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Interorganizational Systems and Supply Chain Management - An Information Processing Perspective

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Abstract- **Supply chain management has become an excellent strategy to effectively link all the trading partners and ensure cost effective and timely movement of materials from the raw material supplier to the final end-consumer.Inter-organizational systems provide the technology infrastructure to facilitate the flow of information along the chain and thereby ensuring the smooth flow of goods. The two areas have been developing independently without realizing the synergies in integrating the research from the two fields. This paper attempts to provide an integrated perspective of supply chain management and inter-organizational systems highlighting the potential benefits, management issues, and guidelines for implementation.**

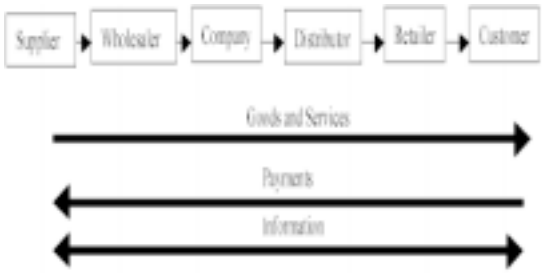
I. Introduction

In recent years supply chain management has been touted as one of the major strategies to improve organizational performance and generate competitive advantage in the market [1, 7]. A variety of changes in the business environment including time-based competition, fast product cycle, just-in-time production, cost leadership, use of inter-organizational systems, and global competition have fueled interest in supply chain management. Supply chain management (SCM) encompasses many activities, but for the purposes of this paper will be defined as follows; "Supply chain management is the integration of all activities associated with the flow and transformation of goods from new materials, through to the end user, as well as associated information flows, through improved supply-chain relationships to achieve a sustainable competitive advantage" [9]. This definition clearly identifies the two major flow components of supply chain - flow of materials and information along the chain. The growth in inter-organizational systems (IOS) has made it possible to have electronic flow of information across the supply chain.

Traditional research on supply chain has focused on the flow of material and information independently - the operations and logistics researchers focusing on movement of materials [2] and IT researchers focusing on electronic flow of information [13]. In this paper we try to integrate the findings from these two research streams and identify critical management issues related to implementation of an electronic supply chain that integrates traditional supply chain with inter-organizational systems.

2.0 SUPPLY CHAIN MANAGEMENT

A supply chain is a series of inter-linked suppliers and customers that takes a basic raw material at one end and delivers a finished product to the ultimate end-user at the other end. Figure 1 shows the players in a supply chain.



The supply chain can be decomposed into many levels. We could have a single level supply chain that just includes the focal firm's immediate set of suppliers and customers, or you could go down *n* levels to include the raw material supplier on one end and the disposal of used finished product at the other end. Supply chain becomes sufficiently complex beyond 2 levels. The complexity stems from the fact that it is not a simple linear chain as shown in figure 1, but a complex web of chains, as each customer and supplier in the chain has many supply chains with their many suppliers and customers. Since most organizations have neither the control nor the resources to monitor the entire web, they normally restrict their focus to one or two levels.

There are three components flowing through the supply chain. Goods and services in one direction, payments in the other direction, and information in both directions. Sometimes payments are shown as an information flow and not as a separate flow, although its characteristics are different and require different set of entities. To facilitate the movement of these three components we need the service of other entities. While transportation carriers and logistics firms are used for movement of goods, banks and financial institutions are used for movement of payments. Information flow can occur between the entities directly or through an outsourcer or third party. Direct links between firms are becoming more popular than the latter. However, there are large third party industry-wide IOS that create the infrastructure to facilitate the movement of information. An example of such an agency is the airline reservation system (e.g.: Sabre) that facilitates movement of information among various entities in the transportation industry (airlines, travel agents, customers, rental car agencies, hotel etc.). Figure 2 shows the various players for the first level of supply chain in an organization.

