

## E-SCM - Intelligent Collaborative Decision Support System

Delia MĂRINCAȘ

Babeș-Bolyai University,

Faculty of Economics and Business Administration, Cluj - Napoca, Romania

marincasdelia@gmail.com

*The Internet has changed the way companies do business and has created new opportunities in many fields. Companies which wanted to attain higher profit rates eliminating expensive intermediates, realized that they have to adapt their supply chain to the Internet and to connect through Web technologies with their business partners to create supply chain networks. The convergence of SCM (Supply Chain Management) and the Internet tools resulted in a Web based application called e-SCM. E-SCM model encompasses business concepts and technological tools that join and activate supply chain competencies and resources into a virtual organization to satisfy customer demand in real time. Web technologies provide access to interoperable business components residing on network servers, allowing cross-company teams to interconnect data and information. E-SCM applications help companies to win competitive advantage because they create more value for the customer and have the goal to satisfy the client requirements better, in real time. The article analyzes the concepts and technologies related with e-SCM model: SCM, ERP (Enterprise Resource Planning), Extranets, portals, Web-based applications, EAI (Enterprise Application Integration), Web technologies and standards. The last section of the article presents an e-SCM model and the architecture which should be employed for the design and implementation of an effective e-SCM application.*

**Keywords:** Intelligent Decision Support System, E-SCM, Web Technologies, ERP, E-commerce

### 1 Introduction

The Internet based Supply Chain Management is one of the most important management concepts today because it enables the supply chain partners to exploit the new realities from the marketplace: Web technologies, collaboration, customer-centered organization, etc.

The e-SCM or Web enabled supply chain can be defined as the supply chain that uses Web technologies to regenerate business networks for the purpose of creating and providing customer value at the lowest cost through synchronization in real time between demand and supply. This synchronization can be achieved through collaboration with all business partners in real time, information sharing and coordination of business processes using decision support tools, data warehousing, Java, XML, wireless devices in order to optimize supply chain activities, to maximize the value supplied to the customer and to better satisfy its requirements [1].

In order to justify the need for implementing and improving e-SCM applications with new capabilities in a company, we will analyze the issues involved in the design and development of an optimized supply chain and a Web based application for supply chain management: the supply chain, ERP systems, e-commerce environment and technologies. In our opinion, there is a lot of literature related to SCM issue, but the implementation of theoretical principles is limited to sharing information and some collaborative forecasting. For this reason, we propose a model for e-SCM applications which employ most of the techniques found in present SCM literature for improving the effectiveness of SC collaboration, sensitiveness and proactiveness.

### 2 Characteristics of SCM and e-SCM

The Supply Chain (SC) encompasses the activities associated with the flow and transformation of goods from the raw materials

stage to the end user, together with the associated information flows. Supply Chain Management (SCM) integrates these activities through improved supply chain relationships to achieve a sustainable competitive advantage [2]. According to [1], SCM represents much more than these and in order to figure out its entire extent, we should approach it from three perspectives:

- tactical: SCM is an operations management technique that seeks to integrate and optimize the capabilities of internal business functions and to direct them to new opportunities for cost reduction and increased channel throughput by working with the matching functions from the supply chain partners, customers and suppliers. Tactical SCM can be divided in four activities:
  - suppliers' management involves inventory optimization, suppliers management, negotiation, forecasting, purchasing and transportation [3]
  - product and service processing: product engineering, manufacturing, costing and service
  - customer management: finished goods warehousing, value added processing, customer order management, fulfillment and transportation
  - channel support activities use partners to facilitate financial transactions, marketing information flows, electronic information transfer and integrated logistics
- Operational SCM aligns internal enterprise departments with the identical functions from the supply chain partners. Operation synchronization will accelerate the flow of inventory and marketing information, optimize channel resources cost reduction and productivity growth.
- strategic: SCM transforms the linear, sequential SC into a networked SC centered on functional and strategic interoperability through collaborative partnerships for the correlation of SC processes. The SC process correlation creates unique sources of value by unifying resources, competencies, capacities of the entire network.

The activities involved are:

- supplier management: collaborative merging of inter-channel procurement volumes, quality, transactional cost reduction
- product and service processing: implementation of tools for shared product design, connection between SC members' ERP systems to facilitate collaborative planning and scheduling, integration of core competencies belonging to member companies [1].
- customer management uses best practices for order fulfillment, managing product lines and services to match customer requirements and treats each customer's needs as unique
- support services unify not only basic logistic function – inventory planning, purchasing, transportation- but also financial, sales, product development

These tactical and strategic approaches are focused on the evolution of business network, resulting in innovations, new processes and technologies, increased reliability and speed and mass customization economies.

- Web technologies: e-SCM enables the integration and synchronization of all SC information and processes. Web based applications allow the reduction of transactional costs with 80% compared to private network cost. E-commerce standards (e.g. XML, Java) enable low cost integration of customer/supplier/product information and competencies from SC partners, the transmission of documents and data in real time at every level in the supply chain. E-SCM generates more value for customers through the agile, flexible, collaborative intelligent systems built on dynamic networks of Web enabled partners. In order to understand the value generation in the supply chain for the customer demand fulfillment, we will detail the value chain term.

