Using ERP Systems to Transform Business Processes: A Case Study at a Precession Engineering Company

C.K.M.Lee[1], Linda Zhang[2], P.X.Lee[1] and K.O. Au[3]
[1]Nanyang Technological University
[2]University of Groningen
[3]ACW Solution Ltd
Corresponding author E-mail: ckmlee@ntu.edu.sg

Abstract: Enterprises nowadays strive to keep transforming their business processes in accordance with the fast-changing customer demands so as to survive the intense global competition. In an attempt to provide practitioners with an insight into ERP implementation and the resulting business performances, this paper investigate how a successful ERP implementation can help transform enterprises processes. Case based research which is based on an in-depth observation under managerial and practitioner situation. A case study at a precession engineering company is conducted to evaluate the feasibility of the proposed strategic enterprise information model. This paper focuses on the implementation of Sales & Marketing and Warehouse modules of an ERP system. The key performance indicators are used to evaluate how the ERP implementation can improve the business processes. It is found that ERP helps to improve data visibility and improve on-time delivery but less effective on improving employee productivity. This research proposes an enterprise information model to exploit what strategy should be formulate and how ERP tactic can be implemented in company to enhance enterprise competitive advantages. The strategic enterprise information model is formulated based on our in-depth case study and ERP consultant's experience.

Keywords: Enterprise resource planning, Business process, Information system, Inventory management, Case study

1. Introduction

Recognizing the significance of better communication, co-ordination and collaborations within companies and between business partners, enterprises have been seeking information systems with the capacity to automate communication and integrate information across a wide range of business functions by collecting and demanding the input data in a highly standardized form. This paves the way for the adoption of Enterprise Resource Planning (ERP) systems. According to a 2007 Aberdeen's study of the role of ERP systems in globalization, enterprises that implemented ERP produced 66% more improvement in reducing total time from order to delivery (Jutras, 2007).

ERP is used to simplify and streamline highly specialized business processes in manufacturing and distribution enterprises. It comprises of the customary ERP modules such as Sales & Marketing, Distribution and Manufacturing. The automation of database transactions across functional areas enable data integrity, information sharing and provides a better analysis and planning. When empowered with the right tools, it is able to transform the challenges of today's business environments into the company's competitive advantages. The objective of this study is to

- examine the management aspects of ERP implementation;
- study the different phases of an ERP project life-cycle to attain successful implementation; and
- analyze how to effectively link operation to strategy and tactics.

The rest of this paper is organized as follows. Section 2 reviews the relevant literature about ERP implementation and supply chain integration. A framework of a strategic enterprise information model is proposed in Section 3. In Section 4, the case study carried out in a Singaporean company producing precision engineering products is introduced to shed light on how sales & marketing and warehouse modules in an ERP system are implemented and how their implementation helps transform the company's business processes. Section 5 discusses and concludes the findings about how ERP implementation transforms an enterprise.

2. Related Work

To concurrently attain high levels of customer services and internal operations efficiency, enterprises strive to effectively manage their supply chains. The major concern of both the academia and the industry alike, integrating supply chains with ERP systems can be

addressed from the strategic, tactical and operational levels. At a strategic level, Ngai et al. (2008) examine the critical success factors for ERP implementation, including business plan/vision/goals/justification, business process reengineering, change management culture and program, communication, ERP teamwork and composition, monitoring and evaluation of performance. By undertaking an empirical study, Bernroider et al. (2008) point out that ERP success increases if firms have explicitly defined IT/IS strategies and employed a participative form of decision making. On the contrary, ERP success decreases if a project team is dominated by business unit. Similarly, Ng et al., (1998) address the importance of developing and implementing such manufacturing strategies that consider both ERP and real-time monitoring systems. The main processes of their model include establishing present position, analyzing strategic requirement, developing strategic improvement and implementing strategy. At a tactical level, Change et al. (2008) study the ERP adoption from a user's perspective by taking into account factors such as complexity and compatibility. Vandaie (2008) examines the issues about tactic knowledge management and process modeling for configuring enterprise systems so as to fit existing organizational processes. At an operational level, Tarantilis et al. (2008) adopted interoperate, cross-platform web-service component to develop a web-based ERP for construction manufacturing enterprise. By undertaking a case study, Bose et al. (2008) study the requirements of ERP implementation, including infrastructure management, human and financial resource management and project management.