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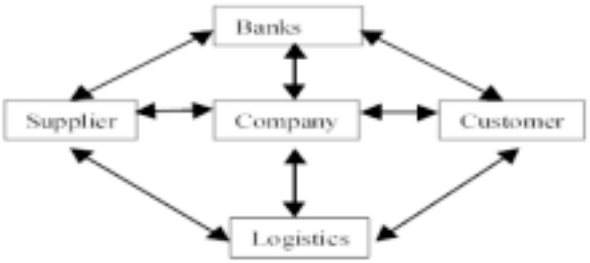

Information flow is a critical component for the efficient performance of the supply chain. The recent growth in IOS has enabled the electronic flow of information among the partners of the supply chain [10]. This has brought in new opportunities as well as challenges to the management of the supply chain.
Some of the major objectives of supply chain are:

- Customer service
- Cycle time reduction
- Inventory turnover
- Flexibility and adaptability in the system
- Effectiveness of business processes

Supply chain management has a broad focus including operations and logistics coordination, partnerships in market research and product development, and coordination of customer service. Some of the implementation issues in supply chain management are:

- Alignment of business interests of partners
- Long-term relationship management
- Reluctance to share information
- Complexity of large scale SCM
- Competence of personnel supporting SCM
- Performance measurement and incentive systems to support SCM

3.0 INTERORGANIZATIONAL SYSTEMS

Information flow between organizations existed ever since human beings traded their goods and services. What is unique about the current environment is the availability of a communications infrastructure to electronically transfer information, with minimal effort and time lag, resulting in easy availability of information. Inter-organizational systems, are application systems that link various partners in the supply chain using a public or private telecommunications infrastructure. These systems provide the ability for computer-to-computer communication of business transactions and documents. Electronic data interchange (EDI) is one of the earliest technology. Although EDI has been in existence for more than 20 years, it is only in the last 5-10 years that it has been widely used. There are basically two types of IOS - electronic dyads between two firms and electronic networks or multi-lateral IOIS.

There are three levels of sophistication in IOS:

1. Communication
2. Coordination
3. Cooperation.

At the simplest level IOS can be used for electronic *communication* of messages between trading partners. This provides the basic infrastructure for electronic transmission of information, and may or may not be integrated with the rest of the IS in the organization. At this level, we are basically substituting paper, phone or fax modes of communication with computer-to-computer communication. Very often this happens in the initial stages of EDI, when a novice partner uses the computer to collect the EDI messages and later print them or rekey them for internal use. The second level of sophistication is *coordination*, where the computer-to-computer communication is integrated with the internal IS. An order from a customer is automatically entered, after routine validation into the order processing and production planning system of the organization. There is active coordination in terms of production planning, delivery schedule, logistics coordination etc. between the partners. The level of coordination or coupling can be tight or loose depending on the level of information sharing and slack existing in the coupling. The last level of sophistication is *cooperation* where the two business partners share common goals and use similar performance measures to evaluate the performance of their inter-organizational activities. Cooperation can occur over a wide range of levels spanning multiple functional areas within the organization. For example, the firm can provide initial product design information to the suppliers and get their inputs on product design; or the distributor can share customer information with their partners to support cross selling of some products or develop joint promotional campaigns. Information technology plays a critical role in many of these cooperative ventures. This level of sophistication forms the advanced level of SCM where we graduate from traditional logistics to the entire gamut of business processes linking the two partners [2].

3.1 Transaction Cost Economics framework

The field of transaction cost economics provides some theoretical framework for discussion of market structures. The two questions asked by all firms are:

> Which activities should a firm keep within its boundaries and which activities should it outsource from outside?
>
> How should it manage its relationship with its customers, suppliers, and other business partners?

A firm could have all the activities within its boundary and operate as a hierarchy or outsource most of the activities, except its core competencies and operate as a market with a core virtual corporation. There are hybrid structures where a firm may outsource only a few activities. Organizational

design is to some extent dependent on the two cost components - production and transaction cost. Production cost is the direct cost to produce the product. Transaction cost includes coordination cost, operations risk, and opportunism risk. Coordination cost includes the cost of exchanging information on product, demand, etc. Operations risk is the risk that other partner misrepresents or withholds information or underperforms. It stems from differences in objectives of partners and information asymmetries. Opportunism risk is the risk due to lack/ loss of bargaining power due to relationship specific investment. While in markets the production cost is low due to economies of scale and specialization, the transaction costs are higher. In hierarchies the production costs are higher due to lack of economies of scale, but the transaction cost are lower due to limited coordination and less risk. The wide spread use of IOS and the adoption of open standards in these systems have considerably reduced the coordination cost [12]. The extensive availability of information has reduced operations risk and the use of open standards for communication has reduced the opportunism risk. Hence, new technologies have favored markets over hierarchies.