Value chain is an interconnected series of organizations, resources, knowledge flows involved in value creation and delivery to final clients. Value chains integrate supply chain activities, from determination of client needs

through product developing, service, manufacturing, operations and distributions including, suppliers on the first, second and third tier [2]. Value chain objective is to place organizations in the value chain in order to attain customer maximal satisfaction and value while efficiently exploiting the companies' competencies in the entire supply chain.

In order to implement an e-commerce system, the concept of value is important from customer's point of view, because the client generates company revenue. The value to the customer has to be considered in the moment of the creation of the e-commerce system management strategies. First, the products have to be in accordance with customers' requirements, to be available and to be accessible for them on the company sites. Customers are attracted by the products price that can be direct proportional with their quality level but also by brand name. Other factors that determine the decision to buy a product are value added services such as maintenance support, especially for technical products [2]. Using e-SCM applications, the value added for each product can be considerably increased.

Together with SCM techniques, the Internet is the main communication infrastructure for collaboration in supply chains; it enables the connection of supply chain partners through Web technologies. In order to take advantage of the Web technologies, it is necessary to study them in correlation with the supply chain network and its needs. The new capabilities provided by the Internet are:

- A new function for information in the supply chain:
  - usage of real time information for collaborative planning, forecasting and replenishment to satisfy the customer in less time and respond to market changes.
  - visibility and management of SC event in real time: from the flow of customer demand to inventory levels and shipment, proactive notifications of exception events, perform simulation, SC control of the network to make timely decisions
  - real option of event management in the SC is possible due to real-time e-

information available in the SC which reduces risk in SC processes and collaboration. Trading partners can handle the demand in real time and plan safety stocks, determine the optimal point for product postponement, allocate capital and minimize forecast error. E-information enables customers' integration in the business system, order fulfillment, proper execution of value added services. At shop floor level, e-information enables the visibility forward in the SC capacities and improves store supply according to current changes in customer demand which are visible and broadcasted to the supplier [4]. Suppliers can adjust their deliveries and stock planning according to the global demand of the entire business network.

-SC integration through integrative IT tools, integrated operating platforms, component-based e-business application and wireless communication that form interoperable networks

- Relationships with partners for the execution of cross-enterprise processes and the integration of trading partners operations from a synchronized Internet based network focused on better customer satisfaction. Suppliers and their customers create real partnerships from which each of them benefits. Suppliers can optimize their inventories to the extent that allows them to use "zero inventories" model. Customers get more added value through product customization, personalized solution for products or services, faster order fulfillment for strategic planning and real time satisfaction of customer demand. At the same time network collaboration allows partners to respond as a team to customer requirements to decide how to fulfill the demand. The collaboration provides the possibilities to respond to the customer requests so that to better satisfy their needs and to retain them.
- SC synchronization of information from all network nodes to quickly respond to the customer needs. This is possible if customer event-driven data are available

in real time across the supply network, allowing concurrent decision making while decision is transmitted in the SC system. Synchronization can provide:

- Connection of partner companies by engineering planning and decision making capabilities
- Reduction of SC costs to remain competitive
- Attracting the most profitable customers by creating value-based relationships
- Access to the most value-added suppliers
- Structuring the organizations and SC networks so that to become agile and flexible to respond to changes in customer demand and supply dynamics [1].

e-SCM is connected with company ERP system which provides for the intra-enterprise transaction data that are needed for SCM. The SCM application uses Web technologies to connect business partners systems and to process and broadcast data stored in their own ERP or in their partners' ERP systems. In order to elaborate the characteristics and the links between technologies involved in e-SCM applications, we will approach these issues: ERP systems, e-commerce and Web technologies.

### 3 ERP Systems

ERP system forms the central nervous system of a company. New ERP systems are open to e-commerce components. They include back-end integration features for end-to-end integration of business process [5]. The Web front-end should be linked to the back-end order processing, manufacture, procurement, accounting and distribution modules included in the ERP system. Other features that enable the integration of e-commerce systems with back-end systems are:

- access to data sources through standard database interface (e.g. ODBC)
- support for XML data formats
- development of application adapters to hook e-commerce packages into back-end systems
- specialized business process workflow engines

Business process can be extended to the internal employees, business partners and customers. Company employees can access the intranet using different appliances: PDAs, PCs, wireless telephone, instead of requiring access to mainframe applications. Business partners can access catalogues and can place orders through their e-commerce site.

The most used method for linking back-end applications and systems for e-commerce is to provide appropriate Web interface. There are several options for this purpose: porting of Web servers on proprietary platforms, developing middle-tier functionality to map between browser and back-end protocols and interfacing e-commerce applications that have standard browser interfaces with back-end applications [6].

