e-SCM AND ERP INTEGRATION AT NEWAY: CHALLENGES AND SOLUTIONS

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ABSTRACT

It is imperative for modern organizations to use ERP and SCM systems to manage their operations. Increasingly, there is a trend to integrate these two systems together as they are found to work in a complementary fashion. But the integration of ERP and SCM systems is usually marked by a number of technical and organizational challenges. The case of Neway discussed in this paper illustrates the process of integration of the ERP and the SCM systems at a modern Chinese organization. Neway used an ERP system that had several shortcomings. To overcome these problems they decided to add an e-SCM system on top of the ERP system. The e-SCM system that was implemented was able to solve the inherent problems of the ERP systems and bring in many benefits that ranged from fostering a paperless environment to efficient inventory tracking and picking to better coordination with vendors and customers. Several challenges were faced in the implementation process and smart solutions were adopted to overcome them.

INTRODUCTION

ERP systems are designed to integrate business functions by providing means to exchange information across different departments in an organization. ERP systems consist of modules from accounting, distribution, marketing, sales, manufacturing, and human resources to enable integrated flow of information within an organization [12]. Using ERP systems the main business processes of an organization can be performed using a single application package in a seamless fashion. ERP systems provide three types of functionalities: namely transactional processing, workflow management, and decision support. ERP systems have been among the most popular options to achieve competitive advantage for organizations [15].

On the contrary, SCM systems are designed to provide high level business planning and decision support for multi-organization wide coordination and execution of production and distribution activities [3]. SCM systems recognize the fact that supply chain partners should work collaboratively to drive efficiency to the highest level and a company should look beyond its’ four walls to link supply chain strategies to business strategies [12]. By timely sharing of information, SCM systems enable the supply chains to function in a synchronized fashion [1]. In a dynamic business world SCM systems provide flexibility and speed to counter demand uncertainty and the necessary infrastructure to influence demand with the help of well concerted efforts by supply chain partners. With broader reach beyond the boundaries of individual corporations, these systems guide businesses in getting the right product to the right place, at the right price, at the right quantity, and at the right time.

Need for ERP-SCM integration

Although ERP systems implementation started with much fanfare, the rate of ERP success rate is relatively low and ERP adoption process faces a number of barriers including poor business processes, resistance to change, inconsistent operating goals, and lack of managerial commitments. The success stories are even rarer in China [15]. A recent study reported that only one-third of the ERP implementations in China were satisfactory [13]. Apart from organizational culture, employee training, language barrier, report and table format issues, and business process reengineering, there are technical issues such as ERP software suitability and information quality that have surfaced as potential roadblocks [14][15].

While ERP systems allow sharing of information across various departments within an organization to achieve internal efficiency, SCM systems focus on handling relationships between trading partners in the supply chain and enable collaborative workflows that cross organizational boundaries. Collaboration among trading partners by integration of
value chains is extremely important to be successful in a highly competitive business environment. Modern organizations have realized that they have to look beyond internal efficiency and align business strategies with a broader view of the supply chain consisting of networks of vendors, suppliers, manufacturers, distributors, retailers, and other partners. Experts have remarked that entire supply chains, rather than isolated companies, will compete in the future [2]. Due to low labor cost in China the value of SCM in terms of efficiency may not be very attractive, but its capability in offering broad visibility and channel transparency definitely helps businesses [6]. For example, inventory planners should not look only at on-hand inventory or raw material inventory committed for future production plans, but they should also account for inventory that left the supplier’s shipping docks and potential excesses or shortages that might occur further upstream in the supply chain in order to modify the inventory ordering strategy dynamically. Unfortunately, some of the ERP systems rely on ad-hoc arrangements to get inventory information from different sources including warehouses and it does not work very well. On the other hand, SCM systems are suitable for tracking inventory of different entities in the supply chain.

