Preface

SUPPLY CHAIN MANAGEMENT AND INFORMATION SYSTEMS: EVOLUTION, CURRENT STATE AND FUTURE TRENDS

Introduction

SCM (Supply Chain Management) is an integrative function, with primary responsibilities for linking major business functions and business processes within and across companies, into a cohesive and high-performing business model. It drives the coordination of processes and activities across areas of marketing, sales, product design, finance and information technology (Simchi-Levi, Kaminsky, & Simchi-Levi, 2008; Eltantawy, Giunipero, & Handfield, 2006). Information systems are an important enabler of effective SCM, since with the advent of e-business, if there is no effective web-based information system in place, there is essentially no business. Any company, though, can benefit from the successful implementation of SCM using different information systems options, including enterprise resource planning (ERP) and decision support systems (DSS) that are aimed towards assisting the different functional areas in a supply chain.

Folinias, Manthou, Sigala, & Vlachopoulou (2004) proposed that, “SCM in the new business era is considered as a medium for achieving short-term economic benefits and gaining long-term competitive advantages” (p.1). As Svensson (2007) noticed and confirmed by Ranjan & Sahay (2008), starting in the early 1990s the use of the SCM increased significantly as more and more companies began to recognize and appreciate its benefits. Businesses were now able to more carefully track their sales and order their merchandise according to the customers’ preferences which lowered their costs of holding unnecessary inventory, and stocking only the items that were actually demanded by the customers. This is critical, since companies today face intense competition from existing rival and new players, and must continue to find new revenue opportunities and continually increase efficiencies.

SCM has become a topic of increased interest among companies of all sizes and specialties. Companies realize that in order to compete in the global marketplace and survive, they must rely on the most effective supply chains. The effective implementation of SCM involves a network of complex webs of independent, but interdependent, organizations which can communicate with each other (Simchi-Levi, Kaminsky, & Simchi-Levi, 2008; Christopher, 2005; Metzer, DeWitt, & Keebler, 2001). SCM builds upon a framework of logistical flows of products and information through a business. With the use of SCM, the whole becomes greater than the sum of the individual parts; however it does require proper management, cooperation, and trust among those involved in the network.

SCM has evolved from operating in an isolated environment, adopting advanced systems such as enterprise resources planning (ERP) systems to creating a network where suppliers and customers col-
laborate in order to extract and share knowledge and value. Many statements have been made to describe the current situation of SCM. SCM remains a high priority for manufacturers as a way to improve margins and retain and increase market share, and the principles of SCM involve responsiveness, reliability, resilience, and the use of effective relationships (Christopher, 2005; Simatupang & Sridharan, 2008). Ballou (2007) stated that the goal of SCM is to deal with the issues of customer satisfaction, inventory management, and flexibility.

According to Bozarth and Handfield (2006), there are three major developments that have brought SCM to the forefront of manager’s attention. Those are electronic commerce, increasing competition & globalization, and relationship management. Littleson (2007) argued that in the past, managers tried to forecast demand, but today and in the future this practice has been replaced by effectively responding to demand. Other scholars (Ranjan & Sahay, 2008; Ferrer, Hyland, & Soosay, 2008) agree with this theory since in such a dynamic market, where consumers’ behaviors and patterns are virtually impossible to forecast, it is better to employ tools that would help the businesses to respond to demand much quicker.

Economic instability in the U.S. and abroad is affecting a wide range of businesses. Therefore, SCM and IS are solid solutions for companies looking to do more with less. Without SCM, an organization is vulnerable to various risks if it cannot flexibly react to market changes -- overproduction and under-consumption, increased demand, changes in consumers’ trends, and decrease in demand due to substitute products and competitors, etc. With the effective use of SCM, a company can adjust its output to the market -- prevent excessive equipment and inventory, reduce inventory costs, and be able to shorten its delivery time while at the same time increasing production to answer market needs in a shorter time frame.

