through the development of a contingency model. A review of the literature identified the most significant factors from previous IOS adoption studies. These factors were evaluated during initial pilot interviews and surveys. If found to be relevant in any of the pilot cases, the variables were included in the Afterwards, a contingency framework was established around these key constructs o determine the adoption factors that impact web-enabled supply chain systems. This framework aims to evaluate the potential level of trading partner collaboration through a web-enabled supply chain system. Our proposed positioning framework integrates three categories of factors that can influence adoption of a collaborative supply chain system:

(1) the organizations' preparedness for the technology implementation with its supply chain partner(s); and

(2) the adopters' perceptions of benefits obtainable from the collaborative system; and

(3) the partnership factors including interaction contingencies (i.e. power and trust) that address the complexities of the relationship dynamics.

These considerations are encompassed into four constructs of organizational preparedness (subdivided into organizational readiness and capabilities); expected benefits; partnership uncertainty and interaction contingencies (Figure 2). Only when these constructs are amalgamated into one framework can a comprehensive evaluation of the potential impact of the collaborative system be obtained. An assessment of these constructs can determine the positioning of the trading partner into an adopter category. Then the same assessment exercise is carried out on the host (or system initiator) partner. Finally, the two respective positions are compared in order to determine the potential impact a collaborative supply chain system can have in this trading scenario.

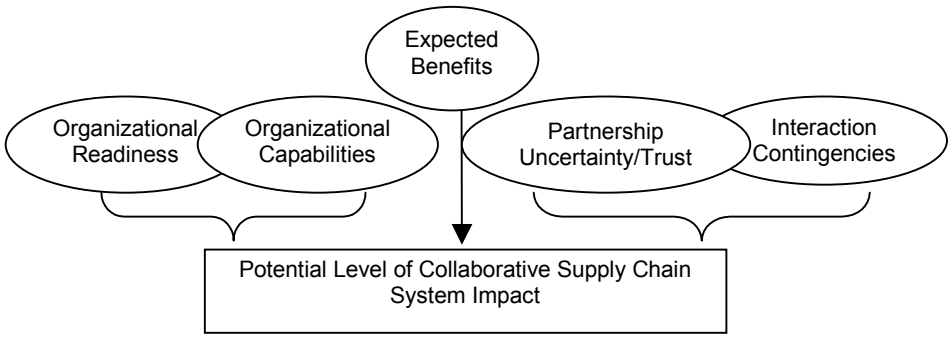


***Figure 2:*** *Framework For Potential Level Of Collaborative System Impact*

### *3.1 Organisational Preparedness*

Organisations require considerable resources to implement an integrated supply chain system (Pant et al., 2003). In order to collaborate, partners not only require a commitment of resources and an adequate IT infrastructure but must be prepared to share goals, operational practices and information.

An integral factor in this proposed model is the organization's level of maturity in terms of readiness. Readiness refers to the level of aptitude within the firm to adopt and implement the system. This construct is based upon an *organization's goals, culture, operational practices and attitudes* towards the objectives of the system. These variables along with technological aptitude all contribute to how ready a firm is to integrate the system. Existence of leadership support has been found to be an important factor in implementing IOS (Grover, 1993). Particularly, top management support has been linked to the successful adoption and implementation of an IOS (Iacovou et al., 1995; Chwelos et al., 2001). Current organizational work practices need to be considered as incompatibility of new technologies with existing values and work practices is one of the greatest inhibitors in successful innovation (Kwon and Zmud, 1987). Furthermore, in order to achieve external integration, an organization has to have the 'ability' and 'willingness' to share critical planning and operational information (Bowersox and Closs, 1996,22).

Along with the readiness of the organization, the capability to implement and sustain the system is crucial. This construct measures an organization's ability to assemble, integrate, and deploy valued resources (Russo and Fouts, 1997). Capabilities are the ability to deploy resources to affect a desired end (Amit and Schoemaker, 1993). The capability level is assessed based upon an *organization's size*, combined with its level of resources - *financial and technological*. The importance of capabilities is exemplified by Williams et al. (1998) who found that "firms with EDI capabilities tend to do business only with suppliers/customers who also have appropriate levels of EDI capabilities" p.83. Many empirical studies have found a positive relationship between firm size and successful adoption of EDI (e.g. Mohr, 1990; Williams, 1994; Williams et al., 1998)**.** Moreover, resource capabilities are important variables to describe how well an organization has adopted and integrated IT solutions to achieve business objectives (Nygaard-Andersen and Bjorn-Andersen, 1994). A description of the readiness and capability constructs; type of measures and supporting studies is located in Appendix Two. It is proposed that a higher level of preparedness leads to higher potential impact of the collaborative system.

