# Process mapping in successful ERP implementations

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**Abstract**

This paper discusses the six core business processes and supporting technology that are impacted by an enterprise resource planning (ERP) implementation. It begins with a brief history of the evolution of ERP and the information systems technology that enabled its development. A discussion of project implementation team preparations is followed by a description of process mapping and its significance to the success of an ERP implementation. Highlights of "As-Is" and "To-Be" process mapping and change management conclude the paper.

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## Introduction

The current evolution of operational planning tools has combined the traditional planning and control functions with all of the other business functions to create an overall enterprise planning system. These enterprise resource planning (ERP) system implementations typically require several modules to be implemented and integrated into the business. There are several different implementation strategies available to firms. Many organizations have struggled with these ERP implementations and have not achieved the efficiencies and cost savings as originally planned.

This paper describes the six key business processes defined by an organization implementing an ERP system. In consideration of the implementation options and the common challenges faced, this organization focused on process mapping to guide it through its implementation of its ERP system.

A multinational high technology company being spun off from a parent company accelerated its separation from the parent using a "Phased Big Bang" ERP implementation approach. The successful implementation resulted in a reduction in the total number of information systems applications from approximately 2,000 to just three systems in less than two years. Although the implementation cost was substantial, the firm received a payback of its ERP investment in less than 18 months.

## Enterprise resource planning systems

ERP is the current evolution of a progression of planning tools that began when computers were applied to materials planning for production. The bill of materials processor enabled communication between previously disparate groups into a single entity with a common understanding of the product to be produced. It brought engineering into the picture as being responsible for maintaining the parent child structure, the quantity per unit, and the units of measure. This information was shared with production so that they could use a typewriter to complete requisitions for purchasing to acquire the materials needed for the product transformation

The company's Project Planning documents are the source for the definitions and descriptions of the Key Business Flows described in this paper. The authors' sincere appreciation goes to this company's Project Team in the thoroughness of its preparation and ability to respond to unexpected events.

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process. Accounting and purchasing worked together via interoffice mail and multiple colored paper carbon copies to insure that the process progressed efficiently.

And so it came to pass in the fullness of time that an organization created the first materials requirements planning (MRP) system (circa 1965). This invention allowed the input of planning data from multiple parts of the organization to be combined into a consolidated picture of all production time-phased requirements. It included a particularly important data element: lead-time. With the inclusion of lead-time, master planning could effectively begin to communicate with marketing to reduce costs, reduce waste, and improve customer service by enabling the automation of the available-to-promise function.

Over many years, more and more manufacturing related systems were added to this core MRP. So the son of MRP was created, called MRPII (manufacturing resource planning) (circa 1980). This innovation combined accounting activities, such as standard costing, to be automatically created using the product structure system. It allowed production's expediting of critical orders to be linked to the planning part of the system in order to re-prioritize the work on the floor. Most importantly for those very long lead-time items, it allowed the reporting of reduced lot yields due to scrap or quality failure while the work was still in progress and reported this at each work center. This innovation allowed planners to pull in existing planned orders to avoid shortages and once again improve customer service.

And now for the latest evolution of tactical operational planning systems – ERP. ERP takes the functions of operational planning and control and combines them with all of the other business functions to create a synergistic knowledge-based management environment (Langenwalter, 2000). What are the advantages of this latest evolution of this business management tool? Further improved customer satisfaction, improved profits, reduced costs, improved quality, improved morale of employees and faster time to market for new products (Rao, 2000).

How is all of this possible? Standardization of business processes and electronically connecting all the functions in the business into, in effect, a real-time data warehouse. Each manager and employee can get the latest information on any aspect of the product, customer or supplier relationship. This allows faster information based decision-making and the improved capability of reducing costs and improving quality. One of the newer modules in ERP systems is customer relationship management (CRM). CRM creates a window into the customer's interactions with the business. It consolidates the customer's interactions from the inquiry, to purchase, to after-sales support; from the highest volume purchasers to the customers who are never satisfied with the product they purchased. All of this information is now available to improve marketing, product development, and production planning.

## ERP technology foundation

ERP does not come without a price. That price includes, in most cases, an extensive IT (information technology) infrastructure. Because most of the transactions are near real-time, a reliable Intranet or local area network/wide area network (LAN/WAN) needs to be in place. The discipline of each person entering data or status information into the ERP system is critical. Each piece of data must be entered immediately upon its availability to maintain system integrity (Vosburg and Anil, 2001). In addition to the communications backbone (LAN/WAN), PC workstations and printers need to be available to all employees that need to access or enter information or require hardcopy output (Langenwalter, 2000). Of course the selection of an ERP software package and the number and availability of resources, will ultimately determine how long and how much it will cost to implement

ERP projects can take from six months to several years to complete. During this time the IT infrastructure and ERP software itself will evolve. Firms should expect to do a technology roll about every 24-36 months. What is a technology roll? According to Moore's law, CPU processing power will either double in performance or its cost will be cut by one-half approximately every 18 months. By the time 36 months have passed, the technology has become so much less expensive for the same or more performance, that it is cheaper to replace it, due to maintenance costs, than to retain the old technology.

