



Competing in the 21st century supply chain through supply chain management and enterprise resource planning integration

Competing in the
21st century
supply chain

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S.C. Lenny Koh

Management School, University of Sheffield, Sheffield, UK

S. Saad

School of Engineering, Sheffield Hallam University, Sheffield, UK, and

S. Arunachalam

*School of Computing and Technology, University of East London,
Dagenham, UK*

Abstract

Purpose – To investigate the integration of supply chain management (SCM) and enterprise resource planning (ERP) systems for competing in the twenty-first century supply chain.

Design/methodology/approach – A case study with a paper manufacturing company in China is conducted. Primary data is collected through interviews with managers of the company. The reengineering activities and processes, and the soft issues of supplier relationship are examined.

Findings – Breaking the traditional decentralised system and introducing the concept of a single, integrated plan, which a company could work together with their suppliers has led to cost reduction, lead-time reduction, improved visibility, reduced time to market, and increased efficiency in the company.

Research limitations/implications – This research is based on a single case study in process manufacturing industry in China, which perhaps limits its usefulness elsewhere.

Practical implications – One should not rely solely on ERP systems for managing their supply chain. Individual company should look at an effective purchasing function as one of the competencies essential to supply chain success.

Originality/value – ERP systems in the case company address only a subset of SCM needs. ERP's main added value is its combination of financial control with multi-facility coordination, but ERP does not deliver supply planning and demand planning functionality for the company. The systems are not designed to support internal supply chains. However, integration of SCM and ERP gives the company the opportunity to build effective processes with suppliers they trust, so they can get the maximum return on relationship with all their suppliers on a continuous basis.

Keywords Supply chain management, Manufacturing resource planning, Integration

Paper type Research paper



Introduction

Managing a supply chain (SC) includes activities such as material sourcing, production scheduling, and the physical distribution system, backed up by the necessary information flows (Bovet and Martha, 2003). Successful management of the SC for competitive advantage has resulted in development of the supply chain management (SCM) philosophy and associated practices such as enterprise resource planning (ERP)

systems. In the twenty-first century, a company locks in a SC complexity with its marketing decisions – from product portfolio and customer base to distribution channels. To succeed in the twenty-first century, managing complexity, relationships and change in a SC become fundamental critical success factors (Kearney, 2003). Hence, a SC that is agile and responsive to these challenges is a pre-requisite.

Competition today is forcing companies to integrate tightly with their suppliers and customers, in order to reduce the time available to flex the SC. Before any company can be linked effectively into an agile SC, their own internal process must be reengineered. Many companies are attempting to link with suppliers and customers only to find that the relationship unravels due to the lack of basic controls in their own business. However, without adequate control of the internal processes, an integrated SC is only as strong as its weakest link. ERP is a way to effectively plan and manage all resources of an enterprise. It is envisaged that this enterprise-wide information system will play a significant role in managing a SC.

Information system is the key technology required for the coordination of the divisions and companies cooperating in the SC (Knolmayer *et al.*, 2002). Only through a tight integration – from the customer's customer to the supplier's supplier – can a company hope to compete successfully. To this end, this research is carried out to investigate the integration of SCM and ERP systems for achieving a successful SC in the twenty-first century. The application of ERP for SCM will be explained and their integration will then be discussed.

Integration of SCM and ERP

The traditional material requirements planning (MRP) and manufacturing resource planning (MRPII) systems may not be up to the challenge presented by manufacturers seeking to capitalise on the competitive advantage offered by an integrated SC (Chen, 2001). ERP system, therefore, has evolved from its predecessors to play an integrated supporting role in the creation of a value chain.

SAP (systems, applications, and products in data processing) is an integrated business system, which evolved from a concept first developed by five former IBM systems engineers in 1972. It is a software package designed to enable businesses to effectively and efficiently run a variety of business processes within a single integrated system. SAP software is deployed at more than 22,000 business installations in more than 100 countries and is currently used by companies of all sizes, including more than half of the world's 500 top companies (SAP AG Corporate Overview, 2000). Today, many large companies have standardised their businesses on ERP systems. For instance, Price Waterhouse Cooper, Dow Chemical, Du Pont, Eastman, Monsanto, and Hoechst are all SAP users (Rick, 1997). The SAP R/3 standard, the leading ERP system, facilitates information integration between the individual information systems, reduces information cost, and enhances its value (Österle *et al.*, 2000).