### 3.2 Expected Collaborative System Benefit

Many previous studies of EDI (e.g. Suzuki and Williams, 1998) include the level of expected benefits as one of the explanatory factors of EDI adoption. Expected benefits refers to the "level of recognition of the relative advantage" that the inter-organizational system can provide the firm (Iacovou et al., 1995,469). This level of recognition is the management's perception prior to implementation of the system. A higher managerial recognition of the benefits from the Internet-based system increases the likelihood that resources - *managerial, technological and financial* - will be allocated to implement the system (Chwelos et al., 2001). In one study (Lederer et al., 1997), the anticipated benefits predicted the firm's intended e-commerce strategy.

This construct is measured through respondent's *expected benefits* achievable from implementing the system. The benefits perceived by management can dictate the business objective of the system. "Direct" benefits refer to the management's focus on information flow related benefits and operational efficiency that are attributable to the system. "Indirect" benefits relate to the management's focus on potential strategic objectives, i.e. improved collaborative relationships and competitive advantage. It is proposed that a higher level of expected benefits leads to higher potential impact of the collaborative system.

### 3.3 Interaction Contingencies

Due to the complexities of modern supply chains, the interaction variables that govern the buyer-supplier relationships need to be evaluated. This construct is based upon the situational context of the exchange relationship that governs supply chain interactions. Several authors e.g. (Malone et al., 1987; Benjamin et al., 1990; Holland and Lockett, 1994; Benjamin and Wigand, 1995; Choudhury, 1997) have evaluated EDI in terms of its exchange structures, classifications range from electronic markets, mixed mode arrangements to electronic hierarchies. However, for collaboration, an evaluation of the relationship based solely on the exchange mechanisms is inadequate; the dependency situation of the trading partners needs to be examined. Trading partner relationship dimensions can be characterised as tightly coupled or loosely coupled based on the level of dependency (Reekers and Smithson, 1994)**.** A *tightly coupled* relationship is typified by mutually high levels of dependency as indicated by percentage of sales (volume represented by the buyer) and high perception of dependency level on the trading partner. Contrary to this, a *loosely coupled* relationship is where both trading partners display low levels of dependency on each other. Furthermore, some authors (Ahmad and Schroeder, 2001) argue that greater extent of use of inter-organizational systems fosters tighter coupling between transacting firms.

A caveat to evaluating relationships based on dependencies is that many trading partner relationships are often dictated by power differentials. Various authors (Premkumar and Ramamurthy, 1995; Hart and Saunders, 1997; Ramamurthy et al., 1999) have investigated the issues around power and coercion in the uptake of systems with suppliers. Often system adopters are classified by the motivation behind the uptake ranging from initiator, motivated, unmotivated to coerced. Some studies (e.g. Iacovou et al., 1995; Chwelos et al., 2001) have concluded that coercive power of the trading partner was related to reasons for adopting and implementing IOS. Whereas integrating supply chain systems requires a larger commitment of resources (financial, technical and human) which in turn increases the vulnerability of trading partners. Hence, the power dimension plays a pivotal role in gaining compliance for the adoption and implementation of

collaborative initiatives. A description of the interaction contingencies constructs; type of measures and supporting studies is located in Appendix Two. It is proposed that a lower level of interaction contingencies (tighter coupling, lower power differential) leads to higher potential impact of the collaborative system.

### 3.4 Partnership Uncertainty & Trust

Uncertainty is viewed as the inability to forecast accurately the resource requirements (technical and organizational factors) to handle variability in the near future *(adapted from William et al. 1998)*. For the purposes of this study, partnership uncertainty is the uncertainty a firm perceives about its relationship with a business partner (Bensaou and Venkatraman, 1996). From a network perspective, a firm facing a high degree of uncertainty may become increasingly dependent on another organization that can more effectively cope with the external uncertainty (Reekers and Smithson, 1996).

