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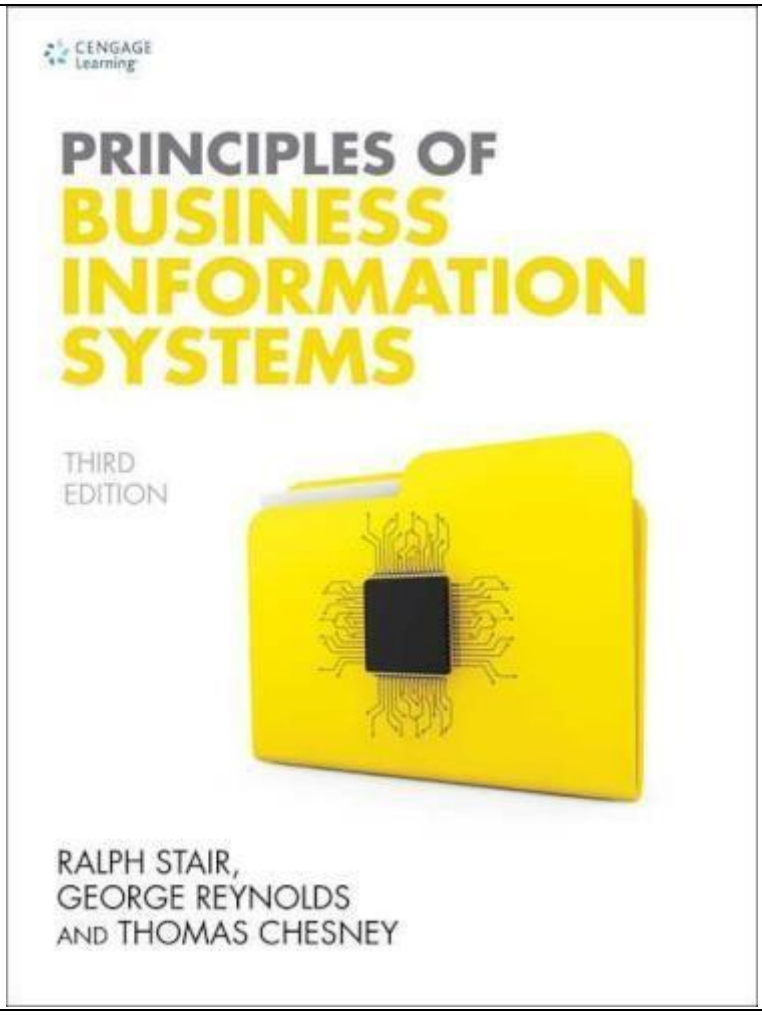

Principles of Business Information Systems

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LEARNING OUTCOMES

After reading this Section of the guide, the learner should be able to:

Learning Objectives

- Identify the basic activities and business objectives common to all transaction processing systems.
- Identify key control and management issues associated with transaction processing systems.
- Describe the inputs, processing and outputs for the transaction processing systems associated with the order processing, purchasing and accounting business functions.
- Define e- and m-commerce and describe various forms of e- commerce.
- Identify the challenges multinational corporations must face in planning, building and operating their transaction processing systems.
- Discuss the advantages and disadvantages associated with the implementation of an enterprise resource planning system

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Introduction

You might that operational systems support the day-to-day running of a firm. Operational systems, such as transaction processing systems (TPS), allow firms to buy and sell. Without systems to perform these functions, the firm could not operate. Organizations today are moving from a collection of non-integrated transaction processing systems to highly integrated enterprise resource planning (ERP) systems to perform routine business processes and maintain records about them. These systems support a wide range of business activities associated with supply chain management and customer relationship management .Although they were initially thought to be cost-effective only for very large companies, even small and medium-sized companies are now implementing these systems to reduce costs and improve service. Employees who work directly with customers – whether in sales, customer service or marketing – require high-quality transaction processing systems and their associated information to provide good customer service. Companies selling online need electronic- and mobile-commerce software to allow customers to perform transactions. No matter what your role, it is very likely that you will provide input to or use the output from your organization's systems.

Your effective use of these systems will be essential to raise the productivity of your firm, improve customer service and enable better decision making. Thus, it is important that you understand how these systems work and what their capabilities E and limitations are.

1.1 Introduction

This chapter looks at those systems that manage the day-to-day running of the firm. Without them an organization couldn't operate. They include systems that sell products and services to customers (transaction processing systems), systems that buy materials from suppliers (supply chain management systems), systems that help manage the after-sales service (customer relationship management systems) and systems that maintain tax records (accounting systems).

Often, especially with the systems described in this chapter and the next, the output from one of the systems is the input to another of the systems. An alternative approach to having separate systems to do all of the jobs that are discussed is to have one enterprise-wide system that does all of them. This is the ERP approach, which is described at the start of this chapter. ERP doesn't really fit into either the day-to-day running category or the long-term planning category since it does both, and the decision to include it in this chapter rather than the next is fairly arbitrary. Also there is no agreed minimum set of tasks that a system has to perform in order for it to be classed as an ERP. However the expectation is that an ERP does some of the tasks described in this chapter, plus some of the tasks described in the next chapter

1.2 Enterprise Resource Planning

ERP systems evolved from systems (called materials requirements planning or MRP systems) that allowed companies to plan out how much raw material they would need at a certain time in the future, plan their production, control their inventory and manage their purchasing process. Many organizations recognized that their existing systems lacked the integration needed to coordinate these activities and also to share valuable information across all the business functions of the firm. As a result, costs were higher and customer service suffered. This led firms to start to create new systems, which came to be known as ERP systems. Large organizations, especially members of the Fortune 1000, were the first to take on the challenge of implementing ERP. An ERP is a system that manages an entire company's vital business information. Many firms consider themselves to have an ERP if the system manages most, rather than all, of their information.

Advantages of ERP Systems

Increased global competition, executives' desire for control over the total cost and product flow through their enterprises, and ever-more-numerous customer interactions drive the demand for enterprise-wide access to real-time information. ERP offers integrated software from a single vendor to help meet those needs. The primary benefits of implementing ERP include improved access to data for operational decision making, elimination of inefficient or outdated systems, improvement of work processes and technology standardization. ERP vendors have also developed specialized systems for specific applications and market segments.

Improved Access to Data for Operational Decision Making

ERP systems operate via an integrated database, using one set of data to support all business functions. The systems can support decisions on optimal sourcing or cost accounting, for instance, for the entire enterprise or for business units, rather than gathering data from multiple business functions and then trying to coordinate that information manually or reconciling it with another application. The result is an organization that looks seamless, not only to the outside world but also to the decision makers who are deploying resources within that organization. The data is integrated to facilitate operational decision making and allows companies to pro- vide greater customer service and support strengthen customer and supplier relationships, and generate new business opportunities.
The British company Flambeau produces a wide range of plastic products and employs thousands of workers in eight manufacturing locations worldwide. It has grown through acquisition, and out of necessity was running multiple, disparate legacy information systems that drew data from multiple databases. The firm had to resort to the use of spreadsheets to manually track critical business information used for cost and inventory control. This inevitably led to errors and poor decision making. Finally, the company implemented an ERP system to deliver timely, consistent data for both production and financial management purposes. Flambeau has used the system to lower its inventory costs, better manage its production operations and provide access to a single set of data used to run the business.

Elimination of Costly, Inflexible Legacy Systems

Adoption of an ERP system enables an organization to eliminate dozens or even hundreds of separate systems and replace them with a single, integrated set of applications for the entire enterprise. In many cases, these systems are decades old, the original developers are long gone and the systems are poorly documented. As a result, the systems are extremely difficult to fix when they break, and adapting them to meet new business needs takes too long. They become an anchor around the organization that keeps it from moving ahead and remaining competitive. An ERP system helps match the capabilities of an organization's information systems to its business needs – even as these needs evolve.

Improvement of Work Processes

Competition requires companies to structure their business processes to be as effective and customer oriented as possible. ERP vendors do considerable research to define the best business processes. They gather the requirements of leading companies within an industry and combine them with findings from research institutions and consultants. The individual application modules included in the ERP system are then designed to support these best practices, which should be one of the most efficient and effective ways to complete a business process. Thus, implementation of an ERP system ensures good work processes based on best practices. For example, for managing customer payments, the ERP system's finance module can be configured to reflect the most efficient practices of leading companies in an industry. This increased efficiency ensures that everyday business operations follow the optimal chain of

activities, with all users being supplied with the information and tools they need to complete each step.

With 22 000 employees serving 4.7 million customers and generating revenues of €14 billion, Achmea is the largest insurance company in the Netherlands. The company had grown rapidly through acquisition and had evolved to using a mix of manual data collection and reporting processes. The company converted to an ERP system to standardize on a set of industry best practices, streamlined work processes and sophisticated data analysis tools across all divisions and operating companies. As a result, the company could reduce staffing levels in some areas of the business by as much as 30 per cent, thus improving productivity and cutting costs. In addition, the time required to complete month-end financial reporting was reduced by 30 per cent, with an increase in the accuracy and reliability of the data.

Upgrade of Technology Infrastructure

When implementing an ERP system, an organization has an opportunity to upgrade the information technology (hardware, operating systems, databases, etc.) that it uses. While centralizing and formalizing these decisions, the organization can eliminate the multiple hardware platforms, operating systems and databases it is currently using – most likely from a variety of vendors – and standardize on fewer technologies and vendors. This reduces ongoing maintenance and support costs as well as the training load for those who must support the infrastructure.

Barloworld Handling UK is the United Kingdom distributor of Hyster forklifts. It also provides parts and service through 26 service locations that field customer service calls, schedule and dispatch field techs, and manage the ordering and delivery of parts. This highly decentralized service operation resulted in inefficient work processes, high costs and inconsistent service levels. Barloworld reengineered its service operations to squeeze out waste and inefficiency. Service technicians were issued with handheld computers programmed to follow the new work processes. The handheld devices could also access work orders, equipment information and inventory data held in the firm's ERP database. By integrating mobile devices with improved work processes and access to ERP data, the firm achieved 'paperless, real-time data entry; immediate parts lookup and availability checks with overnight delivery; time sheets completed as work progresses; and automatic dispatch of work orders', according to Robert S. Tennant, the firm's CIO. The number of service locations was reduced from 26 to 6, service tech efficiency was increased by 10 per cent, and annual revenue increased by more than €500 000.

Disadvantages of ERP Systems

Unfortunately, implementing ERP systems can be difficult and can disrupt current business practices. Some of the major disadvantages of ERP systems are the expense and time required for implementation, the difficulty in implementing the many business process changes that accompany the ERP system, the problems with integrating the ERP system with other systems, difficulty in loading data into the new system, the risks associated with making a major commitment to a single vendor and the risk of implementation failure.

Expense and Time in Implementation

Getting the full benefits of ERP takes time and money. Although ERP offers many strategic ad- vantages by streamlining a company's TPS, large firms typically need three to five years and spend tens of millions of euros to implement a successful ERP system.

Difficulty Implementing Change

In some cases, a company has to radically change how it operates to conform to the ERP's work processes – its best practices. These changes can be so drastic to long-time employees that they retire or quit rather than go through the change. This exodus can leave a firm short of experienced workers. Sometimes, the best practices simply are not appropriate for the firm and cause great work disruptions.

Difficulty Integrating with Other Systems

Most companies have other systems that must be integrated with the ERP system, such as financial analysis programs, e-commerce operations and other applications. Many companies have experienced difficulties making these other systems operate with their ERP system. Other companies need additional software to create these links.

Difficulty in Loading Data into New ERP System

A major amount of work is required to load existing data from various sources into the new ERP database. The new ERP system may have the capability to store hundreds or even thousands of data items (e.g. customer name, bill to address, product description, etc.). The data items that will be required depend on the scope of ERP implementation. If certain processes or transactions are not included within the scope of implementation, there will be less data to load.

Data mapping is the examination of each data item required for the new ERP system and determining where that data item will come from. While most of the data for the new system will come from the files of existing legacy systems, some data items may need to be pulled from manual systems or may even need to be created for the new system. Data clean-up is required because the legacy systems are likely to contain data that is inaccurate, incomplete or inconsistent. For example, the same customer may be listed multiple times in existing customer files with varying billing addresses, or products may appear in the existing inventory files that have not been produced for years. Data loading can be performed either by using data conversion software that reads the old data and converts it into a format for loading into the database or by end-users entering data via the input screens of the new system.

Risks in Using One Vendor

The high cost to switch to another vendor's ERP system makes it extremely unlikely that a firm will do so. After a company has adopted an ERP system, the vendor has less incentive to listen and respond to customer concerns. The high cost to switch also comes with the risk that the ERP vendor allows its product to become outdated or goes out of business.

Selecting an ERP system involves not only choosing the best software product but also the right long-term business partner. It was unsettling for many companies that had implemented

PeopleSoft, J.D. Edwards or Siebel Systems enterprise software when these firms were acquired by Oracle.

Risk of Implementation Failure

Implementing an ERP system for a large organization is extremely challenging and requires tremendous amounts of resources, the best IS and businesspeople, and plenty of management support. Unfortunately, large ERP installations occasionally fail, and problems with an ERP implementation can require expensive solutions.

The following list provides tips for avoiding many common causes for failed ERP implementations:

- Assign a full-time executive to manage the project.
- Appoint an experienced, independent resource to provide project oversight and to verify and validate system performance.
- Allow sufficient time for transition from the old way of doing things to the new system and new processes.
- Plan to spend a lot of time and money training people.
- Define metrics to assess project progress and to identify project-related risks.
- Keep the scope of the project well defined and contained to essential business processes.
- Be wary of modifying the ERP software to conform to your firm's business practices

ERP for Small- and Medium-Sized Enterprises (SMEs)

It is not only large Fortune 100 companies that are successful in implementing ERP. SMEs (both for-profit and not-for-profit) can achieve real business benefits from their ERP efforts. Many of the SMEs elected to implement open-source ERP systems. With open-source software, anyone can see and modify the source code to customize it to meet their needs. Such systems are much less costly to acquire and are relatively easy to modify to meet business needs. A wide range of organizations can perform the system development and maintenance.

Table 1.1 lists some of the open-source ERP systems geared for SMEs.

The following sections outline systems that can be considered as sub-systems of an ERP, or as information systems in their own right.

Table 1.1 Open –Source ERP Systems

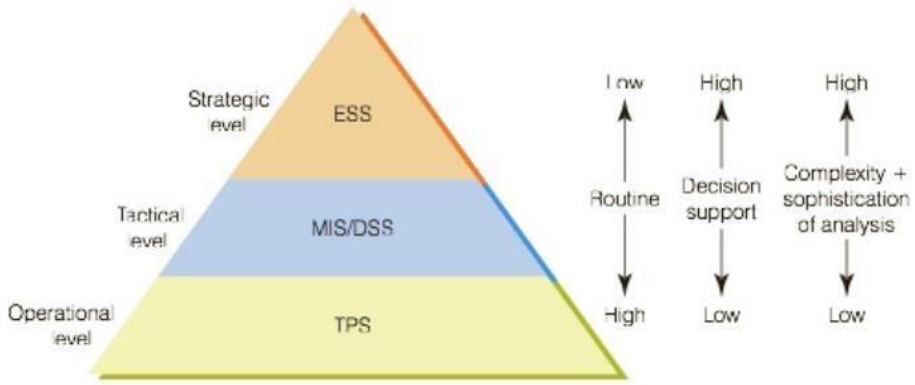
Vendor	ERP Solutions
Apache	Open For Business ERP
Compiere	Compiere Open Source ERP
Openbravo	Openbravo Open Source ERP
WebERP	WebERP

1.3 Transaction Processing Systems

Every organization has many transaction processing systems (TPS). These systems include order processing, inventory control, payroll, accounts payable, accounts receivable and the general ledger, to name just a few. The input to these systems includes basic business transactions, such as a customer placing an order, an employee purchasing supplies, a customer payment and an employee signing on and off at the start and end of a day. The processing activities include data collection, data editing, data correction, data manipulation, data storage and document production. The result of processing business transactions is that the organization's records are updated to reflect the status of the operation at the time of the last processed transaction.

