

Integration of Web-based Procurement and Fulfilment: 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; Christopher, 1998).

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".

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 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 and 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).

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.

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

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 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. 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, Carraro Group, Ducati and Fischer Italia. 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.

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).

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.

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.

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 world wide.

Procurement. 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 TM 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. 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.

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 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.

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.

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.

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 and 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) and 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 processes are simplified and carried out in much less 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.

The analysis shows that only some of the stages of the entire process have been digitalized in the four cases studied. 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 chose 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 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.

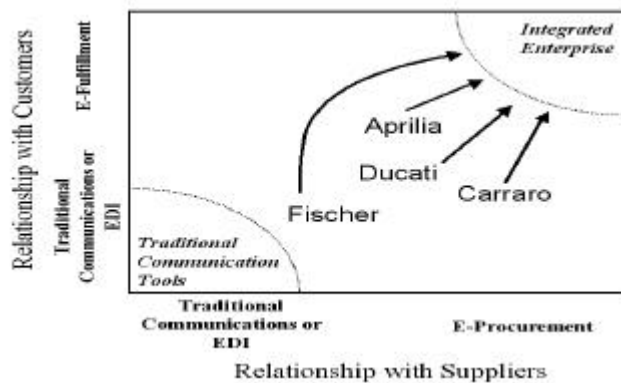


Figure 1: Case positioning and evolution.

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.

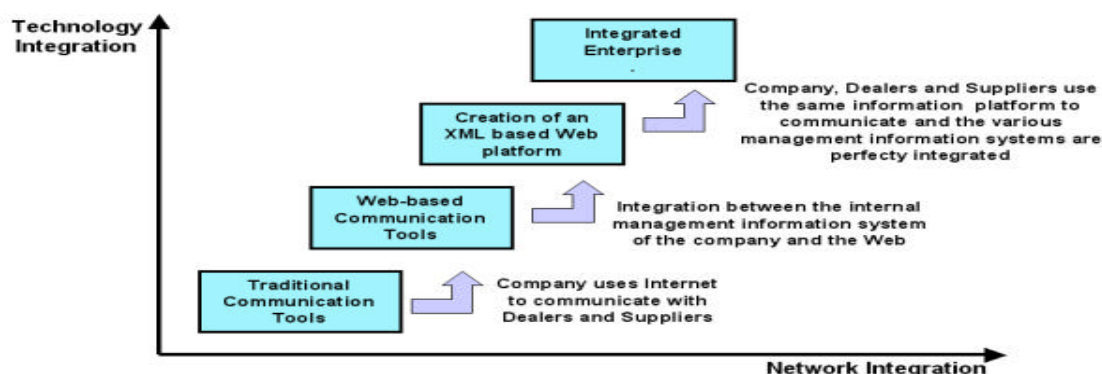


Figure 2: Levels of implementation

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 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.

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.