Manufacturers pursue cooperative agreements to reduce uncertainty, get fast access to information, technologies and know-how. IOS systems can change power balance of a relationship towards manufacturers as they are better able to cope with external uncertainty (Powell, 1990). Often firms agree to participate in technological alliances seek to reduce uncertainties in the supply chain (Murray and Mahon, 1993). However, when technological unpredictability is present, organizations tend not to establish long lasting linkages with partners as they want to retain flexibility to terminate relationships and switch to partners with more appropriate technological capabilities (Heide and John, 1990). It is proposed that a lower level of partnership uncertainty leads to higher potential impact of the collaborative system.

Trading exchange relationships are built on a foundation of trust and commitment. An integral factor in partnership uncertainty and the promotion of collaborative practice amongst trading partners is trust. Trust in trading relationship can be summarized as when the exchange partner is expected to be credible such that his word or promise can be relied on; the exchange partner will behave in ways that protect the welfare of both parties; and the exchange partners are dedicated to reciprocating the obligations and commitments between them (Ba, 2001). Many authors (Grover, 1993; Premkumar and Ramamurthy, 1995; Hart and Saunders, 1997; Ramamurthy et al., 1999) have suggested that a high level of mutual trust is needed for partners to be willing to adopt and implement EDI. Kumar (1996) found that one of the most important factors in the failure to establish a sustainable interconnection between manufacturing firms was down to trust. For a collaborative supply chain system, the need for mutual trust is extremely important because the relationship needs to move beyond an information exchange to achieve greater information ‘transparency’.

Commitment is the belief that the trading partners are willing to devote energy to sustain the relationship (Dion et al., 1995). Inter-organizational transactions are usually managed through requests that form the basis of commitment by mutual agreement (Weltry and Becerra-Fernandez, 2001). The more committed a trading partner the more likely to dedicate resources to pursue sustainable goals with supply chain partners. It is proposed that a higher level of trust and commitment leads to higher potential impact of the collaborative system.

## 4 Methodology

This research study was of an exploratory nature as little empirical, in-depth investigation has been conducted on the impact of supply chain relationships in a collaborative setting. Many of the previous studies on evaluating IOS have deployed large-scale surveys using a static cross-sectional approach. This method often excludes the process leading up to the adoption decision, which is of paramount importance in technologies nurturing collaboration. Furthermore, many political and environmental aspects are not captured by these static rational models (Grover, 1993). By taking a process-based approach, a researcher can obtain more insight into the dynamics of the operationalization, which distinguishes "collaborative technologies" from those cultivated through coercion. A process-based approach can examine the affects of integral issues at various stages of adoption, implementation and impact in all the participating organizations. In order to investigate the dichotomy of the potential factors, this study examines the supply network participants from both perspectives of the dyadic relationship – system integrators and their 1st tier suppliers.

The design of this study combined multiple forms of investigations including literature analysis; empirical studies and observations as a basis for the predictive model (figure 3). Through these multiple forms of investigations, the model has been iteratively refined to provide a comprehensive, yet flexible, framework that represents the empirical situation when implementing and using the collaborative information system.

This field study approach consisted of deploying two questionnaires complemented by observations and interviews during interim periods of the adoption and implementation process. These questionnaires were designed to investigate the main contributing factors to the system adoption based around constructs shown to be significant in previous studies and validated through a pilot study involving one group of participants. The results were used to ascertain the level of potential contributing factors at the preliminary stage of adoption. All the participants were grouped according to their dyadic relationship and categorized based upon the level of contributing factors. This provided the empirical data to revise an earlier conceptual model. Finally, a focus group forum was held to discuss the preliminary results with the participants in order to validate the questionnaire results and contextualize the findings. Subsequently, these indicators have been supported by observations and discussions as well as verified by other academic researchers involved in this EU-funded project.