A TPS also has a second important function – it collects data which is input to other essential information systems – management information systems, decision support systems and other special-purpose information systems (all discussed in the following chapters). A transaction processing system serves as the foundation for these other systems. These higher-level systems require the basic business transaction data captured by the TPS (see Figure 1.1)

Figure 1.1 TPS, MIS/DSS and ESS in Perspective

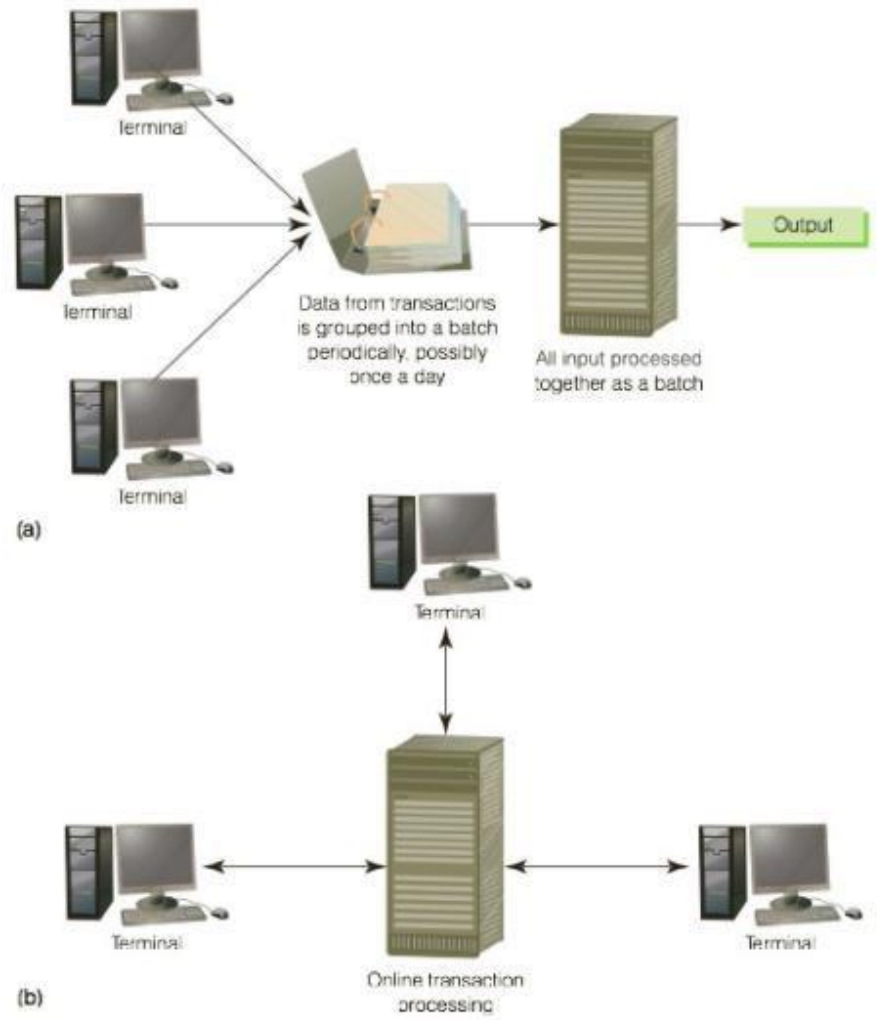


TPS support routine operations in the business. The amount of support for decision making that a TPS directly provides managers and workers is low.
Because TPS often perform activities related to customer contacts – such as order processing and invoicing – these information systems play a critical role in providing value to the customer. For example, by capturing and tracking the movement of each package, shippers such as FedEx can provide timely and accurate data on the exact location of a package. Shippers and receivers can access an online database and, by providing the tracking number of a package, find the package's current location. If the package has been delivered, they can see who signed for it (a service that is especially useful in large companies where packages can become 'lost' in internal distribution systems and post rooms). Such a system provides the basis for added value through improved customer service.

Traditional Transaction Processing Methods and Objectives

With batch processing systems, business transactions are accumulated over a period of time and prepared for processing as a single unit or batch (see Figure 1.2a). Transactions are accumulated for the appropriate length of time needed to meet the needs of the users of that system. For example, it might be important to process invoices and customer payments for the ac- counts receivable system daily. On the other hand, the payroll system might receive process data weekly to create cheques, update employee earnings records and distribute labour costs. The essential characteristic of a batch processing system is that there is some delay between an event and the eventual processing of the related transaction to update the organization's records.

Figure 1.2 Batch Versus Online Transaction Processing



With o**nline transaction processing (OLTP),** each transaction is processed immediately, without the delay of accumulating transactions into a batch (see Figure 1.2b). Consequently, at any time, the data in an online sys- tem reflects the current status. This type of processing is essential for businesses that require access to current data such as airlines, ticket agencies and stock investment firms. Many companies find that OLTP helps them provide faster, more efficient service, one way to add value to their activities in the eyes of the customer. Increasingly, companies are using the Internet to capture and process trans- action data such as customer orders and shipping information from e-commerce applications.

Although the technology is advanced enough, TPS applications do not always run using online processing. For many applications, batch processing is more appropriate and cost effective. Payroll transactions and billing are typically done via batch processing. Specific goals of the organization define the method of transaction processing best suited to the various applications of the company.

Because of the importance of transaction processing, organizations expect their TPS to accomplish a number of specific objectives, some of which are listed next. Depending on the specific nature and goals of the organization, any of these objectives might be more important than others.

- Process data generated by and about transactions. The primary objective of any TPS is to capture, process and update databases of business data required to support routine business activities. Utilities, telecommunications companies and financial-services organizations especially are under pressure to process ever-larger volumes of online transactions.
- Maintain a high degree of accuracy and integrity. Ensuring that the data is processed accurately and completely is critical because reports generated by the TPS are used to execute key operational activities such as filling customer orders and scheduling shipments to various customer locations.
- Avoid processing fraudulent transactions. Related to data integrity is the need to avoid processing fraudulent transactions. Standard Chartered, a London-based international bank, recently implemented anti-money-laundering software to monitor banking transactions against terrorist watch lists, and flags transactions between individuals, organizations or countries deemed high risk.
- Produce timely user responses and reports. The ability to conduct business transactions quickly can be essential for an organization's bottom line. For instance, if bills (invoices) are sent to customers a few days later than planned, payment is delayed, possibly forcing the firm to seek costly short-term borrowing to avoid cash flow problems. As a result, firms employ monitoring systems to measure and ensure system performance.
- Increase labour efficiency. Before businesses used computers, manual processes often required rooms full of administrators and office equipment to process the necessary business transactions. Today, TPS substantially reduce these and other labour requirements.
- Help improve customer service. Another objective of a TPS is to assist an organization in providing a fast, efficient service.
- Help build and maintain customer loyalty. A firm's TPS are often the means for customers to communicate. Customer interaction with these systems must, therefore, keep customers satisfied and returning. A recent web study by All ulent, Inc., found that 55 per cent of consumers surveyed said that a frustrating online shopping experience diminishes their overall opinion of that retailer. Surprisingly, nearly 33 per cent said they might stop shopping at the retailer's brick-and-mortar store as well. Achieve competitive advantage. A goal common to almost all organizations is to gain and maintain a competitive advantage. When a TPS is developed or modified, the personnel involved should carefully consider the significant and long-term benefits the new or modified system might provide.

Transaction Processing Activities

TPS capture and process data of fundamental business transactions. This data is used to update databases and to produce a variety of reports people both within and outside the enterprise use. The business data goes through a **transaction processing cycle** that includes data collection, data editing, data correction, data manipulation, data storage and document production (see Figure 1.3).

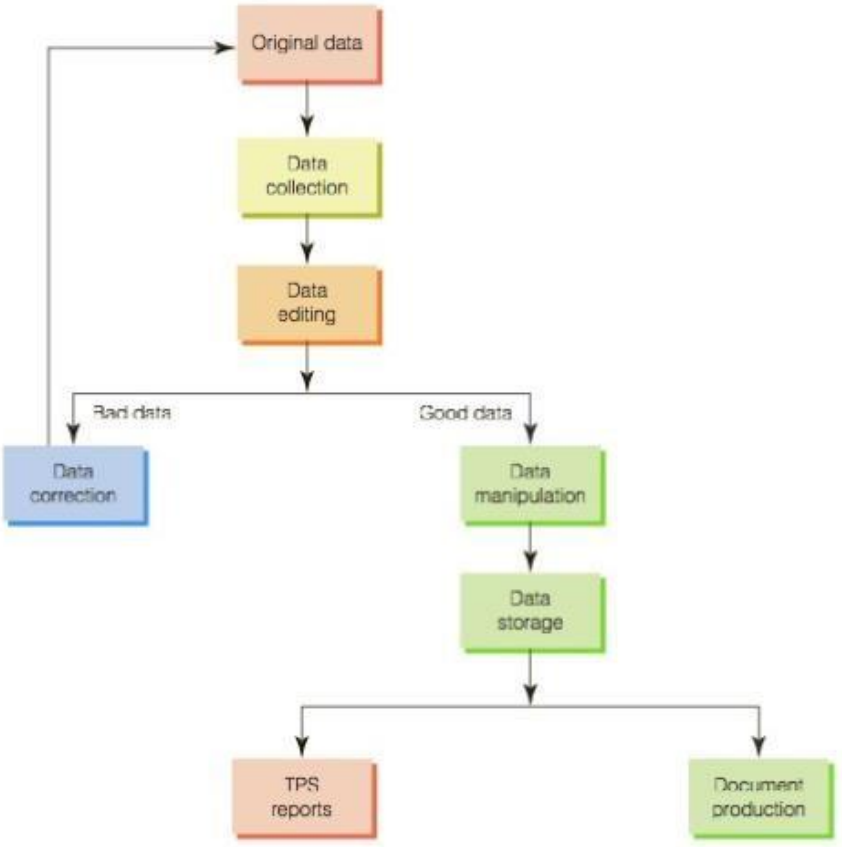
Data Collection

Capturing and gathering all data necessary to complete the processing of trans- actions is called **data collection**. In some cases, it can be done manually, such as by collecting handwritten sales orders or a customer typing in their credit card details on a web page. In other cases, data collection is automated via special input devices such as barcode scanners and RFID readers.

Table 1.2 Examples of Transaction Processing Systems for Competitive Advantage

Competitive Advantage	Example
Customer loyalty increased	Customer interaction system to monitor and track each customer interaction with the company
Superior service provided to customers	Tracking systems that customers can access to determine shipping status
Better relationship with suppliers	Internet marketplace to allow the company to purchase products from suppliers at discounted prices
Superior information gathering	Order configuration system to ensure that products ordered will meet customers' objectives
Costs dramatically reduced	Warehouse management system employing RFID technology to reduce labour hours and improve inventory accuracy
Inventory levels reduced	Collaborative planning, forecasting and replenishment to ensure the right amount of inventory is in stores

Figure 1.3 Data- Processing Activities Common to Transaction Processing Systems



Data collection begins with a transaction (e.g. taking a customer order) and results in data that serves as input to the TPS. Data should be captured at its source and recorded accurately in a timely fashion, with minimal manual effort, and in an electronic or digital form that can be directly entered into the computer. This approach is called 'source data automation'. An example of source data automation is a barcode reader at a supermarket which speeds the checkout process. Using barcodes is quicker and more accurate than having a shop assistant enter codes manually at the cash register. The product ID for each item is determined automatically, and its price is retrieved from the item database. This TPS uses the price data to determine the customer's bill. It also updates the shop's inventory database and its database of purchases. This data is then used by the shop's management information systems to generate reports.

Data Editing and Correction

An important step in processing transaction data is to perform **data editing** for validity and completeness to detect any problems. For example, quantity and cost data must be numeric and names must be alphabetic, otherwise the data is not valid. Often, the codes associated with an individual transaction are edited against a database containing valid codes. If any code entered (or scanned) is not present in the database, the transaction is rejected. For example, when you are buying something online, the system will usually check whether you have entered a correctly formatted email address, and will not allow the transaction to proceed if you have not. A **data correction** involves re-entering data that was not typed or scanned properly. It is not enough simply to reject invalid data. The system should also provide error messages that alert those responsible for editing the data. Error messages must specify the problem so proper corrections can be made. For example, a scanned barcode must match a code in a master table of valid codes. If the code is misread or does not exist in the table, the shop assistant should be given an instruction to rescan the item or type the information manually.

Data Manipulation

Another major activity of a TPS is **data manipulation**, the process of performing calculations and other data transformations related to business transactions. Data manipulation can include classifying data, sorting data into categories, performing calculations, summarizing results and storing data in the organization's database for further processing. In a payroll TPS, for example, data manipulation includes multiplying an employee's hours worked by the hourly pay rate. Overtime pay and tax deductions are also calculated

Data Storage

Data storage involves updating one or more databases with new transactions. As has already been emphasized several times in this chapter, this data can be further processed and manipulated by other systems so that it is available for management reporting and decision making. Thus, although transaction databases can be considered a by-product of transaction processing, they have a pronounced effect on nearly all other information systems and decision-making processes in an organization.

Document Production and Reports

Document production involves generating output records, documents and reports. These can be hard-copy paper reports or displays on computer screens (sometimes referred to as 'soft

copy'). Printed paycheques, for example, are hard-copy documents produced by a payroll TPS, whereas an outstanding balance report for invoices might be a soft-copy report displayed by an accounts receivable TPS. In addition to major documents such as cheques and invoices, most TPS provide other useful management information and decision support, such as printed or onscreen reports that help managers and employees perform various activities. A report showing current inventory is one example; another might be a document listing items ordered from a supplier to help an administrator check the order for completeness when it arrives. A TPS can also produce reports required by law, such as tax statements.

1.4 Traditional Transaction Processing Applications

This section presents an overview of several common transaction processing systems that support the order processing, purchasing and accounting business functions (see Table 1.3).

Order Processing Systems

Table 1.3 Systems that Support Order Processing, Purchasing and Accounting Functions

Order Processing	Purchasing	Accounting
Order processing	Inventory control (raw materials, packing materials, spare parts and supplies)	Budget
Sales configuration		Accounts receivable
Shipment planning		Payroll
Shipment execution	Purchase order processing	Asset management
Inventory control (finished product)	Receiving	General ledger
Accounts receivable	Accounts payable	

Order Processing Systems

The traditional TPS for order processing include order entry, sales configuration, shipment planning, shipment execution, inventory control and accounts receivable. Running these systems efficiently and reliably is critical to an enterprise. Figure 1.4 is a system-level flowchart that shows the various systems and the information that flows among them. Table 1.4 summarizes the input, processing and output (IPO) of the essential systems that include the traditional order processing systems.

Figure 1.4 Traditional TPS Systems that Support the Order Processing Business Function

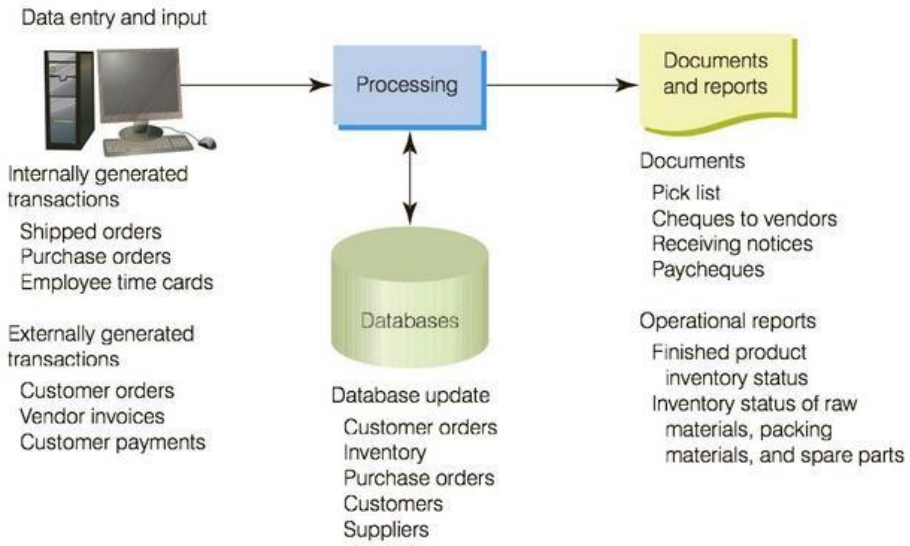


Table 1.4 IPO of the Traditional TPS Systems that Support Order Processing

Purchasing Systems

The traditional TPS that support the purchasing business function include inventory control, pure- chase order processing, receiving and accounts payable (see Figure 1.5). Table 1.5 shows the input, processing and output associated with this collection of systems.

Figure 1.5 Traditional TPS Systems that Support the Purchasing Business Function

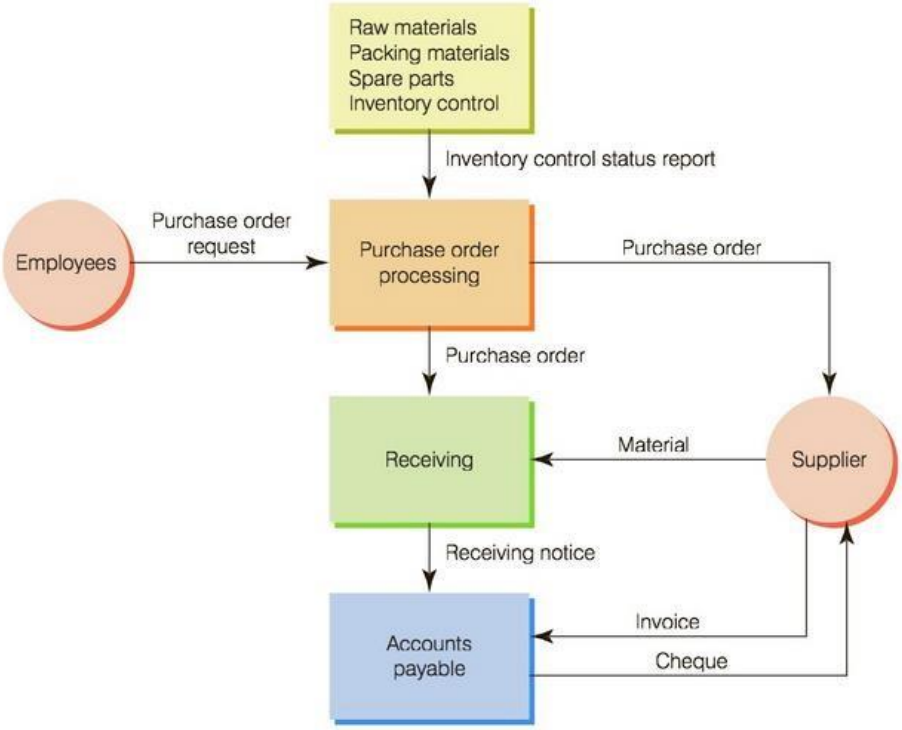


Table 1.5 IPO for the Traditional TPS Systems that Support Purchasing

System	Input	Processing	Output
Inventory control	Records reflecting any increase or decrease in the inventory of specific items of raw materials, packing materials or spare parts	Withdrawals are subtracted from inventory counts of specific items; additions are added to the inventory count	The inventory record of each item is updated to reflect its current count
Purchase order processing	Inventory records, employee-prepared purchase order requests, information on preferred suppliers	Items that need to be ordered are identified, quantities to be ordered are determined, qualified supplier with whom to place the order is identified	Purchase orders are placed with preferred suppliers for items
Receiving	Information on the quantity and quality of items received	Receipt is matched to purchase order, input data is edited for accuracy and completeness	Receiving report is created, inventory records are updated to reflect new receipts
Accounts payable	Purchase orders placed, information on receipts, supplier invoices	Supplier invoice matched to original purchase order and receiving report	Payment generated to supplier

Figure 1.6 An Early Transaction Processing System? The boys are trying to transact with the gent, who looks like he's already done a deal with one of their competitors.

Accounting Systems

The primary **accounting systems** include the budget, accounts receivable and payable payroll, asset management and general ledger. Table 1.6 shows the input, processing and output associated with these systems.

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1.5 Electronic and Mobile Commerce

Electronic Commerce

Electronic commerce is conducting a business transaction (e.g. distribution, buying, selling and servicing) electronically over computer net- works, primarily the Internet but also extranets and corporate networks. An e-commerce system is a type of transaction processing system. Business activities that are strong candidates for conversion to e-commerce are paper.

Figure 1.7 Traditional TPS Systems that Support the Accounting and Finance Business Function

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Table 1.6 IPO for the Traditional TPS Systems that Support Accounting

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Business-to-consumer (B2C) e-commerce

A form of e-commerce in which customers deal directly with an organization and avoid intermediaries.

B2Me e-commerce.

A form of e-commerce where the business treats each customer as a separate market segment. Typical B2Me features include customizing a website for each customer, perhaps based on their previous purchases and personalized (electronic) marketing literature.

Business-to-business (B2B) e-commerce

Business-to-business (B2B) e-commerce is a subset of e-commerce where all the participants are organizations. B2B e-commerce is a useful tool for connecting business partners in a virtual supply chain to cut re-supply times and reduce costs. Many travel agents specialize in organizing business travel. Business Travel Direct in the UK provides flight and hotel bookings, e-commerce A subset of e-commerce where all the based, time-consuming and inconvenient for customers. Thus, some of the first business processes that companies converted to an e-commerce model were those related to buying and selling. Integrated ecommerce systems directly link a firm's website, which allows custom- A form of e-commerce in which customers deal directly with an organization and avoid intermediaries. B2Me participants are organizations. Tailoring its service for business customers.

Consumer-to-consumer (C2C)

E-commerce is another subset of e-commerce that involves consumers selling directly to other consumers. EBay is an example of a C2C e-commerce site; customers buy and sell items directly with each other through the site.

E-government

E-government is the use of information and communications technology to simplify the sharing of information, speed up formerly paper-based processes and improve the relationship between citizen and government. Government-to-consumer (G2C), government-to-business (G2B) and government-to-government (G2G) are all forms of e-government

Mobile Commerce

Mobile commerce (m-commerce) relies on the use of wireless devices, such as personal digital assistants, mobile phones and smartphones, to transact. Handset manufacturers such as HTC, Samsung and Sony Ericsson are working with communications carriers such as Vodafone to develop wireless devices, related technology and services. In addition, con- tent providers and mobile service providers are working together more closely than ever. Content providers recognize that customers want access to their content whenever and wherever they go, and mobile service providers seek out new forms of content to send over their networks. According to the GSM Association, there are 1.8 billion mobile phone users in the world but only 12 to 14 per cent of them have ever accessed the Web from their phones. (GSM stands for Global System for Mobile communication, which is a European digital standard for mobile telephony.) The Internet Corporation for Assigned Names and Numbers (ICANN) created a .mobi domain in late 2005 to help attract mobile users to the web.TlD Top Level Domain Ltd of Dublin, Ireland, is responsible for administration of this domain and helping to ensure that the .mobi destinations work fast, efficiently and effectively with user handsets.In most western European countries, communicating via wireless devices is common, and consumers are much more willing to use m-commerce. Japanese consumers are generally enthusiastic about new technology and are much more likely to use mobile technologies for making purchases.

1.6 Production and Supply Chain Management

Production and supply chain management systems follow a systematic process for developing a production plan that draws on the information available in the system database. The process starts with sales forecasting to develop an estimate of future customer demand. This initial forecast is at a fairly high level with estimates made by product group rather than by each individual product item. The sales forecast extends for months into the future. The sales forecast will be produced using specialized software and techniques. Many organizations are moving to a collaborative process with major customers to plan future inventory levels and production rather than relying on an internally generated sales forecast. The sales and operations plan takes demand and current inventory levels into account and determines the specific product items that need to be produced and when to meet the forecast future demand. Production capacity and any seasonal variability in demand must also be considered. The result

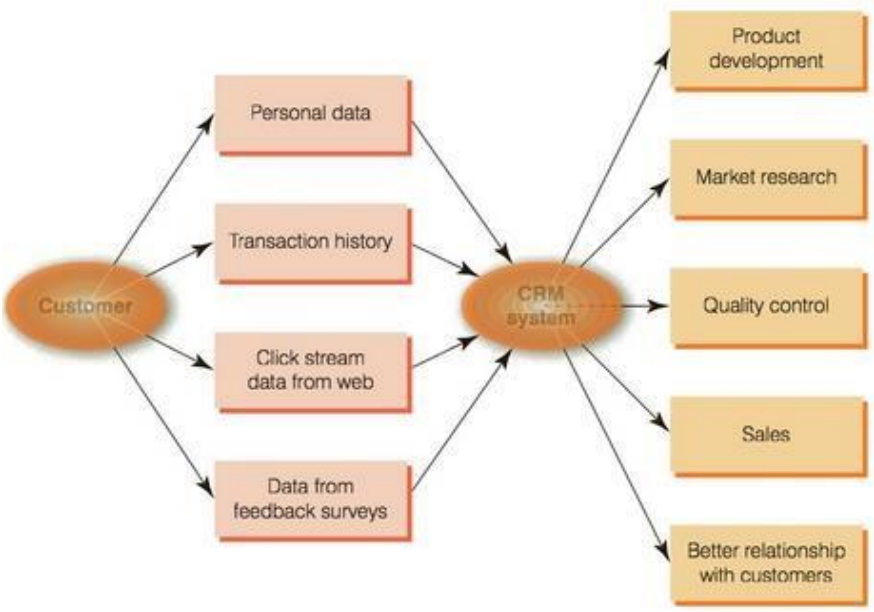
is a high-level production plan that balances market demand with production capacity. Panasonic and other companies have outsourced the development of a sales and operation plan to i2 Technologies in India. Best Buy, a major Panasonic customer, collects information on sales of Panasonic items at its shops' checkout stations and sends the data to i2. i2 processes the data

1.7 Customer Relationship Management and Sales Ordering

Customer Relationship Management

A **customer relationship management (CRM) system** helps a company manage all aspects of customer encounters, including marketing and advertising, sales, customer service after the sale and programmes to keep and retain loyal customers (see Figure 1.8). The goal of CRM is to understand and anticipate the needs of current and potential customers to increase customer retention and loyalty while optimizing the way that products and services are sold.

Figure 1.8 Customer Relationship Management System



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Sales Ordering

Sales ordering is the set of activities that must be performed to capture a customer sales order. A few of the essential steps include recording the items to be purchased, setting the sales price,

recording the order quantity, determining the total cost of the order including delivery costs and confirming the customer's available credit. The determination of the sales prices can become quite complicated and include quantity discounts, promotions and incentives. After the total cost of the order is determined, it is necessary to check the customer's available credit to see if this order puts the customer over his or her credit limit.

1.8 Financial and Managerial Accounting

The general ledger is the main accounting record of a business. It is often divided into different categories, including assets, liabilities, revenue, expenses and equity. These categories, in turn, are subdivided into sub-ledgers to capture details such as cash, accounts payable, accounts receivable and so on. In an ERP system, input to the general ledger occurs simultaneously with the input of a business transaction to a specific module. Here are several examples of how this occurs:

■An order administrator records a sales, and the ERP system automatically creates an accounts receivable entry indicating that a customer owes money for goods received.

■A buyer enters a purchase order, and the ERP system automatically creates an accounts payable entry in the general ledger registering that the company has an obligation to pay for goods that will be received at some time in the future.

■ A dock worker enters a receipt of purchased materials from a supplier, and the ERP system automatically creates a general ledger entry to increase the value of inventory on hand.

■ A production worker withdraws raw materials from inventory to support production, and the ERP system generates a record to reduce the value of inventory on hand

Thus the ERP system captures transactions entered by workers in all functional areas of the business. The ERP system then creates the associated general ledger record to track the financial impact of the transaction. This set of records is an extremely valuable resource that companies can use to support financial accounting and managerial accounting.

Hosted Software Model for Enterprise Software

Business application software vendors are experimenting with the hosted software model to see if the approach meets customer needs and is likely to generate significant revenue. This pay-as-you-go approach is appealing to small businesses because they can then experiment with powerful software capabilities without making a major financial investment. Also, using the hosted software model means the small business firm does not need to employ a full-time IT person to maintain key business applications. The small business firm can expect additional savings from reduced hardware costs and costs associated with maintaining an appropriate computer environment (such as air conditioning, power and an uninterruptible power supply).

1.9 International Issues Associated with Operational Systems

Operational systems must support businesses that transact with customers, suppliers, business partners, shareholders and government agencies in multiple countries. Different languages and cultures, disparities in IS infrastructure, varying laws and customs rules, and multiple currencies

Different Languages and Cultures

Teams composed of people from several countries speaking different languages and familiar with different cultures might not agree on a single work process. In some cultures, people do not routinely work in teams in a networked environment. Despite these complications, many multinational companies can establish close connections with their business partners and roll out standard IS applications for all to use. However, sometimes they require extensive and costly customization. For example, even though English has become a standard business language among executives and senior managers, many people within organizations do not speak English.

Disparities in Information System Infrastructure

The lack of a robust or common information infrastructure can also create problems. For example, much of Latin America lags behind the rest of the world in Internet usage, and online marketplaces are almost non-existent there. This gap makes it difficult for multinational companies to get online with their Latin American business partners. Even something as mundane as the fact that the power plug on a piece of equipment built in one country might not fit into the power socket of another country can affect the infrastructure.

Varying Laws and Customs Rules

Numerous laws can affect the collection and dissemination of data. For example, labour laws in some countries prohibit the recording of worker performance data. Also, some countries have passed laws limiting the transborder flow of data linked to individuals. Specifically, European Community Directive 95/96/EC of 1998 requires that any company doing business within the borders of the (currently) 28 European Union member nations protect the privacy of customers and employees. It bars the export of data to countries that do not have data-protection standards comparable to the European Union's.

Multiple Currencies

The enterprise system of multinational companies must conduct transactions in multiple currencies. To do so, a set of exchange rates is defined, and the information systems apply these rates to translate from one currency to another. The systems must be current with foreign currency exchange rates, handle reporting and other transactions such as cash receipts, issue vendor payments and customer statements, record retail store payments and generate financial reports in the currency of choice.

Chapter Summary/Review

- An organization must have information systems that support the routine, day-to-day activities that occur in the normal course of business and help a company add value to its products and services. Transaction processing systems (TPS) are at the heart of most information systems in businesses today.

- Traditional TPS support the various business functions of organizations that have not yet implemented enterprise resource planning systems. Many organizations conduct ongoing TPS audits to prevent accounting irregularities or loss of data privacy.

- Electronic and mobile commerce allow transactions to be made by the customer, with less need for sales staff, and open up new opportunities for conducting business. E-commerce is the conducting of business activities electronically over networks. Business-to-business (B2B) e-commerce allows manufacturers to buy at a low cost worldwide, and it offers enterprises the chance to sell to a global market.

- A company that implements an enterprise resource planning system is creating a highly integrated set of systems, which can lead to many business benefits. ERP software supports the efficient operation of business processes by integrating activities throughout a business, including sales, marketing, manufacturing, logistics, accounting and staffing.

Review Questions (Short) 1.
Why do data need correction?
2. What is B2Me?
3. What basic transaction processing activities are performed by all TPS?
4. How could RFID be used to minimize data entry errors?
5. What is the relationship between m-commerce and e-commerce?

Review Questions (Long)
1. Systems that allow an organization to conduct business are _____.
2. A wholesaler selling to a high street shop via the internet is an example of _____
3. Systems used to improve interaction between a government and its citizens form _____.
4. Buying a book on a smartphone is an example of _____.
5. Where do data for a CRM come from?

Review Questions (MCQ)

1. What type of processing method waits until several transactions are accumulated before entering them into the computer system?

A. batch processing
B. Electronic Data Processing
C. Mechanical Data Processing
D. Manual Data Processing

2. What type of processing method processes transactions as they occur?

A. Mechanical Data Processing
B. Manual Data Processing
C. batch processing
D. online transaction processing (OLTP)

3. In which system are items that need to be ordered identified, quantities to be ordered determined, and the qualified supplier with whom to place the order identified? A. A.purchase order processing system
B. Shipment execution
C. Shipment planning
D. Sales configuration

4. Which system is responsible for reviewing customer order information and ensuring that the configuration will meet the customer's needs?

A. sales configuration system
B. order processing system
C. Accounting Systems
D. Traditional Transaction Processing Applications

5. The _____ plan takes demand and current inventory levels into account and determines the specific product items that need to be produced and when to meet the forecast future demand.

A. Accounting
B. sales and operations
C. Financial
D. Budget

Case Studies / Projects

When Stock Becomes a Liability

South African company New Era Solutions is helping its clients to reduce stock. Working with their partners Epicor Software Corporation, New Era offers warehouse management systems to control the movement and storage of materials in a warehouse and process goods coming into the warehouse and leaving it. Warehouse management software, part of an ERP system, allows a company to manage its inventory and minimize so called 'dead stock'. A manufacturing company buys raw materials and turns them into finished products. Each of these (materials and products) is stock. Stock includes the materials coming in, products at all stages of being finished, and the final products ready to be shipped. Stock is a major company asset and is usually the main source of a company's revenue. However, there are times when stock can become a liability: stock can generate revenue but it is also a cost. It costs money to keep it, as the warehouse needs security guards, electricity, there may be rent to pay, or payments on a building loan.

Questions

1 List some of the costs associated with running a warehouse.

2 How does warehouse management software help reduce dead stock?

3 How could a company decide at what point stock becomes dead stock?

4 How can companies deal with the disruption that implementing an ERP creates?

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Case Studies / Projects

Non-Linear Presentations

Enterprise software is used to facilitate the day-to- day running of a business. Without it, the business could not 'transact' – they could not sell goods and services to customers. In effect, they could not do business. Support applications are not essential but they are nice to have, and can be replaced easily if there is a problem. Presentation software is an example of a support application. At the end of 2015, BBC technology reporter Jane Wakefield wrote the following: 'Most people who've endured a terrible PowerPoint presentation will have experienced boredom, followed by frustration, then anger that it took up an hour – or possibly even more – of their lives that they will never get back'. She is right that many people will have experienced this: Click. A slide with a colourful background covered in text appears. The presenter reads the text.

Questions

1 What purposes do slides serve? You should be able to list several key points.

2. Outline a guide to using Prezi that would minimize motion sickness. Does your guide effectively turn it back into PowerPoint?

3. Why do you think Steve Jobs was considered to be such a good presenter?

4. Recreate a recent presentation you gave as a talk without slides. Do you think you have made it better or worse?

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LEARNING OUTCOMES

After reading this Section of the guide, the learner should be able to:

Learning Objectives

- Define the stages of decision making.
- Discuss the importance of implementation and monitoring in problem solving.
- Explain the uses of MISs and describe their inputs and outputs.
- Discuss information systems in the functional areas of business organizations.
- List and discuss important characteristics of DSSs that give them the potential to be effective management support tools.
- Identify and describe the basic components of a DSS.
- State the goals of a GSS and identify the characteristics that distinguish it from a DSS.
- Identify the fundamental uses of an ESS and list the characteristics of such a system.

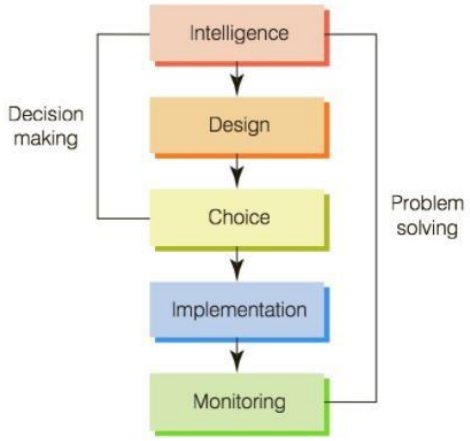
Introduction

The previous chapter looked at systems at the operational level of a firm This chapter considers systems higher up, at the tactical and strategic levels. The true potential of information systems in organizations is in helping employees make more informed decisions, something that is supported by both management information and decision support systems. Transportation coordinators can use management information reports to find the least expensive way to ship products to market and to solve bottlenecks.

2.1 Decision Making and Problem Solving

Organizations need to make good decisions. In most cases, strategic planning and the overall goals of the organization set the course for decision making, helping employees and business units achieve their objectives and goals. Often, information systems also assist with strategic planning, helping top management make better decisions. In business, one of the highest compliments you can receive is to be recognized by your colleagues and peers as a 'real problem solver'. Problem solving is a critical activity for any business organization. After identifying a problem, you begin the problem-solving process with decision making. A wellknown model developed by Herbert Simon divides the **decision-making phase** of the problemsolving process into three stages: intelligence, design and choice. This model was later incorporated by George Huber into an expanded model of the entire problem-solving process (see Figure 2.1)

Figure 2.1 How Decision Making Relates to Problem Solving



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The three stages of decision making – intelligence, design and choice – are augmented by implementation and monitoring to result in problem solving. The first stage in the problemsolving process is the **intelligence stage**. During this stage, you identify and define potential problems or opportunities. For example, you might learn about the need for an intervention or change in an unsatisfactory situation. During the intelligence stage, you also investigate resource and environmental constraints. For example, if you were a French farmer, during the intelligence stage you might explore the possibilities of shipping apples from your farm to shops in Ireland. The perishability of the fruit and the maximum price that consumers in Ireland are willing to pay for the fruit are problem constraints. Aspects of the problem environment that you must consider include import/export laws regarding the shipment of food products.

In the **design stage**, you develop alternative solutions to the problem. In addition, you evaluate the feasibility of these alternatives. In the fruit shipping example, you would consider the alternative methods of shipment, including the transportation times and costs associated with each. The last stage of the decision-making phase, the **choice stage**, requires selecting a course of action. Here you might select the method of shipping fruit by air from you as the solution. The choice stage would then conclude with selection of an air carrier. As you will see later, various factors influence choice; the act of choosing is not as simple as it might first appear**.**

Problem solving includes and goes beyond decision making.

It also includes the implementation stage, when the solution is put into effect. For example, if your decision is to ship fruit to Ireland as air freight using a specific air freight company, **implementation** involves informing your farming staff of the new activity, getting the fruit to the airport and actually shipping the product. The final stage of the problem-solving process is the **monitoring stage.**

In this stage, decision makers evaluate the implementation to determine whether the anticipated results were achieved and to modify the process in light of new information. Monitoring can involve feedback and adjustment. For example, you might need to change your air carrier if it regularly has shipping delays.

Programmed versus Non-Programmed Decisions

In the choice stage, various factors influence the decision maker's selection of a solution. One such factor is whether the decision can be programmed. **Programmed decisions** are made using a rule, procedure or quantitative method. For example, to say that inventory should be ordered when inventory levels drop to 100 units is a programmed decision because it adheres to a rule. Programmed decisions are easy to computerize using traditional information systems. The relationships between system elements are fixed by rules, procedures or numerical relationships. In other words, they are structured and deal with routine, well-defined decisions.

Non-programmed decisions, however, deal with unusual or exceptional situations. In many cases, these decisions are difficult to quantify. Determining the appropriate training programme for a new employee, deciding whether to start a new type of product line and weighing the benefits and drawbacks of installing a new pollution control system are examples. Each of these decisions contains unique characteristics, and standard rules or procedures might not apply to them. Today, decision support systems help solve many non-programmed decisions, in which the problem is not routine, and rules and relationships are not well defined (unstructured or illstructured problems).

Optimization, Satisficing and Heuristic Approaches

In general, computerized decision support systems can either optimize or satisfice. An optimization model finds the best solution, usually the one that will best help the organization meet its goals. For example, an optimization model can find the appropriate number of products that an organization should produce to meet a profit goal, given certain conditions and assumptions. Optimization models use problem constraints. A limit on the number of available work hours in a manufacturing facility is an example of a problem constraint. Some spreadsheet programs, such as Microsoft Excel, have optimizing features. A business such as an appliance manufacturer can use an optimization program to reduce the time and cost of manufacturing

appliances and increase profits. Optimization software also allows decision makers to explore various alternatives.

Consider a few examples of how you can use optimization to achieve huge savings. Bombardier Flexjet, a company that sells fractional ownership of jets, used an optimization program to save almost €22 million annually to better schedule its aircraft and crews.1 Hutchinson Port Holdings, the world's largest container terminal, saved even more – over €37 million annually.2 The company processes a staggering 10 000 trucks and 15 ships every day, and used optimization to maximize the use of its trucks. Deere & Company, a manufacturer of commercial vehicles and equipment, increased shareholder value by over €75 million annually by using optimization to minimize inventory levels and by enhancing customer satisfaction.

Laps Care from TietoEnatorAM is an information system that used optimization to assign medical personnel to home health-care patients in Sweden while minimizing costs. The system has improved care while increasing efficiency by 10 to 15 per cent and lowering costs by €20 million.

A satisficing model is one that finds a good – but not necessarily the best – problem solution. Satisficing is usually used because modelling the problem properly to get an optimal decision would be too difficult, complex or costly. Satisficing normally does not look at all possible solutions but only at those likely to give good results. Consider a decision to select a location for a new manufacturing plant. To find the optimal (best) location, you must consider all cities in Europe. A satisficing approach is to consider only five or ten cities that might satisfy the company's requirements. Limiting the options might not result in the best decision, but it will likely result in a good decision, without spending the time and effort to investigate all cities. Satisficing is a good alternative modelling method because it is sometimes too expensive to analyze every alternative to find the best solution.

Heuristics, often referred to as 'rules of thumb' – commonly accepted guidelines or procedures that usually find a good solution – are often used in decision making. An example of a heuristic is to order four months' supply of inventory for a particular item when the inventory level drops to 20 units or less; although this heuristic might not minimize total inventory costs, it can serve as a good rule of thumb to avoid running out of stock without maintaining excess inventory. Trend Micro, a provider of antivirus software, has developed an antispam product that is based on heuristics. The software examines emails to find those most likely to be spam. It doesn't examine all emails.

Sense and Respond

Sense and Respond (SAR) involves determining problems or opportunities (sense) and developing systems to solve the problems or take advantage of the opportunities (respond).5 SAR often requires nimble organizations that replace traditional lines of authority with those that are flexible and dynamic. IBM, for example, used SAR with its microelectronics division to help with inventory control. It used mathematical models and optimization routines to control inventory levels. The models sensed when a shortage of inventory for customers was likely and responded by backlogging and storing extra inventory to avoid the shortages. In this application, SAR identified potential problems and solved them before they became a reality. SAR can also identify opportunities, such as new products or marketing approaches, and then respond by building the new products or starting new marketing campaigns. One way to

implement the SAR approach is through management information and decision support systems, discussed in the next section.

Big Data

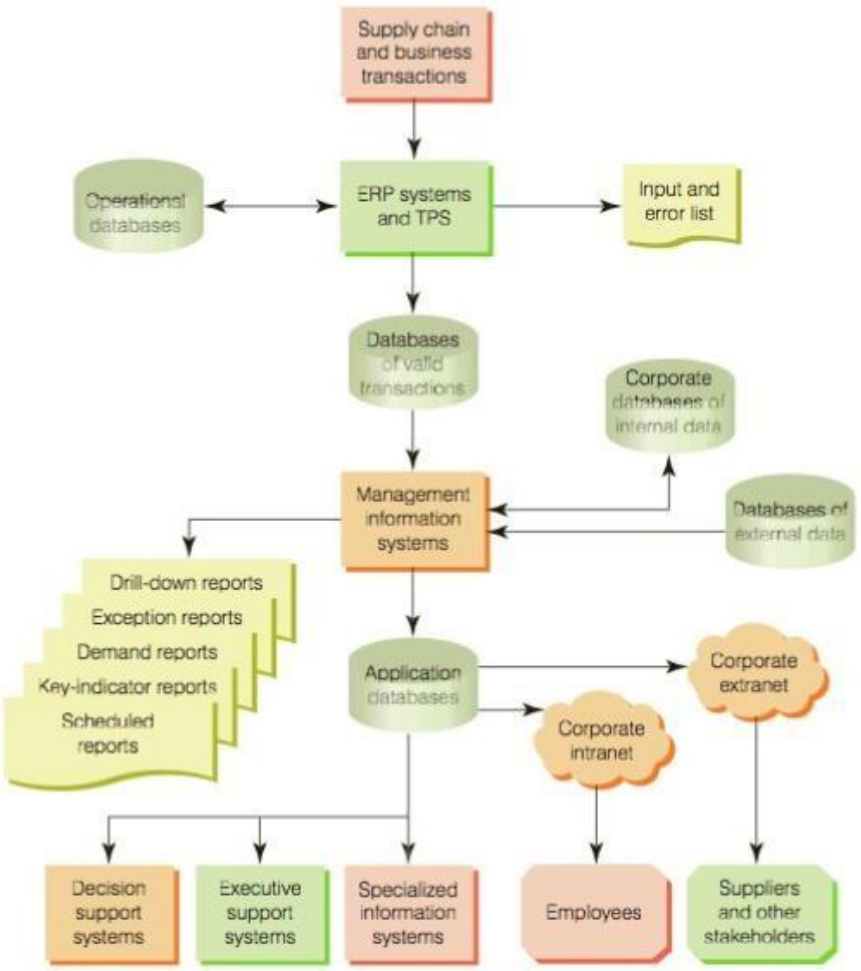
The amount of data that some companies are currently collecting is becoming so huge that it is difficult to process using traditional database technology. This phenomenon is referred to as Big Data, and it is currently a hot research topic in information systems. Big Data is of interest because of the additional insight it can offer into customer behaviour, logistics, factory design and a host of other applications. Big Data involves new ways of capturing data, processing it and visualizing the patterns and trends in it. Often processing Big Data requires many computers operating in parallel.

2.2 An Overview of Management Information Systems

A management information system (MIS) is an integrated collection of people, procedures, databases, hardware and software that provides managers and decision makers with information to help achieve organizational goals. The primary purpose of an MIS is to help an organization achieve its goals by providing managers with insight into the regular operations of the organization so that they can control, organize and plan more effectively. One important role of the MIS is to provide the right information to the right person in the right format at the right time. In short, an MIS provides managers with information, typically in reports, that supports effective decision making and provides feedback on daily operations. For example, a manager might request a report of weekly sales, broken down by area. On the basis of this information, she might decide to redistribute her mobile sales staff to have greater coverage in one place and less in another Figure 2.2 shows the role of an MIS within the flow of an organization's information. Note that business transactions can enter the organization through traditional methods or via the Internet or an extranet connecting customers and suppliers to the firm's ERP or transaction processing systems. The use of MIS spans all levels of management. That is, they provide support to and are used by employees throughout the organization.

Inputs to a Management Information System

As shown in Figure 2.2, data that enters an MIS originates from both internal and external sources, including the company's supply chain. The most significant internal data sources for an MIS are the organization's various TPS and ERP systems. Companies also use data warehouses to store valuable business information. Other internal data comes from specific functional areas throughout the firm. External sources of data can include customers, suppliers, competitors and stockholders whose data is not already captured by the TPS, as well as other sources, such as the Internet. In addition, many companies have implemented extranets to link with selected suppliers and other business partners to exchange data and information. Figure 2.2 Sources of Managerial Information



The MIS uses the data obtained from these sources and processes it into information more usable by managers, primarily in the form of predetermined reports. For example, rather than simply obtaining a chronological list of sales activity over the past week, a national sales manager might obtain his or her organization's weekly sales data in a format that allows him or her to see sales activity by region, by local sales representative, by product and even in comparison with last year's sales.

Outputs of a Management Information System

The output of most management information systems is a collection of reports that are distributed to managers. These can include tabulations, summaries, charts and graphs. Management reports can come from various company databases, data warehouses and other sources. These reports include scheduled reports, key-indicator reports, demand reports, exception reports and drill-down reports (see Figure 2.3).

Scheduled Reports

Scheduled reports are produced periodically, or on a schedule, such as daily, weekly or monthly. For example, a production manager could use a weekly summary report that lists total payroll costs to monitor and control labour and job costs. A manufacturing report generated

once per day to monitor the production of a new item is another example of a scheduled report. Other scheduled reports can help managers control customer credit, performance of sales representatives, inventory levels and more.

Figure 2.3 Reports Generated by an MIS

(a) Scheduled Report

Daily Sales Detail Report

Prepared: 08/10/17

Order #	Customer ID	Salesperson ID	Planned Ship Date	Quantity	Item #	Amount
P12453	C89321	CAR	08/12/14	144	P1234	€3214
P12453	C89321	CAR	08/12/14	288	P3214	€5660
P12454	C03214	GWA	08/13/14	12	P4902	€1224
P12455	C52313	SAK	08/12/14	24	P4012	€2448
P12456	C34123	JMW	08/13/14	144	P3214	€720

(b) Key-Indicator Report

Daily Sales Key-Indicator Report

Prepared: 08/10/17

	This Month	Last Month	Last Year
Total Orders Month to Date	€1808	€1694	€1914
Forecasted Sales for the Month	€2406	€2224	€2608

(c) Demand Report

Daily Sales by Salesperson Summary Report

Prepared: 08/10/17

Salesperson ID	Amount
CAR	€42 345
GWA	€38 960
SAK	€22 100
JWN	€12 350

(d) Exception Report

Daily Sales Exception Report – Orders Over €10 000

Prepared: 08/10/17

Order #	Customer ID	Salesperson ID	Planned Ship Date	Quantity	Item #	Amount
P12345	C89321	GWA	08/12/14	576	P1234	€12 856
P22153	C00453	CAR	08/12/14	288	P2314	€28 800
P23023	C32832	JMN	08/11/14	144	P2323	€14 400

Key-Indicator Reports

A **key-indicator report** summarizes the previous day's critical activities and is typically available at the beginning of each workday. These reports can summarize inventory levels, production activity, sales volume and the like. Key-indicator reports are used by managers and executives to take quick, corrective action on significant aspects of the business.

Demand Reports

Demand reports are developed to give certain information upon request. In other words, these reports are produced on demand. Like other reports dis- cussed in this section, they often come from an organization's database system. For example, an executive might want to know the production status of a particular item – a demand report can be generated to provide the requested information by querying the company's database. Suppliers and customers can also use demand reports. FedEx, for example, provides demand reports on its website to allow its customers to track packages from their source to their final destination. Other examples of demand reports include reports requested by executives to show the hours worked by a particular employee, total sales to date for a product and so on.

Exception Reports

Exception reports are reports that are automatically produced when a situation is unusual or requires management action. For example, a manager might set a parameter that generates a report of all items which have been purchased and then returned by more than five customers. Such items may need to be looked at to identify any production problem, for instance. As with key-indicator reports, exception reports are most often used to monitor aspects important to an organization's success. In general, when an exception report is produced, a manager or executive takes action. Parameters or trigger points, for an exception report should be set carefully. Trigger points that are set too low might result in too many exception reports; trigger points that are too high could mean that problems requiring action are overlooked. For example, if a manager wants a report that contains all projects over budget by €1000 or more, the system might retrieve almost every company project. The €1000 trigger point is probably too low. A trigger point of €10

Drill-Down Reports

Drill-down reports provide increasingly detailed data about a situation. Through the use of drill-down reports, analysts can see data at a high level first (such as sales for the entire company), then at a more detailed level (such as the sales for one department of the company) and then a very detailed level (such as sales for one sales representative). Managers can drill down into more levels of detail to individual transactions if they want.

Developing Effective Reports

Management information system reports can help managers develop better plans, make better decisions and obtain greater control over the operations of the firm, but, in practice, the types of reports can overlap. For example, a manager can demand an exception report or set trigger points for items contained in a key-indicator report. In addition, some software packages can be used to produce, gather and distribute reports from different computer systems. Certain guide- lines should be followed in designing and developing reports to yield the best results. Table 8.1 explains some of these guidelines.

Characteristics of a Management Information System

- Provide reports with fixed and standard formats. For example, scheduled reports for inventory control can contain the same types of information placed in the same locations on the reports. Different managers can use the same report for different purposes.

- Produce hard-copy and soft-copy reports. Some MIS reports are printed on paper, which are hard-copy reports. Most output soft copy, using visual displays on computer screens. Soft-copy output is typically formatted in a report format. In other words, a man- ager might display an MIS report directly on the computer screen, but the report would still appear in the standard hard-copy format.
- Use internal data stored in the computer system. MIS reports use primarily internal sources of data that are contained in computerized databases. Some MISs also use external sources of data about competitors, the marketplace and so on. The web is a frequently used source for external data.
- Allow users to develop their own custom reports. Although analysts and programmers might be involved in developing and implementing complex MIS reports that require data from many sources, users are increasingly developing their own simple programs to query databases and produce basic reports. This capability, however, can result in several users developing the same or similar reports, which can increase the total time expended and require more storage, compared with having an analyst develop one report for all users.
- Require users to submit formal requests for reports to systems personnel. When IS personnel develop and implement MIS reports, they typically require others to submit a formal request to the IS department. If a manager, for example, wants a production report to be used by several people in his or her department, a formal request for the report is often required. User-developed reports require much less formality.

Table 2.1 Guidelines for Developing MIS Reports

Guidelines	Reason
Tailor each report to user needs	The unique needs of the manager or executive should be considered, requiring user involvement and input
Spend time and effort producing only reports that are useful	After being instituted, many reports continue to be generated even if no one uses them anymore
Pay attention to report content and layout	Prominently display the information that is most desired. Do not clutter the report with unnecessary data. Use commonly accepted words and phrases. Managers can work more efficiently if they can easily find desired information
Use management-by-exception reporting	Some reports should be produced only when a problem needs to be solved or an action should be taken
Set parameters carefully	Low parameters might result in too many reports; high parameters mean valuable information could be overlooked
Produce all reports in a timely fashion	Outdated reports are of little or no value
Periodically review reports	Review reports at least once per year to make sure they are still needed. Review report content and layout. Determine whether additional reports are needed

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2.3 Functional MIS

Most organizations are structured along functional lines or areas. This functional structure is usually apparent from an organization chart. Some traditional functional areas are finance, manufacturing, marketing and human resources, among others. The MIS can also be divided along those functional lines to produce reports tailored to individual functions (see Figure 2.4)

Figure 2.4 An Organization's MIS The

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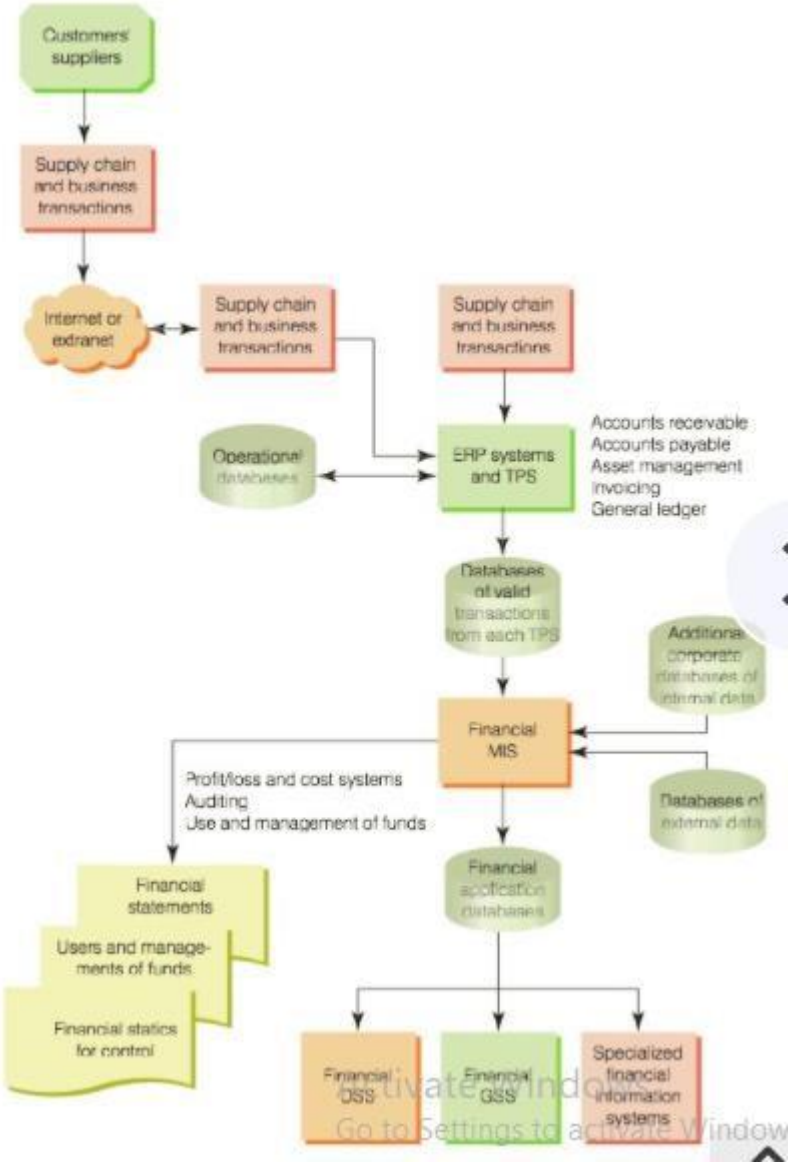
Financial Management Information Systems

A financial MIS provides financial information not only for executives but also for a broader set of people who need to make better decisions on a daily basis. Financial MISs are used to streamline reports of transactions. Most financial MIS perform the following functions:

- Integrate financial and operational information from multiple sources, including the Internet, into a single system.
- Provide easy access to data for both financial and non-financial users, often through the use of a corporate intranet to access corporate web pages of financial data and information.
- Make financial data immediately available to shorten analysis turnaround time.
- Enable analysis of financial data along multiple dimensions – time, geography, product, plant, customer.
- Analyze historical and current financial activity.
- Monitor and control the use of funds over time.

Figure 2.5 shows typical inputs, function-specific subsystems and outputs of a financial MIS, including profit and loss, auditing, and uses and management of funds.



Financial MIS are used to compute revenues, costs, profits and for auditing. **Auditing** involves analyzing the financial condition of an organization and determining whether financial statements and reports produced by the financial MIS are accurate. Financial MISs are also used to manage funds. Internal uses of funds include purchasing additional inventory, updating plants and equipment, hiring new employees, acquiring other companies, buying new computer systems, increasing marketing and advertising, purchasing raw materials or land, investing in new products, and increasing research and development. External uses of funds are typically investment related. Companies often invest excess funds in such external revenue generators as bank accounts, stocks, bonds, bills, notes, futures, options and foreign currency using financial MISs.

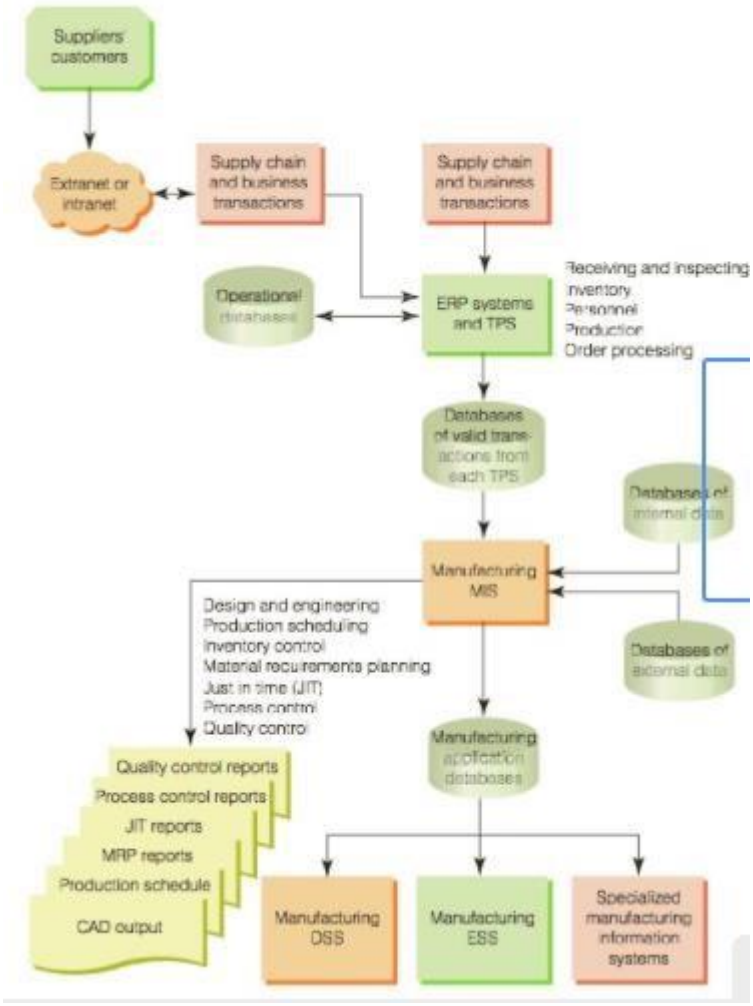
Manufacturing Management Information Systems

More than any other functional area, advances in information systems have revolutionized manufacturing. As a result, many manufacturing operations have been dramatically improved over the last decade. Also, with the emphasis on greater quality and productivity, having an effective manufacturing process is becoming even more critical. The use of computerized systems is emphasized at all levels of manufacturing – from the shop floor to the executive suite. People and small businesses, for example, can benefit from manufacturing MISs that once were only available to large corporations. Personal fabrication systems, for example, can make circuit boards, precision parts, radio tags and more.6 Personal fabrication systems include precise machine tools, such as milling machines and cutting tools, and sophisticated software. The total system can cost €15 000. For example, in a remote area of Norway, Maakon Karlson uses a personal fabrication system that makes radio tags to track sheep and other animals. The use of the Internet has also streamlined all aspects of manufacturing. Figure 2.6 gives an overview of some of the manufacturing MIS inputs, subsystems and outputs.

The manufacturing MIS subsystems and outputs monitor and control the flow of materials, products and services through the organization. As raw materials are converted to finished goods, the manufacturing MIS monitors the process at almost every stage. New technology could make this process easier. Using specialized computer chips and tiny radio transmitters, companies can monitor materials and products through the entire manufacturing process. Car manufacturers, who convert raw steel, plastic and other materials into a finished vehicle, also monitor their manufacturing processes. Car manufacturers add thousands of euros of value to the raw materials they use in assembling a car. If the manufacturing MIS also lets them provide additional services such as customized paint colours on any of their models, it has added further value for customers. In doing so, the MIS helps provide the company with the edge that can differentiate it from its competitors. The success of an organization can depend on the manufacturing function. Some common information subsystems and outputs used in manufacturing are discussed next.

- Design and engineering. Manufacturing companies often use computer-aided design (CAD) with new or existing products (Figure 2.6). For example, Boeing uses a CAD system to develop a complete digital blueprint of an aircraft before it ever begins its manufacturing process. As mock-ups are built and tested, the digital blueprint is constantly revised to reflect the most current design. Using such technology helps Boeing reduce its manufacturing costs and the time to design a new aircraft

Figure 2.6 Overview of a Manufacturing MIS



- Master production scheduling and inventory control. Scheduling production and controlling inventory are critical for any manufacturing company. The overall objective of master production scheduling is to provide detailed plans for both short-term and longrange scheduling of manufacturing facilities. Many techniques are used to minimize inventory costs. Most determine how much and when to order inventory. One method of determining how much inventory to order is called the **economic order quantity (EOQ).** This quantity is calculated to minimize the total inventory costs. The when-to-order question is based on inventory usage over time. Typically, the question is answered in terms of a **reorder point (ROP),** which is a critical inventory quantity level. When the inventory level for a particular item falls to the reorder point, or critical level, the system generates a report so that an order is immediately placed for the EOQ of the product. Another inventory technique used when the demand for one item depends on the demand for another is called **material requirements planning (MRP).**

The basic goal of MRP is to determine when finished products, such as cars or aeroplanes, are

Needed and then to work backward to determine deadlines and resources needed, such as engines and tyres, to complete the final product on schedule. **Just-in-time (JIT)** inventory and manufacturing is an approach that maintains inventory at the lowest levels without sacrificing the availability of finished products. With this approach, inventory and materials are delivered

just before they are used in a product. A JIT inventory system would arrange for a car windscreen to be delivered to the assembly line just before it is secured to the Car, rather than storing it in the manufacturing facility while the car's other components are being assembled. JIT, however, can result in some organizations running out of inventory when demand exceeds expectations.

- Process control. Managers can use a number of technologies to control and streamline the manufacturing process. For example, computers can directly control manufacturing equipment, using systems called **computer-aided manufacturing (CAM).**

Process control. Managers can use a number of technologies to control and streamline the manufacturing process. For example, computers can directly control manufacturing equipment, using systems called **computer-aided manufacturing (CAM).**

uses computers to link the components of the production process into an effective system.

CIM's goal is to tie together all aspects of production, including order processing, product design, manufacturing, inspection and quality control, and shipping. **A flexible manufacturing system (FMS)** is an approach that allows manufacturing facilities to rapidly and efficiently change from making one product to another. In the middle of a production run, for example, the production process can be changed to make a different product or to switch manufacturing materials. By using an FMS, the time and cost to change manufacturing jobs can be substantially reduced, and companies can react quickly to market needs and competition.

- Quality control and testing. With increased pressure from consumers and a general concern for productivity and high quality, today's manufacturing organizations are placing more emphasis on quality control, a process that ensures the finished product meets the customer's needs. Information systems are used to monitor quality and take corrective steps to eliminate possible quality problems.

Figure 2.7 A Vanguard- class nuclear powered submarine

Marketing Management Information Systems

A **marketing MIS** supports managerial activities in product development, distribution, pricing decisions, promotional effectiveness and sales forecasting. Marketing functions are increasingly being performed on the Internet. Many companies are developing Internet marketplaces to advertise and sell products. The amount spent on online advertising is worth billions of euros annually. Software can measure how many customers see the advertising. Some companies use software products to analyze customer loyalty. Some marketing departments are actively using blogs to publish company-related information and interact with customers.8 Customer relationship management (CRM) programs, available from some ERP vendors, help a company manage all aspects of customer encounters. CRM software can help a company collect customer data, contact customers, educate customers on new products and sell products to customers through a website. An airline, for example, can use a CRM system to notify customers about flight changes. New Zealand's Jade Stadium, for example, uses CRM software from GlobalTech Solutions to give a single entry point to its marketing efforts and customer databases, instead of using about 20 spreadsheets.9 The CRM software will help Jade Stadium develop effective marketing campaigns, record and track client contacts, and maintain an accurate database of clients. Yet, not all CRM systems and marketing sites on the Internet are successful. Customization and ongoing maintenance of a CRM system can be expensive. Figure 2.8 shows the inputs, subsystems and outputs of a typical marketing MIS.

Subsystems for the marketing MIS include marketing research, product development, promotion and advertising, and product pricing. These subsystems and their outputs help marketing managers and executives increase sales, reduce marketing expenses and develop plans for future products and services to meet the changing needs of customers.

- Marketing research. The purpose of marketing research is to conduct a formal study of the market and customer preferences. Computer systems are used to help con- duct and analyze

the results of surveys, questionnaires, pilot studies and interviews. Messages on social media sites such as Facebook and Twitter are regularly used for market research, as companies search for their brand names to see what people are saying about them.

- Product development. Product development involves the conversion of raw materials into finished goods and services and focuses primarily on the physical attributes of the product. Many factors, including plant capacity, labour skills, engineering factors and materials are important in product development decisions. In many cases, a computer program analyzes these various factors and selects the appropriate mix of labour, materials, plant and equipment, and engineering designs. Make-or-buy decisions can also be made with the assistance of computer programs.

- Promotion and advertising. One of the most important functions of any marketing effort is promotion and advertising. Product success is a direct function of the types of advertising and sales promotion done. Increasingly, organizations are using the Internet to advertise and sell products and services. With the use of GPS, marketing firms can pro- mote products such as local shops and restaurants to mobile devices like phones and tablets that are close by. You could receive a discount coupon for a shop as you walk past it!

- Product pricing. Product pricing is another important and complex marketing function. Retail price, wholesale price and price discounts must be set. Most companies try to develop pricing policies that will maximize total sales revenues. Computers are often used to analyze the relationship between prices and total revenues. Some companies are using Internet behavioural pricing, where the price customers pay online depends on what they might be willing to pay based on information on past transactions and Internet searches that reveal individual shopping behaviours.

- Sales analysis. Computerized sales analysis is important to identify products, sales personnel and customers that contribute to profits and those that do not. Several reports can be generated to help marketing managers make good sales decisions (see Figure 8.9). The sales-by-product report lists all major products and their sales for a period of time, such as a month. This report shows which products are doing well and which need improvement or should be discarded altogether. The sales-by-salesperson report lists total sales for each salesperson for each week or month. This report can also be subdivided by product to show which products are being sold by each salesperson. The sales-by-customer report is a tool that can be used to identify high- and low-volume customers.

Figure 2.8 Overview of a Marketing MIS

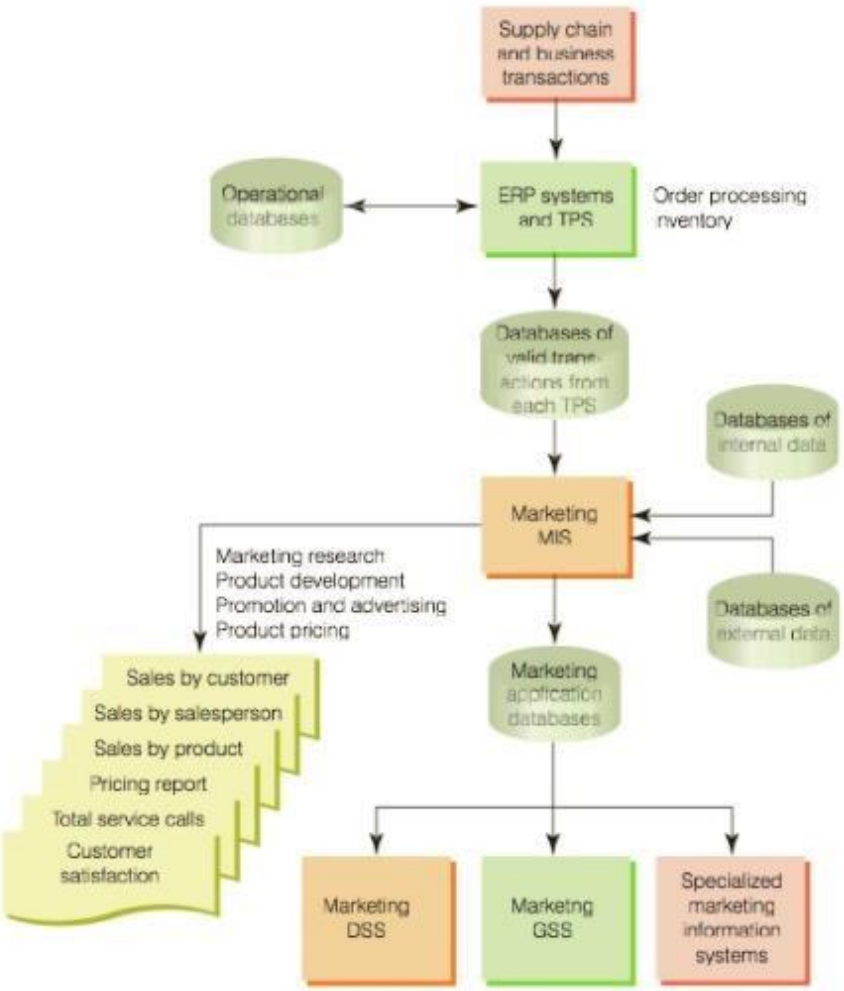


Figure 2.9 Reports Generated to Help Marketing Managers Make Good Decisions

(a) Sales by product

Product	August	September	October	November	December	Total
Product 1	34	32	32	21	33	152
Product 2	156	162	177	163	122	780
Product 3	202	145	122	98	66	633
Product 4	345	365	352	341	288	1691

(b) Sales by salesperson

Salesperson	August	September	October	November	December	Total
Jones	24	42	42	11	43	162
Kline	166	155	156	122	133	732
Lane	166	155	104	99	106	630
Miller	245	225	305	291	301	1367

(c) Sales by customer

Customer	August	September	October	November	December	Total
Ang	234	334	432	411	301	1712
Braswell	56	62	77	61	21	277
Celec	1202	1445	1322	998	667	5634
Jung	45	65	55	34	88	287

Human Resource Management Information Systems

A **human resource MIS (HRMIS),** also called a personnel MIS, is concerned with activities related to previous, current and potential employees of the organization. Because the personnel function relates to all other functional areas in the business, the HRMIS plays a valuable role in ensuring organizational success. Some of the activities performed by this important MIS include workforce analysis and planning, hiring, training, job and task assignment, and many other personnel-related issues. An effective HRMIS allows a company to keep personnel costs at a minimum, while serving the required business processes needed to achieve corporate goals. Although human resource information systems focus on cost reduction, many of today's HR systems concentrate on hiring and managing existing employees to get the total potential of the human talent in the organization. According to the High Performance Workforce Study conducted by Accenture, the most important HR initiatives include improving worker productivity, improving adaptability to new opportunities and facilitating organizational change. Figure 2.10 shows some of the inputs, subsystems and outputs of the HRMIS.

Figure 2.10

Human resource subsystems and outputs range from the determination of human resource needs and hiring through retirement and outplacement. Most medium and large organizaions have computer systems to assist with human resource planning, hiring, training and skills inventorying, and wage and salary administration. Outputs of the human resource MIS include reports, such as human resource planning reports, job application review profiles, skills inventory reports and salary surveys.

- Human resource planning. One of the first aspects of any HRMIS is determining personnel and human needs. The overall purpose of this MIS subsystem is to put the right number and kinds of employees in the right jobs when they are needed. Effective human resource planning can require computer programs, such as SPSS and SAS, to forecast the future number of employees needed and anticipating the future supply of people for these jobs. IBM is using an HR pilot program, called Professional Marketplace, to plan for workforce needs, including the supplies and tools the workforce needs to work efficiently.10 Professional Marketplace helps IBM to catalogue employees into a glossary of skills and abilities. Like many other companies, HR and workforce costs are IBM's biggest expense.

- Personnel selection and recruiting. If the human resource plan reveals that additional personnel are required, the next logical step is recruiting and selecting personnel. Companies seeking new employees often use computers to schedule recruiting efforts and trips, and to test potential employees' skills. Many companies now use the Internet to screen for job applicants. Applicants use a template to load their CVs onto the Internet site. HR managers can then access these CVs and identify applicants they are interested in interviewing.

- Training and skills inventory. Some jobs, such as programming, equipment repair and tax preparation, require very specific training for new employees. Other jobs may re- quire general training about the organizational culture, orientation, dress standards and expectations of the organization. When training is complete, employees often take computer-scored tests to evaluate their mastery of skills and new material.

- Scheduling and job placement. Employee schedules are developed for each employee, showing his or her job assignments over the next week or month. Job placements are often determined based on skills inventory reports, which show which employee might be best suited to a particular job. Sophisticated scheduling programs are often used in the airline industry, the military and many other areas to get the right people assigned to the right jobs at the right time.

- Wage and salary administration. Another HRMIS subsystem involves determining salaries and benefits, including medical insurance and pension payments. Wage data, such as industry averages for positions, can be taken from the corporate database and manipulated by the HRMIS to provide wage information reports to higher levels of management.

Geographic Information Systems

Although not yet common in organizations, a **geographic information system (GIS)** is a computer system capable of assembling, storing, manipulating and displaying geographically referenced information; that is, data identified according to its location. A GIS enables users to pair maps or map outlines with tabular data to describe aspects of a particular geographic region. For example, sales managers might want to plot total sales for each region in the countries they serve. Using a GIS, they can specify that each region be shaded to indicate the relative amount of sales – no shading or light shading represents no or little sales, and deeper shading represents more sales. Staples Inc., the large office supply store chain, used a geographic information system to select about 100 new store locations, after considering about 5000 possible sites finding the best location is critical. It can cost up to €750 000 for a failed store because of a poor location. Staples uses a GIS tool from Tactician Corporation, along with software from SAS. Although many software products have seen declining revenues, the use of GIS software is increasing.

2.4 Decision Support Systems

Management information systems provide useful summary reports to help solve structured and semi-structured business problems. Decision support systems (DSSs) offer the potential to assist in solving both semi-structured and unstructured problems. A DSS is an organized collection of people, procedures, software, databases and devices used to help make decisions that solve problems. The focus of a DSS is on decision-making effectiveness when faced with unstructured or semi-structured business problems. As with a TPS and an MIS, a DSS should be designed, developed and used to help an organization achieve its goals

And objectives. Decision support systems offer the potential to generate higher profits, lower costs, and better products and services. Decision support systems, although skewed somewhat towards the top levels of management, are used at all levels. To some extent, today's managers at all levels are faced with less structured, non-routine problems, but the quantity and magnitude of these decisions increase as a manager rises higher in an organization. Many organizations contain a tangled web of complex rules, procedures and decisions. DSSs are used to bring more structure to these problems to aid the decision-making process. In addition, because of the inherent flexibility of decision support systems, managers at all levels are able to use DSSs to assist in some relatively routine, programmable decisions in lieu of more formalized management information systems.

Characteristics of a Decision Support System

Decision support systems have many characteristics that allow them to be effective management support tools, some of which are listed here. Of course, not all DSSs work the same.

- Provide rapid access to information. DSSs provide fast and continuous access to information.
- Handle large amounts of data from different sources. For instance, advanced database management systems and data warehouses have allowed decision makers to search for information with a DSS, even when some data resides in different databases on different computer systems or networks. Other sources of data can be accessed via the Internet or over a corporate intranet. Using the Internet, an oil giant can use a decision support system to save hundreds of millions of euros annually by coordinating a large amount of drilling and exploration data from around the globe.
- Provide report and presentation flexibility. Managers can get the information they want, presented in a format that suits their needs. Furthermore, output can be displayed on computer screens or printed, depending on the needs and desires of the problem solvers.
- Offer both textual and graphical orientation. DSSs can produce text, tables, line drawings, pie charts, trend lines and more. By using their preferred orientation, managers can use a DSS to get a better understanding of a situation and to convey this understanding to others.
- Support drill-down analysis. A manager can get more levels of detail when needed by drilling down through data. For example, a manager can get more detailed information for a project – viewing the overall project cost, then drilling down and seeing the cost for each phase, activity and task.
- Perform complex, sophisticated analysis and comparisons using advanced software packages. Marketing research surveys, for example, can be analyzed in a variety of ways using programs that are part of a DSS. Many of the analytical programs associated with a DSS are actually stand-alone programs, and the DSS brings them together.
- Support optimization, satisficing and heuristic approaches. By supporting all types of decision-making approaches, a DSS gives the decision maker a great deal of flexibility in computer support for decision making. For example, what-if analysis, the process of making hypothetical changes to problem data and observing the impact on the results, can be used to control inventory. Given the demand for products, such as cars, the computer can determine the necessary parts and components, including engines, transmissions, windows and so on. With what-if analysis, a manager can make changes to problem data, say the number of cars needed for next month, and immediately see the impact on the parts requirements.
- Perform goal-seeking analysis. Goal-seeking analysis is the process of determining the problem data required for a given result. For example, a financial manager might be considering an investment with a certain monthly net income, and the manager might have a goal to earn a return of 9 per cent on the investment. Goal seeking allows the manager to determine what monthly net income (problem data) is needed to yield a return of 9 per cent (problem result). Some spread- sheets can be used to perform goal-seeking analysis.
- Perform simulation. **Simulation** is the ability of the DSS to duplicate the features of a real system. In most cases, probability or uncertainty is involved. For example, the number of repairs and the time to repair key components of a manufacturing line can be calculated to determine the impact on the number of products that can be produced each day. Engineers can use this data to determine which components need to be reengineered to increase the

mean time between failures and which components need to have an ample supply of spare parts to reduce the mean time to repair. Drug companies are using simulated trials to reduce the need for human participants and reduce the time and costs of bringing a new drug to market. Drug companies are hoping that this use of simulation will help them identify successful drugs earlier in development. Corporate executives and military commanders often use computer simulations to allow them to try different strategies in different situations. Corporate executives, for example, can try different marketing decisions under various market conditions. Military commanders often use computer war games to finetune their military strategies in different warfare conditions. The Turkish army, for example, uses simulation to help coordinate its fuel-supply system.

Capabilities of a Decision Support System

Developers of decision support systems strive to make them more flexible than management information systems and to give them the potential to assist decision makers in a variety of situations. DSSs can assist with all or most problem-solving phases, decision frequencies and different degrees of problem structure. DSS approaches can also help at all levels of the decision- making process. A single DSS might provide only a few of these capabilities, depending on its uses and scope.

- Support for problem-solving phases. The objective of most decision support systems is to assist decision makers with the phases of problem solving. As previously discussed, these phases include intelligence, design, choice, implementation and monitoring. A specific DSS might support only one or a few phases. By supporting all types of decision-making approaches, a DSS gives the decision maker a great deal of flexibility in getting computer support for decision-making activities.
- Support for different decision frequencies. Decisions can range on a continuum from oneof-a-kind to repetitive decisions. One-of-a-kind decisions are typcally handled by an **ad hoc** DSS. An ad hoc DSS is concerned with situations or decisions that come up only a few times during the life of the organization; in small businesses, they might happen only once. For example, a company might need to change the layout of its open plan offices. Repetitive decisions are addressed by an institutional DSS. An institutional DSS handles situations or decisions that occur more than once, usually several times per year or more. An institutional DSS is used repeatedly and refined over the years. For example, a DSS used to assist helpdesk staff solve employees' computer problems and queries.
- Support for different problem structures. As discussed previously, decisions can range from highly structured and programmed to unstructured and non-programmed. Highly **structured problems** are straightforward, requiring known facts and relationships. **Semistructured or unstructured** problems, on the other hand, are more complex. The relationships among the pieces of data are not always clear, the data might be in a variety of formats, and it is often difficult to manipulate or obtain. In addition, the decision maker might not know the information requirements of the decision in advance.

- Support for various decision-making levels. Decision support systems can provide help for managers at different levels within the organization. Operational managers can get assistance with daily and routine decision making. Tactical decision makers can use analysis tools to ensure proper planning and control. At the strategic level, DSSs can help managers by providing analysis for long-term decisions requiring both internal and external information (see Figure 2.11)

Figure 2.11 Decision- Making Level Strategic managers are involved with long-term

A Comparison of a DSS and an MIS

A DSS differs from an MIS in numerous ways, including the type of problems solved, the support given to users, the decision emphasis and approach, and the type, speed, output and development of the system used. Table 2.2 lists brief descriptions of these differences. You should note that entity resource planning systems include both MISs and DSSs (and, as discussed in the previous chapter, TPS)

Components of a Decision Support System

At the core of a DSS are a database and a model base. In addition, a typical DSS contains a user interface, also called **dialogue manager**, that allows decision makers to easily access and manipulate the DSS and to use com- mon business terms and phrases. Finally, access to the Internet, networks and other computer-based systems permits the DSS to tie into other powerful systems, including the TPS or function-specific subsystems. Internet software agents, for example, can be used in creating powerful decision support systems. Figure 2.2 shows a conceptual model of a DSS, although specific DSSs might not have all these components.

Table 2.2 Comparison of a DSS and an MIS

Factor	DSS	MIS
Problem Type	A DSS can handle unstructured problems that cannot be easily programmed	An MIS is normally used only with structured problems
Users	A DSS supports individuals, small groups and the entire organization. In the short run, users typically have more control over a DSS	An MIS supports primarily the organization. In the short run, users have less control over an MIS
Support	A DSS supports all aspects and phases of decision making; it does not replace the decision maker – people still make the decisions	This is not true of all MIS systems – some make automatic decisions and replace the decision maker
Emphasis Approach	A DSS emphasizes actual decisions and decision-making styles. A DSS is a direct support system that provides interactive reports on computer screens	An MIS usually emphasizes information only. An MIS is typically an indirect support system that uses regularly produced reports
Speed	Because a DSS is flexible and can be implemented by users, it usually takes less time to develop and is better able to respond to user requests	An MIS's response time is usually longer
Output	DSS reports are usually screen oriented, with the ability to generate reports on a printer	An MIS typically is oriented towards printed reports and documents
Development	DSS users are usually more directly involved in its development. User involvement usually means better systems that provide superior support. For all systems, user involvement is the most important factor for the development of a successful system	An MIS is frequently several years old and often was developed for people who are no longer performing the work supported by the MIS

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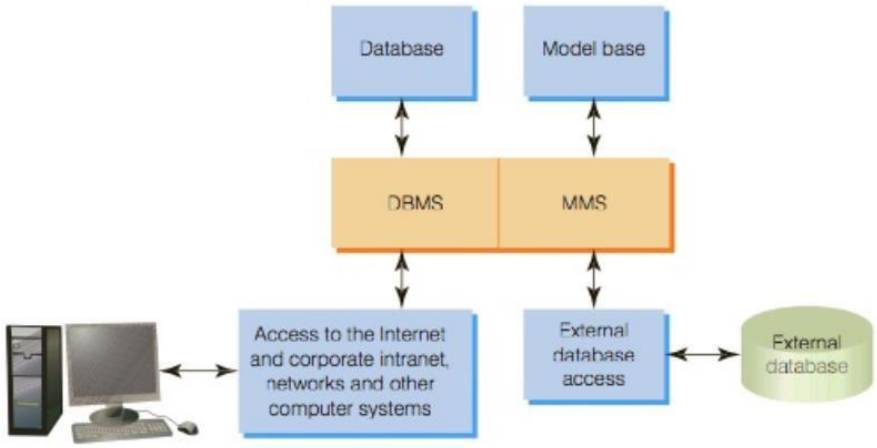
Figure 2.12 Conceptual Model of a DSS



The Database

The database management system allows managers and decision makers to perform qualitative analysis on the company's vast stores of data in databases and data warehouses. DSSs tap into vast stores of information contained in the corporate database, retrieving information on inventory, sales, personnel, production, finance, accounting and other areas.13 Data mining and business intelligence are often used in DSSs. Airline companies, for example, use a DSS to help it identify customers for round-trip flights be- tween major cities. The DSS can be used to search a data warehouse to contact thousands of customers who might be interested in an inexpensive flight. A casino can use a DSS to search large databases to get detailed information on patrons. It can tell how much each patron spends per day on gambling, and more. Opportunity International uses a DSS to help it make loans and provide services to tsunami victims and others in need around the world.According to the information services manager of Opportunity International, 'We need to pull all the data ... to one central database that we can analyze, and we need a way to get that information back out to people in the field'. A DSS can also be used in emergency medical situations to make split- second, life-or-death treatment decisions. a database management system can also connect to external databases to give managers and decision makers even more information and decision support. External databases can include the Internet, libraries, government databases and more. The combination of internal and external database access can give key decision makers a better understanding of the company and its environment.

The Model Base

In addition to the data, a DSS needs a model of how elements of the data are related, in order to help make decisions. The **model base** allows managers and decision makers to perform quantitative analysis on both internal and external data.16 the model base gives decision makers access to a variety of models so that they can explore different scenarios and see their effects. Ultimately, it assists them in the decision-making process. Procter & Gamble, maker of Pringles potato crisps, Pampers nappies and hundreds of other consumer products, use DSSs to streamline how raw materials and products flow from its suppliers to its customers, saving millions of euros. Scientists and mathematicians also use DSSs. DSSs can be excel- lent at predicting customer behaviours. Most banks, for example, use models to help forecast which

customers will be late with payments or might default on their loans. The models and algorithms used in a DSS are often reviewed and revised over time. As a result of Hurricane Katrina in the US, for example, American insurance companies revised their models about storm damage and insurance requirements.

Model management software (MMS) is often used to coordinate the use of models in a DSS, including financial, statistical analysis, graphical and project-management models. Depending on the needs of the decision maker, one or more of these models can be used (see Table 2.3)

Table 2.3 Model Management Software DSS often use financial, statistical, graphical and project-management models

Model Type	Description	Software
Financial	Provides cash flow, internal rate of return and other investment analysis	Spreadsheet, such as Microsoft Excel
Statistical	Provides summary statistics, trend projections, hypothesis testing and more	Statistical program, such as SPSS or SAS
Graphical	Assists decision makers in designing, developing and using graphic displays of data and information	Graphics programs, such as Microsoft PowerPoint
Project Management	Handles and coordinates large projects; also used to identify critical activities and tasks that could delay or jeopardize an entire project if they are not completed in a timely and cost-effective fashion	Project management software, such as Microsoft Project

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The User Interface or Dialogue Manager

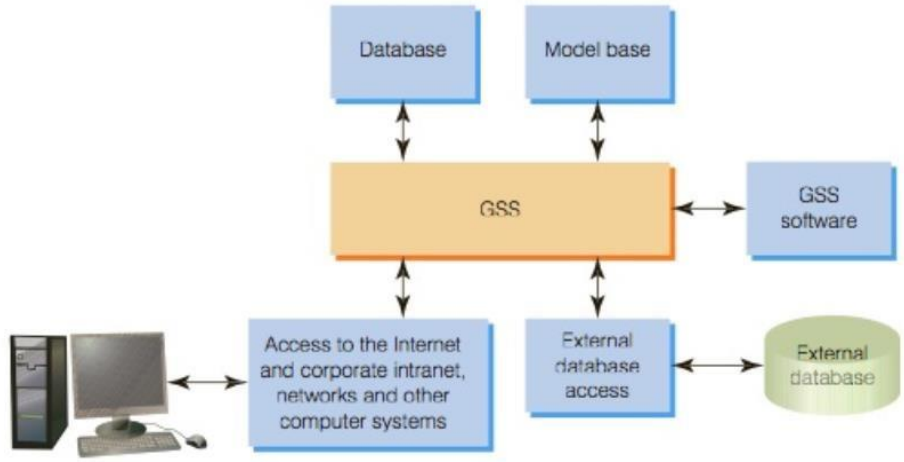
The user interface or dialogue manager allows users to interact with the DSS to obtain information. It assists with all aspects of communications between the user and the hardware and software that constitute the DSS. In a practical sense, to most DSS users, the user interface is the DSS. Upper-level decision makers are often less interested in where the information came from or how it was gathered than that the information is both understandable and accessible.

2.5 Group Support Systems

The DSS approach has resulted in better decision making for all levels of individual users. However, many DSS approaches and techniques are not suitable for a group decision-making environment. Although not all workers and managers are involved in committee meetings and

Group decision-making sessions, some tactical and strategic-level managers can spend more than half their decision-making time in a group setting. Such managers need assistance with group decision making. A group support system (GSS), also called a group decision support system, consists of most of the elements in a DSS, plus software to provide effective support in group 22 decision-making settings (see Figure 2.13).

Table 2.3 Model Management Software DSS often use financial, statistical, graphical and project-management models



Group support systems are used in most industries. Architects are increasingly using GSSs to help them collaborate with other architects and builders to develop the best plans and to compete for contracts. Manufacturing companies use GSSs to link raw material suppliers to their own company systems.

Characteristics of a GSS that Enhance Decision Making

It is often said that two heads are better than one. When it comes to decision making, GSS unique characteristics have the potential to result in better decisions. Developers of these

systems try to build on the advantages of individual support systems while adding new approaches, unique to group decision making. For example, some GSSs can allow the exchange of information and expertise among people without direct face-to-face interaction. The following sections describe some characteristics that can improve and enhance decision making.

- Design for groups. The GSSs approach acknowledges that special procedures, devices and approaches are needed in group decision-making settings. These procedures must foster creative thinking, effective communications and good group decision- making techniques.
- Ease of use. Like an individual DSS, a GSS must be easy to learn and use. Systems that are complex and hard to operate will seldom be used. Many groups have less tolerance than do individual decision makers for poorly developed systems.
- Flexibility. Two or more decision makers working on the same problem might have different decision-making styles and preferences. Each manager makes decisions in a unique way, in part because of different experiences and cognitive styles. An effective GSS not only has to sup- port the different approaches that managers use to make decisions, but also must find a means to integrate their different perspectives into a common view of the task at hand.
- Decision-making support. A GSS can support different decision-making approaches such as brainstorming, the group consensus approach or the nominal group technique.
- Anonymous input. Many GSSs allow anonymous input, where group members do not know which of them is giving the input. For example, some organizations use a GSS to help rank the performance of managers. Anonymous input allows the group decision makers to concentrate on the merits of the input without considering who gave it. In other words, input given by a top- level manager is given the same consideration as input from employees or other members of the group. Some studies have shown that groups using anonymous input can make better decisions and have superior results compared with groups that do not use anonymous input. Anonymous input, however, can result in flaming, where an unknown team member posts insults or even obscenities on the GSS.

- Reduction of negative group behaviour. One key characteristic of any GSS is the ability to suppress or eliminate group behaviour that is counterproductive or harmful to effective decision making. In some group settings, dominant individuals can take over the discussion, which can prevent other members of the group from presenting creative alternatives. In other cases, one or two group members can sidetrack or subvert the group into areas that are non-productive and do not help solve the problem at hand. Other times, members of a group might assume they have made the right decision without examining alternatives – a phenomenon called ‘groupthink’. If group sessions are poorly planned and executed, the result can be a tremendous waste of time. GSS designers are developing software and hardware systems to reduce these types of problems. Procedures for effectively planning and managing group meetings can be incorporated into the GSS approach. A trained meeting facilitator is often employed to help lead the group decision-making process and to avoid groupthink.

- Parallel communication. With traditional group meetings, people must take turns addressing various issues. One person normally talks at a time. With a GSS, every group member can address issues or make comments at the same time by entering them into a PC or workstation. These comments and issues are displayed on every group member's PC or workstation immediately. Parallel communication can speed meeting times and result in better decisions.

- Automated recordkeeping. Most GSSs can keep detailed records of a meeting automatically. Each comment that is entered into a group member's PC or workstation can be recorded. In some cases, literally hundreds of comments can be stored for future review and analysis. In addition, most GSSs packages have automatic voting and ranking features. After group members vote, the GSS records each vote and makes the appropriate rankings.

2.6 Executive Support Systems

Because top-level executives often require specialised support when making strategic decisions, many companies have developed systems to assist executive decision making. This type of system, called **an executive support system (ESS)**, is a specialized DSS that includes all hardware, software, data, procedures and people used to assist senior-level executives within the organization. In some cases, an ESS, also called an executive information system (EIS), supports decision making of members of the board of directors, who are responsible to stockholders. An ESS is a special type of DSS and, like a DSS, an ESS is designed to support higher-level decision making in the organization. The two systems are, however, different in important ways. DSSs provide a variety of modelling and analysis tools to enable users to thoroughly analyze problems – that is, they allow users to answer questions. ESSs present structured inform. about aspects of the organization that executives consider important. In other words, they allow executives to ask the right questions. The following are general characteristics of ESSs:

- Are tailored to individual executives. ESSs are typically tailored to individual executives; DSSs are not tailored to particular users. They present information in the preferred for- mat of that executive.

- Are easy to use. A top-level executive's most critical resource can be his or her time. Thus, an ESS must be easy to learn and use and not overly complex.

- Have drill-down abilities. An ESS allows executives to drill down into the company to determine how certain data was produced. Drilling down allows an executive to get more detailed information if needed.

- Support the need for external data. The data needed to make effective top-level decisions is often external – information from competitors, the government, trade associations and

journals, consultants and so on. An effective ESS can extract data useful to the decision maker from a wide variety of sources, including the Internet and other electronic publishing sources.

- Can help with situations that have a high degree of uncertainty. Most executive decisions involve a high degree of uncertainty. Handling these unknown situations using modelling and other ESS procedures helps top-level managers measure the amount of risk in a decision.
- Have a future orientation. Executive decisions are future oriented, meaning that decisions will have a broad impact for years or decades. The information sources to support futureoriented decision making are usually informal – from organizing golf partners to tying together members of social clubs or civic organizations.
- Are linked with value-added business processes. Like other information systems, executive support systems are linked with executive decision making about value-added business processes.

Capabilities of Executive Support Systems

The responsibility given to top-level executives and decision makers brings unique problems and pressures to their jobs. The following is a discussion of some of the characteristics of executive decision making that are supported through the ESS approach. ESSs take full advantage of data mining, the Internet, blogs, podcasts, executive dashboards and many other technological innovations. As you will note, most of these decisions are related to an organization's overall profitability and direction. An effective ESS should have the capability to support executive decisions with components such as strategic planning and organizing, crisis management and more.

- Support for defining an overall vision. One of the key roles of senior executives is to provide a broad vision for the entire organization. This vision includes the organization's major product lines and services, the types of businesses it supports today and in the future, and its overriding goals.
- Support for strategic planning. ESSs also support strategic planning. Strategic planning involves determining long-term objectives by analyzing the strengths and weaknesses of the organization, predicting future trends, and projecting the development of new product lines. It also involves planning the acquisition of new equipment, analyzing merger. possibilities, and making difficult decisions concerning downsizing and the sale of as- sets if required by unfavourable economic conditions.
- Support for strategic organizing and staffing. Top-level executives are concerned with organizational structure. For example, decisions concerning the creation of new departments or downsizing the labour force are made by top-level managers. Overall direction for staffing decisions and effective communication with labour unions are also major decision areas for top-level executives. ESSs can be employed to help analyze the impact of staffing decisions, potential pay raises, changes in employee benefits and new work rules.

- Support for strategic control. Another type of executive decision relates to strategic control, which involves monitoring and managing the overall operation of the organization. Goal seeking can be done for each major area to determine what performance these areas need to achieve to reach corporate expectations. Effective ESS approaches can help top-level managers make the most of their existing resources and control all aspects of the organization.
- Support for crisis management. Even with careful strategic planning, a crisis can occur. Major disasters, including hurricanes, tornadoes, floods, earthquakes, fires and terrorist activities, can totally shut down major parts of the organization. Handling these emergencies is another responsibility for top-level executives. In many cases, strategic emergency plans can be put into place with the help of an ESS. These contingency plans help organizations recover quickly if an emergency or crisis occurs.

Decision making is a vital part of managing businesses strategically. IS systems such as information and decision support, group support and executive support systems help employees by tapping existing databases and providing them with current, accurate information? The increasing integration of all business information systems – from TPS to MIS to DSS to ESS – can help organizations monitor their competitive environment and make better-informed decisions. Organizations can also use specialized business information systems, discussed in the next two chapters, to achieve their goals.

Chapter Summary/Review

- Good decision-making and problem-solving skills are key to developing effective information and decision support systems. Every organization needs effective decision making and problem solving to reach its objectives and goals.
- A management information system (MIS) must provide the right information to the right person in the right format at the right time. A manage- ment information system is an integrated collection of people, procedures, databases and devices that provides managers and decision makers with information to help achieve organizational goals.
- Decision support systems (DSSs) support decision-making effectiveness when faced with unstructured or semi-structured business problems.
- to handle large amounts of data; obtain and pro- cess data from different sources; provide report and presentation flexibility; support drill-down analysis; perform complex statistical analysis; offer textual and graphical orientations; support optimization, satisficing and heuristic approaches; and perform what-if, simulation and goal-seeking analysis.
- Specialized support systems, such as group support systems (GSSs) and executive sup- port systems (ESSs), use the overall approach of a DSS in situations such as group and executive decision making. A group support system (GSS) consists of most of the elements in a DSS, plus software to provide effective support in group decision-making settings.

Review Questions (Short)

1. The first stage in decision making is the _____ stage.
2. An MIS that supports promotional effectiveness is a _____ MIS.
3. A model that produces a good enough decision is called _____.
4. A GSS supports decision making by a _____.
5. A regular, periodic report is called _____.

Review Questions (Long)

1. Compare and contrast a programmed and non-programmed decision using examples.
2. Outline the main distinguishing features of some of the reports produced by an MIS.
3. Explain the main components of decision making.
4. What is CAD?
5. List some of the characteristics of a decision support system.

Review Questions (MCQ)

1. ERP stands _____ for .
A. Enterprise resource planning
B. Endeavour resource planning
C. Engage resource planning
D. None of the above

2. Systems that allow an organization to conduct business are .
A. System processing software
B. Transaction processing systems
C. Online processing systems
D. business processing system

3. OLTP is _____ .
A. None of the above
B. Offline transaction processing
C. Online transaction processing
D. On transaction processing

4. Buying a book on a smartphone is an example of_____ .
A. C-commerce
B. M-commerce
C. E-commerce
D. D-commerce

5. Systems use to improve interaction between a government and its citizens form _____ .
A. G-government
B. B-government
C. E-government
D. C-government

Case Studies / Projects

Smart Meters Capture Big Data For Energy Decisions

Governments all over the world are putting in place laws and regulations to govern the installation of smart meters that send regular information about utility usage back to energy providers. This information could come in from every household as often as once every thirty minutes. Germany for instance meter by 2020 to record electricity use in the UK, the Department of Energy and Climate Change has plans in place for the installation of 53 millio n electricity smart meters in homes and businesses by 2020. European directive 2009/72/EG lays out the common rules for all EU states regarding the internal market in electricity and requires 'smart grids, which should be built in a way that encourages decentralized generation and energy efficiency'. Similar plans are afoot for metering gas and water.