ERP software functionality will usually be available in incremental changes approximately every six months. What does this mean? The implementation project team's job, although diminished after the initial deployment, is really never finished. As new software releases become available business processes should be evaluated to determine if they should be implemented. People who are knowledgeable about the current systems and the strategic and tactical direction of the business are best suited to this task.

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## The six core business processes in ERP

The firm used as a basis of the following discussion is a high technology, publicly traded company. It has approximately 30,000 employees around the world and annual sales in the $5 billion range. Manufacturing takes place on almost every major continent and there are over 50 sales offices worldwide. The company makes a variety of electronic devices that are used in almost every industry.

According to the way this organization viewed their ERP implementation, there are six key business processes: quote to cash; procure to pay; plan to perform; manufacturing operations; product life cycle; and financial management (Figure 1). The sequence that is described assumes that there is an ongoing business and the organization is most effective when planning is done in a closed loop process that maximizes the organization's strategic and tactical objectives. In this firm's case the strategic objectives are defined by the Hoshin planning and monitoring process.

### Quote to cash

Quote-to-Cash includes the steps required to participate in the marketplace. These steps include the following:

- begin with the identification of qualified customers with needs;
- apply company's products to address the needs; and
- conclude with customer payment for these goods and services.

There are two major variants to this key business factor (KBF):

- Internal Orders, where the "Quote" is an Inter-Company Agreement (ICA) and the "Cash" is a financial transfer between organizations; or
- Vendor Managed Inventory (VMI), where the "Quote" is an agreement to automatically supply products or components to a customer under certain pre-defined conditions and "Cash" is the automated billing associated with those deliveries.

### Procure to pay

Procure to Pay includes functions associated with procurement of, and payment for, all materials required by the Order Fulfillment process. There is one major variant to this KBF: supplier managed inventory (SMI) where the "Procure" is a negotiated agreement to automatically supply the company with specified products or components under certain conditions and the "Pay" is the automated payment associated with the receipt of those materials.

### Plan to perform

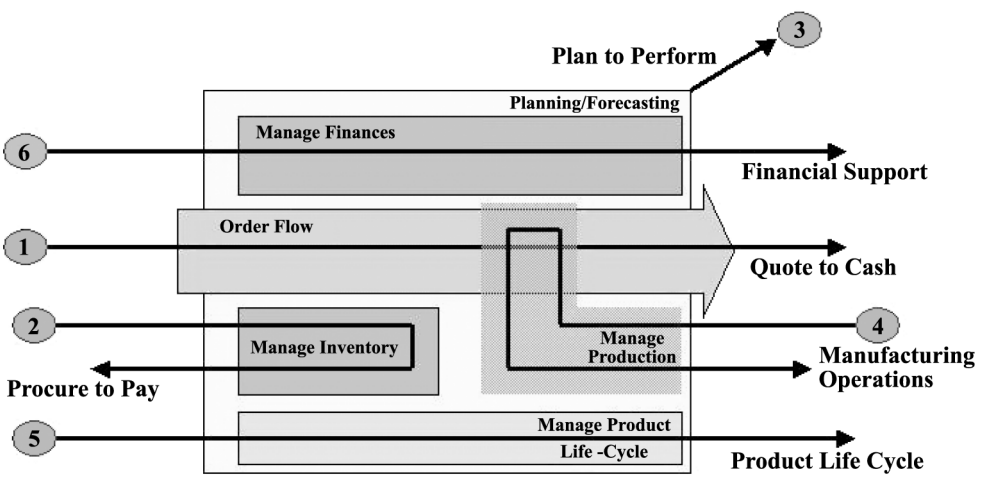
Plan to Perform includes the planning processes associated with demand prediction and associated resource requirements (facilities, personnel, and raw materials). Financial support includes activities required to do the following in all countries where the company has a presence:

- supply management with financial status and performance data; and
- meet statutory and regulatory requirement of various governments and investors.

### Manufacturing operations

Manufacturing operations begins with the receipt of customer orders and ends with the products packaged for delivery to the customer. There are three major manufacturing processes to

**Figure 1** Key business flows



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accommodate production of different classes of products: discrete, lot-based, and flow.