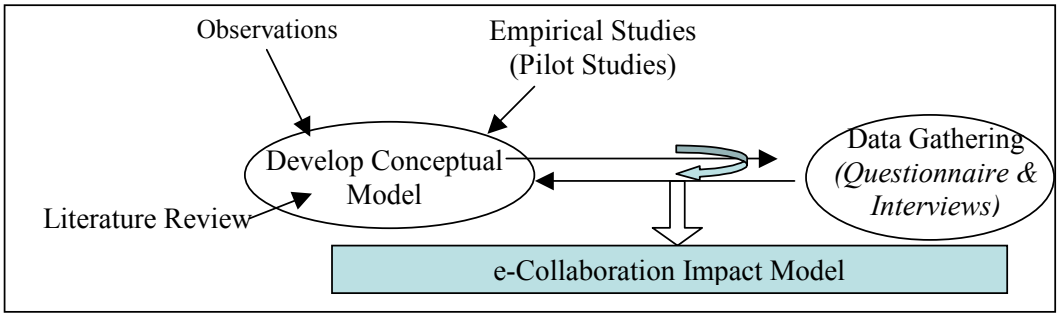


***Figure 3:*** *Research Design For The Study*

### 4.1 Empirical Setting

The empirical testing involved three manufacturing organizations in different EU countries, the Netherlands, Italy and Denmark. These manufacturers are referred to as system integrators (SI) as defined by a company that integrates components provided by suppliers. Each SI agreed to participate in an EU-Funded project called Co-Improve for the Extended Manufacturing Enterprise. This Co-Improve project covered a three year period with all three SI utilizing the same web-based exchange system to facilitate collaborative improvement activities with three to five suppliers. The suppliers ranged from small (less than 100) to medium enterprises (up to 500) and were selected by the SI. From this process, two questionnaires (one for system integrators and another for suppliers) comprised of 26 questions were deployed at the adoption and post-implementation stages of the Co-Improve system. Overall a total of 11 dyads were examined, for consistency the same two instruments were deployed to each participant involved in the project.

## 5 Findings

The questionnaires responses were grouped according to the major contributing factors identified earlier in the e-Collaboration framework. To categorize the results, the positioning process outlined in the contingency framework was utilized. The predictive model was deployed in three steps:

1. Classify how prepared the organization is to exploit the potential of a collaborative system.
2. Assign each organization into adopter categories according to expected benefits and preparedness.
3. Categorize all the participants onto the 'Positioning Map'.

*The first step is to classify how prepared the organization is to exploit the potential of a collaborative system.* The results of the preliminary questionnaire indicate that the amount of preparedness (incorporating readiness and capability) of each supply network incorporates diverse levels (Table 1). In the Dutch network, the system integrator's level of preparedness is classified as *medium*. At the same time, the corresponding suppliers' level of preparedness ranged from *low* (Dutch 3 = new supplier, not yet in serial production) to *medium-high* (Dutch 1 = long-term, key component supplier). A similar situation exists in the Danish network, where the level of preparedness varied in each supplier. Moreover, the lowest of the three suppliers (Danish 3) indicated a *low* level of readiness in shared goals; top management support; and existence of a champion coupled with infrequent meetings and no history of improvement projects. In contrast, the highest supplier response of *medium-high* (Danish 1) illustrated the existence of shared goals, high level of management support, including a champion coupled with very frequent meetings and a substantial history of improvement projects. The responses from the Italian network indicate that the system integrator is *highly* prepared. On the other hand, the suppliers displayed a similar range to the other networks ranging from *medium-low* (Italian 3) to *medium-high* (Italian 2). This difference in preparedness between system integrator and suppliers may hinder the adoption of the system since the level of pre-adoption usage of ICT may constrict the roll-out of the implementation phase.

***Table 1:*** *Level Of Preparedness*

| Preparedness | Level 1 | Level 2 | Level 3 |
|---|---|---|---|
| *Dutch Network* | Dutch 3 | Dutch System Integrator | |
| | | Dutch 1 | |
| | | Dutch 2 | |
| *Danish Network* | | Danish System Integrator | |
| | | Danish 1 | |
| | Danish 2 & 3 | | |
| *Italian Network* | | Italian 1, 4 & 5 | Italian System Integrator |
| | | Italian 2 | |
| | Italian 3 | | |

The second step of the 'positioning' framework is to assign each organization into adopter categories according to expected benefits and preparedness. In order to determine the potential usage of a supply chain system, the two dimensions of 'organizational preparedness' and 'expected benefit' need to be integrated, this is captured in the matrix in Table 3. In order to categorize the types of system adopters, Nygaard-Andersen and Bjorn-Andersen (1994) have used the classifications of the rationalist, functionalist, opportunist and strategist with new intermediate categories of the realist and entrepreneur. These classifications of adopters are important for combining the perception of benefits with the organizational ability to adopt and implement the collaborative initiatives.

