

Challenges of Integration in Supply Chain Networks: An European Case Study

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Abstract

Ever since the Council of Logistics Management (CLM) adopted the definition of logistics in 1984, the integration of somewhat disparate activities of transportation, procurement, inventory control, distribution management, and customer service has been a major thrust in many firms. Realizing the synergies that exists in these functions, many companies have extended the concept further upstream and downstream to include entities outside the company to include vendors and their vendors and customers and their customers. Supply chain management, as the concept is now called, consists of the entire set of processes, procedure, the supporting institutions, and business practices that link buyers and sellers in a marketplace for effectively managing the flow of materials from suppliers to final customers. Many companies have successfully implemented supply chain concepts with spectacular results. Efficient supply chains have enabled these firms to compete better. What were the reasons for their successes? What were the challenges these firms faced in their journeys to achieve integration in their networks? How were they able to overcome these obstacles and challenges? In this paper, we examine these challenges faced by companies in integrating their supply chain networks using case studies.

***Keywords:* supply chain management, logistics, integration, competitiveness, information technology, organizational fusion**

SUMMARY OF RESEARCH METHODOLOGY

The study specifically aims to explore the role of information technology and inter-organizational linkages as essential enablers in the integration process. Case study method has been used to achieve the specified research purposes. A sample group of mainly European firms and European divisions of global firms, along with their supply chain partners, were selected from the automotive, pharmaceutical and electronic industry groups. The firms represented are located in Ireland, the UK and Northern Europe. The selection was based on the following attributes: supply chain awareness of the firms' logistics managers based on the researchers' interactions in conferences and other forums, willingness to participate in the study, and the researchers' budgetary constraints. The focal firms chosen are considered leaders in some segments of the industries they represented. Suppliers and customers are key supply chain members of the respective supply chains they represented. The selection of suppliers and customers has been based on random selection from a list supplied by the focal firms. In one case the list provided by the focal firm had only one firm who was chosen for the sake of convenience. In all, there were 14 firms divided into four triads and one dyad. Each triad consisted of one focal firm, one supplier and one customer. The dyad consisted of a focal company and one of its key suppliers. According to Yin¹, a case study is desirable when a "how" or "why" question is being posed about a current set of events, over which the investigator has little or no control. In this research, we wanted to find out why the supply chain integration process was launched and how it was being managed in these firms. That is, we wanted to understand the motivation for integrating the supply chain, the scope of integration, the challenges encountered in the process, and how these were overcome. Specifically, we wanted to understand the processes and the related dynamics, the motivation of the involved parties, and the challenges encountered in information and organizational integration in the supply chain. Thus, the case study method seems to be the best approach in this case. The results of the case study are considered important and timely due to the increasing importance attached to supply chain management in general, and specifically due to the widespread adoption of contemporary information technology in supply chain integration

Challenges of Integration in a Supply Chain Network

and repeated calls from experts for close partnership with supply chain partners. To ensure validity, for all but one of the respondent firms (often the focal company), we studied at least two other members of the supply chain—one supplier and one customer—forming a triad. In case of the fifth focal company, we studied one key supplier.

Few firms or nations can ignore the forces of globalization and electronic commerce that permeate businesses today. As companies strive to create better value for their customers, managers are beginning to realize the important role logistics plays for better management of commercial transactions and transaction-generated information. Increasingly, in leading edge firms in developed countries, logistics is treated as a strategic activity². Ever since the Council of Logistics Management (CLM) adopted the definition³ of logistics in 1984, the integration of somewhat disparate activities of transportation, procurement, inventory control, distribution management, and customer service has received increased emphasis in many firms. Realizing the synergies that exist in these functions, companies have used logistics as a competitive tool and some have succeeded⁴. In many organizations, logistics has been accorded respect and made equal participant in the strategy formulation process for the organization. Some have carried the concept further to include upstream and downstream partners to include suppliers and their suppliers and also customers and their customers and renamed it supply chain management⁵. According to Handfield and Nichols⁶ a supply chain encompasses all activities associated with the flow and transformation of goods from the raw materials stage (extraction), through to the end user, as well as the associated information flows. Mentzer et al⁷ define a supply chain as *a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer.*

While some researchers⁸ have extolled the viability of the supply chain management concept as an effective competitive tool in the current global marketplace, others⁹ have offered words of caution. These researchers warn of practical limitations of the reality of supply chains and lament that the process of making complex supply chain networks work is not yet well understood.

In this article, we use the following definition of supply chain management as developed by the members of The Global Supply Chain Management Forum (at the Ohio State University) in 1994 and modified in 1998¹⁰: "Supply chain management is the integration of key business processes

Challenges of Integration in a Supply Chain Network

from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders.” A supply chain consists of a network of facilities and actors that procures raw materials and component parts, transforms these into intermediate goods and sub-assemblies, builds the final products, and makes these available to the global marketplace for consumption by the final customer¹¹. The emphasis on both physical supply (inbound) and physical distribution (outbound) sides is not merely on the immediate suppliers and customers, but often on supplier’s suppliers and customers’ customers¹². The interfaces upstream and downstream in the supply chain are frequently enabled these days by a logistics information system (LIS) providing access to each other’s business and manufacturing systems. Suppliers gain access to manufacturers’ production plans and can reduce their reliance on uncertain forecasts. Manufacturers obtain early warning about possible disruptions of supply due to unforeseen events faced by the suppliers and can reschedule their plans and avoid costly disruptions¹³. These and other similar uses of the LIS ensure a smooth flow of information pertaining to order, product design and development, market intelligence, production scheduling, payments, and any other information flow for managing coordination among the various actors in the supply chain.

Insert Figure 1 here

Thus, supply chain management consists of the entire set of processes, procedures, the supporting institutions, and business practices that link buyers and sellers in a marketplace. A supply chain involves four distinct flows. These are: 1) requirement information from buyer to seller which triggers all later activities, 2) the movement of goods from sellers to buyers, 3) transfer of ownership rights from seller to buyer, and 4) payment from buyer to seller. To be effective, a supply chain has to link the members of the network and the functions to ensure uninterrupted flow by matching supply and demand flows in a network and securing accurate response at each buyer-seller transaction in the chain. Coordinating these flows in a network requires integration of supply chain partners to ensure unhindered flows at each of the many buyer-supplier interfaces in a supply chain network. Experts believe supply chain integration

involves efficient management of information and closer organizational coordination among supply chain partners¹⁴. Lee¹⁵ outlines three dimensions of supply chain integration: information, coordination and organizational linkage. Information integration refers to the sharing of information and knowledge among the members in the supply chain, including sales forecasts, production plans, inventory status and promotion plans. Coordination refers to the realignment of decisions and responsibility in the supply chain. Organizational linkages include communication channels between the members in the supply chain, performance measurement, and sharing of common visions and objectives.

The multi-echelon supply chain, we described above, often gives rise to "speculative" buying at each buyer-supplier interface downstream. At each interface, the extent of fluctuation due to speculative buying gets amplified leading to what is known as "bullwhip" effect¹⁶. As a result, the supply chain as a whole often carries more inventories than actual requirement and yet there can be pockets where there is not enough. Customer dissatisfaction becomes common and obsolescence often results. Logisticians frequently have to resort to rework and transshipment increasing costs thereby. Many experts¹⁷ have shown that information sharing and close communication and partnership within the supply chain can help reduce the severity of "bullwhip"¹⁸ effects.

