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# Integrating Supply Chains and Internal Operations Through e-Business

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# **Integration of Web-based Procurement and Fulfillment: A comparison of Case Studies.**

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## **Introduction**

In recent years, a combination of economic, technological and market forces have forced companies to take a look at and redefine their supply chain strategies. Among these forces are the globalization of business, the proliferation of product variety, the growing complexity of supply chains and the reduction in product life cycle. In order to remain competitive, some companies have tried to improve the coordination and collaboration of all the partners involved in the same supply chain. This approach has been called "supply chain integration" (Hewitt, 1994; Cooper et al., 1997; Bechtel and Jayaram, 1997; Christopher, 1998; Ross, 1998; Knoblock and Minton., 1999).

Information and Communication Technologies (ICT), and in particular Internet, have played a fundamental role in helping companies reach the goals of "supply chain integration". In fact, Internet can redefine the way in which some back-end operations, such as product development, procurement, production, warehouse management, fulfilment, post-sales support and even marketing, are managed. In each process, Internet can change the role and type of relationships between the various players, creating new value networks and developing new business models.

The word "e-business" can be used to describe the use of Internet to reach the goals of supply chain integration. In this context, e-business means the "planning and execution of front-end and back-end operations in the supply chain using Internet" (Kalakota and Robinson, 1999).

This work studies the impact of Internet on company business, in particular on procurement and fulfilment processes. The analysis is carried out by considering and comparing four case studies regarding four large Italian companies. Even though, these companies' core business is completely different, their e-business strategies prove to be quite similar. Following the case studies, an evolutionary model for e-business strategy is proposed. This model shows how ICT can evolve from being merely a means of communication to being an instrument which coordinates company processes.

## **Procurement and fulfilment processes and the Internet**

The supply chain, a term now commonly used internationally, encompasses every effort involved in producing and delivering a final product or service, from the supplier of raw materials to the consumer. Due to its wide scope, supply chain management must address complex interdependencies, such as those in an "extended enterprise". Today, material and service suppliers, channel supply partners (wholesalers/distributors and retailers), and customers themselves, as well as supply-chain management consultants, software product suppliers and system developers, are all key players in supply-chain management (Handfield and Nichols, 1998; Saunders, 1997).

Internet makes it possible to efficiently and quickly manage many relationships such as those involving wholesalers, taking on new resources, services, and technology, and purchasing semi-finished products, components and equipment (Lucking-Reiley and Spulber, 2000).

Internet is used in Business-to-Business relationships on a wide-scale for two main reasons:

1. the open nature of the Internet network gives it an important advantage over other information networks (VAN, EDI, etc.) since it requires low set-up costs, limited operation costs and significantly reduced switching costs (Roche, 1995);
2. the possibility of creating high-interaction environments which make Internet useful both as a communication instrument and as a channel for marketing, thus leading to the development of more efficient inter-company relationships as well as opportunities for new cooperative networks (Hoffman et al, 1997).

Procurement and fulfilment are key processes in the supply chain and with the advent of Internet those which have had to be redesigned and reorganized. The new forms of procurement and fulfilment which take advantage of ICT in order to digitize certain stages of these processes are called e-procurement and e-fulfilment.

Procurement includes all of the activities involved in acquiring goods or services and managing their flow from the supplier within the company which is purchasing the goods or services to the semi-finished products and support materials, such as computers and office supply products, which the company uses (Hough and Ashley 1992; Zenz and Thompson 1994).

The stages of the procurement process can be summarized in the following points (Gebauer et al., 1998; IBM, 2000; Lancioni et al., 2000 ):

- the need to procure a particular good or service;
- the search for potential suppliers and the definition of possible alternatives;
- evaluation of the alternatives;
- contact with suppliers to begin the negotiating process;
- evaluation of the offers;
- agreement on the type of supply:
  - standardized products
  - products for which project specifications must be given
  - products which are designed together with the suppliers;
- an agreement is reached;
- a contract is drawn up;
- the contract is signed and the order sent;
- goods and services are transferred in exchange for money or other forms of compensation.

Not all of the single stages mentioned above need be carried out for the procurement of all types of products. In fact, procurement processes can be divided into three categories:

- The procurement of raw materials and production goods.
- The procurement of materials to be used for company maintenance, repair and operation (MRO, Maintenance Repair and Operating supplies).
- The procurement of capital goods.