In a global business perspective, companies are actively expanding outside of their original area to seek new opportunities all over the world. While the dynamic and fast changing external environment has put great pressures on companies' operations and decisions, how to react quickly to external changes and how to compete effectively in the global environment has become a crucial issue. Inside a dispersed company, it requires building integrated information systems, which allow data transmission across the border of one geographic area to another. Even within one area, companies want to build

corporate applications through which different departments can cooperate more efficiently with each other (Tarn *et al.*, 2002). To achieve this goal, functional integration is required, which is the process of integrating all business functions to work together, e.g. a firm's logistics or distribution functions must integrate with supply-management, manufacturing, and information technology before the functional integration can be extended to other companies in the SC (Ferguson, 2000).

ERP aims to improve internal efficiency by integrating different parts in the organisation, while SCM focuses on external relationships with trading partners in the SC. Indeed, the proliferation of ERP systems forces companies to provide communication and information flow between supply-chain agents, overcoming natural boundaries. Therefore, integration of ERP and SCM is a natural and necessary process in strategic and managerial consideration. This proposition is reinforced by Tarn *et al.* (2002). Technologically, ERP is said to be the backbone of SCM. As they both rely on a very similar framework, such as intranet, extranet and electronic data interchange, it is very possible and feasible for their integration. Most ERP system providers have been enhancing their products to include sales-force automation, data warehousing, document management, and after-sales service and support, and the most important trend today is the integration with SCM. From the technology perspective, there is the advancement of the use of radio frequency identification technique, whilst from the management perspective, there is the soft issue dealing with ways to integrate SCM and ERP.

Past research on ERP mainly focused on its implementation issues (Davenport, 1998; McAfee, 1998; Austin and Nolan, 1999; Loh and Koh, 2004). Extensive research can also be found focusing on SCM issues, for example, supplier performance evaluation (Talluri and Sarkis, 2002; Li *et al.*, 1997), e-supply chain (Briant, 2000), agile SC (van Hoek, 2001), green SC (Beamon, 1999), SC risk and uncertainty (Barry, 2004), etc. However, little can be found studying the integration of ERP and SCM. Although Tarn and Razi (2002) have attempted to examine the link between ERP and SCM systems, their work is based on potential approaches for integration which yet to be validated.

Research methodology

A case study approach was thought to be appropriate because it enables in-depth analysis of the case studied, and the process of change to be examined. A Chinese manufacturing company was chosen because it allows understanding of how manufacturing company in China (in the process industry) deals with the management of their SC and how it integrates with ERP. This is particularly important owing to the increase adoption of ERP and SCM practices in the manufacturing sector in China (Lin, 2003), but their successful implementation and/or operation are yet to be improved. Statistics show the success rate of implementing ERP systems in western countries is only 33 per cent, and in China this figure is less than one third of that in western countries (Zhang *et al.*, 2003).

The qualitative-case study research approach was used for this study since the area of the study is relatively new, with little primary and secondary data made available in the public domain. The gathering of secondary data was primarily based on an internal and external literature search through published or online media. The primary data was collected via telephone interviews. Open-ended questionnaires were used to expand the depth of data gathering during the interviews. Five in-depth interviews were conducted with the chief procurement officer of logistics department, the deputy

general manager of purchasing department, the senior manager of purchasing department, the senior manager of IT department, and the SAP systems director.

The case study

A paper manufacturing company in China is chosen as the case for this study. They are one of the largest paper manufacturing companies in China. They involve in the SC process and look outward for a new solution to enhance their competitiveness. SAP R/3 is implemented in the company and it provides one application for most of the company’s core administrative processes. The company employs more than 1,700 people. Their main product range is high quality paperboard.