In an ever changing complex business environment it is important to perform what-if analysis before taking a decision so that implications of possible future scenarios are already known [5]. Efficient management of supply chains require continuous adjustments in the decision making process including but not limited to scenario modeling, dynamic pricing and risk assessment, and evaluation of sourcing and logistics alternatives [8]. While SCM systems are suitable for these types of functionalities, ERP systems are not designed for it. Also the handling of constraints in ERP systems is rather old fashioned. In ERP systems various material, capacity, and demand constraints are considered separately, in relative isolation of each other. On the contrary, SCM systems consider all relevant constraints simultaneously and develop a higher quality plan. SCM systems perform thorough resource planning including detailed scheduling and are capable of identifying the potential problems in supply chain and are able to provide information quickly utilizing memory resident architecture. The ERP system is not designed to identify problems proactively and it takes time (few minutes to hours) to generate reports on ERP systems. The ability to provide quote on a request by SCM, attained through available to promise (ATP) or capable to promise (CTP) functionalities, is primarily absent in ERP. Many times optimization modules are added to SCM systems to generate high quality production and distribution plans and/or configurable heuristic modules are provided to create reasonably good feasible plans. While major ERP vendors are introducing advanced planning and optimization capabilities, SCM vendors are advancing their products further with additional features [7].

Issues and challenges in ERP-SCM integration

One of the major problems faced in ERP-SCM integration is the large number of vendors that provide ERP and SCM systems solutions. It is a big challenge to make these disparate systems talk to each other. One easy solution is for companies to use systems from the same vendor. For example, both SAP and Oracle offer advanced planning functionalities similar to traditional SCM vendors and integration between their planning systems and ERP is relatively easy [12]. However, many companies do not buy ERP and SCM systems from the same vendor. In such cases middleware technologies may be used to establish connections. This has particular appeal as programs can be written to develop customized interfaces between various ERP and SCM systems using CORBA. However, high interface development cost is an issue. Another method of integration is to use specialized integration software (SIS) where mapping of different packages are done in advance and preprogrammed software is used to integrate ERP and SCM systems [12]. In China ERP and SCM packages from a variety of vendors, both local and international, are used and there is no vendor that totally dominates the market [14]. Hence, middleware technologies may be the right choice to integrate disparate systems. Another option that can be used to integrate systems without buying expensive integration software is web services based on XML (Extensible Markup Language). Web services use internet as a universal data bus, data feeds are published according to internet standards, and other programs subscribe to them. Since ERP and SCM systems sometimes have overlapping functionalities, integrating these two types of systems involve decisions about disabling duplicate functionalities. Although this sounds trivial, these decisions have to be made meticulously with careful consideration of various business processes tied to these systems.

Another challenge in ERP-SCM integration is to decide which functions should be performed off-line through batch runs and which functions should be performed real time. For example, customer orders from ERP systems can be fed into SCM systems asynchronously. Also once the production plan is generated in SCM system it can be uploaded into ERP system using a batch process. On the other hand, request for on-time delivery quotation entered in ERP system has to invoke ATP functionality in SCM system in real time. Separation of off-line and real time workflows is required for efficient design. However, the process is complex and requires thorough understanding of business processes and technical architectures. This is further complicated in China as some of the processes are not fully automated to take advantages of cheap labor. Different packages used in China handle workflow differently, thereby making integration even more difficult.

While product costs in the Western countries are relatively stable, they vary a lot in China. In the rapidly changing Chinese market, companies update purchasing plans more frequently to incorporate latest prices of raw materials [14]. Hence, to and fro information flow between cost-control modules of ERP and SCM systems need special attention.
Also the integration architecture has to be flexible enough to support newer concepts like lean, agile, and green manufacturing or customized ERP-SCM integration. There are a number of challenges in integrating ERP and SCM systems and aligning the associated business processes in sync with the decision support tools. A nice framework for customizing ERP systems and making adjustments to the business processes to achieve synchronization is also available in literature [10]. However, the task in China faces additional layer of difficulties. Challenges involve justification of systems automation and return on investment considering lower cost of labor, cultural uniqueness that sometimes gives more emphasis on personal familiarity than on scientific decisions [11], lack of appropriate infrastructures at suppliers’ and customers’ organizations, and fragmented Chinese market with many service providers [4]. Despite all these hurdles the Chinese manufacturing industry is destined to adopt integrated decision support tools to make operations more efficient. With the help of a case study on Neway, a leading valve manufacturer in China, we show how a successful marriage between ERP and SCM systems go on to eliminate a number of operational problems and enhance the overall performance in an organization.