The concept of fulfilment evolved from a word which described the distribution for companies which were involved in direct marketing and from a word which includes all of the processes in the customer-centric supply chain. Fulfilment therefore means managing the following stages (Quillin and Duncan, 2000):

- Receiving the Order.
- Managing the Transaction.
- Warehouse Management.
- Managing Transportation.
- Customer Response.
- Reverse Logistics Management (Fleischmann, 2001).

E-fulfilment makes it possible to satisfy customers who are demanding more and more in terms of faster service, regardless of geographical location. This, in turn, requires greater efficiency in the distribution process of the product (Ricker and Kalakota, 1999; Hintlian et al., 2001; Reynolds, 2001).

Whereas the stages of the process based on the type of product must be identified in procurement, this is not the case in fulfilment since it deals with finished products on their way out of a company. In order to better manage e-procurement and e-fulfilment and to make them more efficient, models generally called *electronic marketplace* or *trade exchange marketplace* can be used to implement these processes. These models bring many different players together into one virtual environment, making the creation of e-supply networks possible. By considering the classification proposed by Tapscott (2000) and by adapting it, three main categories of trade exchange marketplace can be identified:

- Independent Trading Exchange (ITE);
- Private Trading Exchange (PTE);
- Collaborative Community Exchange (CCE).

Independent Trading Exchange is a many-to-many model which focuses on the physical transaction in the process between buyer and seller. This model tries to minimize the transaction costs within a specific industrial sector. It allows members to have greater access to information, such as the price of a given product and the availability of alternative products.

Private Trading Exchange is a marketplace which is the property of a company or of an influential member in the supply chain. The players using the PTE have very strong pre-existing cooperative relationships. It is a one-to-many model and is directly managed by the leader company. This marketplace can be used by the leader company to improve collaboration, control the various processes and improve efficiency, and thus reduce costs.

<b>Trade Exchange Marketplace</b>	<b>Type of Relationship</b>	<b>Relationships</b>	<b>Advantages</b>
Independent Trading Exchange (ITE)	Market	Many-to-Many	<ul style="list-style-type: none"> <li>• Reduction in transaction costs.</li> </ul>
Private Trading Exchange (PTE)	Relationships defined by rules and contracts established by the leader company.	One-to-Many	<ul style="list-style-type: none"> <li>• Greater control over the processes.</li> <li>• Improved efficiency.</li> </ul>
Collaborative Community Exchange (CCE)	Market and relationships defined by rules and contracts established by community members.	Many-to-Many or One-to-Many	<ul style="list-style-type: none"> <li>• Reduction in transaction costs.</li> <li>• Improved partnerships.</li> </ul>

**Table 1: Characteristics of Trade Exchange Marketplaces**

The Collaborative Community Exchange model is a hybrid which attempts to combine into one model the benefits of a reduction in transaction costs, characteristic of an ITE, and the benefits resulting from the strong partnerships, characteristic of an PTE. It is a vertical model in the field it operates in, attempting to get all of the players in the supply chain of a particular product or service involved in one marketplace. Belonging to a CCE allows a company to make strategic and operational plans with its partners with the goal not of winning the battle between one company and its competitors, but rather of winning the battle between rival communities, i.e. inter-supply chain competition. The other added value of this model is the possibility it offers of having better knowledge of the industrial sector a company belongs to.

## **Research Design**

More than 70% of Italian companies are presently developing or have already developed projects geared towards simplifying company processes by using information networks, and Internet in particular. The first activities carried out online were company-customer relations, using a company's own Internet site. During the next stage, suppliers and customers became actively involved in company processes by being given the possibility of consulting warehouse availability and the state of the order in real time. Then some of the stages of procurement were transferred online using Internet.

The aim of this study is to identify some of the variables which can influence the development of a company getting involved in e-business. In particular, the study focuses on how the procurement and fulfillment processes are supported by information and communication technologies.

Our analysis follows the logic of grounded theory (Glaser and Strauss, 1967), developing a multiple-case study methodology (Eisenhardt, 1989). This method has been successfully employed in the emergent field of strategies in high-tech environments (Brown and Eisenhardt, 1997) and specifically Internet-based strategies (Iansiti and West, 1997). We based our sample of a few on the high visibility of the case studies (Pettigrew, 1990). By analyzing four case studies of Italian

companies belonging to different markets and manufacturing sectors, the aspects which influence the complex relationships between the companies and the other players in the supply chain are defined. The relationship between these complexities and the e-business strategies used is then analyzed. Finally, an evolutionary model which describes how e-business strategies develop over time is proposed.