Extranets extend an organization's intranet to include strategic business partners in order to facilitate work collaboration and information sharing. Manufacturing organization deploy similar extranets to streamline their supply-chain processes and activities. Extranets are used for a company's external relationship, but they can be used for internal implementations, too. Some characteristics of extranets are:

- An extranet provides a specific group of users with controlled access to applications unlike the intranets which are accessible to all organization's employees
- Extranets use Internet technologies the same as intranets, but they employ additional security technologies to regulate access to the network (such as VPN-Virtual Private Network)
- Extranets are complex due to the granular security levels required for different security parameters: authentication, authorization unlike intranets which don't need all these security measures
- Extranets are specific for a group of users
- Extranets serve business applications for a specific purpose and require appropriate technologies – for example connecting the business partners from a supply chain to synchronize their activities in real time.

The advantages of deploying extranets are:

streamline operations and cycle times reduction, costs reduction, increase in EDI and other business transactions, secure transfer of transactions, interactive transactions using EDI or other standards, collaboration with business partners, information sharing. Extranets can be implemented for private business partners and for customers for certain business linkages and transactions.

#### 4 E-commerce and e-SCM

Investments in e-commerce systems become a necessity and ensure a competitive advantage. The factors that impose the implementation of an e-commerce system are: new partners and customers requirements, customers' necessities have to be satisfied through different channels: mobile phone, PCs, etc. Competitive necessities impose company to adapt to the market and implement adequate system such as Web based applications. E-commerce modules have to be a part of present e-SCM applications in order to provide customers the possibility to order on company's site and to get customer demand in real time.

E-commerce technology on the Internet comprises communication networks, softwares for e-commerce, databases, communication protocols, security protocols, client/server applications, techniques for applications security, search and indexing mechanisms, intelligent software agents, e-payment systems etc. In order to implement an e-commerce system, a new IT strategy is necessary that allows access to a large number of customers and collaboration with different services suppliers. For this reason, we will present the e-business environment, its concepts and technologies.

Web enabled e-business consist of four definite phases, as follows:

- I-Marketing –between 1995 and 1998. This phase was limited to the presentation of documentation about their products and services, utilizing relatively simple Web-based multimedia functions. Customer use of e-marketing was restricted to searching, viewing graphical presentation and reading static text.

- E-Commerce -1997-2000. A new business model emerged: I-Marketing catalogues and advertising techniques with new technology tools: Web-site personalization, self-service, interactive shopping-carts, bid-boards, credit card payment and on-line communities [7] The new e-business comprises a set of e-applications such as: e-tailing and consumer portals, bidding and auctioning, customer management, electronic bill payment (EBP). All these are taking place between consumers and various types of retailers.
- E-Business marketplace -1998-2003 is concerned with the transaction of products and services between business, involving a long-term relationship and collaboration between partners [8]. The types of e-marketplaces are:
  - independent trading exchange (ITX) – a many-to-many marketplace composed of buyers and sellers networked through an independent intermediary
  - private trading exchange (PTX) – a Web based trading community hosted by a single company that requires or recommends trading partners, using suppliers, participate in as a condition of doing business. The key services provided by PTX are:
    - identity management for the transaction mediums and people executing the transaction, content management, integration with ERP back-end functions of trading partners to achieve synchronization and collaboration, process management, analytics for the measurement of the effectiveness of the supply network relationships enabled by the PTX.
  - consortia trading exchange (CTX) can be defined as some-to-many network consisting of a few powerful companies organized into a consortium and their trading partners. Its goal is to combine purchasing power and supply chains to facilitate the exchange of products and services through Web based tools such as aggregation and auctions. SCM, SRM and CRM applications allow the exten-

sion of value chain, the automation and synchronization of the activities and processes in the supply chain.

- E-Collaboration 2001-2009. E-business marketplace allowed the increase in demand visibility, operational efficiency, customer segmentation and the decrease of procurement costs, replenishment time and geographical barriers. All these faci-

litated the evolution of SCM (supply chain management) applications from transaction based to collaborative and synchronized systems. The value chain has extended from first tier partners to groups of tiers forming a networked supply chain as we can see in the next figure.