In summary, in order to reduce inventory and improve order management, there are a number of approaches and propositions have been reported to implement ERP systems (Jack et al., 2008; Pan et al., 2008; Wang et al., 2008). The literature review suggests that a strategic enterprise information model is able to provide a systematic approach to integrate to supply chains and, there lacks in-depth studies and investigations on such an enterprise information model. In response to the lack of research, in this paper, we propose strategic enterprise information model by undertaking a case study.

3. Proposed Framework

We have identified the major components of the strategic management of enterprise information in literature review, and summarized in the framework in Figure 1. Most scholars address the importance of change management, project management, risk management and business process re-engineering (BPR) during ERP implementation (Bergström et al., 2005; Chiplunkar, 2003; Elisabeth et al., 2003; Huin, 2004; Varma et al., 2007). While including the above concepts at the planning, design and implementation stages of an ERP project is important, it is the alignment of business processes with enterprise information incorporation with corporate

strategies that can help enterprises achieve competitive edges and have quick response to customers' needs. Enterprise information system cannot be implemented without clear mission and strategy. Enterprises intend to improve the existing business processes during ERP implementation and incorporate BPR. However, since the processes changed leads to changes of company's traditional business process, inertia and hindrance will increase. As pointed by Al-Mashari et al. (2002), a successful BPR project normally includes a change management program to deal with human resource issues. An enterprise fails to implement an ERP system due to the un-successful BRP. To have a successful BPR, it is necessary to identify the main business processes and how information assists users to improve the efficiency of their works. Users have a higher acceptance of business process changes when they can benefit from the ERP and the simplified processes. In the framework, we attempt to match the business processes with enterprise tactics so as to fulfill the strategy set by the top management. Instead of a top-down management, the implementation should cater to the needs of the current business processes and the efficient information flow can allow organizations to carry out enterprise tactics and strategy.

4. Case Study

MAE (a disguised name of the precision manufacturer) designs and manufactures equipment and precision engineering products, provide engineering materials and service to the microelectronics industry as well. It is offers competitive manufacturing services to numerous renowned multinational companies. Its various divisions are equipped with high-tech machinery and expertise that enable them to design and manufacture precision engineering products such as test sockets, device change kits, and stiffeners. These products are primarily exported to Asia, Middle East and the USA. It has established branches in Malaysia, Philippines and China to support and complement the overall operations in Singapore.
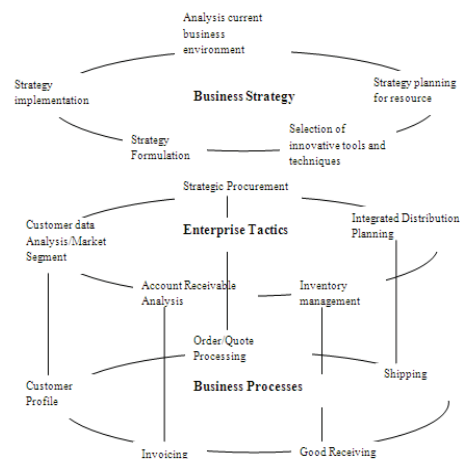

Fig. 1. The strategic enterprise information model

4.1. Strategic Mission for ERP Implementation

MAE faces the challenge of quickly transforming its businesses resulting from the increasing pressure from customers for faster delivery of high quality precision engineering products at lower prices. Manual and out-of-date information management systems that handle MAE's operations are required to be replaced. Although production control runs well, sales management is inefficient to handle customer orders. As each business independently operates, cost calculation is slow; quotes are often incorrect and financial reports are frequently delayed. As MAE implements a make-to-order business mode, the high number of returns and rejects come straight out of its profit. MAE's envisions are to become one of the world's leading companies supplying precision engineering products and services to the global electronics industry by building trust, technical excellence and value chain. Therefore, it sets a mission to search for such an ERP system that is well-suited to its unique environment and could help provide better control of its business. MAE decides to replace its legacy systems with an ERP system.

4.2. Overview of Business Processes

Among all, MAE urgently needs to improve and automate its entire sales workflow, its warehouse management system as well.