Interestingly, the Dutch, Danish and Italian SI all indicated a medium level of expected benefits from the system. This categorizes them as 'realist' or 'functionalist' adopters. The majority of the suppliers were 'realists' indicating only a low or medium level of expectation coupled with a medium level of preparedness. The realist has operational level objectives but is more aligned with the level of organizational preparedness. The functionalist has similar objectives to the realist, but focuses on specific functions where operational benefits can be achieved even though the organization has a high level of resources and ability to achieve strategic benefits. On the other hand, one Dutch supplier and two Italian suppliers were more optimistic indicating a high level classifying them as 'entrepreneurs' when their preparedness is considered. The entrepreneur has strategic objectives, however is ultimately limited by its organizational preparedness although might obtain limited strategic benefits. One supplier questioned about this high level, responded that the most important characteristic of the system was the potential for knowledge sharing and ultimately a closer relationship with the system integrator. Another supplier, Italian 3, was classified as an 'opportunist', due to high expectations although its preparedness limits the ability to achieve to significant collaborative benefits. The opportunist is trying to achieve strategic benefits (such as new business opportunities) however is limited by the low-level organizational constraints. Three suppliers were categorized as 'rationalist' due to their 'low' expectations and limited organizational ability to achieve higher categories of benefits. The rationalist is characterized by having a focus on the operational savings achievable and a low level of organizational readiness and capability. The ultimate category, the strategist, was not represented in this study due to the high level of strategic goals required. This category

enables a full exploitation of collaborative e-business systems coupled with the ability to fulfil these, such as initiators of new systems.

***Table 2:*** *Adopter Categories Of Organizations (by Expected Benefits & Preparedness)*

| | **Level 1** | | **Level 2** | | **Level 3** | |
|---|---|---|---|---|---|---|
| **Category** | Rationalist | Opportunist | Realist | Entrepreneur | Functionalist | Strategist |
| Dutch Network | Dutch 3 | | Dutch System Integrator | | | |
| | | | | Dutch 1 | | |
| | | | Dutch 2 | | | |
| Danish Network | | | Danish System Integrator | | | |
| | | | Danish 1 | | | |
| | Danish 2 | | | | | |
| | Danish 3 | | | | | |
| Italian Network | | | Italian 1 | | Italian System Integrator | |
| | | | | Italian 2 | | |
| | | Italian 3 | | | | |
| | | | | Italian 4 | | |
| | | | Italian 5 | | | |

*The final step is the placing of the participants onto the 'Positioning Map'*. The respective positions categorized in Table 3, are mapped onto Table 4 with the inclusion of the variables - 'interaction contingencies' and 'partnership uncertainties'.

In the Dutch network, the level of dependency varies according to the supplier relationship. The highest level of co-dependency is found in Dutch 1 where the SI is highly reliant on this sole supplier of crucial components and the supplier attributes a high volume of sales to this integrator. This co-dependency coupled with medium level of preparedness categorized this supplier into *Cell VIII*. This 'entrepreneur' potential can take advantage of the 'few' interaction contingencies to capitalize on strategic initiatives with its trading partner to achieve behavioural change and strategic benefits. In fact, this supplier did achieve a strategic gain through increased sales as a result of a collaborative opportunity that led to new product development and future sales contract. Whereas the Dutch 2 supplier is categorized in *Cell VII* with a stabile relationship (10+ years) exemplified through a lower level of uncertainty and tighter dependency. This 'realist' can achieve direct benefits in operational savings and limited efficiency of internal processes with the possibility of benefit sharing with the SI. This relationship achieved operational efficiency and information sharing. However, the prospect of enacting behavioural change was limited. On the other end of the spectrum, Dutch 3, this relationship shows a mutually low level of dependency typical of a new start-up relationship governed by market forces. Furthermore, it is characterized by its high level of partnership uncertainty. This supplier, positioned in the *Cell I*, achieved only limited impact with very low operational change during the project. In fact, the relationship had been beset with initial serial production problems and associated inter-organizational relationship problems.

The third Danish supplier has this same low level positioning, *Cell I,* and consequently achieved only a low level of operational impact. In contrast, Danish 1 & 2 responses indicated a high level of co-dependency, a partial explanation of this high level is the long-term relationship characterized by small suppliers providing tailor-made components to this larger buyer. The suppliers are dependent on this buyer for a high volume of sales and the buyer is reliant on the unique products provided by these suppliers. Danish 2 is categorized into Cell III which can only achieve limited operational effectiveness gains for all the trading partners. The limited organizational preparedness allows only incremental process change thus restricting the depth of the system integration with internal processes. Danish 1 is categorized in *Cell VII,* which enables a higher potential to achieve direct benefits through process efficiencies with collaborative initiatives. Both supplier and buyer achieved operational benefits in terms of quality, cost, engineering change management and order lead-time. Although collaborative benefits ensued, no strategic benefits were observed.