**Product life cycle**
Product life cycle includes management from conception to obsolescence, including product revisions and upgrades. The primary repository is called the product data management system it is the beginning and end of the data needed for the supply chain. In this process the part numbers, product structures, options, warranty period, and initial suppliers are identified. This information is used for purchasing, manufacturing, and sales to do forecasting and budgeting in all areas impacted by new products. At the end of the product life cycle product structures and components are made obsolete.

**Financial management**
Financial management includes all regulatory reporting. Sub-processes include: accounts receivable; accounts payable; general ledger; and fixed assets. Also activities related to tax reporting, shareholder relations, intellectual property and Sarbanes-Oxley compliance reporting are located in this process flow.

## ERP project team preparation

**Implementation process**
In general there are three basic approaches to implementation: Pilot, Parallel, and Big Bang. In the Pilot implementation, a specific functional area is implemented first. This can be across all facilities in a multi-plant environment. The idea is to prioritize the functional areas and implement them in the order that provides the most benefit first. This requires a great deal of interface programming to maintain the data flows between the legacy system and the new module being implemented. It is also the lowest risk alternative. If the pilot implementation technique is the least risk, it also takes the most time as each module is rolled out.

A second alternative is a Parallel implementation. Some ERP suppliers prefer this method since the issue of data integrity and migration are, for the most part, avoided (Xu *et al.*, 2002). Data integrity is the process of evaluation and cleanup of data prior to migration into the new system. It is the same old story "GIGO" (Garbage In, Garbage Out). However, this method requires extraordinary effort from employees since each transaction must be entered into the existing system and then into the new system. If the employee is interrupted transactions may be entered into one system, but not the other causing all kinds of "fun" looking for the cause of the variance in the data. This is a moderate risk alternative.

The last of the three implementation approaches is the Big bang! Why is it called this? Its name is derived from the process taken to implement the new ERP system. A firm prepares, tests, trains, does everything possible to get ready, and then over a weekend or a few days the data in the old system is migrated to the new one. On Monday morning everyone in the company starts using the new system and the old one is simultaneously turned off. This is the most risky alternative. There will always be unforeseen and unexpected events. Several famous companies have been caught in this trap. Mostly high technology companies that thought it could not happen to them, found that it could.

A variation on the Big Bang approach is to combine it with a phased approach. This entails a series of "mini-bangs" that effect a logical portion of the business. One example uses a division-by-division approach where each one uses a Big Bang to migrate to the new ERP system. A second example might use a functional approach, however this requires interfacing while both systems are running their parts of the company, i.e. finance goes first with the new system across all divisions at one time, followed by manufacturing and customer support.

**Scope creep**
One of the biggest challenges of implementing an ERP system is the desire for the business to retain its existing processes and modify the software to match the business. Considering the complexity of the software, future updates, and enhancements that may not be implementable without significant costs for reprogramming. It is by far faster, less expensive, and more productive to utilize the ERP systems standard business process flows. The most common incidence of scope creep in an ERP implementation is adaptation to existing processes, rather than adopting the pre-defined ERP business processes that come with the software package.

**Change management**
An often-overlooked aspect of ERP implementations is the effect that the new system will have on employees and other stakeholders, e.g. customers and suppliers. Change management is the human side of the ERP implementation. With constant, honest communication via a variety of media, stakeholders and employees are kept informed of the status of the ERP project and what it will mean to them personally. A variety of assessment tools

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are available to gauge how well a new ERP system will be received. If there are pockets within the organization that show low change capability, then special programs need to be designed to get these people through the difficult period of transition from the old system to the new one.

## Process mapping

Process mapping is similar to flow-charting for a traditional computer program. However, in the case of a business process map the participants in the process are usually identified as well. This is done using a more hierarchical approach and a perspective for the model that is not found in the computer program flow chart. There are three major phases in process mapping and consequently business process reengineering: creating the "As-Is" model, creating the "To-Be" model, and "Bridging the Chasm," or in other words, getting from the here and now to the future state.

### As-Is

The As-Is process model can be developed in a number of ways. The fastest way to do this is with a multiple step process. First, gather all the key participants in the same room (ask them to bring copies of all the documents and system screens used in the process). Second, unroll a large sheet of brown paper around the room. Third, tape all the documents in the agreed sequence from beginning to end on the brown paper. Fourth, draw lines to connect all the documents together and annotate with cycle time and the specific individuals and organizations responsible for the completion of that work task. Repeat for each process that is performed in the business. This activity should typically be completed within two to four weeks. This time limit will force the issue of how deep to go into the layers of the As-Is process and cause you to focus on the most important or largest areas of concern (Ridgman, 1996).