It is important to understand the difference between paper manufacturing industry and other manufacturing industries in order to analyse the types of modules and functions within ERP that appear to be suitable in such industry. Table I shows the typical differences.

It is clear from Table I that paper manufacturing is process-oriented. This will be a challenge in selecting a suitable ERP system as most ERP systems are designed for discrete and batch manufacturing. Consequently, this will affect the types of modules implemented. Table II shows the degree-of-fit of various functions in ERP for paper manufacturing. It indicates that production scheduling and inventory management appear to be less favourable for paper manufacturing.

Manufacturing paper is a capital-intensive business, and the scales of operations are large. Their paper machines generally run 24 hours a day, 365 days a year, shutting down only for routine maintenance. The changeover of the line from one product to another is very expensive since the whole plant is usually down during the changeover.

Table I.
The typical differences between paper manufacturing and other manufacturing

Paper manufacturing industry	Many other manufacturing
Capacity management focus	Materials management focus
Process + disassembly environment	Assembly of components
Quality management relative	Quality management absolute
Low product standardization	High product standardization
Inventory managed by order/unit	Inventory managed by item/stock-keeping unit
Source: Paperloop (2003)	

Table II.
The degree-of-fit of functions in ERP for paper manufacturing

Good fit applications	Questionable/poor fit applications
Credit	Order entry
Accounts receivable	Block scheduling
General ledger	Trimming
Raw materials	Product tracking
Purchasing	Process/quality/laboratory management
Storeroom	Warehouse/inventory management
Accounts	Payable invoicing
Source: Paperloop (2003)	

The company's purchasing, materials management, and logistics network makes up more than 70 per cent of its operating revenue. The paper manufacturing industry is unique in that it generally uses few materials that are purchased in very large bulk quantities like rail cars or ships. These materials are commonly purchased at a commodity price that can fluctuate widely in the market. Hundreds of millions of dollars are spent each year on raw materials and their transportation, pulp and paper production and storage, and distribution of finished products to customers. This process is often called the paper industry SC. The paper machines used by the case company have many similarities and all produce similar paper products. However, each machine uses different fibre and chemical sources, thus this results in a number of raw material supply options.

They use SAP R/3 to try to standardise, rationalise, integrate and automate business processes. Such systems are complex and require a full understanding of the actual behaviour and inter-relationships of business processes. Currently, the company has about 280 specialised experts. A manufacturing organisation may have quite separate and distinct procurement, manufacturing and distribution support systems. If a truly integrated SC system is to be created, the boundaries between these separate systems must be overcome. This is possible by writing interfaces and links between the separate systems but the need for integration is more important and hence the popularity of ERP systems.

To more efficiently manage the company's overall purchasing activities, changes to the purchasing group were initiated. The group was tasked with aggressively reviewing different cost saving initiatives, productivity improvements, and supplier improvements to come up with a long-term strategic purchasing vision. The group's main focus was to ensure that the right systems, processes, and people were in place for strategic-based purchasing and cost control. To help accomplish these goals, purchasing of operating resources supplies and all raw materials and chemicals were centralised at their corporate headquarters.

Results, analysis and discussions

Purchasing and administration

To the new purchasing group, it was obvious that company's purchasing operations were inefficient due to following a transaction-based purchasing approach rather than a strategic-based one. The purchasing group identified payments to more than 4,000 suppliers for a particular year. To negotiate effectively with suppliers in this scale, the purchasing group began by examining data from the company's legacy purchasing system. This was then replaced by material management (MM) module of SAP R/3. Figure 1 shows the use of SAP to evaluate their suppliers. This has enabled identification of key suppliers within each of the operating resource categories. The group ultimately lowered the number of suppliers from 4,000 to 2,128.

The key in providing visibility of data and leveraging supplier negotiations for the centralised purchasing group has been an electronic procurement (e-procurement) tool that allows the company to control their suppliers when purchased operating resources, hence it has resulted in cost savings. The tool also interfaces with SAP's MM, financial/accounting and controlling modules to automate many purchasing and payment tasks. Table III shows the differences between the processes before and after using SAP R/3.