In contrast to the other two dyads, the Italian situation is distinguished by a SI that is much less dependent on the participating suppliers. The coupling of the relationships appears looser with the suppliers indicating a higher dependence on the larger buyer. This situation is common in the aircraft assembly industry supply chain relationships where the buyer is less dependent. The Italian suppliers 2 & 5 are the highest positioned suppliers in *Cell VIII & VII* respectively. These relationships did achieve operational benefits and had the potential to achieve strategic gains, particularly as the stage is set with the higher positioned SI. Although to date only limited strategic benefits were noted, mainly an increase of sales attributable to new product development. Italian 4, positioned in *Cell VI*, achieved improved effectiveness through discontinuous process change such as reengineering products. The lowest positioned supplier, Italian 3, is placed in *Cell II* which allowed for only marginal gains in direct benefits, such as operational savings and limited change in internal processes. Only marginal evidence of collaborative improvement was displayed.

The positioning of the participants in Table 4 has been corroborated through a so-called *member check* (Flick, 1998) with the Dutch participants and subsequent observations in the field over the duration of this project. Furthermore, local academic researchers involved in this project in Holland, Denmark, Italy were consulted and verified the positioning based upon their research and assessments. To further support this evaluation, details of the collaborative improvement initiatives undertaken during the project cycle were compiled and the impact of each initiative was assessed.

***Table 4:*** *Propagation Of The Positioning Map*

| | **Organizational Preparedness** | | | | | |
|---|---|---|---|---|---|---|
| | **Level 1** | | **Level 2** | | **Level 3** | |
| **Interaction Contingencies** | **Rationalist** | **Opportunist** | **Realist** | **Entrepreneur** | **Functionalist** | **Strategist** |
| **Many** (High Partnership Uncertainty, Loosely Coupled) | Dutch 3<br>Cell I | Italian 3<br>Cell II | Italian 1 & Italian 5;<br>Danish 3<br>Cell V | Italian 4<br>Cell VI | Cell IX | Cell X |
| **Few** (Low Partnership Uncertainty, Tightly Coupled) | Danish 2<br>Cell III | Cell IV | Dutch S. I.; Danish S.I.; Danish 1; Dutch 2<br>Cell VII | Dutch 1; Italian 2<br>Cell VIII | Italian S. I.<br>Cell XI | Cell XII |

## 6 Conclusion

Fostering collaboration between buyers and suppliers is a difficult process. The empirical results indicated diverse levels of use and impact when adopting the same Internet-based supply chain system. Interestingly, each dyadic relationship experienced some degree of impact in terms of information sharing and process change. Consequently, there is no simple one-size-fits-all solution to the successful adoption and use of collaborative supply chain systems. Nevertheless, these preliminary results reveal that four ex ante factors - *organisational preparedness, expected benefits, partnership uncertainty/trust and interaction contingencies* – can provide a forecast toward the future use of a collaborative supply chain system.

Successful deployment of a collaborative system is dependent upon a high degree of co-integration. Potential integration of collaborative initiatives appears to be reliant on the relationship history. In this study, the relationship dimensions displaying a significant indicator of use were: *prevalence of shared goals; high frequency meetings; history of ICT interactions and joint projects*. Surprisingly, these relationship issues are often neglected in other IOS studies even though they appear particularly pertinent to collaborative systems adoption. Concurring with previous IOS studies (Grover, 1993; Iacovou et al., 1995; Chwelos et al., 2001), other relevant adoption factors include a supportive top management and the existence of a champion. This suggests that a significant level of interaction history and management guidance can bolster the transition to new collaborative practices. The capability level of the supplier was also found to be an important indicator of future use. Particularly the size of the firm (e.g. Mohr, 1990; Williams, 1994; Williams et al., 1998) and the willingness to deploy resources (e.g. Nygaard-Andersen and Bjorn-Andersen, 1994; Russo and Fouts, 1997). Partners

classified with a low level of organisational readiness and capability can hinder the adoption and integration of the system.