4.2.1 Existing Sales Workflow

The existing sales workflow, as shown in Figure 1, involves a great deal of manual labor of the sales coordinators. The entire sales procedure is elaborated as follows:
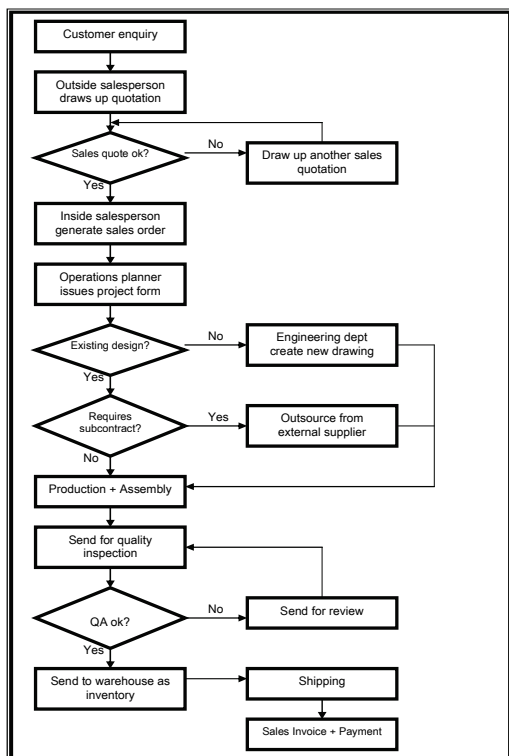

Fig. 2. An overview of the existing sales workflow in MAE

Outside salespersons of MAE will draw up sales quotations (in both hard & soft copies) according to customer requirements. When a sales quote is accepted, the outside salesperson will notify an inside salesperson to generate a sales order through company's legacy information system. The inside salesperson will call an operations planner to double confirm the sales order and to inform him whether or not the order is an existing design and requires reverse engineering. When the order is an existing design, the operations planner will issue a project form for production to manufacture the ordered item. When the order is a new design, the operations planner will issue a project form for engineering department to create new drawing for the ordered item. In case the order requires reverse engineering, the operations planner will issue a project form for the engineering department to create drawings according to the sample given by the customer. The operations planner has to promise a delivery date. If it is far beyond the date requested by the customer or rejected by the inside salesperson, they have to meet face-to-face to negotiate the delivery date.

During the entire sales process, the inside and outside salespersons make frequent trips to the production, engineering and planning departments to keep tabs on progress. There was no automated system to keep track of the orders/items until they reach the warehouse. When items arrive at the warehouse, no mechanism is available to inform the salespersons. Inside salespersons usually check the delayed sales order in the legacy systems. As the warehouse department does not timely update the inventory in the system, the inside salesperson usually trips to the warehouse department to check the inventory status. The salesperson has to pick up items personally and sends to the shipping department as the warehouse department does not handle the sales orders. The shipping department prints out two copies of shipping documents for customer to sign upon receiving orders and for own reference. The finance department prepares invoice and deals with payments made by customers.

4.2.2 Existing Problems

For an outside salesperson, he has to manually generate sales quotes each time customer's enquiry comes in based on his own judgments. Such quote generation brings many troubles to the outside salesperson as he has to run everywhere to meet customers and often generate repeated quotes due to the lack of a system. Spending time to draw up repeated sales quotes is a waste of time and resources.

For an inside salesperson, he has to personally oversee the whole sales process within the company and make frequent trips to all the departments involved to ensure that the sales orders will be ready on time. He also has to personally foresee that the items are being transferred from the warehouse to the shipping department.

For an operations Planner, he has to individually oversee all the manufacturing operations starting from issuing the

project form to items being sent to the warehouse. He also has to promise a date of completion for all orders based on his own verdict, which often results in grieve consequences when orders are delayed.

For the warehouse department, it lacks an efficient method for receiving items from production and, its lack of communication with the other departments causes inefficiency.

For the shipping department, it manually generates shipping documents with reference from the sales order and, this wastes time.

4.3. ERP Implementation

The criteria that MAE uses to select an ERP system is that the system should well suit the industry's requirements and MAE's unique business characteristics. Microsoft Dynamics NAV is chosen to illustrate in this case study. It is necessary to have built-in control for workflow which allows the company to control the business better at the management level with the integration of all functions within the company. In this study, we put the emphasis on the Sales & Marketing and Warehousing modules to highlight the benefits of implementing an ERP system.

4.3.1 Sales Order Processing

The sales order processing without involving ERP in MAE entails a long process where the salesperson manually checks a customer's past records to determine the items' pricing and availability before processing and confirming the order. While waiting for the salesperson to confirm the order, the customer may shop around by calling other distributors and thus the sales may be lost. With the implementation of an ERP system, this problem can be resolved as the system will churn out the information needed with a click of the mouse. It utilizes technology like XML as support for even more complicated orders. Figure 3 shows sales order processing within the ERP system, Sales & Marketing module in particular.