In this research, we consider the challenges faced by companies desiring to achieve integration with internal and external partners in the supply chain and review the techniques employed to overcome these challenges. Specifically, we examine the role of information technology and organizational linkages in obtaining supply chain integration. First, we describe supply chain integration and examine the role and developments in the areas of information technology and organization as they relate to supply chain integration. Second, we explain the research methodology. Next, we describe the cases studied, analyze the responses received, build a conceptual model describing the stages of supply chain integration highlighting the role of information technology and organization structures, and examine the state of supply chain

integration in the cases studied. Finally, we offer our concluding remarks via a set of propositions.

WHAT IS SUPPLY CHAIN INTEGRATION?

In their seminal work, Lawrence and Lorsch¹⁹ defined integration as, “the quality of the state of collaboration that exists among departments that are required to achieve unity of effort by the demands of the environment”. While this definition refers to integration internal to a firm or organization, our emphasis here goes beyond the firm and encompasses external entities that are players in a supply chain.

Bowersox, Closs and Stank²⁰ have classified integration in a supply chain context in six different types. These are customer integration, internal integration, material and service supplier integration, technology and planning integration, measurement integration and relationship integration.

Stevens²¹ identified four stages of supply chain integration, where stage I represented the fragmented operations within the individual company. Stage II focused on limited integration between adjacent functions, e.g. purchasing and materials control. Stage III required the internal integration of the end-to-end planning in the individual company and stage IV represented the true supply chain integration including upstream to suppliers and downstream to customers.

Lee²² outlines three dimensions of supply chain integration: information integration, coordination and resource sharing, and organizational relationship linkage. Information integration refers to the sharing of information and knowledge among the members in the supply chain, including sales forecasts, production plans, inventory status and promotion plans. Coordination and resource sharing refers to the realignment of decisions and responsibility in the supply chain.

Organizational relationship linkages include communication channels between the members in

the supply chain, performance measurement and sharing of common visions and objectives. As already mentioned earlier, we view supply chain integration broadly in terms of information and organizational integration. Accordingly, we restrict ourselves to examining the role of information technology and organizational linkages for rallying the key members of a supply chain network towards common goals for the supply chain.

Information Technology

According to Handfield & Nichols²³ information technology "encompasses the information that businesses create and use as well as a wide spectrum of increasingly convergent and linked technologies that process the information". In this work, we are focusing on the information related to the flows of materials, products and services including the reverse flows contained in a logistics information system²⁴ (LIS). Information integration permits management to examine the operations of the organization in totality and not in a fragmented, functionally isolated manner. Similarly, the participants in a supply chain can be linked by information technology for such logistics activities as inventory management, order fulfillment, production planning, and delivery planning and coordination. Business needs drive managers to become more competitive and they are under increased pressures to integrate the supply chain. Integration often requires coordination of disparate functions among supply chain partners in geographically dispersed locations. Information integration also involves sharing of pertinent knowledge and information among members of a supply chain. It may involve sharing of design and manufacturing data among suppliers, focal manufacturer, and customers²⁵. It may also include sharing forecast and delivery scheduling data between the logistics functions of the customers, the focal company, the suppliers, the carriers etc²⁶. Suppliers and customers may be invited to participate in focal company product design teams to capture pertinent upstream and downstream issues in the product/process designs to reduce costly design and/or process changes later. Information integration makes inventory and production visible throughout the supply chain creating a more congenial climate for collaborative planning and forecasting. Supply chain members, as a result,

Challenges of Integration in a Supply Chain Network

face less uncertainty, can reduce inventory buffers by postponing costly value-adding operations and provide better customer service with more flexible response to customer demand.

A reliable communication infrastructure paves the way for timely and efficient information exchange among partners. For example, using electronic data interchange (EDI) technology, manufacturers can provide up-to-the-minute information about their production needs by giving vendors access to the production planning and control system and vendors can arrange deliveries without the need of any paper transactions. Similarly, timely payments can be arranged using EDI. Reduction of payment delays lowers the cost of doing business significantly, makes supply chains more efficient, and gives the users competitive advantage. The integration of the many IT-enabled electronic commerce tools – bar coding, electronic messaging, electronic data interchange, global network management, and the Internet – is allowing supply chain partners to attain significant productivity gains. The fruits of information integration such as reduced cycle time from order to delivery, increased visibility of transactions, better tracing and tracking, reduced transaction costs, and enhanced customer service offer greater competitive advantage for all participants in the supply chain. Table 1 illustrates these dimensions of information integration and how integration is accomplished.

Table 1 about here

Yet, despite all the classical virtues of information technology (IT), many firms continue to face problems in achieving seamless supply chain management. In a recent survey²⁷ among European firms, a large majority (80%) believed that IT can be the greatest single barrier to supply chain integration due to lack of appropriate IT systems, poor information visibility, and multiple platforms. In the same survey, these respondents also believed that information technology (IT) played a major role in integrating a supply chain network for achieving optimal performance. How widespread has the compatibility problem been? What is the role of information visibility? How do the leading edge firms view the need for information integration?

What tangible steps, if any, are these firms taking to obtain inventory visibility across the supply chain? What problems do they encounter? How are they overcoming these problems? These are some of the questions that we seek to answer. (Prabir, let's take a look at these questions again)

Organizational Integration

Organizational integration encourages partners to become more entrenched members of the network and instills a sense of belonging to the supply chain. It becomes easier to generate trust among partners in an integrated supply chain. Trust promotes collaboration and decision delegation, reduces irrational behavior and “second guessing” among supply chain members thereby reducing the need for safety stocks. The objective of organizational integration is not merely to resolve conflicts should they arise, but rather to recognize and avoid potential conflicts and/or divergence of interest in advance and devise a governance structure to forestall or avoid it. True organizational integration thus paves the way for individual members of the chain to behave more like a unified entity sharing ideas, skills and culture alike. Supply chain integration may fail to blossom without organizational integration among supply chain partners. Supply chain management requires various actors at all levels of hierarchy in multiple organizations to work together for achieving a common goal. Managing coordination among the supply chain partners therefore assumes significant importance. Organization integration can become a catalyst by facilitating information sharing within and among firms. Some researchers opine that flatter organizations work better than cumbersome hierarchical ones²⁸. Some have suggested that process oriented organization structures will work better than traditional hierarchical structures in networks with many partners²⁹. In a recent study, 80% of the respondents indicated that process management (Tage: you mean process organization?) would drive their businesses within the next five years³⁰. Ostroff³¹ and Katzenbach & Smith³² also believe that better organizational coordination takes place when there are avenues for information exchange and coordination at all levels of hierarchy. According to them streamlined organizational integration ensures effective diffusion of shared cultural values across the supply chain; the lack of which often proves to be an insurmountable obstacle to supply chain integration. For example, during restructuring one

pharmaceutical company found that the biggest barrier came from cultural transformation and not from the widely anticipated technical adaptation problems³³. Table 2 illustrates some key dimensions of organizational integration and how these are accomplished.

