“The role of Information systems in extended supply chain management”

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Abstract: This paper aims to explore the impact, both benefits and limitations, of Information Systems on the extended supply chain performance. In the new network economy, supply chain management is concerned not only with the definition of customers, the selection of manufacturing and distribution facilities and the production of goods, but also with the prioritization of the existing capabilities and the efficient, real-time communication between the partners. Information systems could be associated with significant gain in supply chain effectiveness as they enhance transparency across supply chain, by eliminating information delay and increasing data distribution. However, experts state that there are many key limitations of current IS, as they were initially developed to manage products and information flow within a single enterprise. This paper is therefore aimed at challenging academic initiatives in order to focus on the interactions between IS and supply chain management. In addition, a case study of the (para)pharmaceutical supply chain is presented and the authors, explore the benefits and the limitations for the extended supply chain transactions and establish conditions under which IS can be a critical tool for superior supply chain performance.

Key-Words: Information Systems, ERP, Supply chain management, extended enterprise, network economy.

1 Introduction

Recent trends in global production have both increased supply chain complexity and reinforced the notion that logistics strategies and practices are essential elements of business strategy [1]. Logistical complexity has increased as organizations have moved from centralized, vertically integrated, single-site manufacturing facilities to geographically dispersed networks of resources that collectively create value to their customers. Enterprises which are distributed in space and are composed as a temporary joint venture of legally different units recently often called extended (virtual) enterprises [2]. These extended enterprises are designed to provide the speed and flexibility necessary to respond rapidly to new market opportunities and traditional logistics practices and technologies are not sufficient for competitive success. The implementation of IS, such as Enterprise Resource Planning (ERP) systems, enables companies to move towards an extended enterprise business model that enhances value across the total supply chain. In order to gain supply chain efficiencies in the new network economy companies need to exchange large amount of planning and operational data, ranging from information for annual contracts and periodic progress reporting to real-time delivery and invoicing data. Aim of this academic paper is to explore the impact of IS (ERP) on supply chain management (SCM) and identify the areas in which these systems contribute to SCM and the areas in which they can be limiting progress in SCM. While, literature has a great volume of research on IS implementation projects to demonstrate, very little academic research has been done on interrelations between these systems and SCM. From this study, it became clear that there is indeed close interconnection between ERP systems and SCM, but these interrelations are not always positive. The rest of the paper is organized as follows. Section 2 examines the concept of the extended supply chain management and section 3 aims to present an overview of the evolution of ERP systems. A case study of the (para)pharmaceutical supply chain is presented in section 4. Section 5 examines the role of ERP systems in extended SCM and is divided
into two subsections. The first one encompasses the positive interrelations between ERP and SCM, while the second reveals the limitations of current ERP systems. Section 5 raises a discussion about the conclusions and opportunities for further research in this area.

2 Supply Chain Management in the new network economy

The advent of the network economy triggered profound changes in the scope and impact of supply chain management (SCM) and forced companies to adsorb and integrate new ways of delivering value to their customers. The opening of new markets, the increase in globalization, the decentralization of manufacturing facilities and the highest emphasis on total quality issues and customer satisfaction have focused the attention of many supply chain managers on how to deliver efficiently their products and services across a complex network of suppliers, manufacturers and intermediaries. At the same time, many companies recognized that in order to provide global reach and local responsiveness, the traditional vertical business model required re-evaluation [3]. As a result, during the 1990s, a growing number of companies developed close co-operations with their supply chain partners in order to provide seamless services to their customers. This trend inspired the adoption of a new and more complex business model, one that resembles a virtual/extended enterprise, intended as a network of autonomous firms that cooperate in achieving common business goals. In this paper supply chain management encompasses all activities associated with the flow and transformation of goods from the raw material stage to the end user, as well as associated information and financial flows, both up and down the supply chain. Supply chain management is the integration of all these activities through improved supply chain relationships and processes to achieve a sustainable competitive advantage.

This extended enterprise model present many logistical challenges, as information needs to cross organizational boundaries in order to support management decision making. To support this transfer of information between supply chain partners there is a requirement to utilize technology in an effective way. Until recently business information systems development has focused on internal process integration of traditional functions, such as sales, production and material planning. But the last few years ERP developers met the urge to expand ERP systems functionality in order to encompass the new extended supply chain perspective. In the following section the evolution of ERP systems is presented and an attempt to define their impact on SCM is made.

