

# The Development of Enterprise Resource Planning Systems

## Introduction

- Increasing the efficiency of information systems can result in more efficient business processes, making a company more competitive
- Integrating information systems across functional areas is a relatively recent phenomenon
- Lack of integration can lead to costly inefficiencies
  - Errors from keying in the same data more than once
  - Lack of timely data due to periodic updating between systems
  - Problems with data being defined differently in different systems

## Introduction

- ERP systems can integrate a company's operations by providing a company-wide computing environment that:
  - Includes a single database shared by all functions
  - Can deliver consistent data to all business functions in real-time
- ERP systems can dramatically reduce costs and increase operational efficiency
- With ERP, IBM Storage Systems division
  - Reprices inventory in 5 minutes instead of 5 days
  - Ships a replacement part in 3 days instead of 22
  - Checks customer credit in 3 seconds instead of 20 minutes

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## Evolution of Information Systems

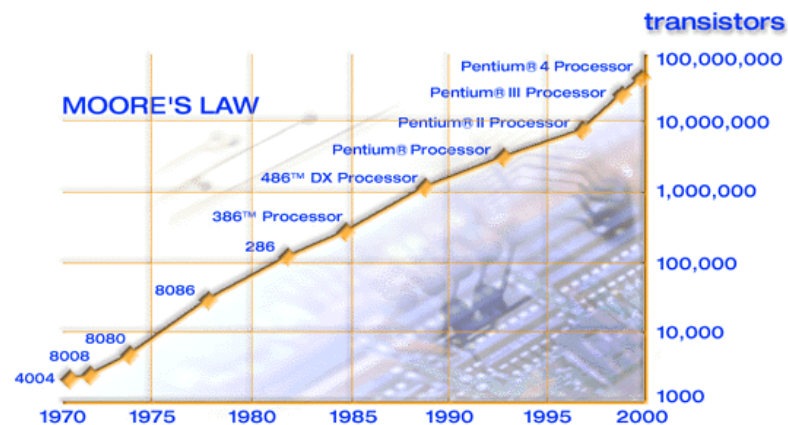
- Using integrated software to manage all functional areas of a business seems obvious today, but it was not technically feasible until the 1990s
- Three factors contributed to the development of ERP systems:
  - Advancement of computer hardware and software
    - Computing power, memory and communications
  - Development of a vision of integrated information systems
  - Reengineering of companies to shift from a functional focus to a managerial focus

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# Computer Hardware and Software

- Computer hardware continues to get smaller, cheaper and faster
- Gordon Moore, an Intel employee, noted that the number of transistors on a computer chip, and thus its power, doubled every 18 months
  - This trend in computing power has continued to this day
- The power of today's computers has made the hardware required for ERP systems affordable
- Moore's observation is now known as Moore's Law

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**Figure 2-1** The actual increase in transistors on a chip approximates Moore's Law  
*Courtesy of Intel Corporation*

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## Computer Hardware and Software

- Computer systems began as mainframe computers
  - One large computer shared by many users who communicated with the system by paper-punched cards or paper tapes
  - Terminals—primarily a monitor and keyboard with no computing capability—were later used to communicate with the mainframe computer
- The personal computer (PC) allowed individuals more control over their computing
- Unique applications like word processing, spreadsheets and presentation software were developed for the PC
- Sharing expensive peripheral equipment led to the development of computer networks

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## Computer Hardware and Software

- Sharing and managing important corporate data became an even more important issue as PCs became more common
- **Client-server** systems were developed to manage data sharing. A central computer (**server**) managed the storage and sharing of common data
- Client-server systems provided **scalability**. The capacity of the network could be increased inexpensively by adding a new server computer to the existing network
- Mainframe systems were generally not scalable. Increasing capacity meant buying a new system
- Client-server systems are much more cost effective over the long run

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## Computer Hardware and Software

- A common database is a key component of an ERP system
- Relational database systems were introduced in the 1970s
  - These systems allowed for more efficient storage and retrieval of data
  - To support ERP systems, relational databases needed to be able to find specific data quickly from a large, complex database
- By the 1990s, the hardware, networks and database software were in place to make large scale ERP systems feasible

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## Manufacturing Roots of ERP

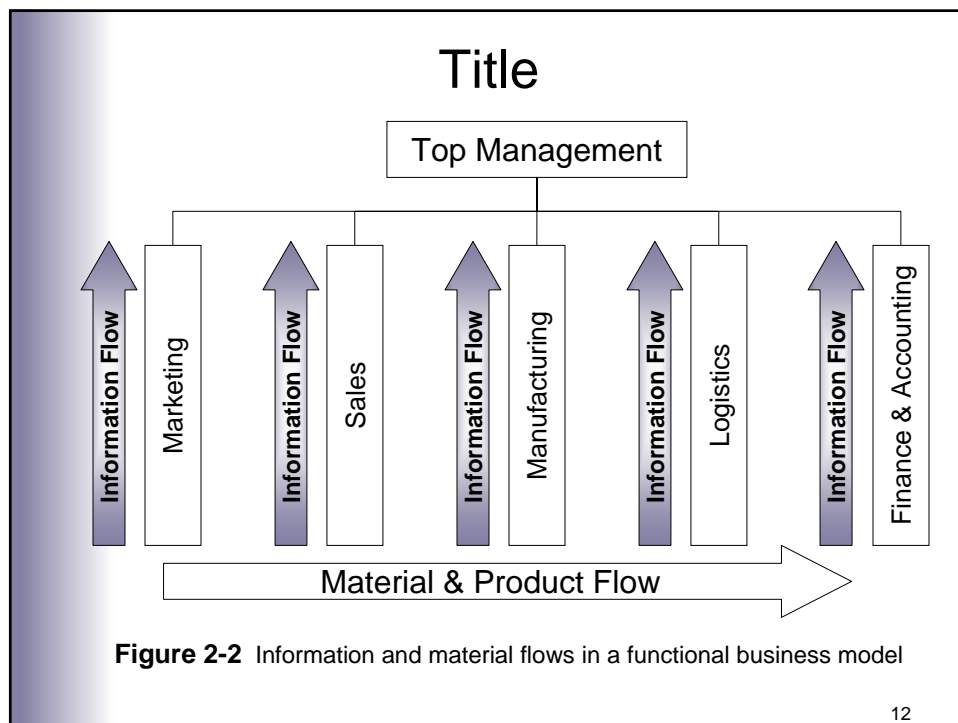
- Materials Requirements Planning (MRP) software was developed in the 1960s and '70s
- MRP software allowed firms to start with a sales forecast and develop production and raw material plans
  - For companies with many products, raw materials and shared production resources, MRP was not possible without a computer
  - Electronic Data Interchange (EDI) allowed a company to communicate its purchase requirements electronically
  - Sharing long-range production schedules between manufacturers and suppliers was the beginning of supply chain management (SCM)

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## Functional Business Model

- Alfred P. Sloan developed the functional organizational model in the 1930s as chairman of General Motors
- The functional model was very successful for decades, but competition in the 1980s highlighted problems with the model:
  - Flexibility and rapid decision-making were not possible
  - Organizations had become overstaffed and top-heavy
  - Ability to respond to change was limited

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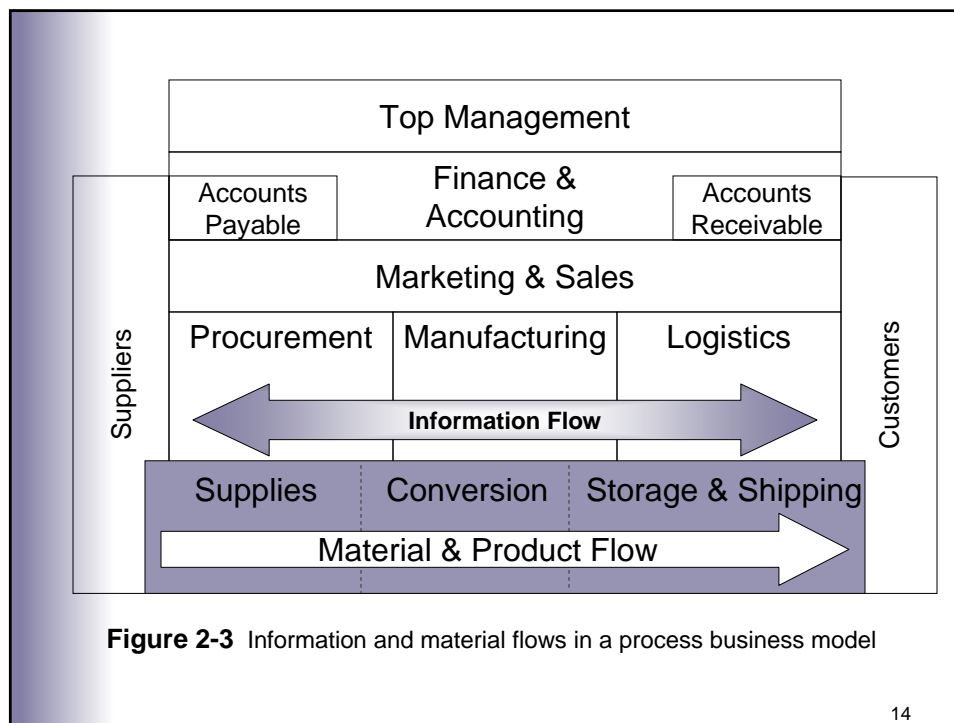


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## Business Process Model

- In a process-oriented company, the flow of information and management activity are “horizontal”—across functions
- The “horizontal” flow promotes flexibility and rapid decision-making
- Michael Hammer’s *Reengineering the Corporation* encouraged managers to take a “horizontal” business process view of their companies

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# SAP

- *Systemanalyse und Programmentwicklung* (SAP) was formed in Mannheim, Germany, in 1972 by five former IBM systems analysts
- SAP's goal was to develop a standard business software product that could be configured to meet the needs of a company
- SAP's founders wanted
  - Data to be available in real time
  - Users to work on a computer screen, not with paper
- Lofty goals in 1972

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# SAP

- SAP's founders had to develop their first software package at night on their first customer's computer
  - Computers were not commonly available in 1972
- The first software package was referred to by various names, including R, RF and R/1
- Between 1978 and 1982, SAP developed a more integrated software package, called R/2
  - R/2 was still a mainframe computer package
- By 1988, SAP had developed R/2 into an international software program and had sold 1,000 systems

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## SAP R/3

- SAP R/3 was developed from 1988 to 1992
  - R/3 is a client/server software package that could operate on a number of computer systems, including Windows NT and Unix
  - Because it was a client/server system, it could easily be scaled up as a company grew by adding additional computers (servers) to the system
  - R/3 was also an **open architecture** system
    - Allows other software companies to develop compatible products
    - Makes integrating hardware like bar code scanners, PDAs, cell phones, etc., easier

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## Y2K

- Most business software programs written in the 1960s and '70s saved storage space by using only 2 digits to store the year
  - For example, 10/29/75 rather than 10/29/1975
- With dates after 12/31/99, computer calculations were likely to be in error
  - 10/29/2001 might be interpreted as 10/29/1901 by a program that only stored the date as 10/29/01
- Companies faced a choice as the new millennium approached:
  - Rewrite old software to store year data correctly
  - Use problem as an opportunity to upgrade to ERP

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## Y2K

- The Y2K problem created explosive sales growth for Y2K-compliant ERP systems
- This led to a significant shortage of experienced ERP consultants, leading many companies to have problems with their sometimes-rushed implementations
- The high demand for experienced ERP consultants prior to Y2K was followed by an abrupt drop off by the middle of 1999
  - By middle 1999, companies had decided how they were going to handle the Y2K problem, so new ERP sales dropped significantly

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## ERP Vendors

- Consolidation is currently taking place in the ERP software business
  - PeopleSoft purchased ERP vendor J.D. Edwards in 2003
  - Oracle, after a long battle, acquired PeopleSoft in 2005
  - SAP and Oracle are now the two largest ERP vendors
  - Microsoft is challenging SAP and Oracle to sell ERP systems to small- and medium-sized businesses

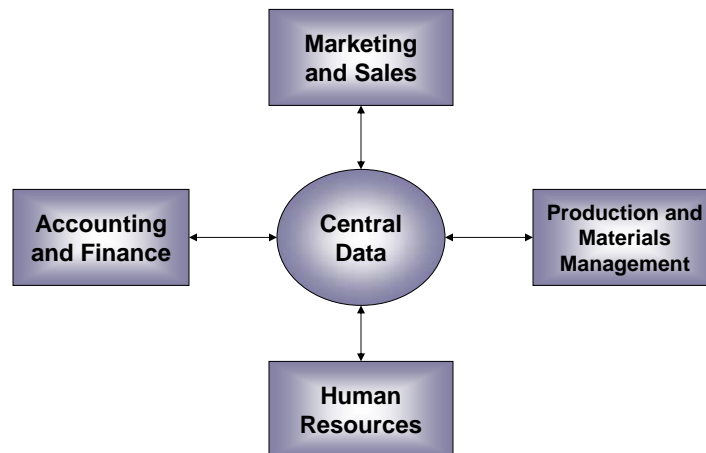
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# SAP R/3 Enterprise

- R/3 Enterprise uses a central database to share data between the primary functional areas of:
  - Marketing and Sales
  - Production and Materials Management
  - Human Resources
  - Accounting and Finance

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## Data Flow between Functional Areas



**Figure 2-4** Data flow within an integrated information system

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## SAP R/3 Modules

- While SAP supports business processes, it is organized around functional modules:
  - The Sales and Distribution (SD) module records sales orders and schedules deliveries
    - Information like pricing, how and where to ship products, how the customer is to be billed, etc. is maintained in this module
  - The Materials Management (MM) module manages
    - The acquisition of raw materials from suppliers (purchasing)
    - Handling of raw materials inventory
  - The Production Planning (PP) module is where production is planned and scheduled, and actual production activities are recorded.

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## SAP R/3 Modules

- The Quality Management (QM) module helps to plan and record quality-control activities, such as product inspections and material certifications
- The Plant Maintenance (PM) module allows planning for preventative maintenance of plant machinery and managing maintenance resources
- The Asset Management (AM) module helps the company to manage fixed-asset purchases (plant and machinery) and the related depreciation.
- The Human Resources (HR) module facilitates employee recruiting, hiring, training, payroll and benefits.
- The Financial Accounting (FI) module records transactions in the general ledger accounts. It is used to generate financial statements for external reporting purposes

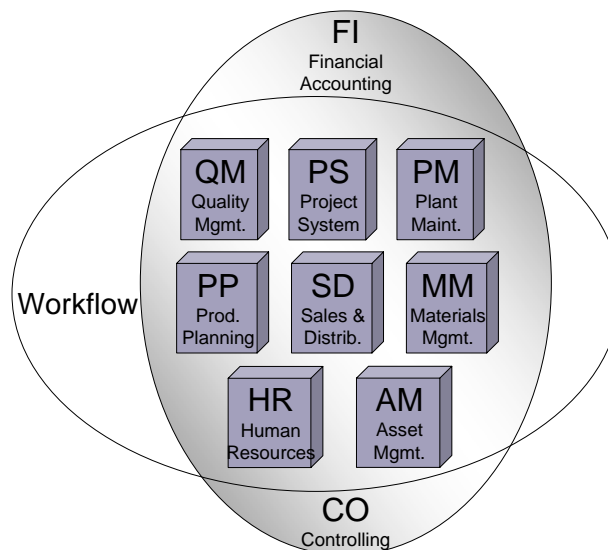
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## SAP R/3 Modules

- The Controlling (CO) module is used for internal management purposes.
  - In CO, the company's manufacturing costs are assigned to products and to cost centers, so that the profitability of the company's activities can be analyzed
  - The CO module supports managerial decision-making
- The Project System (PS) module allows for planning and control of special projects like Research and Development or Marketing Campaigns or low-volume, highly complex projects like aircraft or ship construction
- The Workflow (WF) module is a set of tools that can be used to automate any of the activities in R/3

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## SAP R/3 Modules



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## ERP Implementation

- For a variety of reasons, many companies choose to implement only certain modules of an ERP system
  - Generally, it is easier to integrate business processes when one ERP vendor supplies all modules
  - Data transfer between different ERP systems or an ERP system and a legacy software system is frequently done with batch programs, which eliminates real-time data accuracy
  - Software upgrades can also be problematic between different systems
- Because of these difficulties, a company that chooses to use multiple systems should make sure it is done for valid reasons

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## ERP Implementation

- Primary task in implementation is setting configuration options in the ERP software
  - With SAP, it has been estimated that there are about 8,000 configuration settings possible
- Configuration settings customize the software so that it fits the company's needs
- Example: Tolerance groups in Financial Accounting
  - To minimize the risk from unauthorized transactions, tolerance groups can be established to limit the dollar value of transactions that can be posted by different employee groups

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## Tolerance Group Setting

Leaving the group blank means this is the default tolerance group

Limits for single document and item in a document

Limits on how much an entry can differ from the value that is supposed to be entered

Upper limits for posting procedures			
Amount per document			10,000.00
Amount per open item account item			10,000.00
Cash discount per line item			5.000 %

Permitted payment differences			
	Amount	Percent	Cash discont adj.to
Revenue	100.00	5.0 %	100.00
Expense	100.00	5.0 %	100.00

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## Best Practices

- Before ERP, IS people designed software to reflect a company's business practices
- With ERP software, the software developers have used their experience with a number of companies to develop "best practices"
- Best Practices represent the way an ERP company feels a particular business transaction should be carried out to maximize efficiency
- While customers can customize their ERP systems to represent their own particular way of doing business, straying too far from "best practices" might mean that they will not get the benefits the ERP integration promises

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## ERP for Midsize Companies

- By 1998, most Fortune 500 companies had installed ERP systems
- ERP companies began to focus on midsize companies (1,000 or fewer employees)
- Midsize companies in Europe have an estimated \$50 billion annual IT budget
  - IT budget for US midsize companies is even larger
- To capture the midsize market, SAP developed Industry Solutions—preconfigured versions of its R/3 software for specific industries such as:
  - Oil and gas, automotive, banking, chemicals, etc.

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## Best of Breed Approach

- Some companies have chosen a Best of Breed approach, where they implement ERP modules from different vendors based on actual or perceived advantages
- The Best of Breed approach may become obsolete due to implementation challenges
  - Software must be written to connect different systems
  - Upgrading modules is more complicated with multiple vendors
  - Real-time data integration is frequently not available

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## Implementation Challenges

- A number of companies in the 1990s experienced lengthy and challenging implementations
  - Dell cancelled an SAP implementation
  - Owens-Corning had a lengthy implementation
  - FoxMeyer Drug blamed its bankruptcy, at least in part, on a troubled SAP implementation
- SAP responded by creating Accelerated SAP (ASAP), an implementation methodology and set of tools to aid implementation efforts
- The latest version of ASAP is called Solution Manager

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## New SAP Products

- Business Warehouse (BW) gives users great flexibility in analyzing data and developing custom reports
  - BW simplifies the integration and analysis of data from multiple sources, both SAP and non-SAP
- Customer Relationship Management (CRM) helps manage customer interactions so that they are coordinated and consistent
  - Also allows for analysis of sales data to identify trends and opportunities
- Advanced Planner and Optimizer (APO) helps coordinate production planning and scheduling between multiple facilities and with suppliers and customers
- NetWeaver provides a comprehensive platform to connect R/3 to the Internet

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## Choosing Consultants and Vendors

- ERP systems are so complex, one person cannot fully understand a single system, much less be able to compare systems effectively
- A team, including external consultants, is probably needed to select the best ERP system for a company
- A team made up of consultants and company experts is needed to determine how to configure ERP software properly

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## ERP Software Benefits

- Global integration, including currency exchange rates
- Reduced IT maintenance: single system is easier to maintain
- Provides information so that a company can be managed, not just monitored

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## Examples of benefits

- Service Merchandizing - cost per order from \$50 to \$12 (saving \$7.5 million/year)
- RJR - \$5-10 million/year
- Westinghouse - elapsed time/order reduced from 15 days to 1/2 day (cost from \$90 to \$10)
- Levi-Strauss - replenishment cycle from 14 days to three days

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## ERP System Costs

- The cost of an ERP system:
  - Depends on the size and complexity of the software package, which is a function of the size of the firm
  - Includes new hardware required to run the system
  - Includes consultant and business analyst fees
  - Includes the time required for implementation (disruption of business)
  - Includes training costs (cost to develop and deploy training plus employees' time away from their job)
- A large company, with over 1,000 employees, can spend from \$50 million to \$500 million on a complex implementation

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## Is ERP for everyone?

- A business must analyze its own business strategy, organization, culture and operations before choosing an ERP approach
- A company may not be ready to implement ERP
  - The company's business processes may not be well defined or managed
  - If a company is not prepared to make its processes more efficient, then it will not gain the benefits an ERP system can provide

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## Is ERP software inflexible

- ERP software is designed around best practices, so companies are encouraged to adapt their processes to the way ERP software works
- With SAP, companies can customize the software by creating custom capabilities using its Advanced Business Application Programming (ABAP) language
  - SAP is an open-source product, meaning that the customer has access to the software's source code

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## Returns from the ERP Investment

- ERP eliminates redundant effort and duplicated data, resulting in reduced personnel needs
- ERP systems can help produce goods and services more quickly, resulting in increased sales volume
- An ERP system may be required to compete with competitors who have effectively implemented ERP systems
- ERP systems can reduce frustration resulting from the inability to get accurate and timely data
- More accurate and timely data can improve external customer relations
- The payoff from ERP systems can occur over many years, when other factors may also affect the company, making the return hard to calculate

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## Return on Investment (ROI)

- ROI is the value of a project's benefits divided by the project cost, adjusted to include the time value of money
- The ROI for an ERP system is difficult to calculate
  - Many intangible costs and benefits
  - Some companies have not tried to determine the ROI of their ERP implementation—they just considered it a necessity
  - Some firms, like Pitney Bowes, have seen a return almost immediately
  - Some firms, like Toro, have taken some time before they have seen a tangible return

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## Implementation Problems

- Some executives naively hope ERP systems will cure fundamental business problems
- Some executives and IT managers don't take enough time for proper analysis and planning for implementation
- Some executives and IT managers skimp on education and training
- Sometimes the ownership of the implementation project is not given to the employees who will use the system
- Top executive support is not always given
- The organizational change process is not managed well

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## Kiss of death for Hershey?

Example Problem  
Implementing ERP



## Background

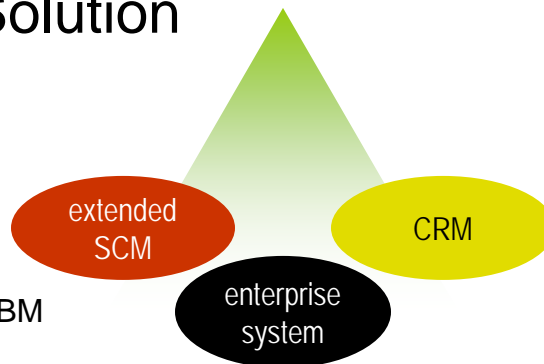
- Industry leader (\$5 billion revenues)
- Lagging behind industry in IT
- Retailers demanding better delivery scheduling
- Existing systems not Y2K compliant
- Decided to embark on major revision of systems in 1996



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## Solution

- 5000 PCs
- New network
- ERP = SAP
- CRM = Siebel
- SCM = Manugistics
- Integration partner = IBM
- Budget > \$100 million



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## Result

- Big bang implementation in July 99
- Early August, two weeks behind on orders
- Customers opt for Mars, Nestle
- Halloween 99 was disaster
- Stock price hammered
- 20% drop in profits



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## Interpretation

- Squeezing 4 year implementation into 30 months
- Too many changes: ERP, SCM, CRM all at once
- Poor change management



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## Epilogue

- Halloween 2000 less haunting for Hershey
- Systems and processes in place and working
- Candy is flowing...



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## Evolution of ERP Systems

- ERP systems have only been in common use since the 1990s
  - ERP is still a young technology, and future developments are hard to predict
- Additional capabilities are being added to core ERP applications
  - Customer Relationship Management (CRM)
  - Supply Chain Management (SCM)
  - Strategic Enterprise Management (SEM)
  - Internet connectivity

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## ERP and the Internet

- ERP developers continue to include Internet connectivity into their ERP applications
- SAP's latest Internet initiative is NetWeaver, a development system to simplify the integration of the Internet with the R/3 system
- ERP systems, in combination with the Internet, have lead to the development of e-commerce

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## Maximizing ERP Value

- To maximize the value of their ERP systems, companies should:
  - Integrate: ERP systems must be integrated throughout the company to share data effectively
  - Optimize: Many implementations were rushed to avoid the Y2K problem. Companies can gain value by using their ERP systems to improve their business processes
  - Informate: Hard work is required to effectively use the rich information provided by ERP systems

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## Summary

- Factors that led to ERP development
  - Exponentially increasing speed and power of computing hardware
  - Early client-server architecture that provided the framework for multiple users sharing common data
  - Increasingly sophisticated software facilitated integration, especially between Accounting and Finance (A/F) and manufacturing resource planning
  - Growth of business size, complexity and competition required more efficient information systems

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## Summary

- SAP R/3 enterprise software can integrate a company's processes using a common database and real-time data sharing
- SAP R/3 is modular, offering a number of modules including Sales and Distribution, Materials Management, Human Resources, Financial Accounting, Controlling, Production Planning, etc.

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## Summary

- ERP software is expensive to purchase, time consuming to implement and requires significant employee training
- Payoff from ERP software implementation can be significant, but determining the return on investment (ROI) may not be immediate or easy to calculate
- Experts predict future ERP developments will be focused on managing customer relationships, improving planning and decision-making, and linking operations to the Internet.