Table 2 about here

Galbraith³⁴ discussed five organizational design strategies depending on the degree of task uncertainty. Three of the design strategies are related to mechanisms, which can reduce the need for information processing (e.g. divisionalization or establishing of slacks in the organization). The remaining two design strategies are supposed to increase the ability of the organization to process information. One is investment in information systems and the other is establishment of lateral linkages in the organization. Lateral linkages could be direct contact between managers at different levels and from different functions or organizations, establishing project teams or liaison positions in the company. An important point is that the organization should choose at least one of the five strategies when it is exposed to greater uncertainty. If not, slack resources and reduced performance levels will occur. In a later work, the same researcher³⁵ discussed the lateral organization as a mechanism for decentralizing general management decisions. He believed that the lateral organization creates an ability to be multidimensional and flexible. However, he delimited lateral coordination to take place within a corporation and did not include lateral coordination across juridical independent firms in a supply chain.

Another organizational issue is the realignment of activities in a supply chain. Where should the activities and processes be located across the collaborating firms? Who should take the responsibility for decisions? Under which conditions should a particular activity be outsourced? The transaction cost approach³⁶ (TCA) gives some normative prescriptions for this issue. TCA recommends that in situations with transaction-specific investments, the activities should be performed within the hierarchy that is vertically integrated in the firm. In situations with low asset specificity the transactions should be performed in the marketplace. Finally, in situations with

medium asset specificity, a hybrid organization structure is the most suitable. Barney³⁷ criticizes TCA for not taking into account the capabilities of the firm and its exchange partners. In situations where the focal firm does not possess the capabilities it needs, it has three ways to gain access to these capabilities: 1) the firm can cooperate with firms that already possess the capabilities it needs. 2) It can try to develop these capabilities on its own. 3) It can try to acquire another firm that already possesses these capabilities. However, there are situations where solutions two and three are not possible or too costly or time-consuming to implement. In this setting a collaborative approach is preferable even if there are significant transaction-specific investments involved.

Another avenue of organizational literature³⁸ is the so-called network perspective, which has been widely published in Europe due to the empirical research by the IMP-group (Industrial Marketing and Purchasing). It is a fundamental assumption in the network perspective that the individual firm depends on heterogeneous resources controlled by other firms. The firm gains access to these resources through interaction with the other member firms of the network. Resources include tangible resources of personnel, equipment, financial means and production capabilities, in addition to intangible resources of customer knowledge, organizational capabilities, and patent rights. The resource structure determines the structure of the supply chain and becomes its motivating force.

We seek to examine these issues using case studies in supply chain networks in European firms.

PURPOSE AND RESEARCH METHODOLOGY

This study seeks to examine the challenges faced by firms in achieving integration in supply chain networks. In particular, we want to identify the major issues and problems the firms face in achieving integration in the supply chain and the tools and processes they employ to overcome the challenges and obstacles. The study specifically aims to explore the role of information technology and inter-organizational linkages as essential enablers in the integration process.

Case study method has been used to achieve the specified research purposes. A sample group of mainly European firms and European divisions of global firms, along with their supply chain partners, were selected from the automotive, pharmaceutical and electronic industry groups. The firms represented are located in Ireland, the UK and Northern Europe. The selection was based on the following attributes: supply chain awareness of the firms' logistics managers based on the researchers' interactions in conferences and other forums, willingness to participate in the study, and the researchers' budgetary constraints. The focal firms chosen are considered leaders in some segments of the industries they represented. Suppliers and customers are key supply chain members of the respective supply chains they represented. The selection of suppliers and customers has been based on random selection from a list supplied by the focal firms. In one case the list provided by the focal firm had only one firm who was chosen for the sake of convenience. In all, there were 14 firms divided into four triads and one dyad. Each triad consisted of one focal firm, one supplier and one customer. The dyad consisted of a focal company and one of its key suppliers. According to Yin³⁹, a case study is desirable when a "how" or "why" question is being posed about a current set of events, over which the investigator has little or no control. In this research, we wanted to find out why the supply chain integration process was launched and how it was being managed in these firms. That is, we wanted to understand the motivation for integrating the supply chain, the scope of integration, the challenges encountered in the process, and how these were overcome. Specifically, we wanted to understand the processes and the related dynamics, the motivation of the involved parties, and the challenges encountered in information and organizational integration in the supply chain. Thus, the case study method seems to be the best approach in this case. The results of the case study are considered important and timely due to the increasing importance attached to supply chain management in general, and specifically due to the widespread adoption of contemporary information technology in supply chain integration and repeated calls from experts for close partnership with supply chain partners. To ensure validity, for all but one of the respondent firms (often the focal company), we studied at least two other members of the supply chain—one supplier and one customer—forming a triad. In case of the fifth focal company, we studied one

key supplier. Figure 2 below shows the composition of a triad. Triads provided us visibility of the entire supply chain and also ensured that the responses from the focal firms were verified for accuracy. Multiple cases made it possible to trace the migration path for achieving better supply chain integration.

Insert Figure 2 about here

In this study, we used semi-structured interviews to collect primary data. A standard questionnaire was used as a guide for each interview to avoid drifting the discussions in a tangential direction and to ensure the coverage of the important research questions. In order to achieve the required depth and understand the process dynamics, some interviews spanned across multiple visits and included observation of actual workflow in the respondent firms. To ensure construct validity, we collected data from multiple sources in each respondent organization and the key informants in each company reviewed the draft case study report. Care was taken to enlist experienced senior managers, who have spent several years in their firms, as respondents in order to ensure their responses as truly representative of their firms' position. Use of multiple cases ensured external validity, while data reliability was enhanced by having two researchers simultaneously conduct the interviews.

This study seeks to examine the challenges faced by firms in achieving integration in supply chain networks. Particularly, we want to identify the major issues and problems the firms face in achieving information and organizational integration in the supply chain and the tools and processes they employ to overcome the challenges and obstacles. The study specifically aims to explore the role of information technology and organizational restructuring as essential enablers in the integration process.

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CASE DESCRIPTION AND ANALYSES

Triad A

Company A is the medical systems division of a Danish health care company. The 1999 revenue of this unit was about US \$ 25 million and employed about 200 people. Company A is recognized as a leader in its field. Supplier A is a manufacturer of precision mechanical components. It employs 150 people and had annual sales of US \$ 20 million in 1999. Supplier A has witnessed significant expansion during the last 2-3 years and its business with Company A has steadily grown and with it mutual trust and dependence. These two companies have had a close working relationship for several years, particularly in product design, development, and manufacturing. Recently Company A and Supplier A have embarked on a new partnership arrangement to enhance supply chain efficiency. Under this program, company A gets access to Supplier A's production plans, order information and history of shipments, including carrier tracking numbers using the supplier's web page. Company A updates its forecast once a week using the web page. This information is retrieved by Supplier A, which feeds it to its ERP system for procurement, production, and delivery planning. While the link is not entirely automated and the need for inventory as a de-coupler has not yet been eliminated, managers in both firms expressed satisfaction about the role it plays in reducing the lead time and enhancing the flexibility of the supplier. While Supplier A, further buoyed by its experience with a few other customers, is ready for remote access and data transfer using XML, Company A, the larger partner, wants to acquire more experience and confidence (and probably trust) in the partnership before advancing the relationship to a higher level.

Triad B

Company B is a Fortune 500 computer manufacturer with annual sales in excess of \$ 30 billion. Its European manufacturing plant is located in Ireland close to its key suppliers such as Intel, Microsoft and others. Company B takes pride in being a good product and technology integrator.