3 Enterprise Resource Planning Systems

In the 1960’s inventory control assumed prime importance and most of the software at that time were designed to help in inventory management. The focus shifted in the 1970’s to Material Requirement planning (MRP) as the complexity of manufacturing operations increased. The tools to support these continued to evolve by adding further functionalities to meet the increased requirements. Then in the 1980's the concept of Manufacturing Resources planning (MRP-II), which was actually the extension of MRP to shop floor and Distribution management activities, grew in importance. However, in the early 1990’s, increased complexity of businesses and the need to integrate all the functions within an enterprise to sustain in the dynamic environment lead to the development of the ERP (Enterprise Resource Planning) systems, which are packaged (though customizable) software applications, which manage data from various organizational functions and provide a fully integrated solution to major organizational data management problems. Additionally, ERP systems addressed technology aspects like client/server-distributed architecture and object oriented programming.

Traditionally, ERP systems were not considered as SCM tools, as the information flow between supply chain partners was slow. The organizations however, soon realized that although internal efficiency is important, their benefits would be limited unless complemented by increased efficiency across the supply chain. They also realized that, seamless flow of real-time information across the supply chain was the key for success in the emerging market, characterized by rapid advancements of technology, shorter product life cycle’s etc. Therefore, organizations started integrating ERP applications with SCM. This ensured that the efficiency was achieved across the supply chain, there was a seamless flow of information and ERP systems became a vital link in the integrated supply chain. In summary, ERP applications help in effective SCM in the following ways:
- Share data: They can create opportunities to share data across supply chain members, which can help managers in making better decisions.
- Real-time information: ERP systems can provide real-time information, facilitating supply chain decisions.

Although, in almost any occurrence, integral process management imposed by ERP systems has well accomplished the management of the information flow within departmental or corporate boundaries, it did not adequately support inter-organizational communication. On the way to new business applications, companies implementing ERP systems, could not remain trapped within organizational boundaries and met the urge to put in the global e-business community endeavors [4]. This trend affected business application systems and on the technical side, ERP vendors and other software developers were forced to extend the traditional client/server to a browser/web server architecture in order to deliver e-business capabilities. Nowadays, almost every ERP system includes a mixed Java/XML application code, providing web-based modules. In order to leverage the benefits offered by this new technology enabler, ERP systems are being "web-enabled" [5]. Internet allows linking of the websites to back-end systems like ERP and providing connections to host of external parties. The benefits of such a system are that customers have direct access to the supplier's ERP system and the vendors in turn can provide real-time information about inventory, pricing, order and shipping status. The concept of the web-enabled ERP and the extended supply chain relationships are presented in figure 1.

The supply chain interactions in the (para)pharmaceutical industry are depicted on a high level in figure 2. Four major players are identified.
- Para-pharmaceutical Production Companies.
- Wholesalers, which operate storage and distribution facilities and act as links between Production companies and the points of sales (either a Pharmacy or a Brand Pharmacy). Wholesalers import also products, which they distribute.
- All those stores that are allowed to sell drugs (Pharmacies and Brand Pharmacies). Individual Pharmacies are small and very small enterprises owned by individuals, where Brand Pharmacies are Unions.

For the objectives of the project, authors studied the (para)pharmaceutical supply chain from a leading production company point of view, which has implemented the Microsoft Business Solution Navision Attain 3.70 ERP system, in order to manage its supply chain processes. Being an internal link of the supply chain, the (para)pharmaceutical production company has to manage the information and material flow with both its upstream (suppliers) and downstream partners (wholesales, distributors, customers).

In the following sections authors present the opportunities and limitations of the ERP systems on the extended supply chain management.