Electronic integration and free flow of information among the supply chain partners opens up a wide range of business opportunities [1]. However, not all of them are easily implementable since there may be resistance to some of them, as they may not provide the same level of benefits to all partners. Typically, EDI has been implemented in a hub and spoke arrangement where the initiator (hub) takes proactive steps to get the smaller firms (spokes), mostly suppliers, to adopt IOS. They may even coerce them into adopting EDI by using a veiled threat of loss of business. Studies have found that the initiator tends to gain more initially, but in the long run all of them benefit from the implementation. A similar situation is found in implementation of supply chains, where a firm normally takes a proactive lead [9].

Most of the discussions on supply chain and IOS is based on the premise that information will be freely shared among the partners, but the reality is otherwise. A critical question on how much information can be shared among the partners is not a technology question but more a business question. Businesses thrive and make money on information asymmetry. Therefore, there are strong disincentives to share information. Unless there is positive proof that sharing information is equally beneficial to all members of the supply chain it will be difficult to convince all members to share information. Withholding of information by even one member in the chain can lead to loss of trust and dysfunctional behavior among all members, despite the best technology to facilitate information flow. Organizations often have twin objectives - (i) reduce their environmental uncertainty by obtaining as much information as possible, (ii) increase information asymmetry to gain maximum benefits from interaction with their partners. The next section discusses the role of IOS in influencing uncertainty and information asymmetry.

4.0 UNCERTAINTY AND INFORMATION SYMMETRY

Most organizations attempt to reduce the uncertainty in their operations by improving the availability of appropriate information for decision making. Information asymmetry among the participating units leads to uncertainty, which in turns leads to inefficiency of the total chain. While all organizations in the supply chain want to reduce their uncertainty, it may be at the expense of others in the supply chain [14]. For example, the buyers may be waiting for a sale to buy in bulk rather than provide advance information of their requirements. Reducing information asymmetry in the supply chain, while ideally optimal, may be threatening the business of brokers who thrive on the asymmetry [11]. The designers of IOS need to be cognizant of practical realities.

The different types of uncertainty and its impact on the supply chain are examined below. Uncertainty can be broadly defined as “the difference in the amount of information required to perform the task and the information already possessed by the organization,” [8]. Daft and Lengel (1986) [4], identified two different forms of uncertainty - (a) uncertainty due to lack of knowledge regarding occurrence of events, and (b) uncertainty due to not knowing how to respond to an event when it occurs (also known as equivocality). In an open supply system it is very difficult to completely eliminate uncertainty since information on orders from customers are random events in most cases. Similarly, there is uncertainty related to supplies from the firm’s vendors. The uncertainty could be due to variations in lead-time or the quality of the products. Hence, a firm has both demand and supply uncertainty that is dependent on their business environment and is normally beyond their control. The firm absorbs the external uncertainty by designing suitable internal systems. It tries to design forecasting systems to better predict the external events. It adds some slack in internal design such as excess inventory (safety stock) or excess processing capacity or longer lead-time to deal with external environmental uncertainty. The lower the external uncertainty the lesser the slack it has to build in its internal design, and therefore, lesser the operation costs. Hence, there is significant incentive to reduce uncertainty.

Organizations also experience uncertainty in its internal sub-units. Whenever there is transfer of goods or information between sub-units that requires coordination, uncertainty is created. For example, variation in production (due to quality or production problems) can create uncertainty in downstream sub-units. Internal uncertainty among the sub-units is influenced by two factors - (a) how the external uncertainty is distributed among the internal sub-units and (b) uncertainty created by its internal operations and information flow. The level of information sharing among the sub-units influences the uncertainty experienced by the sub-units. The

internal units can be isolated from external uncertainty by building inventory on the inbound or the outbound side, or the units can be totally exposed to external uncertainty where everything is made to order. If the information flow between the sales department receiving the orders and the production department producing the products is constrained either by the time it takes to reach the other end or by the accuracy of the information, then it is going to add uncertainty in the production department. For example, if the order lead-time is 1 week and it takes 3 days for the information to reach the production department then they have less time to react to the orders. The flow of information need not be one way. For example, the sales person should have information on production lead-time and inventory for them to promise appropriate delivery schedule. The accounting department should have sufficient information from the buying department to ensure that it has sufficient cash flow to meet payment requirements.

In summary, the design of IOS should also consider the internal supply chain to ensure that information flow is not constrained internally. This brings us to an interesting question. Is it feasible to design an IS that increases free flow of information across all partners in the supply chain? - theoretically-yes, practically - maybe.