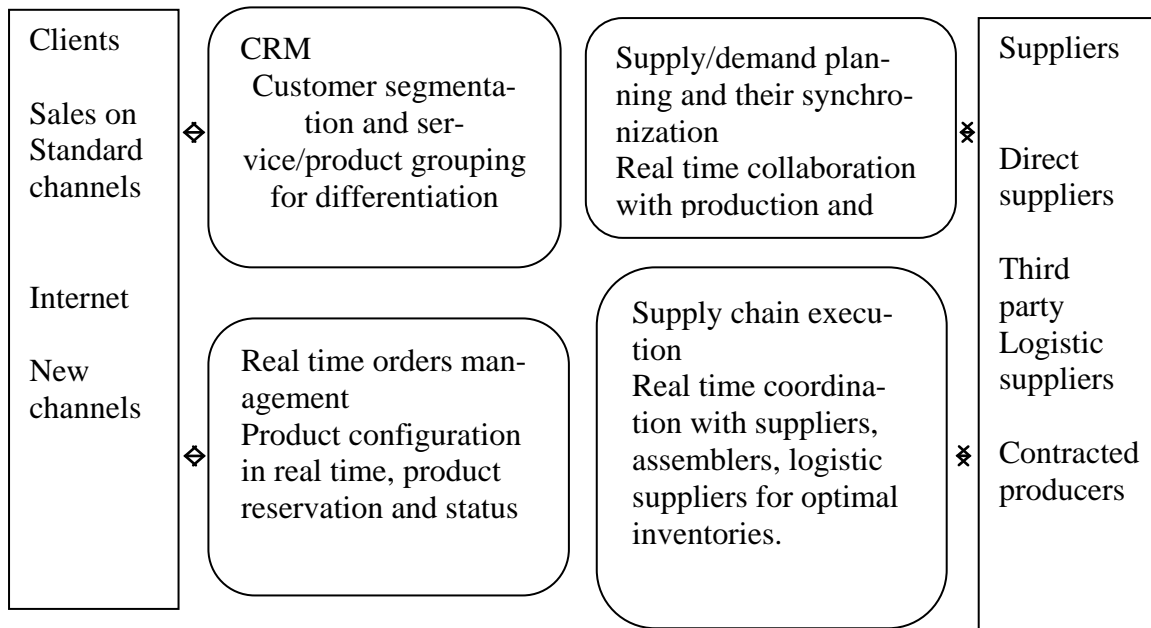


Fig. 1. Network supply chain[15]

The goal of collaborative commerce is to enable greater SC visibility and connectivity. Collaborative commerce can be divided in three groups:

- Basic B2B Commerce consists of application tools that provide marketing information and transaction functions via the Web.
- SC Management develops collaborative Internet technologies to better manage networked customers and inventories. The changes in the supply chain will trigger reaction from network partners through dynamic collaboration to ensure customer service while guarding against excess inventories [9].
- SC Collaboration enables real time collaboration using specific tools such as:
  - Collaborative Forecasting of demand and Collaborative Replenishment

through broadcasting demand requirements in real time

-CPC (Collaborative Product Commerce) – involves the deployment of cross channel teams of developers and engineers to manage product content, sourcing, communication between manufacturers, suppliers, customers to eliminate redundancies, costs, time from the product development process. Collaborative design allows the connection of design teams on the Web, using CAD tools in real time, to design parts, update them, get components ordered and follow the timetable of their deliveries [10].

-Collaborative Strategic Planning through supply chain network for supply, manufacturing, purchasing.

B2B collaboration produces a value Web of customer-focused suppliers, manufacturers and distributors. Traditional SC are linear networks linked through expensive technologies like EDI. The new collaborative SCM provide any-to-any connections that can drive procurement webs, manufacturing webs, linked business strategies. The ability to process information and transactions, to share planning systems and core competences wherever they are on the globe need many technology tools:

- New XML based solutions that allow quickly generation of transaction documents
- Business intelligence tool capable of supporting, extracting and validating data in and out of a multiple, heterogeneous system
- Electronic catalogues with multimedia elements capable of synchronizing product update and dynamic pricing
- Real-time collaborative planning, forecasting and replenishment systems
- Integration and collaboration application services.

All the capabilities of e-commerce systems can be employed in e-SCM applications and most of them were used by e-SCM software producers for their software. We propose a model that includes the above mentioned capabilities and, in addition to all these, broadcasts the changes in demand to all SC members, providing the demand visibility and synchronization that will increase serviceability and „just-in-case” inventories.

### 5 E-SCM Business Model

This section presents the SCM business model implemented in e-SCM applications and the new features we want to employ for SCM optimization. e-SCM business system can be divided into three regions comprising the next components: ERP, Middleware, Web based applications.

- **ERP** (Enterprise Resource Planning)/EBS (Enterprise Business System) is the centre of present business solution. It has converged with Web-based applications to form groups of business soft-

ware functions: production, purchasing, CRM, SCM.

- **Middleware** consists of e-SCM applications enabled by communication standards such as EDI and XML. Internet based EDI is the most used standard for broadcasting documents between SC partners together with VAD (Value Added Networks) and XML
- **Web based applications** are directly integrated with ERP backbone through EAI (Enterprise Application Integration). These applications comprises a variety of supplier and customer-side software applications: CRM (Customer Relationship Management), CPC (Collaborative Product Commerce), SCM (Supply Chain Management), e-Procurement applications, e-Finance and Human Resources.

Nowadays, the most commonly used e-SCM applications are portals. Portals extract data from ERP system for trading partners in the supply chain, reducing at the same time the cost of distributing and sharing content and applications. Portals provide people-to-system coordination, unlike PTXs which provide system-to-system integration at the process level.

Portals are front-end interfaces to the knowledge repositories and enterprise services. Enterprises develop their own portals to provide access to company applications and Internet and intranet-based content [11]. At the same time they can deploy portals for their customers and attract them with customized services, provide intelligent information search, access to groupware function and automatic alerting for customers using settled rules or software agents. Portals link to internal applications in order to retrieve data from internal data sources (ERP data), data from Web, or other vertical portals. The data should be displayed in a manner that enables decision making in a minimal amount of time. The same portal can be used for different departments and business partners with controlled access and customized options. A portal for Supply Chain Management can provide access to company inventory in a different way for suppliers, customers and em-

employees. The development of wireless technologies, allows enterprises to extend their portal services to their mobile users. SCM

partners will be able to access the e-SCM applications through their mobile appliances: smart phones, PDAs, laptops etc.