Why do an As-Is model at all? Sometimes processes have evolved to solve a problem with a particular customer, employee, or manager. Understanding why the process is performed in a particular way will permit the elimination of non-value added work during the last phase of process mapping, the process simplification phase.

An example of an As-Is process would be how a customer's order is processed. A typical order would be somehow communicated to the company via phone, fax or electronically (e-mail or EDI). It would then go to credit verification, assuming all is well; it would then go to the warehouse for picking and shipment. Variations on this process would include any changes for new customers (e.g. more detailed credit checking) or new products being ordered (e.g. may not have enough in stock). This would be considered a sub-process of the "Quote to Cash" process.

### To-Be

In creating the To-Be process, the first thing that must be done is to evaluate what processes are critical to the business (Zhang, 2002). They must have a strategic impact and be customer focused to qualify for the top of the list. An idealized process with no constraints is created in the first part of the exercise for each critical process. The next step can be conducted in three ways. The first alternative is to modify the idealized process for future or current constraints, investment funds usually being the biggest constraint in this area, followed by human resources capabilities. The second alternative is to bring in some of the ERP vendors and have them explain how their system can accommodate the idealized To-Be process or how they would solve it using their system. A third technique, which is also a best practice, says to simplify first before you automate a process. Eliminate non-value added steps; those that the customer is not willing to pay for.

An example of the To-Be process would be where the customer enters their own order via a Web site with online credit checking, then transmitted to the warehouse closest to the customer for shipment. This eliminates delays and reduces the company's costs to process the order. A possible modification to this process might be for a very large order, where special credit arrangements need to be made prior to shipment.

### Bridging the chasm

Moving from today's As-Is to the future To-Be process, the first item to address in this phase is creating a change management program. With proper communications, the usually radical transition from the As-Is to the To-Be process can be somewhat mitigated in the sense that there will be a productivity dip as everyone takes time to get used to the new process and some of the initial kinks are ironed out. Examples abound of organizations coming to a full stop when their well-tested ERP implementation caused an unexpected problem that takes several days or weeks to resolve. Depending upon the implementation strategy chosen crossing the chasm from here to the future can be an enjoyable experience or an unpleasant disaster for those involved.

The second item to address in this phase is the creation of teams to actually implement the new process. These teams would be responsible for

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training, software customization, testing, data quality, and other aspects of using the new process.

**Locking in new process savings**

One of the most interesting aspects of process engineering is the dynamics of the organization to erode the improvements from the new process. For example, as new employees are hired, they are not adequately trained or disciplined in why the process must be followed as designed. Since they were not involved with the design of the process they may elect to do the work in a way that optimizes their particular situation (work environment) and sub-optimizes the entire process. The most successful way of retaining the benefits of process engineering is to support them with a continuous improvement program that forces small, but constant improvement, to the new process. This should continue until the next process review.

A process engineering review should be scheduled either every three to five years or when a significant change in the environment occurs. Moore's law indicates that technology is improving significantly about every 18 months. In 36 months that technology improvement has now occurred two times. The opportunity to take advantage of technology to revise the process should be considered at this point or soon thereafter to determine if the new technology is more cost-effective or if the process can be substantially reengineered due to the new technology available. Second, a significant change in the environment may be because the product, customers, employee skills, regulations or other factors may make the process obsolete or cause it to now be less effective than when it was last designed.

## Conclusion

ERP is the culmination of 40 years of improving systems to plan, procure, and produce products more effectively. Because ERP systems are so comprehensive, suggested business processes are pre-defined. The company described in this paper selected five core processes to focus on for a successful implementation.

The organization studied used a "phased Big Bang" approach to accelerate the spin-off from its parent company. This resulted in several areas of cost savings. First, it eliminated payments to the former parent company for maintaining its existing systems around the world. Secondly, it reduced the total number of systems applications from approximately 2,000 to just three in less than two years. Although the initial implementation cost was substantial, the firm achieved a payback in less than 18 months. In a period on economic uncertainty for high technology firms, the ERP investment made a signification contribution to cost reduction.

The six processes included by the firm were: quote to cash; procure to pay; manufacturing operations; product life cycle; plan to perform and financial management. These processes can be adapted to most business environments using process mapping. The As-Is processes are how the business is currently being run. The "To-Be" Processes are how the business would run under ideal conditions. The roadmap to move from the "As-Is" to the "To-Be" can be considered bridging a chasm. During the process of implementation the need for change management becomes readily apparent. Change management will allow the organization to recognize that there are significant human barriers to overcome and that regular communications is a potent tool to keep everyone aligned on what is happening and what will happen in the future. After the implementation is completed, a program of continuous improvement must be implemented to lock in the benefits of the new processes as employees turnover and as new techniques or technologies are discovered to further improve the processes.

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