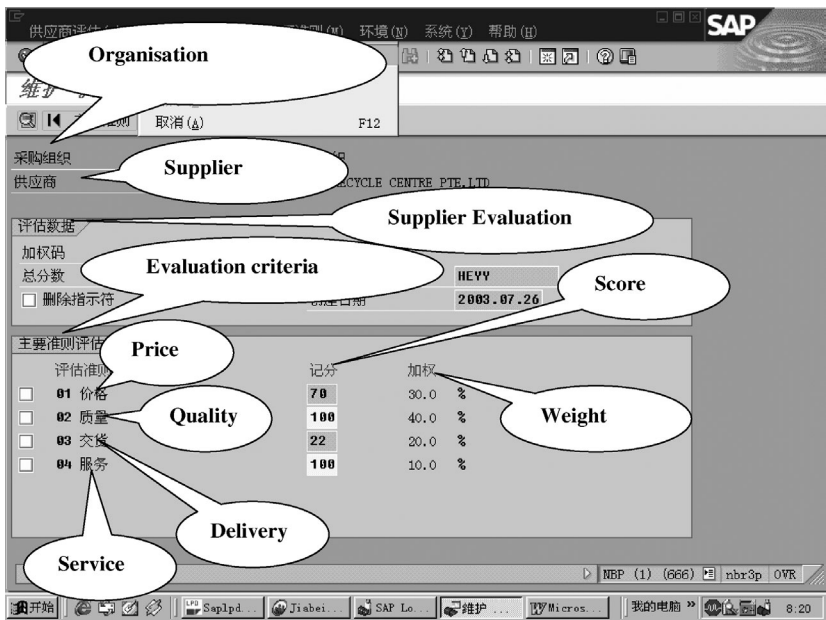


Figure 1.
Using SAP R/3 to evaluate
suppliers

Table III.
The process differences
before and after using
SAP R/3

Before using SAP R/3	After using SAP R/3
Used a lot of paper and much paper work Much duplication of tasks	Type all requirements by using “SAP reservation” All approvals have to be done by using SAP release strategy
Still have a lot of manual approvals	Use fax server and e-mail to automatically send Request for quote and purchase order from SAP to vendors
Used a lot of paper attachments	

The benefits of using SAP in the case company includes: shortened requirements and purchasing processing lead-time; if the lead-time is reduced, this will reduce materials inventory level; reduced administration expenses; and re-allocation of human resources, who execute duplicating tasks to more strategic tasks such as, procurement strategic sourcing, contracts making, etc.

Supplier-manufacturer collaboration

In assessing the challenges and opportunities available through supplier and manufacturer collaboration, we gained valuable insights into the SC process as it exists today. It is apparent that there is still a lot of work to be done before the company can realise the full potential of collaborative SCM. The following is a summary of some of the most important challenges and opportunities that arose from discussions with interviewees.

To begin with, four executives agreed that the existing corporate culture has been slow to exchange the “old world” for the communication and coordination that was

the motivating force behind the initiation of SCM. The most critical factor to successful collaboration is not the technical barriers but rather the people barrier.

The next major challenge identified by the four executives, is the issue of waste within the SC, and how to eliminate it. The waste referred to here is systemic waste, the invisible waste that is inherent in a SC where the various members operate in isolation. The more links in a SC, the more opportunities for waste. Whatever the structure, every member of the SC must look outside their four walls and add visibility to their process if they hope to eliminate waste and add value to their process.

Supplier-manufacturer collaboration, therefore, is the challenge for the future of SCM; but it is also the opportunity. The interviews suggest that supplier-manufacturer collaboration represents the best solution for the case company for achieving real improvements on SC effectiveness.

Strategic supplier development

Analytic solutions bring added value to sourcing by allowing the company to understand exactly how they work with their suppliers. Through strategic analysis, the company has developed much more effective sourcing, procurement and product development.