**BACKGROUND**

Neway is a Sino-USA joint venture with about 1020 employees, and revenue about US$50 million in 2004. It is the leading industrial valve manufacturer whose products include gate, globe, check, butterfly, and ball valves. Neway has two manufacturing facilities located in two different districts in Suzhou. Each of them has two raw materials warehouses, one semi-finished products warehouse, and one finished products warehouse. Except for a few standard valves, Neway fulfills orders using make-to-order policy. Each manufacturing facility produces one category of valves. There are about 20,000 types of raw materials stored in the two raw materials warehouses in the two manufacturing facilities of Neway.

**Neway’s existing ERP system**

Neway’s existing ERP system is provided and implemented by Summiteam, a local ERP systems provider. The ERP system at Neway consisted of four major subsystems:

**Sales and Distribution:** This subsystem supported customer management, order management, order fulfillment, and distributor management. It gave users access to aggregated operational data from all sources, and helped users complete their entire sales cycle from price quotation to invoicing and payment.

**Manufacturing:** This subsystem supported manufacturing planning and scheduling, inventory management, and manufacturing control. It helped users manage, track, and control all phases of the product lifecycle and enabled workers to communicate production information quickly and easily among production units, maintenance units, and other departments within the organization.

**Human resource:** This subsystem supported staff management, payroll management, time management, organizational management, performance evaluation of staff members, and career planning management. This subsystem was based on the Chinese legal welfare and tax system, and was flexible enough to support international human resource practices and salary regulations.

**Accounting and Financial analysis:** This subsystem supported accounting entry, financial control, and financial analysis. It integrated all financial and business performance information, and provided comprehensive and systematic financial reports.

Figure 1 shows the four subsystems in Neway’s existing ERP system.
As shown in Figure 1, all four subsystems in the Neway ERP system were seamlessly integrated. The ERP system benefited Neway in many ways. It eliminated disorders in production planning, improved production capacity, standardized and streamlined the order fulfillment process from purchasing to delivery, and established an open environment allowing corporation wide data sharing. It dealt with resource planning within the whole enterprise through fulfillment of orders. But it did not track or instruct the execution of planning that involved a lot of paper work between handoff points, and also depended on human input of collected data. Also, the coordination with vendors and customers could not be accomplished.

Process flow at Neway
Neway used to place purchase orders for materials to vendors, largely based on anticipated demands and safety stocks. This was more of less done on an ad-hoc basis. When the vendors delivered materials to Neway they were received and put away into the warehouses. Materials were then pulled from the warehouse by the manufacturing units, and either returned to the semi-finished goods stockroom to wait for instructions for assembly operations, or sent to the finished goods warehouse for shipment to customers. The operational processes improved a lot after the ERP system was implemented.

Problems with existing ERP system and existing business practices
Improper picking and tracking of materials: Workers usually picked up based on their experience. It would take new workers several weeks to know where to pick up and where to put away materials. Often work-in-process inventory in the production line was not recorded. The workers encountered even more problems in the finished products warehouse. As many products were make-to-order, products were put away with a label indicating which order they belonged to. Sometimes these labels would get misplaced and finished products belonging to different orders would be put together.

Inaccurate and outdated inventory: Usually it would take employees 1-2 days to collect inventory related information on paper and input to the ERP system. Therefore, the inventories shown in ERP system were usually outdated and inaccurate. This would lead to excessive safety stocks and decreased inventory turnover. Another problem was that materials in the warehouse would be damaged and missing and this would not be recorded in the ERP system on time.

Non value-added activities: Neway’s operations involved a lot of paper work. Paper printing, paper delivery, and paper accumulation consumed a lot of resources, increased the cost of production, and caused delays in the collection and recording of information. Lost or damaged documents, as well as reading and writing errors often resulted in incorrect recording. Another critical problem was that of hand-off delays that resulted in a high cycle time for order fulfillment.

Limited interaction with customers and vendors: In the day-to-day operations, Neway needed to interact well with its
customers. A large number of workers were dedicated to dealing with customers. Neway needed to coordinate various activities such as pricing, ordering, shipping, and product inspection with its vendors. There was much scope to improve coordination and enhance efficiency. Also, Neway did not have standard procedures to evaluate vendors, and add or drop vendors when needed.

**NEWAY’S e-SCM SYSTEM**

In order to improve operational efficiency, Neway implemented the e-SCM system from the vendor Winsvision. Figure 2 gives a schematic representation of the e-SCM system.