Four leader companies were taken into consideration in this study: Aprilia (Motorcycle Industry), Carraro Group (Specialized Components for Vehicles), Ducati (Motorcycle Industry) and Fischer Italia (Fixing Systems for Professionals). The following table summarizes the main characteristics of the supply chain of the companies studied.

Company	Product	Suppliers	Customers
Aprilia	Motorcycle Industry	Many domestic suppliers.	Many multi-brand dealers.
Carraro Group	Specialized Components for Vehicles	Many European suppliers.	Few large companies in the automotive industry.
Ducati	Motorcycle Industry	Many domestic suppliers.	Many single-brand dealers.
Fischer Italia	Fixing Systems for Professionals	Few suppliers.	Many customers and retailers.

**Table 2: Case studies.**

### ***Case 1: Aprilia***

*The company.* Aprilia is the second largest manufacturer of motorcycles and scooters in Europe and offers a complete range of two-wheeled vehicles.

*Procurement.* The goal of Aprilia's e-procurement projects is to involve the suppliers that the company already had a consolidated and trusting relationship with. In particular, the aim is to make the procurement stage of the delivery plan more efficient by reducing above all the time taken up for the communication process between the players and by reducing the errors that result from traditional methods of communication. To achieve these goals, an environment must be used where all information is coded and which is accessible, from both practical and financial points of view, for all of Aprilia's main suppliers.

The company already had an ERP type management system when the e-procurement project was initiated. The ERP project began by extending the information network to external sales businesses, post-sales, logistics and production.

The implementation of the e-procurement project made it possible to digitalize the delivery plan. This leads to greater flexibility and better control of the goods supplied. The difficulty proved to be identifying the number of products to be manufactured and defining the item codes as precisely as possible and as close to the beginning of the production stage as possible. The information regarding the delivery plan come from MRP. Then the delivery plans are published on the company's Internet site. The suppliers can access the site in a "collaboration" environment where they can see the plans and download them from the net. Since the Supply Chain at Aprilia is based on the delivery plans, by making them as efficient as possible, the efficiency of the entire Supply Chain can be improved.

The basic problem related to e-business is the organization that supports it. It is necessary to create an organizational and technological compatibility between the various companies involved, from the suppliers to the customers. Keeping with this basic principle, Aprilia has an information management system on the company server in order to have greater compatibility of the codes used and to reduce the number and variety of interfaces used.

*Fulfillment.* Aprilia has about 300 dealers, most of which sell several brands of vehicles. Aprilia has offered its dealers the opportunity to create and manage a virtual warehouse. The dealers access the company's server via Web and from there they can access the applications which are carried out locally on that server (the applications, therefore, are centralized). Furthermore, in this way Aprilia can have a complete picture of the situation of the various peripheral warehouses at all times thus

obtaining precious market information (customer needs and interests). There are even more problems when dealers do not sell only Aprilia brand products. In fact, in this case, there have been difficulties convincing dealers to use Aprilia's own information interface rather than another company's.

### ***Case 2: Carraro Group***

*The company.* Carraro is an industrial group which designs and manufactures transmission systems and special components for light commercial vehicles and cars, agricultural machinery, materials handling equipment, construction equipment and industrial forklifts.

*Procurement.* Carraro designed and created an information network called the Carraro Private Network (CPN) to link the company to its main suppliers. The goal of the project, involving more than 400 direct suppliers, is to automate some of the stages of the procurement process, thus creating an e-procurement model. The suppliers involved in the CPN are companies Carraro has a solid relationship with. Initially, only Italian suppliers had access to the CNP, but then it was opened up to European suppliers as well. The products managed using the CNP are both standardized products and products which are designed in collaboration with the suppliers.

The suppliers have access in real time to information regarding orders, supply plans and the quality of their supplies. One of the services offered to each supplier is the possibility of having online the entire history of its orders.

In the same way, company buyers can evaluate different offers, archive orders in a shared database and, above all, activate a series of automated procedures which reduce or even eliminate many of the activities which have less added value.

Thanks to the new web-based application, it is possible to reduce the lead time of the supply process and increase the reliability of the entire system. Furthermore, by improving efficiency, administrative costs are reduced and the resources dedicated to procurement are optimized.