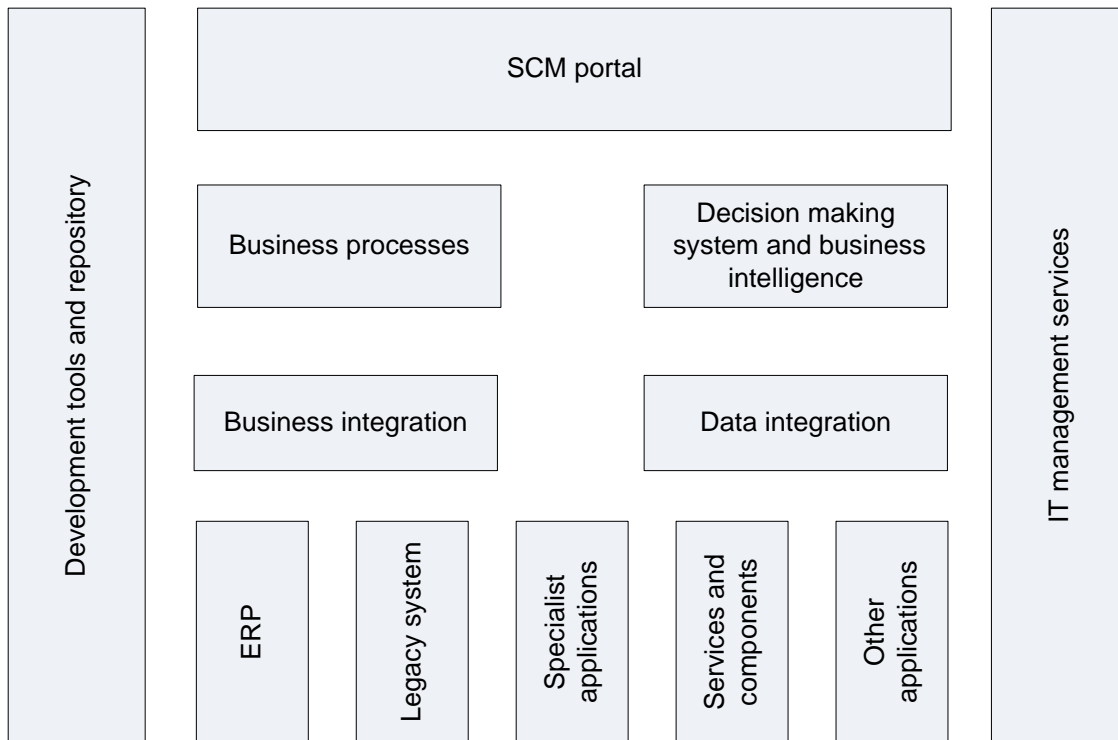


Fig. 2. SCM Portal [12]

The e-SCM application model needs that ERP, resident memory PC and e-business applications to be integrated together so that information and business processes to flow between SC nodes. Internally, companies provide synchronized repositories of data about customers, processes and products and externally partners can traverse the SC network to get information or generate transactions. To make all these possible, linking applications across business units, operating systems and hardware platforms are necessary. To meet these integration requirements, the following issues need to be resolved:

- Availability of integration standards for document formats to enable information transfer
- The integration tools should use Internet transmission protocols as well as open data formats to facilitate data transfer between companies.
- Automated and standard transformation and routing tools must be available to convert and route data in different for-

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- Tools for creation and management of distributed business processes and document exchange
- Security for data transfer: encryption and digital signature

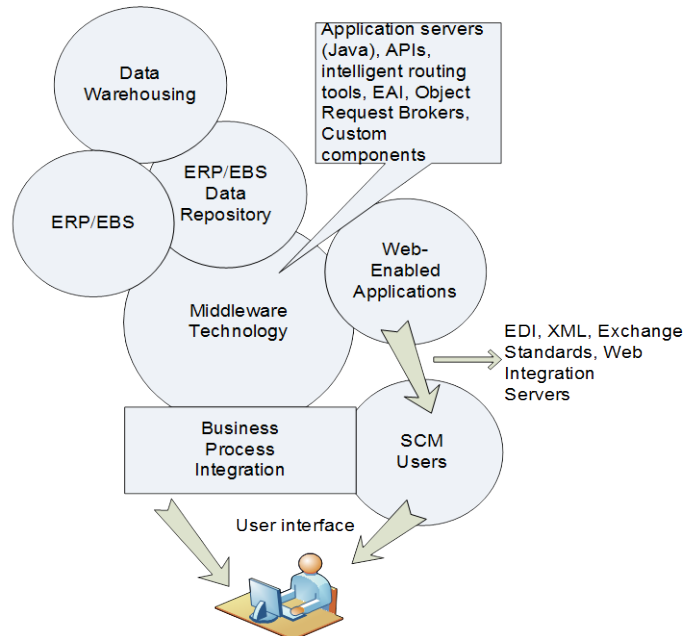
The integration strategy should implement scalable integration capacities that allow system designers to partition the business process logic from applications and create the collaboration needed.