Another valuable measure of system integration was the level of trust displayed by the supplier; a higher perception of trust towards the buyer increased the likelihood of deploying sufficient resources to support collaborative processes. These findings support other IOS studies that trust is critical factor in inter-organisational interactions (Grover, 1993; Premkumar and Ramamurthy, 1995; Hart and Saunders, 1997; Ramamurthy et al., 1999). However, many previous studies (e.g. Premkumar and Ramamurthy, 1995; Hart and Saunders, 1997) have concluded that coercion or exercised power was a critical factor in IOS adoption, whereas our results show that the majority of suppliers rated this as insignificant or no influence. This low level of coercion would be in keeping with a new collaborative initiative requiring mutual consent. However, our results showed that a highly dependent supplier was more likely to comply with the buying firm's request and achieve higher impact than less dependent suppliers. Another significant factor was the level of expected benefits before adopting the system which provided a highly relevant predictor of eventual use. Similar to Iacovou et al. (1995) findings, the firms anticipating the highest level of benefits from the system achieved more impact than the participants with lower level expectations.

Although tentative, the results indicate that the suppliers with the most infrequent use of the system were characterised by: *low organisational preparedness; low level of dependency; low level of trust; and low expectation of benefits from the system* (firms categorised in Cells I & II). These firms were less inclined to achieve a significant impact in terms of operational and strategic benefits - reporting only marginal gains in direct benefits, such as efficiency savings and incremental process improvements. On the other hand, the suppliers with the highest positioning factors (firms in Cells VIII) achieved more significant impact – reporting direct as well as indirect benefits. These indirect benefits included knowledge sharing, new product design, discontinuous process improvements sometimes leading to increase in sales. This supports the assertion made by Subramani (2004) that the combination of supply chain system use and relationship-specific investments enhances suppliers' ability to benefit from the system.

## 7 Discussion

Collaborative supply chain systems are relatively recent phenomenon with limited published studies evaluating the relationship between information systems, collaborative relationships and the supply chain. Existing IOS frameworks are inadequate to capture the ubiquitous nature of web-based collaborative supply chain systems. This paper identifies the development of a contingency framework which can be deployed to 'position' supply chain partners as well as estimate the potential impact of collaborative systems. This 'positioning' approach is designed to overcome the shortcomings identified earlier in the IOS/EDI literature when dealing with the more multifaceted potential of integrating supply chain systems.

The results suggest several implications for managers and researchers alike. For managers considering an investment in collaborative systems, it is important to forecast the potential use and impact of the system. We believe our framework can help decision makers by providing a method of selecting trading partners for collaboration. It is important for decision makers to assess particular situational and relationship factors, both internally and externally, before embarking on collaborative initiatives. Decision makers need to ascertain if the potential returns justify the large outlay of resources - *financial, managerial, and organizational* - to implement an integrated supply chain

system. Our contingency approach provides system integrators with several options in choosing appropriate partners and collaborative initiatives. Through the generation of a positioning map, existing suppliers can be evaluated to select the most suitable based upon their potential contribution and strategic relevance. It demonstrates that an instrument can be deployed to categorize supply chain partners in terms of their appropriateness for collaborative initiatives in the pre-adoption phase. Its predictive nature can assist firms with determining whether or not the pursuit of an integrated supply chain system would prove to be a viable undertaking. By restricting the scope of supply chain integration to the most appropriately chosen partners, these decision makers can reduce the risk of failure during the process of implementation. For system integrators, selecting suppliers with the highest level of preparedness, trust and commitment can reduce the risk of inertia during the role out of the system and collaborative practices. System integrators can leverage these supplier capabilities to encourage supplier investment and use of the system. On the other hand, suppliers can ascertain the level of committed resources required to benefit from partaking in a buyer's collaborative network.

As this is the initial empirical testing, there is need for further operationalization and validation of the framework. Other researchers and practitioners could use this 'positioning' approach for further investigations into the concept of the e-integrated supply chain. Given its paucity, additional empirical research is required into evaluation of Internet-based collaborative supply chain systems.

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## *Appendix 1*

Review of IOS Frameworks/ Topologies (By Date)