Challenges of Integration in a Supply Chain Network

It relies almost entirely on close partnerships with its suppliers for the infusion of the latest technology. Company B's supply chain strategy can be summarized as follows:

- ◆ Close to customer—using the power of Internet to get close to customers (and also direct-to-customers) to transform the management of supply chain around customer needs. Company B receives about 50% of the orders on-line.
- ◆ Market segmentation (by geography, by industry, by customer groups) and tailoring logistics services to the appropriate needs of the segment.
- ◆ Best-in-class alliances with suppliers who provide the latest technology and close partnership with three main logistics providers for distribution of finished products all over Europe.
- ◆ Continuous inventory flow management to improve material velocity. Factory keeps only a few hours inventory, while the warehouse keeps a few weeks inventory. Factory receives one truck from the warehouse every seven minutes. Although the warehouse is located adjacent to company B's plant, the inventory at the warehouse is owned by the suppliers and managed by a third party.
- ◆ Minimize obsolescence by postponing manufacturing until receipt of firm order and minimize inventory by better coordination with suppliers. This strategy also gives the company more flexibility to match customer needs.

For example, the long term alliance with UPS has resulted in new service innovations such as merge-in-transit, a call center operated by UPS, and good track and trace capability tailored for Company B. This alliance now works as a model for forging alliances with other partners. The company has similar close partnerships with other key suppliers. It has reduced the supplier base to 200 suppliers selected for consistent quality, competitive price, flexibility, and ability and track record for innovation. Close contact with key suppliers at the design stage keeps Company B better prepared to adopt the latest technological developments in design. Local suppliers replenish stock directly on the assembly line—unused stocks on the lines belong to suppliers. Figure 3 below shows the supply chain of Triad B.

Insert Figure 3 about here

Challenges of Integration in a Supply Chain Network

Production output information is instantly available to the warehouse from where the information is relayed to key suppliers. Suppliers also receive demand forecasts once a month (more often if there are changes) for planning replenishment. Larger items and those that do not require assembly, such as the display equipment, printer, and speaker are consolidated in the distribution centers—these items do not come to the factory. Company B has three distribution centers in Europe that are managed by third party logistics providers chosen for consistent high quality service and flexibility. While the company has excellent IT integration with customers, its IT integration with suppliers is rudimentary. Suppliers do not yet have online access to focal Company B's manufacturing planning system and they are still driven by periodic forecasts. With distribution companies it does not yet have on-line IT integration, although EDI is used for many transactions.

Supplier B supplies display products to the focal company that sends a 13-week shipment plan every month via e-mail—first month in daily buckets, second month weekly, and the balance in one lump. In case of significant change in demand, close collaboration (mostly using e-mail) takes place between Company B and Supplier B to resolve differences and agree on an acceptable plan. Supply commitment is again conveyed via e-mail. Electronic purchase orders using ARIBA software are then received by the account representative of Supplier B. There is no real time link between manufacturing planning systems between Company B and Supplier B, although installation of such links have been discussed in the past. Supplier B does not yet have direct access to Company B's manufacturing or sales plans. Supplier B keeps two weeks buffer stock at the warehouse where it rents space from the warehousing company, in addition to one-week in-transit inventory. Supplier B and Company B have weekly meetings on upcoming new programs, customer satisfaction issues, demand changes and other pertinent areas. Periodic meetings also take place at other levels—such as design teams from Supplier B and Company B, logistics teams from Supplier B, Company B and the personnel from the warehouse and distribution centers.

Dyad C

Company C is a trusted name in automobiles, particularly known for manufacturing safe and reliable cars. It has initiated close partnerships with many key suppliers for several years with significant mutual benefits. Over the years it has developed a supplier evaluation model for identifying, selecting, and evaluating its suppliers in a multi-disciplinary mode with active participation from logistics, quality, manufacturing and environment departments. Suppliers are chosen in two phases: development and production. Company C has almost 500 suppliers in all, out of which each manufacturing plant has close partnership with 15 key suppliers (also known as systems suppliers and tier-1 suppliers) located in a supplier park adjacent to the plant. While the core competency areas are all within direct control of the automobile manufacturer (Company C here), almost 70% of the material content in each automobile is procured from these 15 key suppliers and other upstream suppliers. Tier-1 suppliers work closely with a group of tier-2 suppliers who constitute the physical supply side of the chain. Logistics in Company C is organized into two groups: a central logistics group and a plant logistics department. The central logistics group is usually involved in long term planning and strategy design, while the plant logistics department provides operational support to each plant, including coordination with suppliers. Suppliers have access to 60 weeks forecast, although they receive orders for six weeks at a time. The suppliers receive daily feed, synchronized with every car manufactured by Company C, via EDI links. Web-based EDI is not yet common with only about ten percent using this method. Suppliers have no access yet to Company C's MRP system. On-line access and installation of a supplier portal are in the conceptual stage with this company. Hourly deliveries from tier-1 suppliers are arranged by Company C using self-selected logistics providers. Company C also recommends approved carriers for transportation between tier-1 and tier-2 suppliers. Extensive cooperation takes place with suppliers at the product design stage. For example, Company C shares production information with key suppliers quite early in the design stage, often years before the products roll out of assembly lines. Continuous interaction with suppliers at all levels is quite common. Company C periodically organizes supplier forums where mutual relations/questions are discussed in a free and open environment. Workshops are

regularly organized on important topics. For example, Company C recently organized workshops on waste avoidance and the role of teams in purchasing. While significant help is made available to the suppliers for improvement, key suppliers are expected to meet targets related to design and development, cost, quality, and logistics performance.

Triad D

Company D—one of the leading healthcare companies in the world—discovers, develops, manufactures, and markets pharmaceuticals, vaccines, over-the-counter medicines and health-related consumer products with worldwide annual sales in 1999 of \$ 12.55 billion. It is a highly diversified company with pharmaceuticals accounting for 23 percent of product sales. The company employs 47,300 people worldwide with operations in 160 countries. The discussions in this paper largely reflect the conditions prevailing in the nutritional healthcare business.

Company D operates in a very dynamic marketplace with low demand forecast accuracy. It has recently implemented the “Account Expert” concept for each customer. These account experts manage the customer interface from ‘order to cash’. Account experts regularly meet with customers. In addition, Company D has regular interfaces with customers at all levels (such as between general managers or logistics managers). Although there are no online IT links with customers, proactive initiatives at Company D to understand customer needs have improved customer service, lowered headcount and increased line fill rates. Company D has also built close relationships with a few key suppliers. Some suppliers have representatives at the company’s plants for providing tailored service. One plant has identified ten key suppliers (out of a total of 500 suppliers) with whom Company D has close partnerships. Supplies from these key suppliers are not subjected to incoming inspection. Company D relies on these suppliers’ own quality control system. These key suppliers are selected and continuously monitored based on a detailed vendor approval and performance measurement system. Before introduction of the performance measurement system supplier input is usually solicited. Some suppliers provide access to Company D to their ERP systems to offer better inventory visibility, although Company

Challenges of Integration in a Supply Chain Network

D does not yet grant online access to suppliers. Providing online access to suppliers using “Extranet” is being tested in other parts of Company D with several key suppliers, the success of which may pave the way to expanding access to more suppliers across the company. Before a product goes into production, it is customary for Supplier D to receive design and production information. Purchase orders are usually transmitted to suppliers on hard copies and facsimiles. Consensus forecast, based on historical sales and close consultation among supply chain partners, is used for demand forecasting. For about 20% of the business volume, the company receives electronic point-of-sale (EPOS) data. Key suppliers receive volume commitments as an enticement to work closely and flexibly. Key suppliers often receive technical and financial help. For example, Company D has provided Supplier D, a small supplier, with PC, software and other technical help to get connected online. Supplier D also felt that performance measurement by Company D has helped it to focus better in improving its operations, and it believes the process has also helped it to become a better company.