**Evolution**

Much of the SCM literature has suggested frameworks for identifying and analyzing the evolution of SCM. Some analysts, such as Muzumdar and Balachandran (2001) and Ballou (2007), support a three-stage evolutionary process, while others such as Folinas et al. (2004) prefer a four-stage evolutionary process. Macmillan Group (2003) reflected a specific approach to the phenomenon of SCM, and created chronological dates to indicate SCM development. The evolution of supply chains has moved from the functions of logistics and physical distribution to focus on integration, time reduction and more streamlined processes. The integrated activities involved buyer and supplier relationships, and also purchasing and marketing strategies. The success of these activities relies on a corporate ability to develop the firm’s internal and external linkages.

Ballou (2007) supported Macmillan Group (2003)’s idea. He divided SCM into 3 periods; past, present and future. He suggested that SCM was founded on the maintenance and transportation of military facilities and materials. People started trading one cost for another; however, there was logistic fragmentation which led to conflicts among those responsible for logistics activities. Physical distribution and logistics were used by both marketing and production areas, but they gave a little concern for issues of product flow. Later on, people started to embrace SCM in business. The flow of goods in the entire supply chain required the coordination of demand and supply from many institutions all the way to ultimate consumers. People focused more on the integration of SCM, rather than on logistics and physical distribution. Finally, he indicated that SCM and logistics would move toward globalization, free trade and outsourcing.
In keeping with Muzumdar and Balachandran (2001), SCM is becoming a mix between centralized planning and decentralized performance. This approach divided SCM into three stages; departmentalized or functional supply chain management, transformation into integrated supply chain management, and transformation to value networks. At the beginning, the attempts of executive managers to centralize supply chain planning were ineffective due to the lack of standardization of business information, poor data integrity and analysis support, and disparate technology systems. Later on, corporate managers utilized business process reengineering (BPR) to align their organizations. Many companies used advanced technologies such as enterprise resource planning (ERP) systems to lower the costs of computing and increase the penetration of enterprise. This led to an increase in the effectiveness of integrated and centralized supply chain planning processes. In the late 1980s, Wal-Mart made point of sale (POS) information available to its suppliers, deployed electronic data interchange (EDI) and rigorously enforced more frequent replenishment of its inventory with direct shipments to stores (Devendra & Owen, 2007). The Internet has also changed the way of companies do business. Integrated and centralized supply chain planning has become more effective and widespread and it will generate more customers for the firm. The sharing of information around product seasonality, promotional events, and new product launches between buyers and sellers will further enhance the trend, and increase the associated benefits of higher customer service levels and lower supply chain costs.

Besides using time sequences, some analysts use business processes to identify SCM evolution. Folinas et al. (2004) divided SCM into four types: core logistics activities efficiency, co-ordination of internal organizational processes, inter-enterprise business exchange and the establishment of dynamic networks between virtual organizations. SCM became more than a database process but rather a decision support system that helped managers to make decision effectively. Also, collaboration and coordination were additional and new changes that had taken place within the SCM process (Fawcett, Mannan, & McCarter, 2008; Pramatari, 2007). The change from single decision making into collaboration is essential in today’s business world.

**Future Trends**

Increased globalization, free trade, and outsourcing have a resulted in a tremendous shift in the movement and consumption of goods and supply chain process. This trend required managing supply chain activities including material sourcing, production scheduling, and the physical distribution system and information flows (Benyoucef & Jain, 2008; Bovet and Martha, 2003); therefore, successful management of supply chains will give management a competitive advantage. However, Ballous (2007) argued that SCM should shift away from the contemporary view that SCM is a new frontier for demand generation-competitive weapon towards a new emphasis on designing and operating the supply chain to generate more profit for a company. In today’s global economic crisis, Bovet (2008) stated that uncertain economic times can bring great opportunity for supply chain managers if they operate and think like global economists.

**Sustainable Supply Chain**

A paramount issue in SCM is sustainability. The Earth, probably the largest universal SCM, needs tremendous help given its current environmental woes. While environmental risks and pollution can disrupt supply chains to the extent of annihilating modern civilization, many leading organizations of the world are presenting evidence of a critical link between improved environmental performance and
financial gains. As a result, business has an opportunity to not only save the world, but also to ensure its own profitability (Wang, 2008).

The objective of a sustainable supply chain is to recognize the environmental impacts of goods and processes, starting from the extraction of raw materials to the use of goods produced, all the way through to the final disposal of those goods. One goal of sustainability is, for example, to reduce resource use and waste generation, while at the same time moving away from one-time use and product disposal. The typical additions to this more efficient supply chain involving recycling, re-use and remanufacturing.