| Author(s) | Theoretical Perspective | Evaluates Organizational Elements | Evaluates Interorganizational Relationships | Evaluates Process Integration | Evaluates Adopters Perceptions | Evaluates Environmental Factors | Evaluates Implementation Factors | Description of Framework / Typology |
|---|---|---|---|---|---|---|---|---|
| Bakos (1986) | Transaction Cost Approach | Yes | Limited | Limited | No | Limited | No | Interconnections between the system participants and the location of the value-adding processes |
| Malone, Yates and Benjamin (1987) | Transaction Cost Approach | Limited | Limited | No | No | Limited | No | Evaluates the exchange structures as 'Electronic Markets' or 'Electronic hierarchies' |
| Johnston and Vitale (1988) | Transaction Cost Approach | Yes | Yes | Limited | Limited | No | No | Three dimensions incorporating the business function, dyadic relationship and the information function |
| Holland, Lockett and Blackman (1992) | Diffusion of Innovations, Transaction Cost Approach | Yes | Yes | No | Yes | Limited | Limited | Interdependencies of structures, asset specificity, market complexity and coordination strategy |
| Nygaard-Andersen and Bjorn-Andersen (1994) | Competitive Analysis | Yes | Limited | Limited | Yes | Limited | Limited | Three main elements: environment; organization and the EDI system are used to evaluate the threats and opportunities |
| Iacovou et al. (1995) | Diffusion of Innovations | Limited | Yes | Yes | Yes | Limited | Limited | Conceptual framework based upon power and trust |
| Premkumar and Ramamurthy (1995) | Resource Dependency | Yes | Yes | Yes | Limited | Yes | Yes | Social, political and economic factors to ad implementation |
| Chatfield and Bjorn-Andersen (1997) | Value Chain | Limited | Limited | Limited | Yes | Yes | Limited | Generic framework incorporating environment, business challenges, and management methodologies |
| Choudhury (1997) | Transaction Cost Approach | Yes | Yes | No | Limited | No | No | Expands Bakos (1987), Malone et al. (1987) frameworks by adding a third industry structure |
| Hart and Saunders (1997) | Resource Dependency | Yes | Yes | No | Yes | Limited | No | Theoretical framework based upon power and trust |
| Walton and Gupta (1999) | Transaction Cost Approach | Yes | Limited | Yes | Yes | No | Limited | Typology combining two dimensions of process focus and transaction set impact |
| Chatfield and Yetton (2000) | Competitive Advantage, Embeddedness | Yes | Yes | Yes | Limited | Limited | Yes | Competitive advantage model merging theory of Embeddedness& MIT 90s model of fit |

## Appendix 2

Details of the Readiness Construct

| *Subconstruct* | *Description* | *Type of Measure* | *Source* |
|---|---|---|---|
| • Modes of interaction<br>• Goal congruency<br>• Management support<br>• Champion<br>• Organizational<br>• Compatibility | • Types & frequency of work practice interactions<br>• Level of goal setting and information sharing<br>• Level of management support<br>• Existence of individual promoter<br>• Types & frequencies of work practices in IT | • Perceptual<br>• Perceptual<br>• Perceptual<br>• Indicative<br>• Perceptual | • Grover 1993<br>• Developed for this study<br>• Premkumar et al. 1994<br>• Premkumar et al. 1994<br>• Developed for this study |

Details of the Capability Construct

| *Subconstruct* | *Description* | *Type of Measure* | *Source* |
|---|---|---|---|
| • Organizational size<br>• Financial resources<br>• Technical resources<br>• Level of IT maturity | • Number of employees; amount of turnover<br>• Level of financial resources willing to commit<br>• Level of technical resources willing to commit<br>• Level of IT use & integration in business process | • Indicative<br>• Perceptual<br>• Perceptual<br>• Perceptual | • Premkumar et al. 1994<br>• (Saunders and Clark, 1992)<br>• Grover 1993<br>• Grover 1993 |

Details of the Interaction Contingencies Construct

| *Subconstruct* | *Description* | *Type of Measure* | *Source* |
|---|---|---|---|
| • Organizational ownership<br>• Dependency on trading partner<br>• Trading partner power | • Level of ownership/investment between the organizations<br>• Percentage of sales and profit related to trading partner<br>• Level of trading partner influence on system adoption | • Indicative<br>• Indicative<br>• Perceptual | • Malone et al. 1987<br>• Chelwos et al. 2001<br>• Iacovou et al. 1995 |

Details of the Uncertainties Construct

| *Subconstruct* | *Description* | *Type of Measure* | *Source* |
|---|---|---|---|
| • Environmental<br>• Demand variability<br>• Competitive pressure<br>• Partnership<br>• Trust<br>• Commitment to the relationship<br>• Trading partner pressure | • Variability in forecasting; supply frequency<br>• Pressure from competition for implementing system<br>• Level of trust toward trading partner<br>• Commitment in the relationship<br>• Pressure from trading partner for collaborative system | • Perceptual | • Bensaou & Venkatraman 1995<br>• Grover 1993<br>• Hart & Saunders 1997<br>• Hart & Saunders 1997<br>• Chelwos et al. 2001 |