The way that the Sales & Marketing module of ERP improves MAE's sales order processing is elaborated as follows.
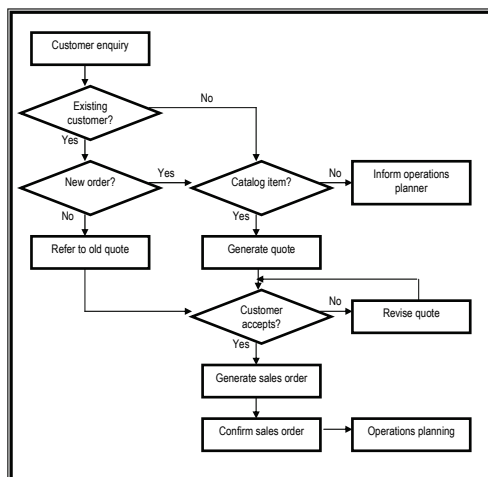

Fig. 3. Sales order processing after implementing ERP

Automatic conversion of sales quotes. ERP provides a sales ordering functionality where sales quotes can be automatically converted to sales order without the salesperson's intervention. Based on the generated quote number, the salesperson can retrieve the information from a list of items and thus quickly responding to customer requirements. The system will then automatically generates the relevant item information such as description, unit price and warehouse location code. Furthermore, it also automatically calculates the total price for each item, with which the salesperson can provide an accurate quotation to the customer.

In addition, the system automatically transfers the relevant information from sales quotes to sales orders. Subsequently, the salesperson will key in the requested delivery date and promised delivery date. When all the required information is entered, the salesperson posts the sales order. The operations planning department, thus, will be notified of the new sales order and accordingly process it.

Generation of more accurate information about order delivery. To provide customers with the accurate information about order delivery, MAE makes use of an Order Promising Feature. It is accomplished based on the customer requested date while considering the purchase and operation lead time to suggest a possible delivery date. Figure 4 shows the Timeline for items from staying in inventory to being delivered to customers. A planned delivery date is the date when MAE plans to deliver an order to a customer. A planned shipment date is the date when the picking process is completed and items are shipped out from the warehouse. A shipment date is the date when an item must be available in inventory. The picking process can start on this date. The above three types of dates are automatically calculated. An outbound warehouse handling time is the time duration that is required to pick, pack and label the items in an order. A shipping time is the time duration between the time that the items shipped out from the warehouse to the time that they reach the customers.

To calculate the earliest delivery time for an order if there is no requested delivery date, the equation is as follows:

$$\text{Shipment Date} + \text{Outbound Warehouse Handling Time} = \text{Planned Shipment Date}$$

$$\text{Planned Shipment Date} + \text{Shipping Time} = \text{Planned Delivery Date}$$

Combined invoicing. In a supply chain, enterprise intend to place large orders in order to get the benefit of the
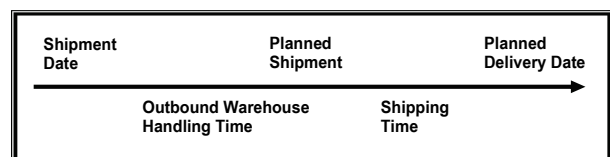

Fig. 4. Timeline from item in inventory to item being delivered to customer
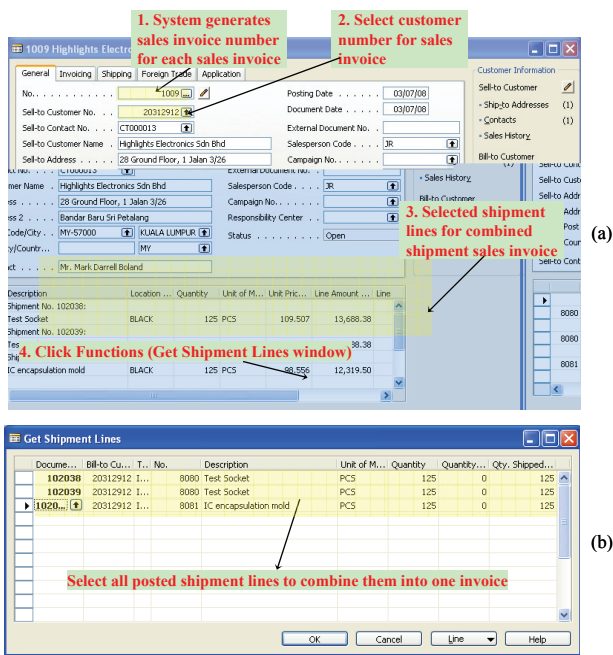
Fig. 5. Invoicing process for combined shipments

economic of scale in purchasing but prefer to receive an order in several deliveries so as to better manage inventory and efficiently schedule production. In MAE, Microsoft Dynamics NAV can split the shipping for the same order and combine several shipments into one invoice to improve efficiency. Figures 5 (a) and (b) show the invoicing process of combined shipments.