Distribution of Company D’s end products is carried out by a National Distribution Center (NDC) in each national market using preferred carriers such as DANZAS or DFDS in Scandinavian countries. In the UK for example, the NDC manages the national distribution of nutritional healthcare products for the company. A third party logistics provider manages the UK NDC. The NDC uses an automated warehouse management system and an ERP system. It uses barcodes at the warehouse and an automated picking algorithm. Inventory is visible after the finished products reach the NDC. Company D has a strategic relationship with the third party logistics provider and has signed a multi-year contract with clearly specified performance targets and associated penalty clauses for non-performance. Company D and the logistics provider took time to undertake due diligence during the selection process. As a result, although the alliance formation process took 11 months from the order to start of operations, and there were a few minor hiccups primarily due to high sales fluctuation and early problems associated with linking of their information systems, the integration process was smooth overall. Company D is currently

reviewing its European distribution center operations and rationalization of national distribution centers into fewer central distribution centers is being considered.

Organizational restructuring for closer integration with suppliers and customers has just started in some pockets in Company D. While the company recognizes the benefits of integration, the process is more cumbersome due to the size and diversity of the company and its impending merger. Level of IT and organization integration varies widely among various divisions/markets.

Triad E

Focal Company E is a high-end manufacturer of audio and video consumer electronic equipment based in Denmark with a loyal customer base. The company employs 2,600 people and had net annual sales in 1999/2000 of \$ 450 million. Worldwide, the company reaches its customers via 1,700 shops, of which 450 are dedicated to the products of the company. Approximately 90% of its sales come from Europe, but the US market is steadily increasing. Recently, the company launched Internet sales in the United States. Faced with increasing competition and falling market share, Company E launched a supply chain excellence program several years ago, the cornerstone of which was the establishment of close partnerships with key suppliers and customers. Supplier E, a manufacturer of plastic molded parts, is one of the key suppliers who agreed to work closely with Company E under this program. Supplier E is a member of the design team that Company E assembled for launching new products and models. Company E has also provided its technical expertise and financial support to identify and choose the most competent mold/tool maker for products supplied by Supplier E. Supplier E typically receives demand forecasts several months in advance and has on-line link to Company E's manufacturing and inventory planning software. Manufacturing plans, progress, changes in plans, and inventory are visible to Supplier E, enabling it to plan supplies on a just-in-time basis. Goals are set for inventory turnover and minimum/maximum levels of stocks on hand. Supplier E is responsible for assuring that Company E never runs out of materials and that stocks on hand do not become too large (vendor-managed inventory). Meetings between operational, technical and management

Challenges of Integration in a Supply Chain Network

personnel are common among the partners. Additionally, personnel from Supplier E are frequently invited to technical and management training programs organized by Company E. Cooperation is based on conditions of mutual trust.

In 1999, Company E installed the SAP R/3 ERP system, which has opened up new possibilities for on-line connection with the suppliers through its system, for example, through the Internet. With this connection, key suppliers can see forecasts and daily materials requirements. In the year 2000, 30% of Company E's yearly purchases went through the on-line system and more than 20 suppliers are connected through a partnership agreement. Company E wants to install an electronic connection with the supplier, so that drawings, documentation and payments can take place electronically. In addition, Company E also wants the suppliers to have the greatest influence possible on planning and ordering, and furnishes the supplier with regular forecasts based on production plans. Alternatively, the supplier can pull out forecasts through the EDI system. Company E has recently changed itself into a more process-oriented organization. The company has established process improvement teams for key processes, such as customer order fulfillment, planning, external and internal material flows and stocks.

Table 3 provides a summary of the companies in the five supply chains studied in this research.

Insert Table 3 about here

Based on our analyses of the above cases, we have presented the salient characteristics found in various models of supply chain integration using IT and organizational transformation. We have also studied the degree of integration as these firms strengthen their bonds. We have divided the integration achieved into three levels—low, medium and high. Table 4 gives the integration path used by the sample firms using IT. For example, a company still using legacy systems, including MRP II systems and relying on fax/phone and limited e-mail/Internet use for communication with supply chain partners, has been classified low on the IT integration scale. By ways of contrast, we classify a company high on the IT integration scale if it uses ERP and supply chain planning software, makes extensive use of bar codes, EDI, and XML technology for communication and data transfer, and provides supply chain partners online access to its

production and sales plans.

Insert Table 4 about here

Similarly, Table 5 presents the integration migration path using organizational linkages. For example, a company with an integrated logistics and/or supply chain management function at the highest echelon of the organizational hierarchy, and practicing close collaboration at all levels of hierarchy with supply chain partners and inter-organizational and inter-functional process teams, has been classified high on the organizational integration scale. These highly integrated companies are often found to have adopted or in the path to adopting process oriented organization structure and have introduced joint teams for planning and measurement of supply chain operations and customer satisfaction.

Insert Table 5 about here

Thereafter, in Tables 6, 7 and 8, we present a scheme to measure the state of supply chain integration in the five supply chains studied here using a three-point scale—low, medium and high. Table 6 presents the status of IT integration in the five supply chains using the factors stated in Table 4. It would be quite obvious from Table 6, that despite tall claims of the dawning of a "paperless" society, our respondent firms had not yet established online working relationship with most of the supply chain members. In fact, the extent of information integration is quite uneven. While the focal company in Triad D, a large multinational in the healthcare sector, still uses hard copy/fax purchase orders with many suppliers, the key members of the Triad E supply chain can access forecast, production plans, and inventory status online and have EDI links with the focal company.

Similarly, Table 7 presents the status of organizational integration in the sample supply chains using the scale and factors explained in Table 5. We can readily observe from Table 7 that internal integration has already progressed a great deal in most of the respondent firms, although integration with external partners of the supply chain remains in infancy. Only in Dyad C and Triad E, we notice visible signs of external integration with key suppliers in selected areas. The focal company in Dyad C, a multinational automobile manufacturer, has identified 15 key suppliers, who are located in an industrial park adjacent to the focal company's manufacturing

plants and with whom it has engaged in collaborative planning, forecasting, sharing of design at early stages of product development, and research. It was quite clear from our discussions with several logistics managers of this dyad that they found the close integration very useful and beneficial for the partners, and that they would like to continue and intensify the scope of the integration.

In Table 8, we have attempted to present an overall status on supply chain integration, taking into account both IT and organizational integration achieved in these firms.