5 ERP systems and the Extended Supply Chain Management

ERP systems manage data for virtually every process within a company, including finance, procurement, production, sales and logistics. Every financial or material flow is accounted for in the
ERP system, providing efficiency to companies’ internal processes. An ERP system could potentially enhance transparency across the supply chain by eliminating information distortions and increase velocity by reducing information delays [6]. Hence, there is a good reason to believe that ERP could be associated with significant gains in supply chain management. Both academic research [7], [8], [9] and the findings of the project presented here, suggest some main benefits:

- Better systems integration,
- Standardization of data and processes,
- More mass customization of products and services leading to increasing assortments, while decreasing cycle times and inventories,
- Grater transparency of the marketplace,
- Real-time access to organizational data,
- Visibility across the extended enterprise and
- Improved decision support functionality, assisting in the creation of plans or deciding on the acceptance of specific customer order.

In addition, ERP systems seem to completely integrate the e-business evolution. More than ever, customers, vendors and supply chain partners are recognizing that e-commerce is a fast, efficient and convenient way to do business. However, experts state that there are many key limitations of current ERP systems, as they were initially developed to manage products and information flow within a single enterprise. In the following subsections opportunities and the limitations of current ERP systems are presented in a more detailed way and the functionality of the main ERP components is depicted along with its impact on supply chain management processes.

5.1 The role of ERP systems in managing the extended supply chain

The objectives of this subsection, as mentioned above, are to establish conditions under which ERP systems can be a critical enabler for superior supply chain performance. In order to achieve so, authors follow an ERP-driven approach, where the functionality and the main operational characteristics of the supply chain collaboration modules are described.

**Inventory Management**: this component of the ERP systems aims to solve the major problem related with the inaccurate view of company’s own stocks and provides better real-time visibility of products, automatically, as well as the ability to retrieve specialized information. Having direct access to accurate information is critical in managing the company efficiency and meeting customers’ needs and inventory modules provide various data such as reports about how many items are in stock, in which warehouses, stock movements over time, statistical information about the increment or the decrement of inventory. Before the evolution of ERP systems warehouse managers had to print out very long standard, fixed lists and they had to take out manually the figures and the data the needed. Nowadays, they are able to ask about certain articles alone, in combinations, or in certain periods. The managing director of the (para)pharmaceutical company, studied during this research project, claims that these specialized inventory reports have cut their administration time and costs at half and have increased accuracy. Moreover, during the last year, they have reduced their stocks by about 25% and expect to go even further. From a technical side point of view, the ERP inventory application area contains all the features that a company needs to manage its inventory:

- Item cards, used to enter basic information about a product,
- Stock keeping units, which allow users to differentiate information for a specific warehouse or a specific variant for the same item,
- Non stock items, which concern products that the company sells but does not carry in inventory.
- Item substitution, which is used to substitute an item with another when the desired item is out of stock.
- Item tracking, which is usually consisted by codes or serial and lot numbers,
- Order promising, which is crucial for managing sales orders and supporting decision making. This feature, in most ERP systems, operates with two concepts. Available to Promise (ATP) is used in connection with date calculation functionality and is based on the inventory reservation systems. This means that the program performs the availability check on the uncommitted portion of company’s inventory, taking into account planned production orders, purchase, transfers and sales return, in order to calculate the delivery date. The Capable to Promise (CTP) concept is used to perform “what if” scenarios. If no items are available in inventory and there are not any orders scheduled, the program can calculate the earliest date that the items can be available if produced, bought of transferred from another warehouse.

**Warehouse Management**: this application area helps companies to organize the receipt, put-away,
assigning, picking and shipping items to and from their warehouses. Advanced editions of this module can handle warehouse routines at zone and bins level or even establish routines to optimize the use of space within physical parameters of the warehouse. **Manufacturing and Planning**: this module addresses the problem of low visibility of internal manufacturing processes and provides higher productivity. The planning system suggests which actions should be taken to ensure that customers demand is met and is usually driven by anticipated and actual demand, such as forecast and sales orders. In addition, another goal for the planning system is to ensure that the inventory does not grow unnecessarily and proposes the actions that should be taken in order to avoid the increment. In addition, as effective supply chain strategies require operational flexibility, this module provides capabilities such as:
- **Make-to-Stock (MTS)**, in which items are produced to stocking levels
- **Make-to-Order (MTO)**, in which items are produced to specific customer requirements
- **Blanket orders**, represent a framework for an agreement between a company and its customer
- **Flexible costing methods**, in which the choice that a company makes determines the way that the program calculates unit cost by making assumption about the flow of physical items through the company.
- **Various consumption methods**, such as forward, backward and manual.
- **Forecast and Master Production Schedule (MPS)**. Production forecast can be calculated for different time intervals, while the results of the MPS appear in planning worksheets as order proposals and users can modify them.
- **MRP and simultaneous planning of materials, capacities and costs**, which provide user with availabilities, suggestions to increase efficiency and detailed information about the method of a manufacturing a specific product.