4.3.2 Warehousing

The warehouse management module provides a solution for MAE to improve efficiency and to shorten handling times. It allows items to be easily tracked with respect to the basic warehousing handling activities such as receiving, putting away, picking and shipping. Furthermore, this module can accommodate the increasing complexities in warehousing activities caused by, e.g., the expansion and progress of MAE.

Receiving and putting away. With the warehouse management module, in their daily receiving and putting away activities, MAE posts the delivery documents as received. In other words, receiving and putting away is combined in one step by posting the corresponding documents as received. It thus helps MAE minimize the paper work. Moreover, all actions will be recorded in the system such that the buyer can check the delivery status. After receiving an order, the system updates the corresponding inventory records, and the items are identified as available to use after being putting away into appropriate bins. The improved process of receiving and putting away inventory items within the warehouse management module is generalized as follows. (a) A purchase order (PO) is created in the warehouse management module for the replenishment of inventory items. (b) When the PO is released, it serves as a signal to the warehouse that the order is complete and the vendor is ready to deliver it. (c)Once the shipment arrives at the

warehouse, the warehouse staff checks the accompanying delivery documents to determine the PO that the shipment belongs to so as to perform the corresponding receiving and putting away activities. (d)To confirm that the shipment has been received, the warehouse staff will post the order as received. (e)As a result of posting the receiving and registering the put-away, the system has 1) run the Receive function for items received and updated inventory; 2) created a warehouse register to record the put-away information for the bins involved; and 3) updated the contents of the corresponding bins.

Picking and shipping. Users can pick and ship an order by directly registering the picking information on the order line. This meant that when a salesperson creates the sales order, the warehouse management module automatically fills in the corresponding bin information on the order line. When the shipment date arrives, the warehouse staff uses the specified bin code on the order to find the item to pick up. Once the order is posted as shipped, the module automatically posts the picking information such that the bin contents reflect that the items have been taken out from the bins. This module also provides warehouse entries to record the picking activities.

4.4. Analysis of ERP Implementation

The entire ERP implementation life-cycle in MAE lasts for one and a half years starting from the project analysis to the post-implementation. The return on investment is longer than expected due to the lack of experience and knowledge on ERP systems. In addition, it took MAE several months to experience the benefits resulting from ERP implementation. Implementing ERP, in general, contributes to MAE's business performance improvement, as commented by the ERP project manager: *"The implementation of ERP system and the standardization of company's business processes has brought about a raft of improvements that have influenced management quality, cost control and customer satisfaction."*

During the initial stage of project development, there were too many definitions of the project plans. As a result, without a cohesive strategy at the beginning, the ERP project team had to return to the previous phase to modify the workflow. The iterative process resulted in costly effects, delays, frustration and low morale which may in turn affected the entire business operation. The ERP project was able to get back on track when a controlled planning and monitoring system was established and project manager have more interaction with ERP Consultancy Company. One of the factor that lead to project delay is resistance to use ERP system because employees were afraid to make any errors as one single error can have significant effects on the accuracy of the data. Consequently, employees became resistant to the ERP system. Nevertheless, with the support of top management and successful change management approach, the employees quickly adapted to the system and supported its implementation.

Although implementing ERP presented a major change to MAE, especially from employing a legacy system to ERP system, MAE was able to tide over all their pitfalls and enjoy the benefits of a successful ERP implementation. MAE has transformed to hold a much stronger competitive position in the global microelectronics market.

5. Conclusion

This study is to examine how ERP implementation can transform the business processes of an enterprise. A case study was carried out and, the results of ERP implementation in the case company favored the company's mission. Significant improvements have been experienced after implementing an ERP system. More specifically, it is found that implementing ERP systems involves more than just the technical aspect. The crucial phase is the analysis and planning stage where the management aspects of ERP system implementation are considered. This has been proved to be vital by the high failure rate of ERP implementation where enterprises lacked strategy and tactic. In this paper, we elucidate how ERP transforms sale and purchase workflow of an organization. Our research also has implication for the practice about ERP implementation. Through descriptive case study approach, the strategic enterprise information model has been come out to link strategic vision to operations. It is recommended for the researcher to utilize the innovative information technologies to create value for customers by extending their ERP system functionalities with customer relationship management techniques to provide ultimate customer satisfaction. Further research on data mining, particularly relating to the synergetic combination with advance data analysis technology, is needed to disseminate the corporate knowledge.

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