



Enterprise Resource Planning (ERP)

Technology Note

Elizabeth Benson, purchasing manager for Tristen, Inc., hung up the phone and turned quickly to her desktop computer. She had just received word of a fire in a manufacturing plant belonging to a key vendor. The vendor provided Tristen, a tier-one automotive supplier, with a number of resins used to manufacture plastic parts that went into the dashboard assemblies Tristen sold to auto manufacturers. Fire had damaged the process for making a key resin. The vendor was calling to alert Benson and to offer whatever assistance it could in allocating the now scarce resin supply.

Both Benson and the vendor knew that if the situation was not dealt with quickly both Tristen's and their auto manufacturing customer's lines would soon shut down for lack of parts. Losses would mount by the hundreds-of-thousands of dollars per hour. Fast action was needed.

Benson's first move was to generate an on-line report of resin inventory across all of Tristen's raw materials warehouses. This allowed her to assess where shortages were most likely to occur. Next she called up the manufacturing forecast for the next several days to analyze where product would be needed and when. Using this information Benson generated materials movement requests to reallocate the resin across the organization. She also transmitted purchase order revisions to the vendor in order to reroute incoming resin shipments to appropriate locations.

No matter how good a job Tristen did in reallocating its own inventory, the battle would still be lost if the company's other vendors ran out and were unable to supply Tristen with needed sub-components. By running a "where-used" report across the Bills-of-Materials for all the sub-components in the item database, Benson was able to generate a list of vendors that needed notification of the impending shortage. Checking again with the production plan Benson forecast each affected vendor's resin needs so that appropriate supplies could be sent.

Research Associate Cedric X. Escalle and Doctoral Student Mark J. Cotteleer prepared this note under the supervision of Professor Robert D. Austin as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Still facing a shortage, Benson's final step was to search the item database for alternative materials that could be used. Checking these alternatives against a list of approved vendors yielded several supply combinations. A quick cost rollup calculation allowed for vendor selection and the generation of a series of purchase orders for immediate EDI transmission to the new sources.

Three hours after she had begun Benson rested. In that short time she had managed to avert a disastrous plant shutdown, both for Tristen and its customers. Savings potentially ran into the millions of dollars. Benson thought about how only a year ago such a feat would have been impossible. In the course of an afternoon she had processed information from Procurement, Engineering, Inventory Management, Finance, and Manufacturing. Without the high levels of integration and standardization offered by Tristen's new information systems, days or weeks would have passed before they could have acted as they did. More likely, they would not have been able to act at all.

The above is a hypothetical example of the capabilities that an Enterprise Resource Planning (ERP) system can provide to a company. ERP, when successfully implemented, links financial, manufacturing, human resources, distribution, and order management systems into a tightly integrated single system with shared data and visibility across the business. Potential benefits can include breakthrough reductions in working capital, huge bounties of information about customer wants and needs, and—perhaps most important—the ability to view and manage the extended enterprise of suppliers, alliances, and customers as an integrated whole (see **Exhibit 1** for a sample ERP “footprint”).

ERP systems are expensive, complex, and notoriously difficult to implement. Systems integrators with expertise in ERP implementation are usually brought in to help with installation of the software. Total implementation cost (including software, hardware, consulting, and internal personnel) can run as high as two or three percent of a company's revenues (e.g., \$100 million for a \$5 billion company).

Industry Background

ERP has its roots in Europe and in the manufacturing industry. In 1979 the German-based company SAP (short for “Systeme, Anwendungen, und Produkte in Datenverarbeitung” or “systems, applications, and products in data processing”) released R/2, an early version of ERP software. R/2 was a mainframe-based software package that integrated financial and operational data into a single database, with the goal of significantly reducing the effort invested in managing data entry and paperwork. SAP met with major success and by 1994, when SAP released its next generation software known as R/3, the company had an installed base of over 1,400 systems. The release of R/3 marked a shift in technology platforms from mainframe to the increasingly popular UNIX-based client-server architectures.

In 1994, SAP's competitors also grew. Companies such as Oracle, Baan, and Peoplesoft, were taking aggressive steps toward seizing some of this new and lucrative market. By the end of 1994 the estimated ERP market size was \$2.9 billion. Over sixty percent of ERP sales were accounted for by Fortune 500 companies. The top 10 ERP vendors accounted for nearly 85 percent of the market.