There are many interpretations of what “sustainability” refers to in SCM. In Carter & Rogers’s words (2008), “The term sustainability, which increasingly refers to an integration of social, environmental, and economic responsibilities, has begun to appear in the literature of business disciplines such as management and operations” (p.361). This is commonly called the triple bottom line: sustainable supply chain management (SSCM) or green supply chain management (GSCM) is the strategic, transparent integration and achievement of an organization’s social, environmental, and economic goals through the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains. GSCM is based on integrating environment thinking into the part of SCM. It includes product design, material sourcing and selection, the manufacturing process, delivery of a final product to the customers, and the end-of-life management of a product (Srivastara, 2007). Other scholars (Sarkis, 2003; Dubler-Smith, 2005; Klassen & Vachon, 2006) also agree that GSCM emphasizes environmentally friendly practices, like source reduction, recycling, material substitution, reuse of materials, waste disposal, refurbishing, and repair.

An important social factor refers to a company’s culture, core values, and ethics. In other words, it is how well a company pursues avenues of improving the community along with creating and delivering socially responsible products and services. These social factors influence the decisions made relating to environmental factors. These environmental factors include such choices as packaging materials, suppliers, logistics, etc. All of these have impacts on the carbon footprint of a company. Going green is one of the goals of, as well as the future of SCM. In line with Robinson & Witcox (2008), “The general perception of survey respondents is that ‘green’ holds more opportunity than risk. Seventy-one percent of executives view sustainability, green, and carbon-related issues as a source of brand/reputation opportunity. Similarly, sixty-three percent see these areas are presenting the opportunity for significant growth” (p. 62). The reason for such a heightened focus is that consumers are now buying with the consideration of the environmental impact from products and services. This brings about a new ideology of companies reviewing their supplier’s SCM and making decisions based on sustainability. As the future of business is sustainability, new partnerships are being made between suppliers and companies with these principles of environmental factors and sustainability. These put a new face on the global competitive landscape with going green at the core.

Clearly, the economic factor is the firm’s bottom line and should be transparent to shareholders. This allows companies to grow by improving profits, creating jobs, increasing the customer base, reducing costs, and promoting long-term competitiveness. The implementation is transparent in that going “green” has the element of reducing energy cost in utility bills or transportation costs, along with reducing package waste and hazardous materials from production. These items directly affect the bottom line, and are important since traditional competition differentiators have become broadly similar across many suppliers. One way, in which companies can differentiate themselves, reduce costs and improve service, is to consider the environmental, social as well as economic factors relating to their supply chain, thus building comparative advantage. Re-evaluating a company’s supply chain, from purchasing, planning,
and managing the use of materials to shipping and distributing final products, with an emphasis on improving environmental and social performance, has had real benefits.

Improving sustainability allows companies to create new products, cut costs, avoid long-term ills and give them an edge over less-sustainable companies. To move from a superficial level of support to a profound commitment, companies need to incorporate socially responsible values into their supply chains. Svenson (2007) argued that it is not enough to simply match supply and demand, the points of consumption, and origin first-order (non-renewable and non-recycled resources) supply chains to support SSCM, but must extend to second and n-order (non-renewable and non-recycled resources) supply chains in the future. There are potential economic advantages of intersections of economic, with social and or environmental performance. Consistent with Carter & Rogers (2008), companies that proactively address environmental and social concerns can influence government regulations, achieving reduced costs and shorter lead times. The proportion of environmental and social initiatives which result in enhanced economic performance cannot be ignored.

Comm & Mathaisel (2008) noticed a perfect example of sustainability. Since 1980, Wal-Mart has been using computers to track inventories. Wal-Mart’s discount retailer position required tight controls on supplier management, for economic survival. Wal-Mart practices tough negotiations in terms of supplier pricing and delivery, and supplier contracts are solely placed on the merits of supplier efficiency. Some contracts are written with yearly pricing reductions, forcing suppliers to be more productive, and those that have met the standards have had sustainable success.