SAP R/3 gives the company visibility across the entire enterprise, regardless of the transaction platform deployed at a particular site. This allows the company to analyse purchasing history, identify commodity groups and consolidate purchase agreements. SAP R/3 empowers the company to constantly evaluate and fine-tune their supply strategy, enables their suppliers to improve accuracy and compress sourcing cycle times, and engages collaborative processes more effectively to reduce the cost of goods sold while improving service levels across the board.

Integration of SCM, supplier relationships management and ERP gives the company the opportunity to build effective processes with suppliers they trust, so they can get the maximum return on relationship with all their suppliers.

Supplier qualification

Accurate information and timely access to a credible source of suppliers is vital to strategic sourcing. However, for many companies today, discovery remains a manual process with phone, fax and paper catalogue as the primary tools.

SAP R/3 helps the company to define the criteria by which suppliers are qualified and tested. Automating the qualification checking process and maintaining an approved vendor list makes it feasible to screen a larger number of suppliers than ever before. They can reduce risk of supply with reliable and expedited processes for supplier discovery and qualification.

The trend towards outsourcing and increased specialisation among companies makes it critical to obtain good, clean supplier data and build efficient processes to manage supplier relationships. Using SAP R/3 is a powerful way for businesses to maximise the return on all their suppliers. In the past, the company has connected all their suppliers to address all purchasing categories. The true value of profitable supplier relationships can now be realised through a solution of SAP R/3 that allows the company to collaborate with few qualified suppliers for all purchased goods and services. With SAP R/3, the company can constantly optimise supplier selection, compress cycle times, and devise focused sourcing and procurement strategies.

Supplier selection

Purchasing personnel have become relationship managers; facilitating decision-making by bringing together the pertinent parties internal and external to the organisation. A central responsibility is selecting suppliers with the mission of achieving system-wide goals as opposed to minimising piece price. Higher levels of customer satisfaction and firm performance result from selecting and evaluating suppliers based on their ability to provide quality components and sub-assemblies, reliable delivery, and product performance. By effectively evaluating and selecting suppliers, the company has lowered the cost of goods purchased and assigned sources of supply to both planned and unplanned demand. The interviews result show that selecting suppliers based on unit price does not have a positive impact on customer satisfaction or firm performance. A critical duty is developing and maintaining long-term strategic alliances with suppliers.

SAP R/3 significantly streamlines and optimises supplier selection. Structured requests for quotation allow the company to specify unique requirements or increase pricing pressure on potential suppliers. Custom-designed and engineered goods can also be sourced using built-in capabilities for document collaboration and communication. With SAP R/3 they can compress sourcing cycle times with a variety of auction and bidding techniques that match supplier capabilities with business needs.

The interviews result note that understanding what information the suppliers needs or other problems that they face is essential for the organisation to be successful. Generally, in a closed-loop system the input equals the output. Parts suppliers must play an important role if a company is to compete effectively in the market place. To have a win-win situation, it is necessary to understand the supplier's role. The supplier has to be recognised as an "extension of the in-house capability". Establishment of credit and confidence given to in-house departments must also be extended to the supplier. Effectively communicating and working with suppliers can provide excellent insights for internal processes that need to be improved.

Communication

Communication is a two-way process. These are easy words to say but actually difficult to put into practice. The interviews result suggests that win-win relationship is nothing more than communication, but it is critical to the SC process. In addition, the result also shows that communication must be open-ended and two-sided, if both sides are to win. Too often in the past, communication was one-sided. If it is all one-way communication, it is ultimately going to fail. It absolutely must be a win-win for both sides, or the relationship will not be sustainable.

There are still several other major obstacles associated with implementing such a broad-based SCM system. First and foremost, is the issue of trust among trading partners. Secondly, is that companies cannot even share information internally, much less externally. And, thirdly, is the recurring need for a standard data interface.

Relationship monitoring

Supplier management also entails capturing information to understand how a company works with its suppliers on an ongoing basis. Tracking interactions and transactions, collecting and managing contract information, and administrating the process flow are all essential processes for the ongoing health of its strategic sourcing initiatives.