5.0 INTEGRATED SYSTEM - A UTOPIA OR A MYOPIA

The concept of an integrated system linking information from order processing, inventory control, production planning, warehousing and accounting has been a dream for IS professionals for more than 3 decades. However, they never considered the organizational reality. Organizations, or even sub-units within an organization, have two types of information - public and private information. The proportion of the two information types is dependent on the culture of the organization. If information is power, and information asymmetry between sub-units provides better opportunities and negotiation capabilities, then there is going to be reluctance to share information. While information asymmetry may cause greater uncertainty among the partners it also provides the ability for one to exploit that uncertainty. Hence, even if it is technically feasible to integrate systems and share information, organizationally it may not be feasible since it may cause major upheavals in the power structure. Dearden (1972) [5] in a classic article in Harvard Business Review claimed that it would be foolish to wish away the organizational realities and attempt developing these integrated systems since they are bound to be implementation failures. Despite these predictions, IS designers in modern organizations have been slowly increasing the level of public information in an organization for the improved performance of the whole organization. The recent introduction of enterprise resource planning (ERP) systems integrating internal IS is a step in that direction. The problems and challenges in implementing ERP highlight some of the organizational constraints. While information flow in current organizations are much better compared to organizations ten years ago, basic information is still not totally transparent within the organization. If the process of opening up the information flow within the organization was a difficult task it is going to be even more difficult across organizations that have widely different business objectives, different stakeholders, and servicing multiple business partners. It is going to require a very high level of trust among trading partners. For example, a sales department would be very unwilling to reveal its promotional campaign since it would like to get as much sales without the promotion before using the promotion to attract new buyers. The development of IOS and integration with the supply chain has many management issues that are highlighted below.

6.0 MANAGEMENT ISSUES

The focus of both SCM and IOS are external to the organization and therefore brings in many unique management issues that are outside the control of senior management. Many of them involve developing better relationships and partnerships with the trading partners [2,3]. The successful implementation of IOS requires the cooperation of a large number of external trading partners., The management and technical issues are discussed below.

6.1. Commonality of Objectives

IOS are built on the premise that all firms in the chain gain from sharing information. However, the benefits may be more for some. The free flow of information may even be a threat to some intermediaries as their existence may be solely based on being an information agent or a buffering agent to overcome uncertainty [11]. For example, if information from the retailer to the manufacturer is instantaneous, the existence of a distributor may be in jeopardy, as its primary role is to act as an information broker between the two or as a warehouser, stocking inventory to buffer for uncertainty and variation in demand. Many industries have been affected by the ability to electronically deliver information across the chain. Direct marketers such as Dell computers have leveraged the Internet to directly provide information to end consumer, thereby bypassing part of the chain [15]. In the airline industry, the ability to directly sell to consumers has put the information broker's (travel agent) business in jeopardy. The middlemen have some clout in the chain and can exert significant influence on the development and adoption of these systems. Compaq, a PC anufacturer, had to reformulate its Internet marketing plan since it alienated its retail dealer network with its web-based online shopping. Hence, although technically feasible, the lack of commonality of objectives and the differences in the benefits among the partners in the chain may create major roadblocks to implementation. Goal congruence between two business partners, intent on maximizing their business goals, is a difficult issue, especially considering the fact that the

organization participates in multiple dyads both at the upstream and downstream end.

6.2. Data Security
IOS provide access to information in databases to their trading partners. While various security measures can be implemented to ensure security, it still exposes the firm and its trading partners to some data risk. The firm would be concerned about intruders hacking into database and getting confidential information about its operations. The partners would be concerned about whether its competitors would get information about its business dealings with the firm. The problem becomes more serious if there is a possibility of vertical integration. Trading partners would be concerned about safeguards to protect its information in their partners' databases. There should be safeguards to ensure that a partner has access to information only related to its operations.

6.3. Alignment with Business Strategies
It is not only adequate to build a technically sophisticated IOS, but also formulate business and marketing strategies that complement these systems. If IS objectives and business strategies are not in alignment, then these IOS are bound to fail. For example, if a firm wants to design an IOS that establishes a long-term relationship with its supplier, it needs to provide the supplier information on its requirements and perhaps even let the supplier monitor its inventory and replenish it as and when necessary. A key component for the success of this system is the mutual agreement and trust that the supplier will supply at a certain price and the firm's buyer will not resort to buying it in bulk during sales promotions in alternative channels. Hence, there needs to be an alignment of business strategies and commitment among firms for long term business cooperation if the system is to succeed.