A dimension that must not be overlooked is SCM for sustainable products, which is “comprehending all kinds of products that have or aim at an improved environment and social quality, which can be related back to the already mentioned implementation of environmental and social standards” (Seuring & Muller, 2008, p. 1705). An example of this is today’s cleaning products. Windex has a new concentrated, small container, refillable container. Consumers can refill the previously purchased Windex container with a new refill concentrate and then just add water to dilute the substance. This saves in many ways. Plastic containers are reused, which reduces material, energy and waste in the product life cycle. Consumers enjoy the same product standards and also the added benefit of improving the environment.

As indicated by McDaniel and Fiksel (2000), a company needs to incorporate environmental management as an integrated part of an entire organization. Therefore, it can monitor how the change is implemented and maintained while realizing its benefits. The payback includes major cost reductions and increased profitability, realized through the avoidance of purchasing hazardous materials as inputs which harm the environment as well as preventing the storage or disposal of process wastes which increase costs. This results in another cost reduction based on a decrease in publicity and potential liability risks.

Mahler (2007) proposed that “The best companies view sustainability not only as a chance to contribute to social goals, but also as a powerful source of competitive advantage” (p. 59). GSCM helps the businesses to actually reduce the costs through the environmental practices. Reusing and repairing materials instead of replacing them with new ones itself saves a lot of money that would otherwise be unnecessarily spent. A study by Sheu, Chou and Hu (2005) proved this theory through their findings. Using a linear multi-objective programming model these authors realized that the implementation of the GSCM increased the net profits by about 21%. Such growth and improvement suggests that every company in the future should follow the practices of GSCM. Also, Ko, Tseng, Yin, & Huang (2008) investigated the factors influencing suppliers’ satisfaction of green supply chain management systems in Taiwan.
Service-Oriented Architecture (SOA)

Next-generation platforms incorporating Service-Oriented Architecture (SOA) and Radio Frequency Identification (RFID) deserve attention. Perceived as a key to interoperability and flexibility for future on-demand business applications, SOA is business-oriented, with an integrated end-to-end process view that focuses on integrated data (Sankar & Rau, 2006). It is built on an open architecture that uses standards such as Web services and protocols such as simple object access protocol (SOAP) and extensible markup language (XML).

SOA is a Web based support system that enables the sharing of data and information among users in a supply chain. SOA frees businesses from being limited by their systems through the creation of a platform that enables custom innovations and flexibility to change. The SOA system breaks up functionality into small individual components that are stored in a library or service repository. The components are then brought together using a set of business process workflow statements, where each process block in the workflow is a functional component of service (Aimi & Finley, 2007). SOA is the latest industry approach to IT integration. SOA allows businesses to plug in new services or upgrade existing services with relative ease to address new business requirements while providing the option of making services accessible through different channels without eliminating or complicating existing applications, preserving existing IT infrastructure.

New supply chain challenges come from increased data volumes that will continue to grow exponentially as more products, network configurations, customer details, and user preferences require management. Although all this data can give greater control to the business and make the supply chain information workers more productive, users also risk drowning in data if applications cannot synthesize and deliver the right data, at the right time, and in the right format. Automation in supply chain is needed with SOA concepts. SOA aims to enhance business services efficiency. As enterprises continue to exploit the opportunities provided by the Internet, Web services are becoming a new form of enterprise computing that is becoming more important both within and between enterprises. What’s more, products are becoming more complex as customers demand sophisticated features, new services, and a greater number of choices. The increased rate of change is shrinking product life cycles and forcing supply chains to become more dynamic and diversified.

Simchi-Levi et al. (2008) found that SOA is the architecture adopted by all the major business software vendors as the basis for their development tools and platforms. Additionally, it is also widely used by systems integrators to develop custom applications. SOA provides new opportunities and challenges for SCM due to a business process execution language that makes maintenance much simpler and easier to learn. The use of business process management (BPM) to develop a top down approach to both application development and the composition of integrated, reusable components make them easy to use and maintain. Using SOA, companies can define their business processes and benefit from separating business logic from applications.