EAI (Enterprise Application Integration) allows the integration of company application using a set of technologies and services that form a middleware. It automates business processes, avoiding the storage of the same data in more locations and significant changes in applications and data sourcing. EAI is very frequently used in SC integration for linking enterprise applications within a supply chain and enables collaboration among supply chain partners. Technologies available for EAI are used at different levels: data level – ODBC, Java Database Connec-



tivity, application level-CORBA, JavaBeans (EJB), Component Object Model (COM/DCOM) and business process levels – Web Service Business Processes Execution Language (WSBPEL). There are specialized SC integration technologies such as ebXML,

RossetaNet developed on the basis of generic integration technologies. The above technologies provide physical integration. The logical integration includes agreement on concepts and model integration [12].



**Fig. 3.** Middleware – e-business Integration Architecture

The core of the integration architecture is the middleware. It coordinates and enables the communication of applications running on different computers. Middleware facilitates the access of ERP, data structures, data warehouses and enables internal and external business functions to pass data between each other. Middleware can be:

- Data-oriented middleware - facilitates information sharing between different applications
- Process-oriented middleware – enables the processing and integrity of transactions and insures system integrity.

They can be implemented in one of many application layers. When a transaction takes place, the data passes through to the middleware layer, is translated in a language like XML or Java and is sent in a readable format to another application layer. The process oriented layer is named Business Process Management (BPM) and integrates process across business units, applications, enterpris-

es so that to align business processes and to deliver key information. BPM provides visibility to business processes residing on different computers and architectures to support the monitoring and synchronization of business processes and events management across networked supply chains.

Success in present marketplace is going to those companies that focus on strategic capacities of their value chain network. In order to structure effective supply chain business architecture, it is needed to approach three aspects:

- physical aspect - refers to mapping out the network nodes and the level of value contributed by each channel business node
- setting a map of business partners competencies with which they contribute to individual company and total SC value.
- defining the type and robustness of the connecting links for each node.

By identifying the technologies used in the

SC, the planners can determine how effectively data and process information can traverse the network. Deciding on the mix of collaborative technologies depends on how individual firms want to use their network relationships. E-business solutions can connect business partners to increase revenue and relationship enhancement. The more e-business strategies are employed, the more the supply chain model becomes a value network, capable of generating collective advantage beyond the capacities of individual members. In order to structure an effective e-SCM strategy, two phases must be accomplished:

- Training and education from the executive level down to all employees. The role of business partners must be established, the value creation in the chain and which processes can be executed in a collaborative manner.
- Structuring of the supply chain strategy in five steps: constructing the business value, elaboration of detailed value portfolio for products and services, specifying the collaboration detailed on activities and processes, the utilization of resources that support e-SCM, settling a performance measurement set for the evaluation of operational effectiveness of the SC.

The new features we want to employ for SCM optimization are:

- usage of software agents for SC event management, collaborative planning and forecasting with business partners, purchasing and selling.
- real time information sharing for the entire network so that to provide the right information to the right SC node, not to everyone.
- analysis of customer requirements and preferences so that to know in real time what clients want and to behave proactively to these trends by supplying new products or mixes of products together with SC partners to meet customer requirements before their competitors.

By employing these features, companies can win new customers and retain them as a mean to remain on the market and to obtain

profit.

## 6 E-SCM Architecture

We consider that technology supports the creation of very efficient value systems, but applying technology to a fragmented business process will increase the problems in the value chain. However, when the business process was planned in detail, deploying B2B applications on the supply chain structure may have a competitive advantage [13]. We consider that an important phase before implementing a supply chain information system is relationship settlement with partners for information exchange and performance improvement to create the suppliers and customers network. Companies must reduce the number of suppliers and select those with greater potential for collaboration in a process of supply base optimization. After designing the physical supply chain and the collaboration model, the SC partners should establish the network integration model. This is similar to a business model for a virtual organization because the SC network should behave as a virtual entity to respond to customer requirements. For this reason, the design of a e-SCM application has to take into consideration the four supply chain levels of integration:

- Internal integration of business functions for internal optimization
- External integration of SC operations ensure the integration of logistics functions through the intranet network
- Strategic collaboration with suppliers and customers for product development and order fulfillment according to customer demand through the extranet system which provides strategic integration
- Web-enabled strategic collaboration for joining SC partners competencies through e-SC interoperability to satisfy the customer demand in real time.

A basic e-SCM system should be linked with the production, marketing and order management, purchasing and forecasting ERP modules or applications in order to get the data concerning orders, production and pro-

curement so that to be able to synchronize the activities in the supply chain and to react to changing requirements in customer demand. The application should first be a Web based portal for information sharing, transaction execution and process synchronization with business partners, concerning demand, production and supply in real time. This application should then be developed to integrate the components of the information systems of business partners and their applications, so that to automate the activities in the supply chain network under a common Web interface.