6.4. Internal Systems and Performance Measures
It is not only important to align the external partners' business strategies but also look inward and redesign internal control systems and performance measures to ensure the success of these systems. For example, if a buyer's performance is evaluated based on the level of savings through buying in sales promotions, then the buyer will continue to engage in buying practices that is advantageous to him/her, but is dysfunctional from an SCM perspective. The organizational structure and the internal systems have to be modified to reflect the new buying arrangements.

An equally important aspect, particularly in the context of SCM, is the performance measurement for the entire supply chain. Suitable benchmark measures need to be developed. An important consideration is how does the chain perform against competing chains to sustain its competitive advantage

Internal control systems and audit measures for IOS are not very well developed. While some of the contractual and legal aspects are considered it should also evaluate various aspects of security, information exposure risk, and fraud.

6.5. Technical Compatibility Issues
Tight integration of systems highlights many technical compatibility issues. While it may be relatively easy to establish a simple system to exchange messages (using EDI or other messaging technologies), the order of complexity increases multi-fold if you have to tightly integrate multiple systems spanning multiple partners. The only solution would be the use of open systems that can exchange information regardless of the hardware and software, or use VANs to provide translation services. The development of XML (extensible markup language) and its integration with EDI provides opportunities to create open systems. Another major technical issue is the transformation from a message passing IOS to an event-driven system where events trigger messages, which trigger various actions.

7.0 GUIDELINES FOR IOS IMPLEMENTATION

The implementation of IOS has to be well planned and carefully implemented. Here are some guidelines.

7.1. Assess business strategy and internal climate of firm
Before embarking on any major IOS it is important to assess the business strategy and top management's views on IOS. If the firm is committed to SCM as a business strategy, then it makes sense to launch an IOS initiative. However, if the organization has not considered or is not in favor of SCM, then it is an uphill battle to sell the idea. Sometimes it may be necessary to be proactive since some organizations may not have visualized an opportunity or formulated a formal business strategy relating to these ideas. It is important to realize that IOS implementation may not be the best strategy for all organizations. Since IOS can create major changes in the industry structure, one has to carefully examine the long-term implications of introducing IOS and determine the threats and opportunities from the new environment.

Once the organization decides to evaluate the technology, the sponsoring department, normally the IS function, can take the lead in championing the adoption by creating an awareness of the technology, its potential and its impact on the firm. It is important to find support from the functional areas that would benefit from IOS implementation. Explore the potential for IOS in the inbound (purchase) or outbound (sales) side and identify a strong champion for the technology. If they have already started an initiative in SCM, IOS can be piggybacked on that initiative. Another strategy that is used in some firms is the "fear" factor. In some firms IOS implementation is initiated in response to external pressure from powerful customers or suppliers. You can examine the external environment to identify potential customer or supplier who may be able to exert pressure to implement IOS. In summary, before launching the IOS project assess the internal environment for synergy with the business strategy, evaluate the long term implications of introducing IOS in the industry, determine the level of support from functional areas, and

identify champions in the functional area to sell the idea to senior management.

7.2. Assess the External Environment for IOS partners
Once you have determined that there is adequate internal support, you need to identify 1-3 potential trading partners for the pilot phase of IOS implementation. Some of the criteria that could be used for the selection of the partner are:

- Implementation focus - Inbound or outbound side
- Desirability of establishing a long-term relationship from a business perspective
- Partners' willingness to participate
- Technical compatibility
- Technical expertise of the partner

Top management has to decide from a business strategy perspective if the supply chain and IOS needs to be implemented on the inbound or outbound side. While traditional supply chain efforts start on the purchase side, some organizations have proactively implemented it on the sales side. The decision is based on the level of support in the functional areas, external pressure, and maximization of benefits. The firm has to identify a few partners with whom it desires to have long-term business partnership, as the systems may evolve to very sophisticated levels of integration and cooperation between the firms. It is necessary to explore with the partners and determine the level of cooperation possible in these activities. Also, the availability of technical expertise at the partners' end and technical compatibility of their systems need to be assessed to determine the level of complexity and effort required for IOS implementation.