The evolution of SOA has enabled significant opportunities for companies to expand their existing SCM solutions, without making large scale upgrades. Zeng, Liu, & Zhen (2008) observed, “The service-oriented architecture (SOA) approach has attracted the most promising technology strategy for meeting the business imperative to increase agility while lowering total operating costs” (p. 364). Actually, SOA is a transparent aspect of sustainability. Providing a customizable interface that allows companies to continuously improve on their business applications without the additional technology costs associated with system upgrades. Smith (2008) reported that Flextronics used SOA to integrate
acquired Soletron in more than 60 locations, 60 systems that supported more than 100 midsize and large sites in 30 countries across four continents without any service disruptions. SOA can be a useful aspect of almost any business.

Nadhan (2004) outlined eight key challenges companies face when implementing a SOA, namely service identification, location, domain definition, packaging, orchestration, routing, governance, and messaging standards adoption which required careful planning. Granebring and Revay (2007) explained why adopting new developments like service-oriented business intelligence (SOBI) will help daily decision support in the retail trade. SOBI, which is a mix of SOA and Business intelligence (BI), can solve integration problems in an enterprise. Kim and Lim (2007) also proposed that a new SOA approach using Web services for service delivery domain in the area of telecommunication Operations Support System (OSS), can help achieved business agility rapidly in today changing market circumstances.

Radio Frequency Identification (RFID)

Radio Frequency Identification (RFID) is an electromagnetic proximity and data transaction technology that has become increasingly important in improving the efficiency and optimization of SCM. RFID provides a way, using microchip-based tags, to identify individual items and distinguish them from each other, in turn tracking their location and movement. Supply chains commonly experience limited visibility, which can hinder progress. The emerging technology behind RFID enables dramatic improvements in visibility, which reduces uncertainty and the need for extra inventory buffers. The tags used are either active or passive; Active tags transmit information to receiving stations, while passive tags are read by scanners as they move through a supply chain. As Roberts (2006) claimed, “RFID was first conceived in 1948 and has taken many years for the technology to mature to the point where it is sufficiently affordable and reliable for widespread use” (p. 19).

RFID allows tagged items to be read by scanners without contact or a direct line of sight. The areas of theft protection and security are growing, and applications of RFID are being worked on due to the increased need for solutions. RFID has the potential of being applied everywhere, and regardless of its usage application, RFID provides broader efficiency and operational improvements over traditional processes. RFID is revolutionizing supply chains and offers a more efficient means of communication between suppliers and their partners, since scanning can be done at greater distances, and at greater speeds, than with previous technologies. It therefore enables customers to have more readily available the desired products where they are sought. The retail sector has been one of the main drivers of RFID adoption, led by Wal-Mart, Best Buy and DHL, and RFID technology ensures information can be efficiently collected, tracked, shared, and managed in a real time manner resulting in cost savings for companies (Sengupta & Sethi, 2007; Li & Ding, 2007).

A key advantage of RFID is that it is a system using non-contact, non-line of sight means to improve SCM, including replenishment in retail stores. Heinrich (2005) reported that a one time savings of about 5% of total system inventory can be achieved through RFID. “The savings is achieved by reducing order cycle time and improving visibility, which leads to better forecasts…reduction in order cycle time yields a reduction in both cycle stock and safety stock…” (p. 215). Manufacturers can also benefit from RFID through better inventory visibility, labor efficiency, and improved fulfillment. RFID can reduce the efforts requested for cycle counting, bar code scanning, and manual inventory tasks, and help provide benefits
including reduced shrinkage, improved dock and truck utilization, and the ability to more accurately trace products movements are additional benefits.

The use of RFID is not without its challenges. Smith (2005) claimed that the problems facing the implementation of RFID include costs, failure rate, interference, security and privacy issues. Early adopters face higher initial cost, and late adopters face the cost of losing market share. Spekman and Sweeney (2006) believed some of the challenges facing RFID are due to lack of experience and expertise related to the physics of RFID. Examples of these concerns are demonstrated in the possibility of RFID tags to track banknotes (Angell & Kitzmann, 2006) and in the proposal to use bracelets with an embedded RFID tag to detect human activity (Smith, Fishkin, Bing, Philipose, Rea, Roy, & Sundara-Rajan, 2005). Yu (2007) argued that RFID still faces issues like reliability, interference from noise, and high implementation costs. Muir (2007) found that libraries using RFID can result in violations of patron privacy. Fenn and Raskino (2008) discovered that the technology itself is challenging, in that deploying two sets of equipment in the chips and readers and then modifying the data systems and workflows to work with it is not a simple task. RFID also cannot travel through metals and liquids, which could hinder information flow. RFID technology currently has no industry standardization, so standards should be put in place in the future to make tags and readers compatible regardless of the manufacturer. Viehland & Wong (2007) contended that lack of skilled professionalism might slow the development of RFID. Linking RFID with GPS will also enable users to pinpoint the exact location of their items, rather than giving a status update. The main threat is identified in five ways by Krotov & Junglas (2008) which could prove to be a threat to civil liberties and privacy. Those are hidden placement of tags, unique identifiers for all objects worldwide, massive data aggregation, hidden readers, and individual tracking and profiling.