In the years that followed, companies began to pour billions into ERP implementation. By the late 1990s, industry prognosticators were forecasting that the ERP market would sustain an

industry growth rate of 30 to 40 percent, and that the market would exceed \$50 billion by 2002.¹ At the end of 1998, five firms held 64% of the market (listed in order of ERP revenues): SAP, Oracle, PeopleSoft, Baan, and J.D. Edwards (see **Exhibit 2** for more detailed information on market share, revenue, and number of employees). SAP remained the industry leader and, with revenues approaching \$5 billion, had positioned itself as the fourth largest software company in the world.²

Implementation of ERP is more costly (by a factor of three to ten, depending on the target company) than the product itself. Consultants and systems integrators have moved aggressively into the implementation market.³ Implementation costs are driven by a variety of factors including an extreme shortage of personnel with ERP software experience, the heavy reengineering focus traditionally adopted by implementing companies, and the need for implementing companies to replace huge percentages of their existing information technology architecture in order to support ERP.

Firm's Experiences with ERP Implementation

A survey conducted at the Harvard Business School in 1998 revealed that a large percentage of executives felt it was at least moderately likely that:

- 1) ERP technology could not support their businesses;
- 2) That their organization could not make changes needed to extract benefits from the new systems;
- 3) That ERP implementation might actually damage their business.

The same survey revealed that many implementing companies had overrun cost and schedule targets and underachieved relative to their expectations on benefits.⁵

Despite the reservations about ERP, most companies surveyed were going ahead with ERP initiatives. The most popular reasons cited by respondents included a desire to standardize and improve processes, to improve the level of systems integration, and to improve IT responsiveness and information quality. Another oft-cited driver of ERP implementation was the need for the respondent's

Foxmeyer Drug, a \$5 billion pharmaceutical company, filed for bankruptcy in 1996, arguing that the primary cause of its difficulties was a failed ERP implementation that had crippled the business. Bankruptcy trustees filed suit against Andersen Consulting and SAP seeking to recover damages of \$500 million from each. Andersen had allegedly claimed that Foxmeyer would save \$50 million annually by using SAP's ERP software. Both Andersen and SAP called the suit "preposterous". Trustees claimed that the ERP software "messed up" orders and "could handle no more than 10,000 orders per night" compared to the old system that "could process 420,000 orders".⁴

¹ These estimates include implementation costs.

² It is interesting to note that SAP's competitor Oracle, while lagging in ERP application sales, generated larger overall revenues. At the end of 1998 Oracle was the second largest software company in the world behind Microsoft.

³ The five leaders in the ERP consulting market are Andersen Consulting, Ernst & Young, PriceWaterhouseCoopers, Deloitte & Touche, and IBM Global Services. Each firm's global, ERP-related revenues exceeded \$1 billion in 1998.

⁴ *Drug Store News*, July 20, 1998, page 4.

⁵ "How to Manage ERP Initiatives," Harvard Business School Working Paper, 99-024, Revised October 1998.

companies to resolve “Year-2000” issues and to prepare for the conversion of the European Union’s conversion to a single currency.

There is some evidence that ERP implementations fail at a very high rate. Depending on definitions of “failure,” some have suggested that the rate is greater than 50 percent. There have also been high profile horror stories (see sidebar on Foxmeyer Drug). HBS ERP survey respondents cite user acceptance of process change, budget and schedule overruns, availability of adequate skills, and technical failure as key risks to ERP implementations. Firms continue in their ERP efforts, however, because of the opportunity for substantial reward. In some cases, firms recognize benefits in the tens or hundreds-of-millions of dollars (see sidebar on Cisco Systems, Inc.).

ERP and Business Issues

One of the primary business issue having to do with ERP centers on the question of how much standardization in business process is good for a company. Managers experienced in ERP implementation recommend caution when considering changes to core ERP code. As a result, successful ERP implementation often requires that business processes be changed to meet software functionality. At issue is whether competitive advantage can be gained from a standardized software package when a firm’s competitors also have the opportunity to implement it. In response to this issue, several successful implementers recommend a hybrid approach to implementation in which changes to ERP code are allowed, but only in circumstances where the competitive advantage derived from using non-standard processing is clearly demonstrable. Deciding what constitutes sufficient competitive advantage to justify software modification remains one of the more daunting project management challenges surrounding ERP implementation. Where changes to the software’s code are made, firms face the additional issue of maintaining the ability to upgrade to future releases of the ERP package. Strategies range from maintaining adequate skills and documentation internally to make changes in the future, to encouraging (or in the case of some large or critical clients, demanding) the software vendor to incorporate modifications into future software releases. If changes cannot be incorporated quickly enough, the ERP system can have implications for the flexibility and responsiveness of business operations (see sidebar on Dell Computers).