Insert Tables 6, 7 and 8 about here

As we can readily observe, we have classified most of the firms in our sample low to medium in the overall integration scale. For example, the focal company in Dyad C, which still relies on outdated but working MRP II systems for manufacturing planning and inflexible EDI systems, and has only recently started experimenting with Internet EDI, has been rated as medium integration. The successful but relatively low-tech supply chain planning and communication system has been modulated by low level of technology adoption. The same company has taken extraordinary initiatives to engage key suppliers into close partnerships with significantly better performance, and we rate the relationship high on the integration scale. Although many of the respondent firms had either implemented or were in the process of implementing ERP systems, none of them yet felt it prudent to provide online access to its suppliers despite demonstrated capability and urgings from some of their reliable partners. In most cases, it was the larger focal company, often a multinational organization, that was less receptive to these ideas. Indeed, the closest integration we have been seen regarding such collaboration was in Triad C, between a niche player in consumer electronics and its supplier, a regional SME. By all accounts, this close partnership blossomed because the dominant partner, the focal company, initiated and nurtured the integration process. Interestingly, even in this case the extent of close collaboration was limited to non-core areas.

MANAGERIAL IMPLICATIONS

The message from what we witnessed is quite clear. Supply chain integration happens when there are tangible benefits. While many respondents felt that supply chain integration was desirable, the drive to accomplish integration has been rather uneven. In some firms, respondents were not yet fully convinced of the need for close collaboration with suppliers. While these managers had no objection to sharing some logistics and production plan related data, they were not quite ready (or fully convinced of the need) to provide suppliers access to sensitive and proprietary data pertaining to core competence areas. Thus, collaboration at the design stage did not include suppliers as part of basic design teams. Rather, in rare instances when collaboration prior to production took place, it was quite often restricted to sharing broad ideas about future products and technology and the scale of future production of new products. The scenario regarding IT integration is not much different. While some companies have provided customers with IT integration via the Internet, integration with suppliers is still in rudimentary stages. SMEs have certainly been in the forefront in experimenting with IT integration and some have accomplished significant advantages through closer working relationships with some key customers and suppliers. Larger multinationals have been somewhat slower in information technology adaptation and integration with suppliers. Given our experience and analyses of the cases studied here, we are pleased to offer the following propositions.

Proposition 1: While enterprise-wide planning systems have proliferated, supply chain information systems integration is still not common. Although some managers acknowledged the desirability of efficient information transfer among supply chain partners, and there are notable examples of information systems integration at selected interfaces, the initiatives required to integrate information systems of all supply chain partners are not yet discernible. Some managers remain unconvinced about the true value of such links and providing remote access to sensitive business information to suppliers and customers. Many fear potential loss of proprietary information and loss of control. Hesitancy, due perhaps to the lack of trust, was more noticeable among larger more established businesses than among small and medium scale firms. It was quite apparent that the reluctance of the larger organizations stemmed in part from the fixed mindset of their managers. Additionally, past success prevented

these organizations to look beyond the familiar environment. In several cases, there was a stark disparity in technical savvy among supply chain partners. Every partner was not equally well prepared to adopt the new IT tools and systems. In addition, weak supply chain leadership failed to energize the members to acquire new technology, resulting in uneven integration. Sometimes supply chain partners used multiple IT platforms, thus slowing down the information systems integration among them, although this was not cited as an insurmountable problem. In our interviews with participating managers the following barriers were cited more often:

- ◆ Fixed mindset of managers
- ◆ Lack of trust. Fear of sensitive business information falling in competitors' hands
- ◆ Every member of the supply chain not equally well prepared
- ◆ Loss of control
- ◆ Multiple IT platforms

Proposition 2: While the benefits of integration among the members of a supply chain are often extolled by pundits, true organizational integration is hard to come by. Many respondents in our study felt that their organizations should actively pursue closer organizational coordination with suppliers and customers for mutual benefits. Yet, in reality their efforts to do so were spotty at best. Yes, we did notice several examples of close partnership in design and logistics including real time sharing of data, but these were the exceptions rather than the commonly accepted procedure. Many were content to run their businesses the old fashioned way. In some cases the old hierarchical organization proved too much of an obstacle. While at some levels, the partnership worked well through regular exchange of ideas and information, the lack of a systematic coordination could be noticed at other levels. Sometimes exchanges were on a one-time or case-by-case basis, which is not adequate to build an identity for the supply chain. In the few cases that the organizations worked well, they often had the following characteristics:

- ◆ Flatter organization resulting in better coordination among supply chain partners without the need for always channeling information exchanges through the hierarchy
- ◆ Conscious efforts made by one or more organizations to make partners work together at all

levels

- ◆ A greater sense of trust among supply chain partners

It was also evident that organizations were rather selective in choosing partners with whom they would have very close collaboration. For example, the closest form of collaboration was usually reserved for partners providing much needed support in the core competency areas. It must be added here that in most cases, firms preferred to keep core competency areas under their own control to avoid potential loss of proprietary technology and/or skills. In the rare instances that these firms bring in partners in core areas, utmost care is taken in choosing the collaborators, nurturing the relationships and forming the closest form of partnership. In addition, these firms also form close partnerships (but not the closest form) with other partners in the non-core critical areas. The level of integration with the latter category is not as extensive as the former. While the partners in both these categories may be “tier 1” suppliers and may be responsible for a network of “tier 2” and “tier 3” suppliers, the extent of collaboration is certainly stronger and more extensive in the innermost core areas. Figure 4 describes the characteristics of the intensity of various levels of integration.

Insert Figure 4 about here

Proposition 3: The success of a drive to integrate supply chain depends on the power, influence, motivation and zeal of the prime mover in the supply chain. When the larger, more influential firm in a supply chain did not believe in the virtues of integration and did not display sufficient enthusiasm, integration remained a distant objective. Attempts would be made occasionally by smaller but more progressive members of the supply chain to work closely in tandem, only to fizzle out before long due to apathy shown by more influential partners. On the other hand, we have also observed cases where genuine interest and initiative on the part of the supply chain member wielding power in the chain was able to rally the whole chain around the concept. Such partnerships included coordination at all levels among supply chain partners. Thus the drive for a supply chain integration initiative ought to come from the member who wields power in the chain. Before moving along too far, supply chain members would do well to

understand the motivation of the prime mover in the initiative. The “little engine” would not progress too far in the process and would be well advised to beware.

Proposition 4: While globalization and concomitant fierce competition has forced companies to seek supply chain excellence, ease of use and affordability has accelerated the adoption of information technology for integrating the supply chain. Recent advances in information and communications technology has made it easier for companies to execute business transactions electronically, enabling them to open new distribution channels, find new buyers and sellers, increase revenue, and improve efficiency of their businesses⁴¹. Our study has shown that supply chain managers have embraced information technology to facilitate supply chain integration. The process, according to some respondents, has been accelerated to a great extent due to enhanced affordability of both hardware and software and user friendliness of the Internet. Also noteworthy is our observation that small and medium size organizations appear to be more agile in experimenting and adopting the latest in information and communications technology. In contrast, larger, more established companies, who also have more hierarchical layers and shared decision-making points, take a more cautious approach when it comes to new technology adoption and/or sharing sensitive information. In hindsight, it is quite logical and often desirable for larger organizations to be more hierarchical and have higher organizational inertia, as they often have more sensitive and proprietary information and technology to guard.