Business processes automation involves process integration in company decision support systems, of their suppliers and clients, in a bidirectional manner. This is referred to as M2M – machine-to-machine integration. Supply chain members can dynamically interact and initiate business processes in the information system of its partner through pre-defining business rules first and then they can trigger events along the systems. This means that physical supply chain can become at least partially automated. Automation frees staff from routine work, as well as they can involve in planning and strategy that will increase processes efficiency in their own company and in the whole supply chain [14]. After studying the theory and the study literature, we consider that the e-SCM should share more information in real time: demand information should be sent through SC network to all partners responsible of supplying, manufacturing, distribution, selling, so that to be able to react in real time to market changes and to foresee the future customer behavior. Every single change in the market should be noticed and approached by SC partners. The e-SCM application has to manage quickly the events in SC network and each exception or unforeseen situation. The literature studies the SCM issue and the various means of collaboration between supply chain partners using information technologies and web technologies. After studying the market and the SCM applications provided by the main SCM software producers (SAP, Oracle, J.D. Edwards, i2, Adexa, Ross SCM,

Mitrix Inc, Compania Ariba) we have concluded that all this theory is implemented only partially in practice.

There are significant statistics showing that companies loose important revenues due to low level of customer satisfaction, late answer to market changes, poor collaboration, communication, process synchronization between business partners. [15]

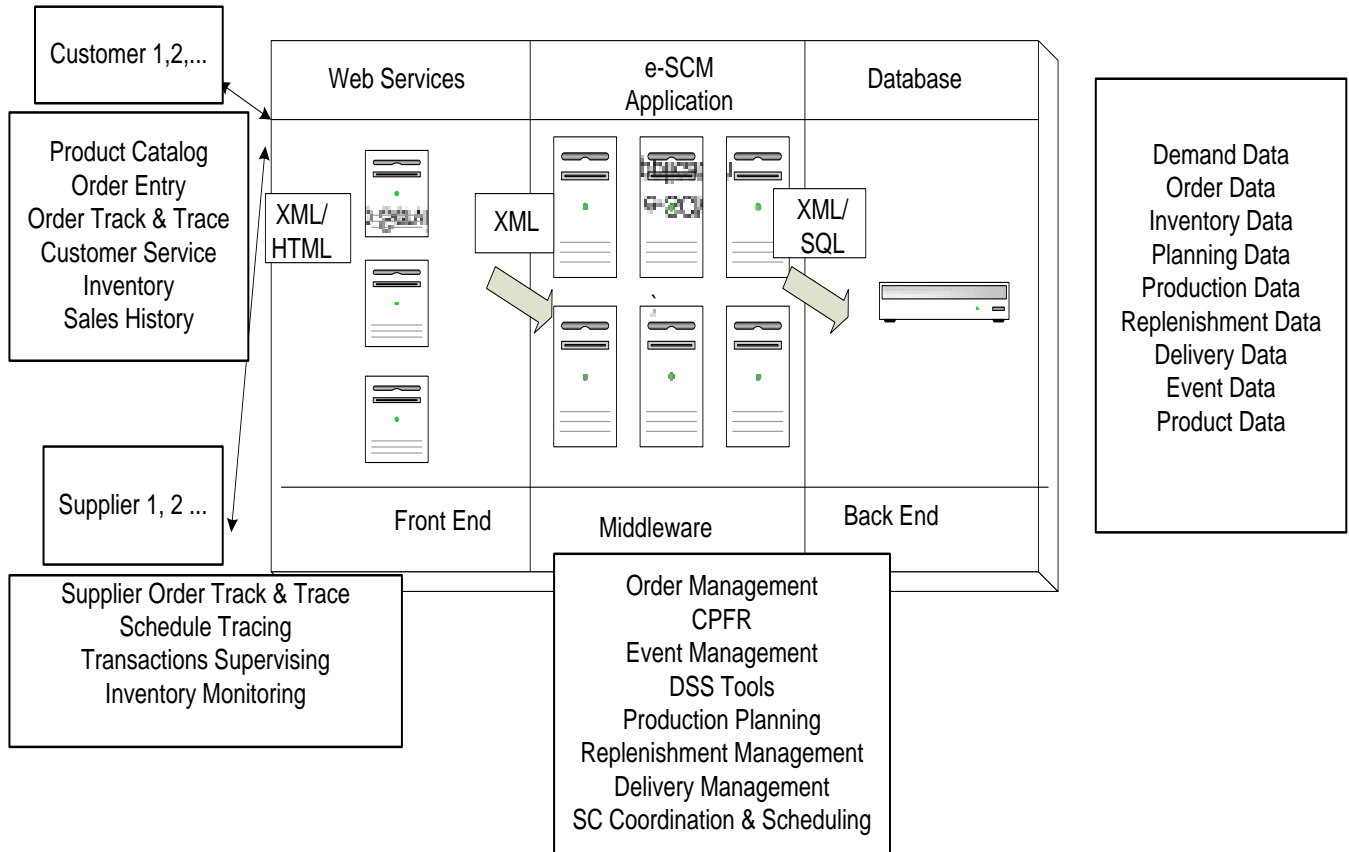
After several years of research and experimentation of existent theories and applications for SCM, we consider that there is not enough collaboration and valuable information sharing in supply chains. The only real collaboration we can find in current applications is between big companies and their suppliers and sometimes customers, for order management, make-to-order manufacturing, replenishment and inventory management. Concerning small and medium sized company, there are just a few companies using e-SCM applications. The effects of not collaborating with customer in real time can be seen on the market in every field of the economy: inappropriate levels of inventories, unsatisfied demand, low level of service, customer dissatisfaction, low income, low profits, late response to market changes and poor management of events in SC network.