Cisco Systems, Inc. was able to integrate its ERP systems with key suppliers and to realize its “Single Enterprise” vision for dealing with them. Suppliers use ERP to run their Cisco production lines allowing them to respond to customer demand in real time. Changes in part of the supply-chain are communicated almost instantaneously. For example, if one supplier is running low on a component, Cisco can instantly analyze the entire supply chain for excess supplies elsewhere. Changes in forecasted demand are also communicated in real-time, thus enabling suppliers to immediately respond to requests for materials.

Benefits also accrue in the payment portion of the order-to-payment cycle. Manual processing of an invoice is no longer needed. Payment to suppliers is triggered by a shop-floor transaction in the ERP system indicating that production is complete. The transaction backflushes inventory, figures out the value of components sold by the suppliers and triggers an electronic payment to suppliers, in the process consolidating what were five sequential events into one. Annual benefits from these improvements, and many others, are estimated to run into the tens-of-millions of dollars per year. The ERP solution is also seen to be supporting the rapid growth the company has experienced through its ability to scale and flex with changing business conditions.⁶

⁶ Source: HBS Case #398-127 “Cisco Systems, Inc.”. Also see HBS case #699-022 “Cisco Systems, Inc.: Implementing ERP” and #699-043 “Tektronix Inc.: Implementing ERP” for more information on successful ERP implementation.

Dell Computer's experience illustrates the relative advantages of two approaches to ERP: using a single-vendor vs. a "best-in-breed" strategy. The advantage of a single vendor strategy is that functionality is well integrated and the client company can deal with a single product company in addressing problems and changes. The primary disadvantage of the single vendor approach is that it can limit flexibility.⁸ The advantages and disadvantages of best-in-breed ERP, which involves combining the best packages in specific functional areas from a variety of vendors, mirror those of the single vendor strategy. Best-in-breed potentially offers greater flexibility, but integration and vendor relationships become more complex.

Another business issue that significantly impacts the ease with which ERP can be implemented is the state of a company's old or "legacy" systems. ERP systems generally must integrate with a variety of such legacy systems, and depending on the variety of technologies and the modernity of legacy systems, the ERP-legacy integration task can be very formidable.

In 1994, **Dell Computer** began implementing SAP's R/3 to run its manufacturing operations. At the time, the company was the number three computer maker in the world. Two years later, in 1996, the company abandoned R/3. Terry Kelley, Dell's Chief Information Officer justified the decision by saying: "Over the two years we were working with SAP, our business model changed from a worldwide focus to a segmented regional focus... [SAP] was too monolithic to be altered for changing business needs."

In 1997, the company choose i2 Technologies (a supply chain vendor) to manage raw materials and Oracle for order management. A year later, Dell selected Glovia for manufacturing. "We keep carving out pieces of the puzzle and delivering quicker value than if we were putting in one huge ERP system" said Kelley.⁷

Future Directions

The ERP market at the end of 1998 was experiencing several new trends. As the Fortune 1000 ERP market reached saturation, more and more vendors began targeting the midsize and small companies. To do that, the vendors began to tout cheaper ERP products and faster implementations.

ERP vendors also started to target functional niches such as sales-force automation, customer service, and complex demand planning software. By moving into these functionality niches vendors intended to expand the "footprint" of their product and to enter industries such as financial services where they had not been traditionally strong. Vendors implemented this strategy through acquisitions and by partnering with smaller software firms. For example, in one 12-month period, Baan purchased four sales-force automation software firms.