Proposition 5: Supply chain partitioning facilitates management, but often degrades information flow to the partners in tier 2 and beyond and may result in alienation of these partners to the detriment of the smooth functioning of the supply chain. While integrating supply chains, firms often noticed they had large supplier bases and reckoned that close relationships could not be consummated with a large number of partners. Many firms drastically reduced the supplier base and created tiers of suppliers (or customers). Tier 1 suppliers were considered closest to the focal company and were made responsible for a group of tier 2 and 3 (and beyond) suppliers. While partitioning supply chain in this manner enabled firms to manage

better due to fewer points of contact, the hierarchy thus created raised a wall between the focal company and the tier 2 and beyond supply chain partners. Communication across the supply chain often got blurred and vital information did not percolate through the tier 1 suppliers with the same speed and efficiency. In some cases tier 2 suppliers resented the loss of direct contact with the focal company and harbored a sense of alienation from the supply chain. These suppliers sometimes felt that they could no longer identify with the supply chain. Luckily, this is an area that has also immensely benefited from the information and communications technology applications, enabling distant suppliers and customers to be in touch with other supply chain members. Added information visibility brought on by the Internet and Web-based supply chain planning systems helps to partially compensate for the loss of direct contacts.

While these propositions do provide us with a glimpse of the state of supply chain integration in some sectors of European businesses, surely many researchers will question its generalization and the somewhat arbitrary nature of integration migration path that we propose here. We propose these as preliminary findings, which can be used as hypotheses for further research. For example, the proposition offered in Figure 4 may be used as a normative model and tested with a different sample of firms. We believe a larger study should be conducted over a wider cross section of businesses to obtain a fuller picture. Studies may be undertaken in other markets and compared with our results to obtain better understanding. We are careful, therefore, not to claim these propositions to be universally applicable. Rather, we believe we are able to start a healthy debate as to the needs for, and extent of, integration in supply chains.

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**Challenges of Integration in Supply Chain Networks: An European Case Study
Tables and Figures**

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TABLE 1
 Characteristics of Information Integration in a Supply Chain Integration

Characteristic	What goes on	How Accomplished
Information integration	1. Information and knowledge exchange takes place regarding: <ul style="list-style-type: none"> ◆ Design and development ◆ Process management ◆ Planning/control 2. Shared decision-making 3. Technology exchange and adaptation 4. Resource and risk sharing	1. Information sharing often using same or compatible systems and procedures 2. Linking computer information systems using new information and communications technology including EDI/XML/RF etc. 3. Pooling resources among supply chain partners 4. Collaborative planning, forecasting and designing 5. CAD/CAM 6. Learning from one another

TABLE 2
 Characteristics of Organizational Integration in a Supply Chain

Characteristic	What goes on	How Accomplished
Organizational Integration	1. Risk, cost, and gain sharing 2. Sharing ideas and institutional culture 3. Shared decision-making 4. Skills sharing	1. Extensive communication at all levels 2. Joint design teams 3. Process and quality teams 4. Incentive realignment 5. Mutual trust and accommodation 6. Joint performance measurement and problem resolution 7. Managing coordination among supply chain members 8. Participation in joint technical and management forums 9. Decision delegation—chosen member in the supply chain deciding for the whole supply chain 10. Joint cultural programs to achieve better bonding

TABLE 3
Case Study Database

Supply Chain	Supplier	Focal Manufacturer	Customer
Triad A	Precision Mechanical components Regional SME ¹	Medical Systems and pharmaceuticals Division of large multinational pharmaceutical company	Articles for medical equipment Division of a medium-sized pharmaceutical distributor
Triad B	EDP-equipment Large multinational company—manufacturer of computers and peripheral equipment	EDP-equipment Large multinational company Manufacturer of EDP-equipment	Key account client within the toy industry Large multinational company
Dyad C	Exhaust systems Large multinational company	Passenger Cars Large multinational company	
Triad D	Packaging materials Regional SME	Healthcare Manufacturer of drugs and nutritional healthcare items Large multinational company	Distributor Division of medium-sized pharmaceutical and drugs distributor Regional SME
Triad E	Plastic molded parts Regional SME	High-end audio and video equipment Multinational company	Exclusive distributor/dealer of audio and video equipment Regional SME

¹ SME - Small & Medium sized Enterprises (less than 250 employees according to the EU definition)

TABLE 4
Integration Migration Path--IT

Supply Chain Integration Using	LOW Integration	MEDIUM Integration	HIGH Integration
Transaction and Warehouse Management systems	MRP II systems Legacy Systems	ERP Systems <ul style="list-style-type: none"> • Intra-company • Rigid interfaces Value: Mechanization of existing processes	ERP and Supply Chain Planning (SCP) systems <ul style="list-style-type: none"> • Inter-company integration • Flexible interfaces Value: Process Improvement
Communication Systems, Internet/extranet	E-mail/Fax/phone Internet/extranet only used for limited purposes	Few EDI/Internet links to customers/suppliers Extranet - on experimental stage	Extensive use of EDI/Internet/XML links within supply chain
Bar-coding and track-and-trace systems, Electronic POS(point-of-sale) data capture Inventory visibility	Only bar-coding of finished products Track-and-trace and electronic POS not used Extranet not used	More extensive bar-coding, automated e-mail updates and confirmations	Bar-coding from entry to dispatch Track-and-trace throughout the SC Key suppliers and customers connected
Vendor Managed Inventory (VMI)	Not used	Experimental stage with one or a few suppliers	Strategic suppliers have access to production plans, materials requirements, sales forecasts and orders

TABLE 5
Organization Migration for Better Integration

Organization Characteristics	Low Integration	Medium Integration	High Integration
Orientation	Functional orientation	Internal Integration	Process oriented
Status of Logistics/SCM in the organization	Logistics sub-function Not part of senior management team	Unified logistics function under one organizational entity	Logistics/SCM member of corporate management group
Degree of integration	Fragmented logistics activities	Integration process has just begun	Integrated across supply chain
Importance of logistics	Logistics not considered a core competence— fragmented logistics functions	Logistics considered a critical activity— logistics activities integrated under one function	Logistics/SCM considered a core competence
Communication across the supply chain	Few contacts points between companies in the supply chain	Regular contact at top/senior levels— rare operational level contact	Multiple contact points at all management levels
Formal lateral organizations	No teams across the supply chain	Cross-functional teams in some areas Key account managers	Teams across the supply chain—regular interaction
Performance measurement	Measurement of delivery service and inventory levels in some parts of the supply chain	Measurement of order lead time, logistics costs and service levels Joint measurement in some interfaces	Measurement of performance of supply chain processes Performance data shared across the supply chain Focus on end-customer value

TABLE 6
State of Information Integration in the Supply Chain

Characteristics	Triad A	Triad B	Dyad C	Triad D	Triad E
Transaction systems/Warehouse Management	Separate ERP-systems—no online links between systems	MRP II and ERP systems—no online links	MRPII-systems—online links between systems	MRPII and ERP-systems—no online links Advanced warehouse management system	ERP system recently installed—no online links between systems
Communication, Internet/extranet	Forecasts directly into supplier's ERP-system Suppliers and customers have online access to production plans & order information, forecasts Stock information from the affiliates No use of EDI	Forecast every month No online access to sales and production plans for suppliers No on-line IT integration with third party logistics providers EDI used for customer orders on-line via the Internet	Suppliers have online access to forecast Orders transmitted online via EDI Production plans known one year in advance Key suppliers involved in design stage Web-based EDI not common	Orders transmitted to suppliers in fax/hard copy Key suppliers have online access to forecasts, inventory status (trial stage) Limited use of Extranet with key suppliers Some suppliers provide online access	Key suppliers have online access to forecasts, production plans, inventory status Extensive use of EDI/Internet/XML-files Configuration software available for customers
Bar-coding, track-and-trace, POS data capture	No Bar-coding No Track-and-trace from supplier	Yes	Yes	Limited use of EPOS data from customers	Bar-coding at all stages, track-and-trace, POS
Vendor Managed Inventory (VMI)	No	Replenishment of stock on assembly line	No	No	VMI with key suppliers