7.3. Plan the technology infrastructure
The development of a strong information technology infrastructure is very critical since the scope of IOS in terms of the variety of applications and the number of partners can grow at a very rapid rate. The applications and communications architecture, the two pillars of IT infrastructure, has to have a strong foundation for growth of IOS. The firm has to first determine the level of sophistication (communication, coordination and cooperation) required in the system. Although they evolve through these three levels over a period of time, it is important to decide on the level of integration for the next 3 years so that the infrastructure to support that can be built.

The applications architecture provides a blueprint of the various applications in IOS that users interact with. Some of the major issues that need to be addressed are:

- What will be the primary technology?
- What will be the client-server architecture?
- What will be the nature of linkage?

7.3.1. Technology Choice
The technology choices available are EDI, proprietary application software, simple web-based system, XML, or a combination of these. Some of the factors to be considered are the level of sophistication required, technology trends and commercial availability of the technology, technical expertise of the firm and its partners, partners' preferred technology, type of linkage (one to one, one to many) and resource availability. EDI is a natural choice for a firm wanting to establish a one-on-one connection with its partner. Newer technologies such as XML/EDI integrate the web to EDI and provide more opportunities. Firms such as GE are attempting it on the purchase side by allowing suppliers to bid on GE's requirements posted on the web. An organization may use all of these technologies, choosing the technology that best fits each application. While EDI may be appropriate for large volume event triggered transaction applications, a web-based user interface may be better for online interaction for information retrieval and decision making.

7.3.2 Client server architecture
The client server architecture provides the blueprint for applications development. While the web or EDI determines the user interface to communicate with the partners, a firm has to decide on the back-end system that either provides or uses the data, and how the front-end and back-end system will be integrated. Typically, a middleware exists between the two, creating a 3-tier architecture. The middleware is responsible for a variety of services including mapping data from the front-end system to the specifications of the back-end system, facilitating communication between the two through translation and protocol services, providing common applications programming interface (API) to a widely divergent set of front-end and back-end system and network protocols, and incorporating some validation and business logic for transaction processing. For example, the middleware may receive the EDI message (eg., sales order), map the contents to data fields, validate the data, convert it to a SQL statement, update the back-end database system, and, if necessary, trigger some downstream action. Organizations could use one or more tiers in the middleware depending on the complexity of the system, hardware/software and networks used, vendors' preferences, and performance issues.

7.3.3. Linkage
The nature of system linkage between the partners can be defined along three dimensions - access mode, access type and update mode. *Access mode* could be message-based or interactive. EDI systems are message-based system where there is computer to computer communications, but normally minimal direct user interface for the external users. Alternatively, IOS could have a direct user interface to enable the user to directly interact with the partner's system. The user interface could be proprietary, web-based, or a combination of both. For example, Federal Express provides proprietary interface for large corporate clients to access their tracking system but also provides a web-based interface to the general public. Similarly, the airline reservation systems have proprietary interface for travel agents but also provide web-based interface for general public. Currently, the

proprietary systems have more functionality and better performance compared to web-based systems.
Access type describes the operations the users are allowed on the system - only query or query and update of information. A firm may provide product information to customers but may not allow placing orders online. The access type is to some extent dependent on the firm's level of trust with its partners. Organizations have to assess the level of risk exposure from providing external access. The risks could arise from damage or corruption of data, data security issues, and information privacy issues in terms of access to others' confidential information in the database, and other legal issues.

Update mode specifies the frequency of update of back-end system with the transaction data from IOS - whether it is batch mode or real time mode. In most EDI installations, where tight coupling between the two systems do not exist, the data is updated at periodic intervals in a batch mode. The other option is a real-time update of the database. This could create a significant load for the back-end system if the number of external users and their transactions increase significantly, leading to system performance problems for internal operations. The nature of linkage in terms of access mode, access type, and update mode is determined to some extent by the level of IOS sophistication.