**Business-to-Business collaboration**: this advance feature gives the opportunity to companies to electronically exchange trading documents with their business partners irrespective of each other’s convention requirement and data formats. This exchange of documents means that companies can streamline their business processes and reduce transaction costs. In addition, it is easier for companies to meet the changing demands of their trading partners, regardless the industry they are in, the systems that they use or the standards that their partners require. In summary, B2B components can help a company participate as a supply chain partner cost effectively, share real-time information, such as stock availability both internal and external, set up new agreements and map transactions easily and adapt to changing requirements of any partner quickly.

**E-commerce portal**: this ERP component answers most of the company’s interactive business needs. It streamlines interactions through web-based trading, self-service and other forms of collaboration. Supply chain partners interact with each other through a personalized web portal that matches the needs of its particular role. By responding to their customers with web access, companies accomplish real-time information, always up-to-date and accurate. This component actually opens a window to information and services that allows partners to serve themselves.

Although ERP systems seem to evolve to an important tool for real-time extended supply chain management, there are still some limitations that need to be taken into consideration by supply chain managers. These obstacles, found from both the research project and the academic literature, are presented in the following subsection.

### 5.2 Supply Chain Management shortcomings of current ERP systems

The findings of the research project highlighted some shortcomings in current ERP systems and most of them were even confirmed by the existing academic literature:
- **Lack of advanced decision support capabilities.** Existing ERP systems can perform limited decision support functions, such as available to promise (ATP), capable to promise (CTP) checks or MPS and provide answers regarding the acceptance of an order, the availability of the inventory or the fit within the MPS. Additional functionality would check not only on the technical feasibility of the order but also on its profitability in combination with an engineer-to-order strategy, providing answers concerning the development of a requested product, which could simultaneously be profitable for the production company. A next level of sophistication could include decision support function in accordance with the supply chain partners. In particular, ERP systems should check not only within a single company, but also within its partners’ capabilities and suggest an answer to request taking into account the extended supply chain as a whole.
- **Lack of flexibility in adapting to different types**
of partners relationships. A single organization might have different types of relationships with its supplier and customer base [10]. Some suppliers may have adopted Vendor Managed Inventory (VMI), some may have adopted Collaborative Planning, Forecasting and Replenishment (CPFR) and others may still be engaged in a classical vendor/buyer relation. Existing ERP systems are not sufficiently flexible to accommodate all these different modes of collaboration simultaneously.

6 Conclusion – further research

Many business and academic studies have recently certified that the advent of the new network economy is fundamentally changing the way that companies interact with their supply chain partners. This advancement encompasses a new and more complex business model, one that resembles a virtual/extended enterprise, intended as a network of autonomous firms that cooperate in achieving common business goals. To support the transfer of information between supply chain partners there is a requirement to utilize technology in a more effective way and the evolution of ERP systems seem to contribute to the management of this extended supply chain. The findings of the research project, presented in this paper, suggest that ERP systems could be a critical enabler in many areas of SCM, such as real-time communication between partners, inventory control, planning and production management. On the other hand, there are certain shortcomings in current ERP systems that can be limiting progress in extended SCM, such as their lack of advanced decision capabilities and their low flexibility. In order to draw some conclusion, one can state that ERP systems could be a helpful tool for advanced supply chain management, but companies should not expect too much from their ERP implementations. These systems have become essential in business because they replaced different local legacy systems, but they were not initially designed to support SCM. Only recently ERP vendors have started to develop “add-on” modules for real-time supply chain management and it is early to tell if these systems will evolve to be fully integrated with advance extended SCM. Further, we expect that as ERP systems and SCM are developing rapidly and simultaneously, more academic initiatives will focus on the interactions between them.

References: