Proceedings of the V International Conference Business Excellence (ICBE)
Brasov, 15-16 October 2010
Vol. 1, pp. 117-120, ISBN 978-973-1747-23-1

A NEW MODEL OF SUPPLY CHAIN MANAGEMENT IN A WEB SERVICE ORIENTED ARCHITECTURE[*]

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Abstract: *This paper focuses on web innovation of the supply chain management of an expanded enterprise from the provision, production to final delivery of a product/service in accordance with customer requests. In an open architecture the technology of web services improves system performance in terms of cost, time and quality. The ability to interact online with all subjects of supply chain breaks down geographical barriers and ensuring timeliness and transparency of information. The enterprise becomes greater agile, flexible and speed in responding to customer needs and market changes.*
Keywords: extended enterprise, rfid, service-oriented architecture, supply chain management, web services.

1. INTRODUCTION

Nowadays the Supply Chain Management (SCM), focuses on relations with all operators of chain and in particular includes all procurement activities, production planning, order management, control stock, cargo handling, warehousing and delivery to intermediate and final customers. The main goal is to satisfy efficiently the needs of customers by offering a product, with appropriate characteristics, in the right place at the right time. To this end all various actors in the supply chain (suppliers, distributors, wholesalers, retailers and customers) must work together to create and add value to product/service. There is necessary an exchange of information based not on power but on trust and relationship. The sharing of information and its processing time, supported by a web-based information system, it's significant and plays a central role in an effective and efficient management of physical flow of goods.
This paper is organized as follows: in the second and third section we give a brief description of extended enterprise and its technological innovations. The fourth section is devoted to present our web-based model of SCM. Finally some conclusions are drawn.

2. THE EXTENDED ENTERPISE

Recently many changes have occurred in enterprise organizational systems, from single enterprise to company networks until the extended enterprise open to all stakeholders (customer, suppliers, sponsors, partners). Customers, suppliers and trading partners, together establish the so-called "extended enterprise" (Fig. 1) (Ghoshal and Gratton, 2002).

[*] This article is the result of a common research activity of the authors. Nevertheless, single sections can be attributed as follows: sections 3.2,3.3,4 are attributed to Domenico Consoli, sections 1,2,3.1,5 to Fabio Musso.

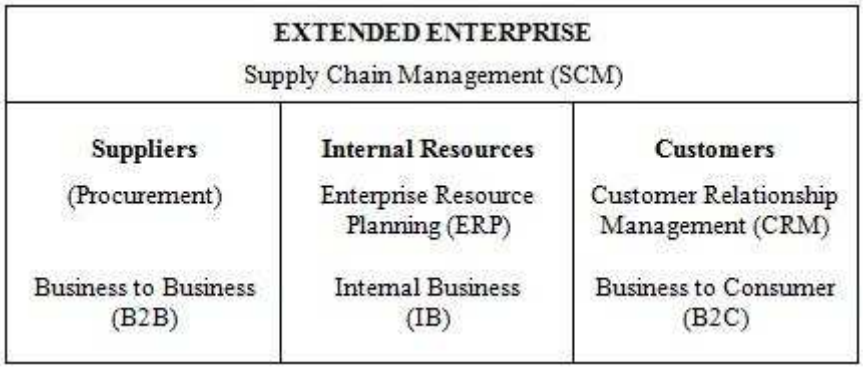

Fig. 1 Extended Enterprise supported by SCM.

Even the suppliers that provide materials to enterprise (procurement), such as customers, can be considered an important subjects for strategic business goals (Weston and Ted, 2003). Stakeholders feel a strong "sense" of belonging to enterprise community and cooperate actively to achieve the mission. The expanded enterprise, supported by the Supply Chain Management (SCM), coordinates more efficiently demand, production and supply.
The Enterprise Resource Planning (ERP) focuses mainly on integration and improvement of internal processes, materials and information while SCM (Kumar, 2001) manages and improves the integration and relationship between internal and external business processes among all stakeholders of the supply chain. In the extended enterprise the SCM includes also the management of customers: Customer Relationship Management (CRM). The extended enterprise generates value based on the core business and on the collaboration with other business partners (Davis and Spekman, 2003).
It is important sharing knowledge with all subjects of global extended enterprise for generating excellent and innovative products/services, best practices and best relationship with customers.
With the expansion of global market, companies network can be seen as constellation of enterprises linked together that, thanks to Information Communication Technology (ICT), manages the complexity of supply, production and sales. The support of an efficient Information System reduces the product time-to-market and all enterprise inefficiencies.

3. TECHNOLOGICAL INNOVATIONS IN THE EXTENDED ENTERPRISE

We can't computerize the enterprise management without innovate the business processes; it's necessary a total process re-engineering. Nowadays the evolution supply chain uses RFID, GIS technologies and can exploit web services of Service-Oriented Architecture (SOA). More details are shown in following sub-sections.

3.1 Process re-engineering

Business Process Reengineering (BPR) restructures enterprise processes to eliminate waste and improve quality of products/services. The company must have the ability to support dynamic and articulated processes. It is necessary an orchestration layer that bind processes to logic rules of the business. The Business Process Management (BPM) (Harmon, 2008) models and designs enterprise processes as strategic assets and aligns external factors with business strategies.
In the research of the value and its creation, companies have gradually abandoned the competencies not-core by outsourcing and making a network of more cooperating entities (de-verticalization). In the Internet-era the technical office is beyond its limits and boundaries and reachs the global and extended enterprise.
The core element of the value chain is the business process. The business process consists in a set of coordinated and inter-functional activities, among all companies of network, to reach a business goal that contributing to the creation of value. The restructuring of enterprise in processes is, very well, supported by Internet-based technologies, that already pervade many enterprise activities. With web technologies it is possible to reduce errors and defects in the product life cycle and enhancing the quality of product/service. In the large-scale manufacturing companies, the web-based SCM manages, in a timely manner, all stages of the supply chain: document preparation, shipment, trading, material and product delivery. We can insert an order via web and monitor its traceability. With an efficient web-based system it's possible to improve and optimize the forecasting, production, delivery times and continually update the production plan and deviations from the schedule plan.
The processes-based company is an adaptive enterprise that respond with agility to frequent changes in demand. Agility (Plummer and McCoy, 2006) is the ability of an organisation to react quickly to market changes. For example in the airport, the Information System responds in real time to booking changes; in a large distribution company we have a real time vision of the invoice of various sale points.

3.2 RFID and GIS technologies to support the logistics

In the globalized economy and increasingly mobile society, companies must increase their capacity to develop and optimize the mobility to operate, act, collaborate and decide more quickly with all partners of the value chain. In a scenario in continuous and rapid technological evolution it's important the development of Infomobility.
The Radio Frequency Identification (RFID) is a technology based on radio frequency that allows an automatic identification more accurate than other technologies currently in use. The data trasmission of RF code, in wireless modality, occurs when a tag (microchip), attached on product and connected to own antenna, is syncronized and coupled with the frequency of an electromagnetic field generated by an electronic device (reader). RFID technology is very important to speed up loading-unloading, goods delivery and to localize vehicles and drivers. The data is transmitted according to standard Electronic Product Code (EPC) and processed by a centralized information system. From the operations center, via the Internet Protocol (IP), it's possible to know all movements of mobile units and associate the data of goods transported.
GIS technology can be used to develop and implement an IT system for planning distribution routes. In this way we can provide the best routing plan and new scenarios depending on the timing, cost, locations, etc… The system manages all means of transport, combinations of locations and deliveries.
The control of the fleet can be operated also with other technologies: Wi-Fi, Global Positioning System (GPS) and General Packet Radio Service (GPRS). The efficient management of fleets is also useful to reduce consumption, emissions, minimize operating costs and to increase the sustainability.

3.3 Web services in a Service-Oriented Architecture

Every business application, in the supply chain, is seen and considered as a service for satisfy user needs. In the context of Service Oriented Architecture (SOA) and Software as a Service (SaaS), different services can be reused, modified or combined (mash-up) to create new services for satisfying workload changes and the evolution of applications.
The SOA (Dan et al., 2008) lets to build, deploy and integrate services independently from applications and computing platforms. For implement an efficient and agile technological architecture a real alignment between SOA and Business Process Management (BPM) is required.
SOA is a design framework for developing rapid and low-cost systems and improving the total quality.
SOA architecture presents following components:

- Web Services (WS), collection of services by web technology
- Universal Description Discovery and Integration (UDDI), directory of available services (recorded and identified)
- Web Services Description Language (WSDL), for describing services and access modality
- Simple Object Access Protocol (SOAP), protocol for service request

The Web Services (Yu et al., 2008) describe a collection of operations accessible through an eXtended Markup Language (XML) messaging. The service provided by web services is described with a WSDL document and published into UDDI repository. The framework SOAP transports the information contained in messages and the processing method.
In our particular case, of extended supply chain, for example, the model of service request for delivering a specific product by carrier is represented in Fig. 2.

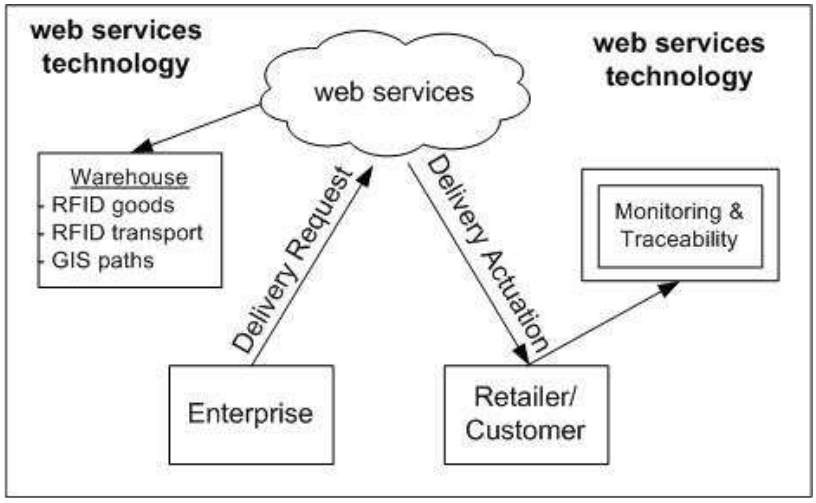

Fig. 2 Delivery implementation by web services technology.

The company requires a delivery service to web services of SOA. The web service basing on product type, location and means of transport, stored in the database (Warehouse) , responds and activates a specific Service Delivery. The delivery process using RFID and GIS technologies can monitor and track manufacturers, suppliers, intermediate (wholesale, retailers) and final customers.

4. THE SCM MODEL WEB-BASED

Our original model, in a web-services context, is represented in Fig.3. In this figure, the central subject is the customer. In fact, the SCM system focuses on customer satisfaction. The customer may be served by original manufacturer or other players in the chain process: supplier, distributor, wholesaler, retailer.
It's important to annotate the direction of the arrows linking the various actors. The customer can obtain products/services directly from the manufacturer or from subjects of the next stage. All products and means of transport are provided with RFID/GIS tags. The service requests and their deliveries are implemented via web services. This model is supported by a web-based Information System that provides, in real-time, product information and logistics.

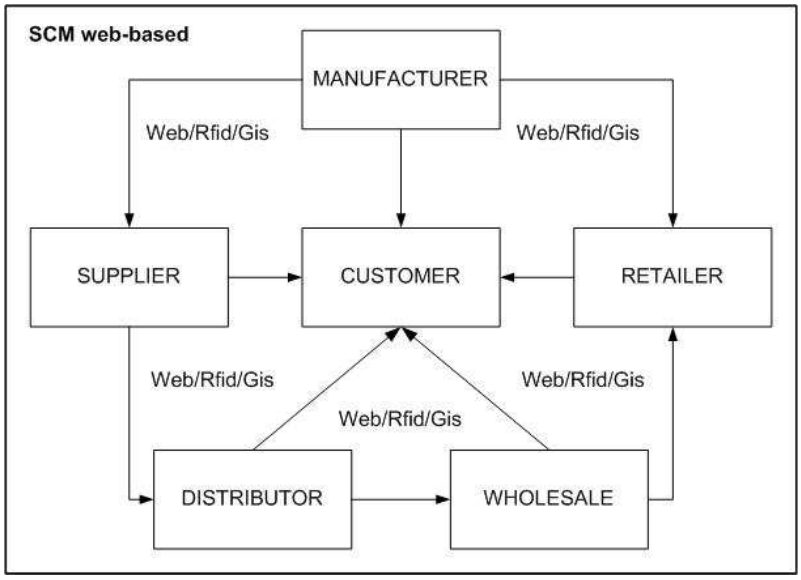

Fig. 3 A model of SCM supported by web technologies.

With this model, we can have several advantages in terms of efficiency in the supply chain:

- Optimization and processes automation
- Good availability on time
- Reduction of reading times and self-identification
- Monitoring of products and means of transport

The Information System coordinates all stakeholders and uses web collaborative tools to enable the interactive exchange of information, the planning and the execution of activities in the supply chain. The sensor network that monitors the operations in real time, plays a crucial role to improve the demand driven global system and in particular processes, infrastructure and information flows.

5. CONCLUSIONS

This paper provides a web-based system for managing a supply chain in an Service-Oriented Architecture (SOA). The system provides information to various involved players at any time and anywhere by web-based interfaces. The system uses the GIS for the management and optimization of distribution paths and RFID technology to identify, in real time, products/carriers. An effective web-based information system streamlines the management of the processes involved in the supply chain and reduce cycle times, costs and stocks with an overall improvement of corporate assets performances. The online software updates, in real-time, database that feeds the supply chain. In this way a lean and agile enterprise is created to give a quick response to market and customer needs.

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