SAP R/3 helps the company manage their total spend by closely monitoring supplier relationships and performance, including financial stability, external rankings, sourcing contracts and so on. They can complement and customise this analysis with additional information on products and materials, integration into planning and operations systems.

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Conclusions

In the twenty-first century, it will no longer be single companies competing against each other. The individual company must position itself into a competitive SC and the different SCs will compete against each other. The big return on ERP investment and the future revenue and profit growth comes from integrating the company to its entire SC. A company will compete in the market based on the overall strength of its SC.

The paper manufacturing company adopted a different way to integrate their ERP and SCM by managing supplier relationships. This study suggested that good management of supplier involvement and an agile SC can lead to better supplier performance, improved manufacturing, and product and process improvements that in turn enhance customer satisfaction and firm performance.

External environment or culture may have an impact on using ERP systems in the company. One reason is that the use of ERP is not pervasive in China. If partnering suppliers do not use ERP, the company is also reluctant to use it either to integrate SC across companies.

This research shows that the ERP systems in the case company address only a subset of SCM needs. ERP's main added value is its combination of financial control with multi-facility coordination, but ERP does not deliver supply planning and demand planning functionality for the company. The systems are not designed to support internal SCs. However, integration of SCM and ERP gives the company the opportunity to build effective processes with suppliers they trust, so they can get the maximum return on relationship with all their suppliers on a continuous basis.

The main conclusion from this study is that one should not expect too much from ERP for managing their SC in paper manufacturing environments. However, individual company should look at an effective purchasing function as one of the competencies essential to SC success. It is found that breaking the traditional decentralised system and introducing the concept of a single, integrated plan, which a company could work together with their suppliers lead to cost reduction and increased efficiency. This unique practice is suited to new market requirements.

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About the authors

S.C. Lenny Koh, BEng (Hons), PhD, MIEE, MCMI, MIOM is a Deputy Director of MBA in EcoBusiness and a Senior Lecturer in Operations Management at the University of Sheffield, Management School, UK. Her research interests are in the areas of production planning and control (particularly in MRP, MRP II and ERP), uncertainty management, modern operations management, logistics and SCM, e-business, e-organisations, sustainable business and

development, and eco-logistics. She has published over 100 articles in various international and national academic journals and conferences. She is the Chief Editor of the *International Journal of Enterprise Network Management*, Associate Editor of the *International Journal of Operational Research*, editorial board member of the *International Journal of Logistics Systems and Management* and *Benchmarking: An International Journal*, serves as a chair and on the board of committee of various international conferences, and a referee for several international journals in these disciplines. S.C. Lenny Koh is the corresponding author and can be contacted at: S.C.L.Koh@sheffield.ac.uk

S. Saad, BSc (Honours), MSc, PhD, CEng, MIEE, ILTM is a Reader in Advanced Manufacturing Systems and Enterprises Modelling and Management, in the School of Engineering at Sheffield Hallam University, UK. His research interest include design and analysis of advanced manufacturing systems, integrated planning, loading and scheduling systems, Enterprise modelling and simulation, production planning and control, operations management, reconfigurable manufacturing systems, virtual, responsive (agile), biological and fractal manufacturing. He has published over 70 articles in various national and international academic journals and conferences. He acted as a referee for a number of international journals in the field of manufacturing systems and operations management.

S. Arunachalam is a Senior Lecturer in Operations Management in the School of Computing and Technology, University of East London (UK). He received a PhD in Manufacturing Engineering from the University of Hertfordshire (UK). Prior to his appointment at the University of East London, he served on the Manufacturing Faculty of the Coventry University (UK). He has published over 50 papers in various international journals and conferences. He has given a number of invited talks in various countries and reviewed articles for several leading journals. He has developed and delivered many short courses in quality management, productivity, process reengineering, six sigma and inventory management. He is currently interested in researching, lean manufacturing, six sigma, product life cycle management, SCM and total quality management.