In order to solve all these problems, we propose a model for information sharing in real time and automation of SC activities inside and outside the company among business partners. This model will allow a better knowledge of the market, of demand evolution in time, appropriate levels of inventories for raw materials and products, real time event management in SC, real time response to customer requirements.

For the design and implementation of the e-SCM application, it is needed a technical architecture that enables the integration resulting from the linkage of computer system and people. The integration merges operational functions allowing coordination of business processes in the network. Networking activates the linkages by enabling people to pass departmental and enterprise boundaries and inter-wave common knowledge to execute a wide range of business processes.

The e-SCM application architecture should have components for cross-business processes that can integrate intra-enterprise and inter-enterprise business functions and

can solve networking requirements. We present the proposed e-SCM model with new features included:



**Fig. 4.** e-SCM Architecture

The e-SCM model presented above integrates the enterprise with suppliers, customers and partners. It is designed for the integration of a different computer environment.

E-SCM application should have three tiers architecture with the following functions:

- **Front-End Functions** - should be capable of handling a wide volume of data. XML is used to integrate Web and server-based components. The tools used have to be flexible, scalable and to support any load of Web access. This tier includes an e-shop for customers and a panel for clients with order track & trace. Another module for this tier is supplier's module which allows the monitoring of supplier orders, schedule tracing and transactions supervising. Customer behaviour can be supervised online, allowing the adaptation

of the company offer so that to address the latest customer requirements and demand changes.

- **Middleware Functions** - the front-end passes the external requests for further processing to the middleware application servers. The logic processing is mostly executed at this level. The structure is distributed and provides business process extensibility and scalability. The e-SCM application uses data from ERP system belonging to manufacturing company and data from partners ERP systems. Partners' data are extracted from their ERP systems and stored in a common database. Suppliers use the Internet to connect their information systems, increase their supply chain value and to increase suppliers and customers efficiency. The

functions executed at this level are: order management, production tracing, collaborative forecasting and planning for demand, purchasing, manufacturing, delivery, agent based event management, demand analysis and monitoring. Intelligent agents supervise the execution of activities and trigger warnings when exceptions occur to the SC companies involved.

- **Back-End Functions.** Data warehousing is needed for real-time data mining, large databases and the utilization of analytical processing needs such as OLAP (Online Analytical Processing). The hardware should provide storage solutions for dynamic applications, scalability, flexibility.

The model can employ components for wireless usage that brings many advantages: allows SC applications to transmit real time data from the field, customer demand information is available in real time, employees can share information about activities and processes in the SC. Wireless technologies allowed data access for collaborative information exchange and for tracking the position of items in the SC. The RFID (Radio Frequency Identification) technology allows the real-time posting of data by mobile operators so that to identify products location in the supply chain network. Wireless enables more participants from the SC to bring automation for many processes and to provide information in real-time through devices like PDA, a laptop, a two-way pager, a GPS antenna, a remote sensor. The optimized e-SCM application can be adapted for mobile devices so that to accessible to mobile users wherever they are located. Fast and bidirectional flow of information accelerate business cycle, facilitates just-in-time delivery, reduces transactions cost and accelerates materials flow along the supply chain.

Customer-centric suppliers will compete not only with the price and product and service quality, but also information services and e-business connection. Suppliers that operate in intelligent supply chains, will be able to reduce inventories, will be more sensitive to

market requirements and will improve customer service. For a real collaboration, partners must trust each other in sharing critical information between functional departments and partners, must share risks and rewards and build a base infrastructure to apply B2B software tools [16].

The new features we included in e-SCM architecture like: usage of software agents for SC event management and collaborative planning and forecasting, information sharing for right SC node, market analysis of customer requirements, proactive behavior for the entire supply chain will bring competitive advantage and effectiveness, customers loyalty and increased revenues.

## 7 Conclusions

E-SCM is a tactical and strategic business management model that networks the supply chain capacities and resources using Web technologies to allow SC partners real time collaboration and synchronization. There are numerous Web technologies and e-commerce tools involved in creating an e-SCM application, their employment being determined by the SC partners information systems and applications and the level of integration needed. The new features we proposed for e-SCM model refer to: automating SC activities through usage of intelligent agents for collaboration and real time reaction, optimized e-information sharing and flows, analytics tools for decisions to support company proactive actions on the market.

In our future work we will implement this model to accomplish the synchronization of flows of e-information, materials and products to optimize operations and processes, to adapt to marketplace and to respond in real time to changes in customer demand and supply dynamics.

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**Delia Adriana MARINCAS** has graduated the Faculty of Informatics in 2003 and a master in Business Management in 2005. She is currently studying for her PhD thesis on Collaborative Decision Support Systems at the Faculty of Economics and Business Administration at Babes-Bolyai University, Cluj Napoca, Romania.