7.3.4. Communications Architecture
The communications architecture is designed to support the applications architecture. It is dependent on a variety of other factors including the partners' preferred mode of communication, cost, level of security and reliability, traffic volume, number of partners and level of communications expertise. The options available are:

- Direct connection using a modem
- Value-added network (VAN)
- Public internet infrastructure
- Virtual private network (VPN)

If the company has only a few partners and infrequent communications, a direct connection using a modem may be the least cost alternative. If the organization has large volume communication with only a few partners, they may be able to justify a leased line between the partners that provides continuous communication. If the firm or its partners do not have the necessary communications expertise then a value added network that provides various EDI related services such as translation, store and forward mail boxes, conversion, and integrated on-site services including front-end and back-end systems would be a good choice to facilitate the adoption of IOS. The growth of internet has created a public packet switched data communications infrastructure that is almost ubiquitous and provides a public highway for communication. However, the internet suffers from perceptions of insecurity and unreliability. If adequate security precautions such as encryption and digital authentication are used, it provides a cost-effective infrastructure for communication, especially for one to many communications where you do not have a fixed set of trading partners. For firms that require a higher level of security and reliability in their communications infrastructure, virtual private network (VPN) provides all these services in a packaged form. VPN piggybacks on the public internet protocol and infrastructure, but uses additional security measures and better quality transmission.

7.4. Design and Implement the System
The firm, depending on its expertise and resources, can choose one of the following options:

- In-house development
- Packaged solution from a vendor
- Third-party development of software solution that specifically meets its needs
- Combination of all the above options

Unlike traditional information systems, IOS is implemented across organizational boundaries. The success in implementation is not only dependent on the firm's level of preparedness, but also on all their partners' readiness. Hence, implementation of IOS is a more complex issue that needs advanced planning. A firm's partner can have a wide range of IS expertise ranging from a novice to an expert, wide range of hardware and software platforms, and numerous other IOS with other trading partners. This web of connections brings in significant technical complexities to overcome, especially if you are using a proprietary system. Apart from the technical complexities some of the partners may not have adequate technical expertise and may require hand holding and training to enable them to implement the IOS. Since success of IOS is dependent on usage of systems across multiple partners, the firm has to manage the implementation process not only locally, but also across all partners. A firm could use supportive or coercive strategies, or both, to ensure success in implementation. Firms that have the economic power over their partners have been successful in using coercive strategies such as demanding IOS for doing business with them. They have found a supportive strategy, such as training and technical support, to be more beneficial for diffusion of IOS.

7.5. Plan for next level of integration
As organizations realize the enormous potential from electronic integration between firms, IOS evolves into more sophisticated levels of integration. As described earlier, firms go through three broad phases of evolution - communication, coordination, and cooperation. Depending on the level a firm started it has to develop a time line for evolution. If a firm started with a simple EDI system for 1-2 transactions with one partner it could plan to expand its scope. Some of the strategies for expansion are:

- Increase the variety of transactions, thereby improving the coordination of various activities between the two firms

- Expand the scope of coverage from one firm to multiple firms, both on the inbound and outbound side, thereby increasing the proportion of transactions communicated using the IOS

- Automate many of the routine transactions such as order processing, delivery scheduling, etc., to event based trigger system that directly communicates to partners' computers without any human intervention

- Evolve from a message-based system to an interactive system providing the partners direct access to information

- Expand information sharing beyond business transactions to other areas of cooperation.

The first strategy is attractive for firms that want to develop very close working relationship with a few partners so that they could graduate to tight integration of their operations in a short time period. The second strategy increases the breadth of coverage of partners. This is helpful if a firm decides to completely automate at least one of its IOS activities so that it does not have to maintain two systems, manual and IOS, for an extended period of time. Event-based triggering is a very good strategy if a firm has excellent information systems with suitable controls, and can provide clear guidelines to trigger business transactions using IOS. Online access to information is a natural evolution for partners reaching their limit in message based communication. Finally, as more information become available, organizations have to leverage the information availability for more extensive cooperative ventures such as collaborating on product design, joint promotional campaigns, and improving logistics.

8.0. SUMMARY

Supply chain management has become an excellent strategy to effectively link all the trading partners and ensure cost effective and timely movement of materials from the raw material supplier to the final end-consumer of the finished product. Inter-organizational systems or extranets provide the technology infrastructure to facilitate the flow of information along the chain and thereby ensures the smooth flow of goods. The basic premise in both these initiatives is that organizations are willing to share information with their business partners on their internal operations including orders, inventory, shipments etc. However, reality may be the opposite. Firms are interested in protecting information and this may become the primary inhibitor to successful implementation of these two initiatives. A climate of trust and true partnership needs to be created among the partners for these initiatives to be successful. The paper discusses various management issues and technology strategies for successful implementation of supply chain and IOS.

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