The e-SCM system obtains up-to-date planning information from the ERP system and generates operational details that are returned to the ERP system. It allocates tasks to unoccupied workers based on required completion times of tasks. Then it instructs workers to finish assigned tasks through radio frequency handheld devices that have wireless connections to a local area network. These devices measure the performance of each worker with respect to their assigned tasks. As soon as the tasks are finished, relevant feedback information on worker performance is sent to the ERP system as XML files. The workers use the handheld devices to collect accurate inventory information in real time and this eliminates manual paperwork.

**Challenges encountered in implementation of e-SCM system at Neway**

*Managing data:* Most of the initial data of the e-SCM system came from the Oracle database of the ERP system. Several issues were faced with regard to the ERP data. Firstly, the table structures were different between the ERP system and the e-SCM system although both systems used the Oracle database. Secondly, the inventory data recorded in the ERP system was inaccurate and outdated as there was no facility to provide real time update of the data. These problems were solved by deciding that all in-process tasks would be finished by a specific date and the data would be loaded at midnight of the finish date. At the same time data would be transferred to a format acceptable to the e-SCM system.

*Design of the appropriate system interface for efficient information exchange:* Due to the complexities involved in the ERP and e-SCM system it was important to decide what information should be exchanged. The implementation team had to decide about the format of data exchange. After a series of meetings, it was decided that information from ERP system to e-SCM system would include item masters, initial inventory information, and inbound and outbound orders. Information from e-SCM system to ERP system would include receiving, put-away information, inspection results, pick-up, and inventory adjustment information. The systems specialists from Summiteam and Winsvision decided to use XML for data exchange.

*Management of capacity of computer network:* Before the e-SCM came into existence, the data transfer of ERP system consumed almost the entire bandwidth of the 2 Mbps optical network connection between the two facilities of Neway. Since the e-SCM system was a real time system that involved large amounts of data transfer between the host system and all handhelds, the response time of the handhelds was quite low, especially when the ERP system was also at peak volume of data transfer. This problem was solved by leasing another optical network connection from China Telecom.
Handling of Chinese characters on handheld devices and barcode printers: The major problem for handheld devices was their inability to display Chinese characters on their screens. Also, due to the limited size of the display screens some information for a task could not be displayed in full in one screen and some characters would almost always disappear. The first problem was handled by reinstalling compatible Chinese character sets for the terminal emulation software. To solve the second problem, the size of display of the data in the host system was adjusted according to the display area of the handhelds. The barcode printer also had problems printing Chinese characters. This was handled by installing compatible Chinese characters on the printer software.

Determination of appropriate handheld devices: There were many choices of handheld devices available for use with prices between US$ 500-2500. The implementation team narrowed down the choice to two models – one manufactured by Symbol (US$ 1625), the world’s leading handheld device provider for logistics applications and the second (US$ 500) manufactured by a Taiwanese company named Biotech with no prior experience in the logistics industry. The handheld devices were to be used in a demanding environment of dirty and crowded warehouse and it was necessary to choose a reputed product. Yet, the second model’s cheaper price was attractive. Initially the team bought 8 handheld devices with 5 devices from Symbol and 3 from Biotech. Eventually the remaining 12 handheld devices were all bought from Symbol because the devices bought from Biotech did not perform well.

Handling initial project management blues: At Neway, the initial problems included software bugs, incorrect initial data, inconvenient operation of software functions, human mal-operations, and errors in data exchange between the two systems. It was decided that in the initial stage a meeting would be arranged between the representatives every two days. The team members from the e-SCM team would record the problems and present their solutions the next day. Problems recorded in these meetings would be later classified into different types according to their importance and urgency.

Coordination among team members: It has been argued in the literature that active involvement of leadership is an important factor in successful implementation of enterprise systems [9]. This project was no exception. Team coordination was a major challenge since team members came from three parties and each party wanted to implement things in a way that minimized their workload. It was found that the senior management’s involvement was necessary for critical decision making activities when there were conflicts between members of the e-SCM team and the ERP team. Sometimes the ERP team would lag behind schedule because they were unable to have full commitment for the Neway e-SCM project. In such cases, the senior management had to step in on request of the e-SCM team to push the ERP team to finish their jobs on schedule. Often guidance from the senior management was needed to coordinate the tasks as planned.