TABLE 7
State of Organizational integration in the Supply Chain

Characteristics	A	B	C	D	E
Orientation	Internal integration	Internal Integration Early stage of external integration	Internal integration External integration with key suppliers at early stage	Internal integration started	Early stage of external integration Process improvement teams for key processes
Status in the organization	Logistics not part of the senior management team	Decentralized logistics function Logistics part of senior management	Corporate logistics group Decentralized line function	Decentralized logistics function	Logistics/SCM member of corporate management group
Degree of integration	Decentralized logistics function at each plant	Integrated with key suppliers and logistics providers—long term alliances	Integrated logistics Organization Integrated with key suppliers	Partnerships with some key suppliers and third party logistics providers Integration process just begun	Integrated logistics function—close alliances with key suppliers
Importance of logistics	Logistics controls stocks at the affiliates	Logistics/SCM considered a core activity	Logistics considered critical	Logistics not considered critical	Logistics considered a core competence
Communication across the supply chain	A few regular contacts	Key account managers Regular contacts at multiple levels	Multiple contact points all levels	Regular contact points with key customers A few regular contact points with suppliers	Multiple contact points with key suppliers
Lateral	Inter-functional	Design-	Key suppliers	Key account	Key suppliers

Challenges of Integration in a Supply Chain Network

organizations	teams meet with key suppliers	collaboration with key suppliers	participate in design-teams Regular supplier contacts at multiple points	managers for customer interface	member of design teams
Performance measurement	Occasional supplier performance evaluation	Close monitoring of supplier performance	Supplier performance measured Regular logistics audit	Occasional supplier performance evaluation	Performance measures shared across the supply chain

TABLE 8

Overall evaluation of the stage of integration

	Triad A	Triad B	Dyad C	Triad D	Triad E
Transaction systems	Low/ MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Internet/extranet /communication	LOW	MEDIUM towards suppliers High towards customers	Medium	Low	Medium towards suppliers High towards customers
Bar-coding Track-and-trace	Low	Medium	Medium	Medium	Medium/high
VMI	Low	Medium	Low	Low	Medium
Cross-organization communication	Low	Medium	High with key suppliers	Medium	High with key suppliers
Formal Lateral organizations	Low	Medium	Medium	Low	Medium
Overall evaluation	Low/ medium	Medium	Medium	Low/ medium	Medium

FIGURE 1
Flows in a Supply Chain

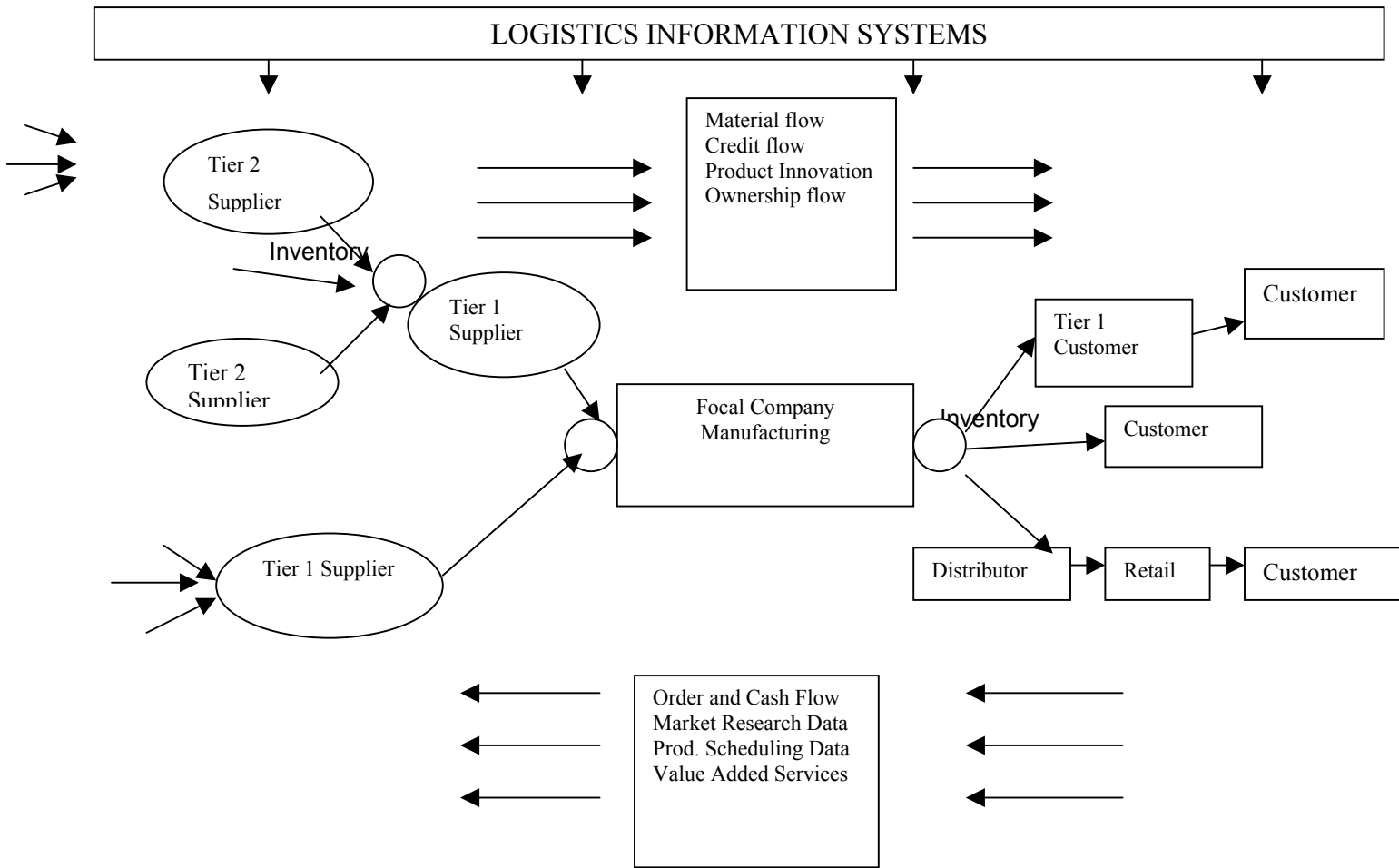


FIGURE 2
Composition of a Triad

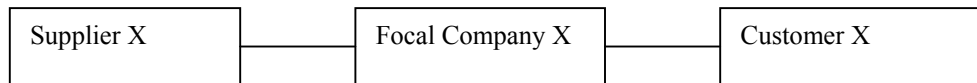


FIGURE 3
Supply Chain of Triad B