*Fulfillment.* The Carraro Group has a small number of customers which are mostly large, internationally-known vehicle manufacturers, such as Fiat and Ford. For this reason, the company has not yet felt the need to have an e-fulfillment strategy. A possible further evolution of the system could be the development of a virtual environment where all of the players can cooperate by digitalizing most inter-company relationships. This will only be possible when one standard is created for and adopted by all of supply chains in various industrial sectors. There will have to be a standard for both the technology and the protocol in order to create company information systems which can interact without needing hardware and software interfaces to make the various communication and information flow formats compatible. The standard will increase company flexibility. In fact, with a standard, suppliers and customers will no longer be tied down to the system used by the leader company, as is the case at present.

### ***Case 3: Ducati***

*The Company.* Ducati is one of the leader manufacturers of high-performance motorcycles. In addition to motorcycles, Ducati also sells accessories and clothing in more than 40 countries world wide, especially in Europe and North America (85% of sales). The remaining 15% is distributed between Asia and Australia.

*Procurement.* All Ducati motorcycles are manufactured in Bologna. The company has carried out several projects to reduce production costs and improve the production process. In January 1999, Ducati introduced a production software which controls the flows of information from when the customer places the order to when the product is delivered. By using an MRP created specifically for the company, the system generates production plans based on sales forecasts, optimizing the amount of stock in the warehouse, makes the orders for the purchase of materials and manages the flow of materials needed for production.

Ducati gives its suppliers a platform which allows them to be responsible for sending the semi-finished products which will make up the final product and which manages the relationships with each sub-supplier. This reduces the number of suppliers, increases the number of products each supplier provides and strengthens Ducati's contractual power. Since the same components are used for several different motorcycles, the company can maintain high levels of efficiency even with relatively low volumes of sales.

*Fulfillment.* In the Business-to-Business sector Ducati set up an Extranet called DesmoNet™ in order to have greater control over managing customer orders, to facilitate the exchange of information between dealers and the headquarters and to offer better customer service. The network connects all of the Ducati Stores to the headquarters. DesmoNet was introduced in Europe in 2000 during the initial stages which were intended for customer assistance and distributors. Even though users were offered training courses, the network was not widely used.

Ducati dealers, which are located all over the world and mostly sell only Ducati products, were also involved in DesmoNet. The network makes it possible to see in real time if a particular spare part or accessory is available in other stores' warehouses, which are geographically nearby, in order to satisfy customer requests in as little time as possible. Furthermore, DesmoNet allows the headquarters to check on all of the stores in real time and to use the information collected to generate statistics, optimize warehouse stock, develop new marketing strategies and to "feel the pulse" of the market.

The network has also improved the company's relationships with the end customer; by being able to better check on the availability of spare parts in each dealer's warehouse, it is possible to satisfy customer needs in very little time.

#### ***Case 4: Fischer Italia***

*The company.* Fischer Italia is a division of a multinational company, whose headquarters is in Germany. The company's most representative product present on the market is the fixing system invented by Arthur Fischer.

*Procurement.* The aim of company's e-business project, based on an Oracle application server in J2EE technology, is to make Internet the main instrument for managing the transactions between the company and its suppliers, external work centers, which work with semi-finished products to produce the final product, and customers. The project is already up and running for suppliers, while the part of the project regarding the external work centers is in its final stages and will be launched soon. As far as customers are concerned, this part of the project must still be developed.

Fischer's e-procurement project consists in having created an environment where the stages pertaining to orders were automated. The goal of this project is to substitute the use of traditional communication systems used in all of the stages of negotiation between the buyer and supplier with automated stages. In other words, the goal is to eliminate the use of telephone calls and faxes, for both confirmations and placing orders, in order to make everything as transparent as possible.

The supplier has selective access to the e-procurement environment via Internet and does not have to have any particular application installed on its own computers to do so. Not having to install any software also means a significant reduction in the training needed to actually use the information technologies.

In addition to the e-business application, the EDI continues to be used with the headquarters, which is the main supplier, for the exchange of orders.

*Fulfillment.* As far as fulfillment is concerned, the EDI system continues to be the most important communication instrument with some customers, in particular for large stores. A significant advantage to EDI is that it allows the customer to go directly into the company's management system. This helps avoid the need to manually input various product codes. The communication that an order has been confirmed or refused is sent via Web.