Training end users: It was not clear whether the employees at Neway would resist dramatic process changes since they were complex and involved operating a handheld device. To solve this problem the implementation team first identified all affected parties, arranged meetings to educate workers about the e-SCM system, and established a demo system to let the workers have a simulative environment to train before the actual system went live. The training program was customized according to the varying needs of workers. As workers got a good practice of the simulation system they developed an expectation about the actual system and did not offer any resistance.

Table 1 summarizes the challenges faced by Neway and the corresponding solutions that the implementation team came up with to overcome these challenges.

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Solutions</th>
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<tbody>
<tr>
<td>Design of appropriate interface</td>
<td>• Use XML as the interface standard</td>
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<td></td>
<td>• Joint decisions of ERP and e-SCM system analysts</td>
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<tr>
<td>Management of data</td>
<td>• Load data at midnight of deadline dates</td>
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<td></td>
<td>• Transform data to acceptable standard before loading</td>
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<tr>
<td>Handling Chinese characters</td>
<td>• Reinstall compatible Chinese character sets for terminal emulation software</td>
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<td></td>
<td>• Adjust size of display of data in host system according to display area of handhelds</td>
</tr>
<tr>
<td>Capacity of computer network</td>
<td>• Provide second optical network connection between two manufacturing facilities of Neway</td>
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<tr>
<td>Choice of handheld devices</td>
<td>• Trade off between cost and risk</td>
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DISCUSSION OF LESSONS LEARNT

The implementation of the e-SCM system involved a number of challenges. Among technical challenges Neway had to deal with problems related to design of appropriate interface between the two systems, management of data, handling of Chinese characters in handheld devices and barcode printers, capacity of computer network, and choice of handheld devices. Among these challenges some (e.g., inability to display Chinese characters on handheld devices and printers) are distinct for a Chinese enterprise and may not be seen in other parts of the world where standard English characters are used. Both Summiteam and Winsvision team members agreed to adopt XML as the standard for data exchange between the ERP and e-SCM systems. This was governed by the available expertise among team members and also the ability of the ERP system to handle XML files and that it is simple to handle data exchange using XML. No fancy software solutions were attempted and simplicity was the key in designing a solution.

Neway realized that the ERP system was perhaps underperforming due to the misalignment of key processes in the operations. So the e-SCM was implemented with a change in the process flow as well. Neway is a large manufacturing organization with a great variety of products and so the emphasis was put on key manufacturing processes such as receiving and put away, picking up, and order management. This was done in order to get a quick return from the implementation of the e-SCM system which in turn could justify the financial investment made by Neway for the e-SCM system.

The management at Neway demonstrated evidence of long term vision. Management allowed the adoption of handheld devices and introduced the technology in a gentle manner among the factory workers go on to show that they were aware of the cost savings that an advanced technological gadget like a handheld device can provide for Neway in the long run. They also did not compromise on the quality of the device and chose the expensive handheld devices by Symbol instead of the cheaper ones from Biotech.

There are interesting lessons in project management as well. Since a number of teams had to work together in this project the senior management had to be responsible for the reign of control so that no teams could dominate the situation to their own advantage. Had they left the entire task of co-ordination with Summiteam on Winsvision, the project would not have been successful because Summiteam had already implemented the ERP system and there were few team members who were present on-site and willing to take any responsibility. The management of Neway forced members of Summiteam to be on schedule and in a very direct way helped Winsvision to do their job. Winsvision also demonstrated great responsiveness in this project. At the initial stages of the project when things were not running smoothly the team members had to be introspective to find out their shortcomings and remedy them quickly.

The case of Neway also helps us identify the factors that were responsible for the success of this large scale implementation project. The Chinese ERP and SCM systems providers understood the needs of a Chinese manufacturing organization very well. Most of the members of the ERP team, the e-SCM team, and the Neway team were Chinese and native speakers of Mandarin. This made the exchange of ideas and views easy. The senior management at Neway was extremely co-operative with the implementation team and provided advanced infrastructure like high speed network connection and good quality handheld devices. Their active involvement helped sort out various organizational issues, enabled the project to be on track at all times, and allowed timely completion of the project. The use of XML solved many problems that occur in any integration project with regard to mismatch of data and table structures. Finally, the use of a simulation system for training the users enabled them to get a practice with the new system before it went live and eased the acceptance of the new system.

REFERENCES