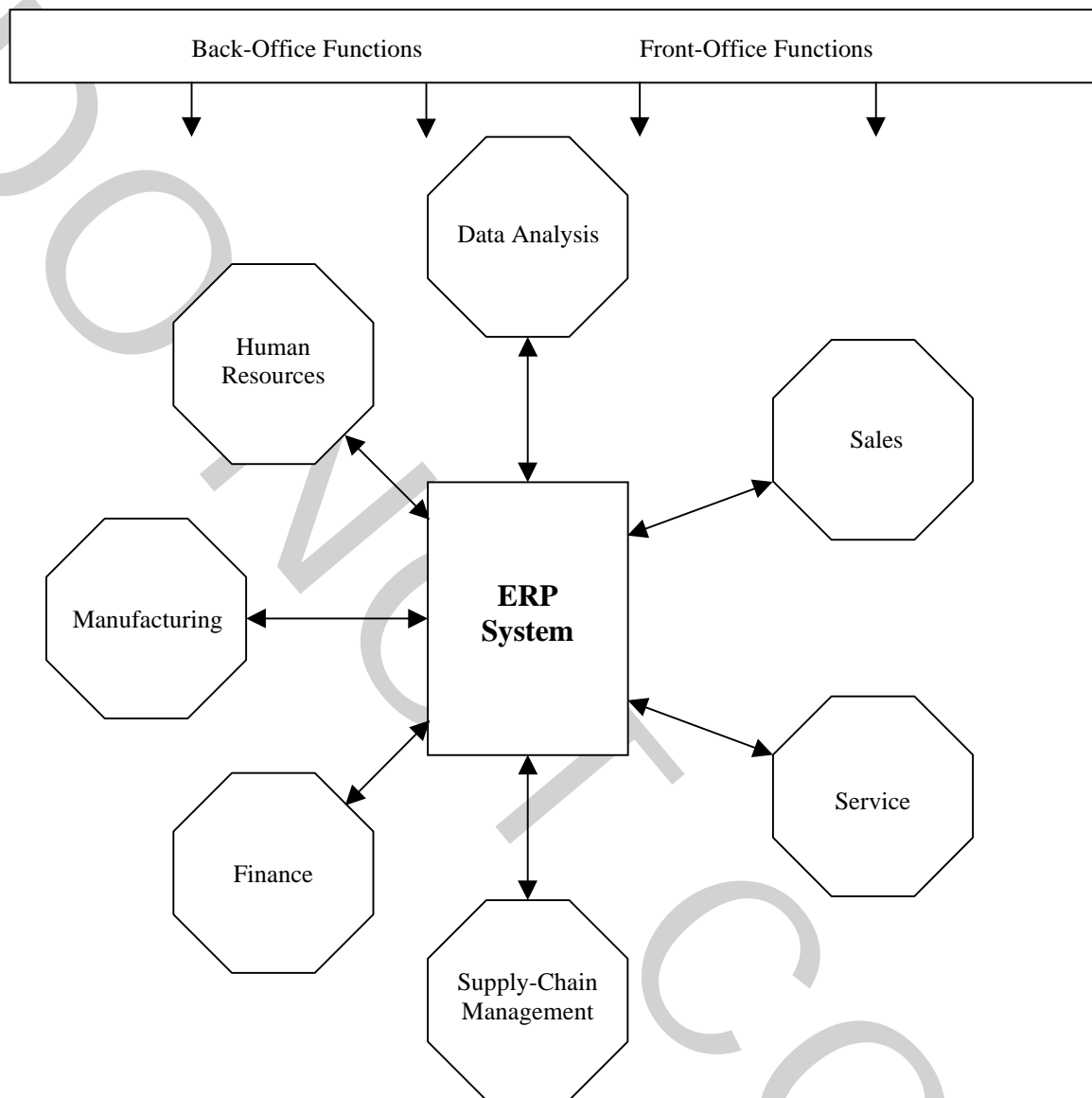
Client company demands were also beginning to lead to product changes. Hot issues in 1999 revolved around making products easier to implement, facilitating implementation of smaller pieces of functionality, and promoting the ability to upgrade by module rather than by entire application.

⁷ *InformationWeek*, May 11, 1998.

⁸ In the HBS ERP survey, 58 percent of respondents indicated that their companies had adopted a single vendor strategy.

Conclusion

ERP systems have the potential to significantly enhance the performance of many companies' operations. In order to obtain value and avoid serious difficulty, however, firms need to solve the ERP implementation problem. The peculiar characteristics of ERP as an organizational initiative bring to mind the words of Fredrich Nietzsche: "That which does not kill me makes me stronger." ERP has the potential to make a company very much stronger (as it did with Cisco Systems). As the Foxmeyer Drug story allegedly illustrates, it also has the potential to kill a company

Exhibit 1 ERP Footprint

Source: Information in this exhibit is compiled from Putting the Enterprise into the Enterprise System, by Thomas Davenport, *Harvard Business Review*, July-August 1998, page 124; and ERP: The Next Stage, *Computer World*, September 14, 1998, page 63.

Exhibit 2 Profile of leading ERP companies

Company (1997 data)	Sales (in \$ millions)	Market Share	Employees
SAP	3,461.2	30%	12,856
Oracle*	5,684.3	10%	29,431
PeopleSoft	815.7	7%	4,452
Baan	679.6	6%	4,254
J.D. Edwards	647.8	9%	3,577

Source: Companies' 10ks and annual reports; *Red Herring*, August 1998, page 67.

Note: * Numbers are for Oracle as a whole.