The company receives about 60 thousand orders from customers per year. Many of them are sent using traditional means of communication. The e-business project aims to automate these fulfillment

procedures and involve small customer companies and sales representatives as well. The future prospects for development are geared towards Web-EDI solutions.

## **Case study analysis**

This analysis will take into consideration the main factors that lead a company to adopt e-business strategies, in particular e-procurement and e-fulfillment.

Some of these factors depend on the type of relationship existing between a company and its suppliers and customers. These factors can be seen as catalysts to e-business applications.

As far as the company-supplier relationship is concerned, the most significant variables are:

- number of suppliers;
- product complexity;
- design complexity;
- number of product codes for suppliers.

As the complexity of these factors increases, so does the complexity of the company-supplier relationships. This is then accompanied by a significant number of information exchanges with the players involved. Speed, integrity and security in information exchanges are the pre-requisites for managing relationships with a significant number of players.

The exact same variables proved to be relevant for suppliers as well, regarding the supplier-company processes. The complexity of relationships is therefore defined by:

- number of customers;
- complexity of the product being sold;
- sales contract with the customer (single-brand; multi-brand);
- number of product codes for customers.

As was the case above, a significant number of customers means that transactions involving many different products (product codes) must be managed; this leads to the development of e-fulfillment strategies.

These considerations can be used to create a mapping which describes the present situation of each of the companies study. The situations can then be compared.

The companies, all leaders in their market sector, market very different finished products: Fischer has a highly standardized and not very complex product, i.e. the fixing system, whereas Aprilia, Carraro and Ducati supply very products which are very complex from both the design and manufacturing points of view.

The supply chains used are very different. As far as procurement is concerned, in Aprilia, Carraro and Ducati there are many suppliers, whereas Fischer only has a few. Carraro has few but large customer companies, while Fischer has a lot of customers, made up of large companies, as well as small retailers. Aprilia works with multi-brand dealers, while Ducati has mostly single-brand dealers all over the world.

The e-procurement systems developed of the leader companies allow suppliers to access a reserved area via Web. The main advantages are that the buying and selling (acquisto e vendita) processes are simplified and carried out in much less time. Furthermore, suppliers and buyers can have information regarding orders, supply plans and the qualitative level of their supplies/goods forniture in real time.

To improve the efficiency of the procurement process, in all the cases relationships with suppliers have been digitalized, especially in the order stage. The aim of the e-procurement projects studied is to eliminate all of the manual procedures involved in the order process. The main problem has been the need to integrate the company's information system into the company's internal management system. Once full integration is achieved, orders placed via Web can be automatically transferred to the internal information system which also controls, for example, the stock in the warehouse.

Neither Carraro's nor Fischer's projects for managing customer relations via Internet are currently up and running. On the other hand, Aprilia's and Ducati's are and their e-fulfillment strategies are

quite similar. The latter two companies have created an Extranet which links all of the stores directly to the company. In this case, the differences between the two companies' dealers can lead to some problems. Since most of Aprilia's dealers are multi-brand dealers, a dealer may be hesitant to adopt one company's information system which is not compatible with other motorcycle companies' systems. Ducati, on the other hand, runs its own Ducati Stores, which are single-brand dealers, so that adopting the company's platform is less complicated than in the previous case.

The advantages of an e-fulfillment project are better control of sales, optimization of warehouse stock and better understanding of market trends.

Ducati has a brand which leads the customer to identify him/herself with the philosophy and exclusive nature of the company, whereas Aprilia does not. This influences the approach to e-business. For example, while Ducati was able to sell the MH900e model exclusively online with great success, Aprilia, due to difficulties with the distribution of the product, has not yet started a real project for e-business geared towards end customers.

The analysis shows that only some of the stages of the entire process have been digitalized in the four cases studied. For example, the companies do not use Internet to look for new suppliers or to evaluate potential suppliers. In this way, marketing is not taking full advantage of the Internet. Similarly, Internet is not used to look for and establish contact with new customers.

Other characteristics which can influence the development of e-business are the size and contract power of the company. Large companies have the investments needed to develop personalized applications which can be integrated into their own management systems. Furthermore, the greater the contract power of the company, the easier it is for the company to have its suppliers adopt the new applications.