RFID definitely has the potential to be placed into various objects to store and track information; therefore the objects are smarter and more useful. In addition, these new applications of RFID will be the base for new business opportunities (Puffenbarger, Teer, & Kruck, 2008; Bottani & Rizzi, 2007).

Firms that employ and make investments in RFID are likely to achieve significant strategic and operational advantages. At a minimum, it is expected that RFID can improve the governance of organizational processes due to enhanced inter-organizational integration and information sharing. This results in the assumption that RFID investments are associated with improved future benefit stream and consequently enhanced market value (Jeong, Lu, 2008). Fenn & Raskino (2008) even stated that, “a forced innovation becomes an opportunity” (p. 13). If manufacturers are forced to use RFID technology, the opportunities could be limitless.

RFID technology will no doubt continue to grow. It is one of the single most important features for improving the management of supply chains. RFID helps to optimize supply chains and allow them to function more effectively. Krotov and Junglas (2008) suggested that when looking at the future the development of RFID branches off in two different ways - there is the object orientated approach on the one side and then you have the visionary approach on the other. Other scholars do not try to differentiate between different approaches. Özelkan and Galambosi (2008) presented a financial return analysis that captures RFID’s costs and benefits, and quantifies the financial risks of implementing RFID to better understand when RFID makes business sense. RFID technology and the underlying standards are readily available and mature enough to support production level pilots. RFID will have a substantial and positive impact on supply-chain performance, as it will improve operating margins, speed the flow of inventory, and improve supply-chain service levels. RFID-enabled supply chains will outperform their competitors with regard to operating cost and excellence of execution.
Conclusion

This preface reviews the history and evolution of SCM and information systems. The future of SCM continues to be driven and affected by the topics discussed in this paper. Several trends in SCM are discussed, including the integration of IT throughout the supply chain, the attention placed on enterprises, supply chain relationships, the growing importance of sustainability, and reverse logistics. As a current trend, we found that the supply chain path from crude oil to the consumer is interactive and dynamic. Fluctuations in gas prices can push up or down the supply and demand chain. The effective use of SCM extends the organization beyond its walls to cover the whole entire chain starting from material suppliers, to end consumers, providing knowledge and analysis on the entire process of the movement of goods. As such, effective SCM influences all participants of the chain and includes many companies in the process.

Going “green” has had a substantial impact, and is one of the core principles of sustainability. Rising fuel costs and global warming have driven the need to find renewable sources of energy, along with environmentally friendly products and services. The companies of today and tomorrow are making supplier decisions based on the influence of sustainability as an important factor. Suppliers who cannot meet the expectations of sustainability find themselves falling short, thereby passing opportunities on to the next supplier. New alliances are being formed through the sustainability process, and SSCM help companies to view sustainability not only as an opportunity to contribute to social goals, but also to be leveraged as a powerful source of competitive advantage.

SOA is driving value by providing a customizable interface that allows companies to continuously improve on their business applications without the additional technology costs associated with system upgrades. SOA offers a way to deal with the challenges and improve supply chain performance. Companies are driven to introduce better and cheaper products more frequently because of rising consumer influence and global competition. New applications of RFID continue to be developed and refined, and the potential of RFID helps companies maximize their sales and profits. Finally, with all the benefits associated with future trends of SCM, there are also costs in terms of implementation, integration, privacy, security and interference. Although some ethical issues arise with the tracking of goods and buyers, the future of RFID technology is promising. Once appropriate and meaningful industry standards are set, the opportunities can be limitless.

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REFERENCES