The companies considered here are all large companies with significant contract power. In fact, all of them have pushed either their suppliers or customers to adopt their own personal information system. Therefore, these companies have used the Private Trading Exchange model. This choice depends on the lack of trust these companies appear to have in online auctions and marketplaces and explains why they did not choose the ITE model. Finally, the companies did not adopt the CCE model because the conditions needed to carry it out are still lacking: there is no type of coordination between these companies and others working in the same sector; there is no industry-wide standard for internal management systems or for managing orders.

The following table shows the relationship between e-procurement and e-fulfillment strategies and the complexity of a company's relationships.

		Complexity of relationships with suppliers	
		Low	High
Complexity of relationships with Customers	High	e-fulfillment	e-procurement and e-fulfillment
	Low	Traditional communication systems or EDI	e-procurement

**Table 3: Relationship between strategies and complexity of relationships.**

When the complexity of relationships with both suppliers and customers is low, companies continue to use traditional means of communication or hierarchical information networks, such as EDI. The fewer players are involved in the supply chain, the lower the cost is to coordinate these players. When this is the case, it doesn't seem to be any real value in investing in ICT. Companies which manage their own sales network with single-brand dealers are placed in this category as well since they can be considered to have a limited number of customers. In this case, the company can impose its own standard and way of operating on all of its dealers in the same way. Low complexity of relationships can also be defined by few product codes in both supply and sales. In these

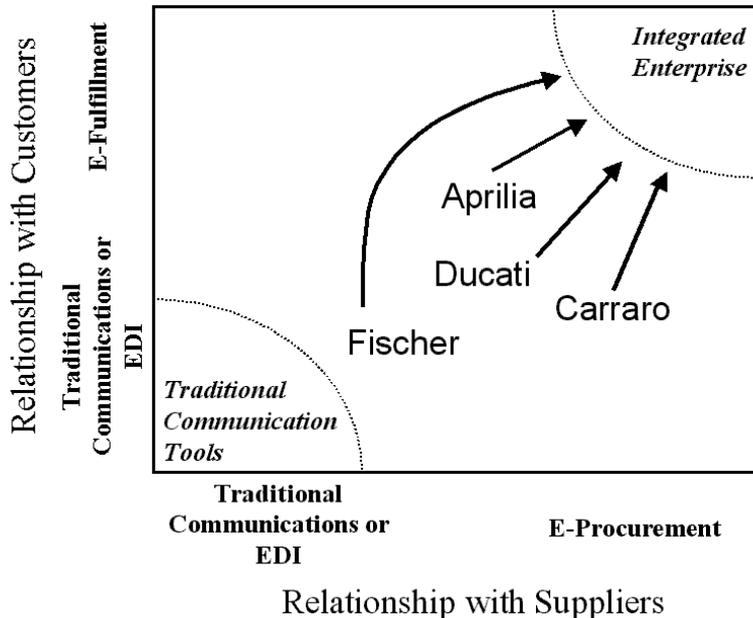
circumstances it is not necessary to invest in Internet ICT because of the simplicity of coordinating and transferring product information.

The companies which have set up or are currently setting up integrated e-procurement and e-fulfillment projects are characterized by very complex relationships with suppliers and customers. The e-business strategies are an attempt to create the best flow possible of products along the supply chain.

The main advantages of applying e-business strategies are:

- Fewer mistakes in data acquisition and transfer and greater reliability;
- Better coordination with suppliers;
- Greater external visibility of company process; increase in the amount of information customers have access to (product availability, sales forecasts, coordinated production and delivery, product tracing);
- Better control over the bills of materials;
- Less overstock;
- Possibility of having more product information on line.

The following figure places the four companies studied in a diagram to help represent the similarities and differences. The area in the lower left-hand corner, called *Traditional Communication Tools* in the evolutionary model presented in the following paragraph, corresponds to low complexity of relationships with both suppliers and customers with the consequent use of traditional communications systems. The area characterized by the combined application of e-procurement and e-fulfillment, in the upper right hand corner, is called *Integrated Enterprise* in the evolutionary model. The arrows in the diagram below represent the evolutionary path which takes company strategies towards Integrated Enterprise.



**Figure 1: Case positioning and future projects.**

Aprilia is characterized by many suppliers and many multi-brand customers. All production is done using outsourcing. The product is complex and made up of thousands of codes. In fact, it is this complexity which has led Aprilia to adopt an integrated project of e-procurement and e-fulfillment. Carraro has many suppliers and few customers. The Carraro Private Network aims at optimizing the procurement stages, neglecting, for the moment, fulfillment, which is still coordinated using traditional means of communication.

Since a part of Ducati's production is internal, it has a limited number of suppliers. Its dealers are mostly single-brand dealers and the company therefore has significant control over the sales network. Therefore, at present the company has only set up an e-procurement process.

Fischer has many customers and few suppliers and its products are not very complex. The company has already set up an e-procurement project, even if the orders with the main suppliers are still managed using an EDI. The company is starting up a project which aims at coordinating sales.

As can be seen in figure 1, all of the companies have set up projects aimed at developing integrated e-procurement and e-fulfillment strategies. The forecast is that these companies will be moving more and more towards becoming Integrated Enterprises over the next few years. This evolution, which starts from traditional communication tools, follows distinct stages which are discussed in the following paragraph.

### **An evolutionary model of e-business implementation**

An analysis of the literature and case studies makes it possible to define a model which can describe the evolutionary path which takes place when Internet is adopted to more efficiently manage inter-company relationships and processes. The model involves two variables: network integration and technological integration.

Network integration is the sharing of resources and co-participation in a common environment where the relationships in a supply network are coordinated using information networks. Technological integration is a company's ability to have information systems which can be used to control many different company functions and which interact with each other either using similar communication protocols or adopting interfaces to allow different systems to communicate. Technological integration is even more complete when different players in the supply network use the same communication protocols or the same computer applications.

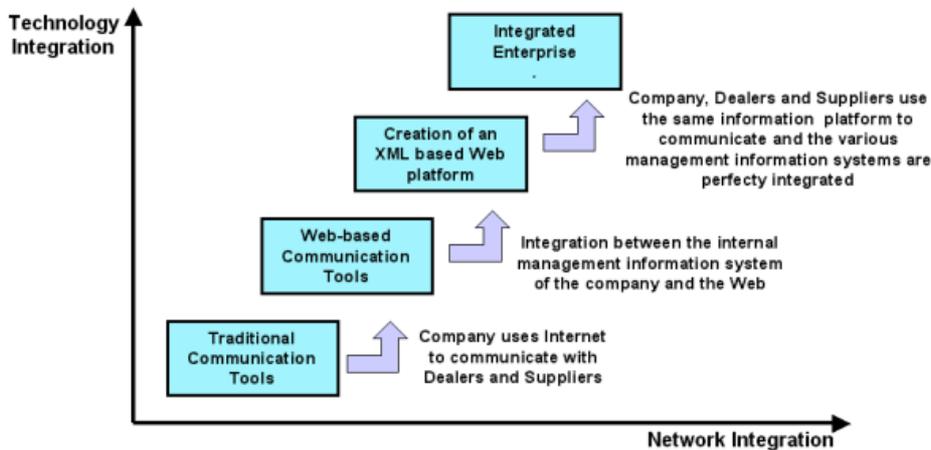
The model presented here proposes four stages for the implementation of e-business within an existing company: traditional communication tools, Web-based communication tools, XML Web-based platform, Integrated enterprise.

Traditional communication tools. In the first stage, the information flow between the various players in the same supply chain and the company in reference is managed using traditional communication systems. In this case, a company's information systems are mostly used to manage internal processes rather than communicate externally. However, a company may have its own communication network, such as EDI. There are many limitations at this stage, such as the implementation cost, the difficulty in interacting with other information systems, the need for a company's partners to adopt the same technology, the need for particular skills, the lack of flexibility which makes it difficult to bring in new partners and creates high switching costs for those who wish to leave (high entry and exit barriers).

Traditional communication systems are very inefficient in that they do not make it possible for information to be transferred quickly with a low probability of error. Furthermore, if the company uses a traditional management system, all of the entry and exit orders must be put in the system manually.

Web-based communication tools. During the second implementation stage, on the other hand, Internet is used to communicate with suppliers as well as with all of the players involved in the supply chain. In this case, an environment is created where the players can access and use various services via the Web. This solution does not integrate the Web environment with the company's internal management system. Therefore, some of the interfacing activities between the different information systems must be carried out manually. Compared to the previous stage, the time needed for the various players to communicate is reduced (faster information flow) and the accuracy of the information transferred increases, with a significant reduction in the number of mistakes. Dealers and retailers can access a series of forms via Web which allow them to place orders. In this case, the

codes are transferred correctly, avoiding the mistakes which occur when telephone and fax are used. The network of relationships between the players becomes very flexible and there are no particular entry or exit barriers. This solution is particularly appropriate for small suppliers and retailers since there are no significant investments required with regards to technology or skills.



**Figure 2: Levels of implementation**

XML Web-based platform. The third implementation stage involves more integration between a company's internal management system and the Web environment. At this stage an interface between the two environments must be developed. Not all of the companies in the supply chain can carry out this type of implementation, rather, only medium- to large-sized companies which have significant contract power with regards to their suppliers and customers can. In this case, the leader company develops a software which allows the main suppliers and customers to see the situation of the warehouse in real time. Whereas in the previous stage, orders placed via Web were transferred manually to the company's internal management system, in this stage they are automatically converted from the Web channel and transferred to the leader company's management system. Access to the system is directly controlled by the leader company; at the beginning, only the main partners have access. In this way, the manual activities are reduced, as is the lead-time, and all of the stages of procurement and fulfillment can be traced. The technology needed to make all of this possible is offered by XML applications.

The companies considered in the two case studies presented in this paper belong to this stage of implementation.

Integrated enterprise. The fourth stage represents a probable evolution of information and communication systems. In particular, the information system being developed would have to bring together different companies working in the same field into a sort of consortium. By using Web interfaces, a platform is created in which many suppliers and customers can collaborate to make some processes more efficient.

The adoption of strategies to integrate the supply chain offer much more than just an improvement in company efficiency. Some companies are discovering new ways of carrying out business and new opportunities which were previously not possible. In fact, at this level, all of the logistical flows are redefined and there is a move towards the creation of a "supply network" (Lee and Whang, 2001). The players involved in these networks can create new products together, work towards mass customisation and penetrate new markets and new customer segments.

New rules will come about as a result of the integration made possible by Internet. This integration would not be complete without strong ties between the companies involved in the network. Success would be based on the following rules:

- The channels of communication must be well defined and managed according to norms and responsibilities which are clear and articulate.

- There must be several ways of measuring the performance of the entire supply chain.
- Within the network, all of the players involved must have a real sense of added value. The value and risk must be equally distributed among all the players.

The “glue” holding the various players together will above all be the standard of communication, at present not possible, which allows players to share resources and create a strong collaboration resulting from a high level of trust and commitment.

The companies considered here are presently using XML Web-based platforms. However, the specific need to integrate more and more all of the players in the supply chain was expressed during the interviews. A “supply network” would make it possible to optimize the management of the following activities (Simchi-Levi et al., 2000):

- Demand Planning: setting sales forecasts based on historical data and on an analysis of customer buying behavior.
- Supply Planning: efficiently allocating logistical resources in order to satisfy demand.
- Manufacturing Planning and Scheduling: allocating production resources in order to satisfy demand.

All of this requires the shift from the local optimization of the relationships between customers and suppliers to the global optimization along the entire supply chain lead by end customer demand. Information networks could make global optimization possible even if the standardized communication protocols needed are not presently available.

## Conclusions

Even if the companies studied are geared towards different markets, the strategies they have used are quite similar. In particular, they have adopted the XML Web-based platforms model.

As far as e-procurement is concerned, the players involved are suppliers that the companies already have a stable and trusting relationship with. Furthermore, they are suppliers the companies deal with quite frequently. As far as the technological aspect is concerned, the companies created platforms at the beginning of the supply chain which allow suppliers to take part in a private environment where they can access the companies’ production plans. This way each supplier can manage its own virtual warehouse and plan its own production from a distance without having to invest in software systems to carry out in-house management.

Further studies will have to be carried out to better understand the evolution process involved in implementing e-procurement and e-fulfillment projects in companies. In particular, it is important to understand if there is an evolutionary path which aims at integrating the procurement and distribution stages into one single virtual environment.

It would be interesting to study which stages of the procurement and distribution processes are made digital, if this takes place in the same way for the two processes and if this can be applied to different industrial sectors. Furthermore, it is necessary to evaluate if the evolutionary path changes according to the product which is being commercialized and what effects this may have on the entire process. The "supply network" will be the field of research of further studies. In this studies, it will be analyzed the importance of standard in the supply chain cooperation.

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