Questions

1 Should citizens have a choice in whether a smart meter is installed in their homes?

2 Why was testing so important for Yedaș ?

3 How will smart meters make electricity production more efficient?

4 What are some of the privacy concerns with smart meters?

Read

Principles Of Business Information Systems 3rd Edition, Ralph Stair,George Reynolds and Thomas Chesney Chapter 8 Page Number 299

Case Studies / Projects

Taking Designs into the Next Dimension

Established in 2002, Avia Technique has become a leading repair center for aircraft components, with their business director Chris Wright emphasizing their reputation for quality, service and competitiveness. Avia's capabilities are on creating aircraft safety components including engine fire extinguishers, oxygen bottles and masks, emergency locators as well as life jackets and evacuation slides and rafts. The safety requirements are strict and aircraft cannot fly without the proper, certified safety gear. At the same time, every second a plane sits on a runway awaiting parts costs an airline dearly. Avia Technique partners with many airlines throughout the world to ensure that this doesn't happen. 300

Questions

1. What is the problem with 2D designs?
2. What are the advantages of 3D designs?
3. Why is it important to Avia that the software can import designs?
4. How could this software 'reduce the error rate'? Does this seem like a legitimate claim?

Principles Of Business Information Systems 3rd Edition, Ralph Stair,George Reynolds and Thomas Chesney Chapter 8 Page Number 300

Chapter 3: Knowledge Management and Specialized Information Systems

LEARNING OUTCOMES

After reading this Section of the guide, the learner should be able to:

Learning Objectives

- Describe the role of the chief knowledge officer (CKO).
- List some of the tools and techniques used in knowledge management. Define the term ‘artificial intelligence’ and state the objective of developing artificial intelligence systems.
- List the characteristics of intelligent behaviour and compare the performance of natural and artificial intelligence systems for each of these characteristics.
- Identify the major components of the artificial intelligence field and provide one example of each type of system.
- List the characteristics and basic components of expert systems.
- Identify at least three factors to consider in evaluating the development of an expert system.
- Outline and briefly explain the steps for developing an expert system. Identify the benefits associated with the use of expert systems.
- Define the term ‘virtual reality’ and provide three examples of virtual reality applications.
- Discuss examples of specialized systems for organizational and individual use.

Introduction

Knowledge management systems are used in almost every industry. If you are a manager, you might use a knowledge management system to support decisive action to help you correct a problem. If you are a production manager at a car company, you might oversee robots, a specialized information system, that at- tach windscreens to cars or paint body panels. As a young stock trader, you might use a system called a neural network to uncover patterns and make money trading stocks and stock options.

3.1 Knowledge Management Systems

Defining knowledge is difficult. One definition is that knowledge is the awareness and understanding of a set of information and the ways that information can be made useful to support a specific task or reach a decision. Knowing the procedures for ordering more inventory to avoid running out is an example of knowledge. In a sense, information tells you what has to be done (low inventory levels for some items), while knowledge tells you how to do it (make two important phone calls to the right people to get the needed inventory shipped overnight). A knowledge management system (KMS) is an organized collection of people, procedures, software, databases and devices used to create, store, share and use the organization's knowledge and experience

Overview of Knowledge Management Systems

Like the other systems discussed throughout this book, KMSs attempt to help organizations achieve their goals. For businesses, this usually means increasing profits or reducing costs. For non-profit organizations, it can mean providing better customer service or providing special needs to people and groups. Many types of firms use KMSs to increase profits or reduce costs. According to a survey of CEOs, firms that use a KMS are more likely to innovate and perform better.2 A KMS stores and processes knowledge. This can involve different types of knowledge. Explicit knowledge is objective and can be measured and documented in reports, papers and rules. For example, knowing the best road to take to minimize drive time from home to the office when a major motorway is closed due to an accident is explicit knowledge. It can be documented in a report or a rule, as in 'If the A453 is closed, take the M1 to junction 25 and from there to the office'. Tacit knowledge, on the other hand, is hard to measure and document and typically is not objective or formalized. Knowing the best way to negotiate with a foreign government about nuclear disarmament or deal with a volatile hostage situation often requires a lifetime of experience and a high level of skill.

These are examples of tacit knowledge. It is difficult to write a detailed report or a set of rules that would always work in every hostage situation. Many organizations actively attempt to convert tacit knowledge to explicit knowledge to make the knowledge easier to measure, document and share with others In a well-known Harvard Business Review paper called 'The Knowledge Creating Company' (from the November–December, 1991 issue), Ikujiro Nonaka describes four ways in which knowledge can be created.

1 When an individual learns directly from another individual, in an apprentice type relation- ship, tacit knowledge is created from tacit knowledge.

2 When two pieces of explicit knowledge are combined. For example, a website mash-up could be considered an example of this type of new knowledge. (Mash-ups were described in Chapter 6 as the combining of information from two or more web pages into one web page.)

3 When an expert writes a book teaching others, explicit knowledge is being created from tacit knowledge.

4 When someone reads that book and (eventually) becomes an expert themselves, tacit knowledge has been created by explicit knowledge.

A diverse set of technologies can help capture, create and share knowledge. Expert systems (this chapter) can be used to share explicit knowledge. Blogs can be used to share tacit knowledge. Data mining algorithms can be used to discover new knowledge.

Obtaining, Storing, Sharing and Using Knowledge

Knowledge workers are people who create, use and disseminate knowledge. They are usually professionals in science, engineering or business, and belong to professional organizations. Other examples of knowledge workers include writers, researchers, educators and corporate designers. The **chief knowledge officer (CKO)** is a top- level executive who helps the organization work with a KMS to create, store and use knowledge to achieve organizational goals. The CKO is responsible for the organization's KMS and typically works with other executives and directors, including the managing director, finance director and others. Obtaining, storing, sharing and using knowledge is the key to any KMS. Using a KMS often leads to additional knowledge creation, storage, sharing and usage. A meteorologist, for example, might develop sophisticated mathematical models to predict the path and intensity of hurricanes. Business professors often conduct research in marketing strategies, management practices, corporate and individual investments and finance, effective accounting and auditing practices, and much more

.

Drug companies and medical researchers invest billions of pounds in creating knowledge on cures for diseases. Although knowledge workers can act alone, they often work in teams to create or obtain knowledge. After knowledge is created, it is often stored in a 'knowledge repository'. The knowledge repository can be located both inside and outside the organization. Some types of software can store and share knowledge contained in documents and reports. Adobe Acrobat PDF files, for example, allow you to store corporate reports, tax returns and other documents, and send them to others over the Internet. You can use hardware devices and software to store and share audio and video material. Traditional databases and data warehouses, discussed in Chapter 5, are often used to store the organization's knowledge. Specialized knowledge bases in expert systems, discussed later in the chapter, can also be used.

Because knowledge workers often work in groups or teams, they can use collaborative work software and group support systems to share knowledge. Intranets and password- protected Internet sites also provide ways to share knowledge. The social services department of Surrey Council in the UK, for example, uses an intranet to help it create and manipulate knowledge.5 Because knowledge can be critical in maintaining a competitive advantage, businesses should be careful in how they share it. Although they want important decision makers inside and outside the organization to have complete and easy access to knowledge, they also need to protect knowledge from competitors and others who shouldn't see it. As a result, many businesses use patents, copyrights, trade secrets, Internet firewalls and other measures to keep prying eyes from seeing important knowledge that is often expensive and hard to create. In addition to using information systems and collaborative software tools to share knowledge, some organizations use non-technical approaches. These include corporate retreats and gatherings, sporting events, informal knowledge worker lounges or meeting places, kitchen facilities, day-care centres and comfortable workout centres. Using a knowledge management system begins with locating the organization's knowledge. This is often done using a

knowledge map or directory that points the knowledge worker to the needed knowledge. Drug companies have sophisticated knowledge maps that include data- base and file systems to allow scientists and drug researchers to locate previous medical studies. Lawyers can use powerful online knowledge maps, such as the legal section of Lexis-Nexis, to research legal opinions and the outcomes of previous cases. Medical researchers, university professors and even textbook authors use Lexis-Nexis to locate important knowledge.

Organizations often use the Internet or corporate web portals to help their knowledge workers find knowledge stored in documents and reports. The following are examples of profit and nonprofit organizations that use knowledge and knowledge management systems. China Netcom Corporation uses KM software from Autonomy Corporation to search the records of up to 100 million telecommunications customers and create knowledge about its customers and marketing operations. Feilden, Clegg, Bradley, and Aedas, an architectural firm, uses KM to share best practices among its architects. According to one designer, 'Knowledge management was one of those ideas that sprang up in the 1990s, along with fads such as total quality management and the concept of the learning organization. But knowledge management (KM) appears to have had staying power, and it is still firmly on the business agenda.' Munich Re Group, a German insurance organization, uses KM to share best practices and knowledge. 'It was always important to us that knowledge management isn't just an IT plat- form', said Karen Edwards, knowledge management consultant in Munich Re's Knowledge Management Centre of Competence in Munich, Germany. 'The Munich Re people, they really were the assets. They're the things you try to bring together.'

Technology to Support Knowledge Management

KMSs use a number of tools discussed throughout this book. An effective KMS is based on learning new knowledge and changing procedures and approaches as a result. A manufacturing company, for example, might learn new ways to program robots on the factory floor to improve accuracy and reduce defective parts. The new knowledge will likely cause the manufacturing company to change how it programs and uses its robots. These powerful tools can be important in capturing and using knowledge. Enterprise resource planning tools, such as SAP, include knowledge management features. We have also seen how group- ware could improve group decision making and collaboration. Groupware can also be used to help capture, store and use knowledge. In the next chapter, we will examine more technology that could be used to share knowledge. Lastly, of course, hardware, software, databases, telecommunications and the Internet, discussed in Part 2, are important technologies used to support KMSs. Hundreds of companies provide specific KM products and services. In addition, re- searchers at colleges and universities have developed tools and technologies to support knowledge management. Companies such as IBM have many knowledge management tools in a variety of products, including Lotus Notes and Domino. Lotus Notes is a collection of software products that help people work together to create, share and store important knowledge and business documents. Its knowledge management features include domain search, content mapping and Lotus Sametime. Domain search allows people to perform sophisticated searches for knowledge in Domino databases using a single simple query. Con- tent mapping organizes knowledge by categories, like a table of contents for a book. Lotus Sametime helps people communicate, collaborate and share ideas in real time. Lotus Domino Document Manager, formerly called Lotus Domino, helps people and organizations store, organize and retrieve documents. The software can be used to write, review, archive and publish documents throughout the

organization. Morphy Richards, a leading supplier of small home appliances in the UK, uses Domino for email, collaboration and document management.

According to one executive, 'Rather than relying on groups of employees emailing each other, we are putting in place a business application through which documents will formally flow – to improve the efficiency of the supply chain and create more transparent working practices'. Microsoft offers a number of knowledge management tools, including Digital Dashboard, based on the Microsoft Office suite.16 Digital Dashboard integrates information from different sources, including personal, group, enterprise and external information and documents.
'Microsoft has revolutionized the way that people use technology to create and share information. The company is the clear winner in the knowledge management business', according to Rory Chase, managing director of Teleos, an independent knowledge management research company based in the UK. Other tools from Microsoft include Web Store Technology, which uses wireless technology to deliver knowledge to any location at any time; Access Workflow Designer, which helps database developers create effective systems to process transactions and keep work flowing through the organization; and related products. In addition to these tools, several artificial intelligence, discussed next, can be used in a KM

3.2 Artificial Intelligence

At a Dartmouth College conference in 1956, John McCarthy proposed the use of the term artificial intelligence (AI) to describe computers with the ability to mimic or duplicate the functions of the human brain. Advances in AI have since led to systems that recognize complex patterns.17 Many AI pioneers attended this first conference; a few predicted that computers would be as 'smart' as people by the 1960s. This prediction has not yet been realized and there is a debate about whether it actually ever could be; however, the benefits of AI in business and research can be seen today, and the research continues.

Artificial intelligence systems include the people, procedures, hard- ware, software, data and knowledge needed to develop computer systems and machines that demonstrate characteristics of intelligence. Researchers, scientists and expert on how human beings think are often involved in developing these systems.

The Nature of Intelligence

From the early AI pioneering stage, the research emphasis has been on developing machines with intelligent behaviour. Machine intelligence, how- ever, is hard to achieve. Some of the specific characteristics of intelligence behaviour include the ability to do the following:

■ Learn from experience and apply the knowledge acquired from experience. Learning from past situations and events is a key component of **intelligent behaviour** and is a natural ability of humans, who learn by trial and error. This ability, however, must be carefully programmed into a computer system. Today, researchers are developing systems that can learn from experience. For instance, computerized AI chess software can learn to improve while playing human competitors. In one match, Garry Kasparov competed against a personal computer with AI software developed in Israel, called Deep Junior. This match was a 3–3 tie, but Kasparov picked up something the machine would have no interest in – €500 000. The 20 questions (20Q)

website, www.20q.net, is another example of a system that learns. The website is an artificial intelligence game that learns as people play.

■ Handle complex situations. People are often involved in complex situations. World leaders face difficult political decisions regarding terrorism, conflict, global economic conditions, hunger and poverty. In a business setting, top-level managers and executives must handle a complex market, challenging competitors, intricate government regulations and a demanding workforce. Even human experts make mistakes in dealing with these situations. Developing computer systems that can handle perplexing situations requires careful planning and elaborate computer programming.

■ Solve problems when important information is missing. The essence of decision making is dealing with uncertainty. Often, decisions must be made with too little information or inaccurate information because obtaining complete information is too costly or even impossible. Today, AI systems can make important calculations, comparisons and decisions even when information is missing.

■ Determine what is important. Knowing what is truly important is the mark of a good decision maker. Developing programs and approaches to allow computer systems and machines to identify important information is not a simple task.

■ React quickly and correctly to a new situation. A small child, for example, can look over a ledge or a drop-off and know not to venture too close. The child reacts quickly and correctly to a new situation. Computers, on the other hand, do not have this ability without complex programming.

■ Understand visual images. Interpreting visual images can be extremely difficult, even for sophisticated computers. Moving through a room of chairs, tables and other objects can be trivial for people but extremely complex for machines, robots and computers. Such machines require an extension of understanding visual images, called a perceptive system. Having a perceptive system allows a machine to approximate the way a person sees, hears and feels objects. Military robots for example, use cameras and. reconnaissance missions to detect enemy weapons and soldiers. Detecting and destroying them can save lives. ■ Process and manipulate symbols. People see, manipulate and process symbols every day. Visual images provide a constant stream of information to our brains. By contrast, computers have difficulty handling symbolic processing and reasoning. Although computers excel at numerical calculations, they aren't as good at dealing with symbols and 3D objects. Recent developments in machine-vision hardware and software, however, allow some computers to process and manipulate symbols on a limited basis

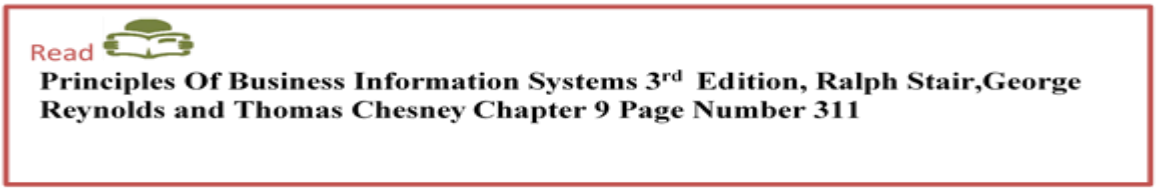
. ■ Be creative and imaginative. Throughout history, people have turned difficult situations into advantages by being creative and imaginative. For instance, when defective mints with holes in the middle were shipped, an enterprising entrepreneur decided to market these new mints as 'LifeSavers' instead of returning them to the manufacturer. Ice-cream cones were invented at the St Louis World's Fair when an imaginative store owner decided to wrap ice cream with a waffle from his grill for portability. Developing new and exciting products and services from an existing (perhaps negative) situation is a human characteristic. Computers cannot be imaginative or creative in this way, although software has been developed to enable a computer to write short stories.

■ Use heuristics. For some decisions, people use heuristics (rules of thumb arising from experience) or even guesses. In searching for a job, you might rank the companies you are considering according to profits per employee. Today, some computer systems, given the right programs, obtain good solutions that use approximations instead of trying to search for an optimal solution, which would be technically difficult or too time consuming. This list of traits only partially defines intelligence. Unlike the terminology used in virtually every other field of IS research in which the objectives can be clearly defined, the term 'intelligence' is a formidable stumbling block. One of the problems in AI is arriving at a working definition of real intelligence against which to compare the performance of an AI system.

The Difference Between Natural and Artificial Intelligence

Since the term 'artificial intelligence' was defined in the 1950s, experts have disagreed about the difference between natural and artificial intelligence. Can computers be programmed to have common sense? Profound differences separate natural from artificial intelligence, but they are declining in number (see Table 3.1). One of the driving forces behind AI research is an attempt to understand how people actually reason and think. Creating machines that can reason is possible only when we truly understand our own processes for doing so

Table 3.1 A Comparison of Natural and Artificial Intelligence



The Major Branches of Artificial Intelligence

AI is a broad field that includes several specialty areas, such as expert systems, robotics, vision systems, natural language processing, learning systems and neural networks. Many of these areas are related; advances in one can occur simultaneously with or result in advances in others.

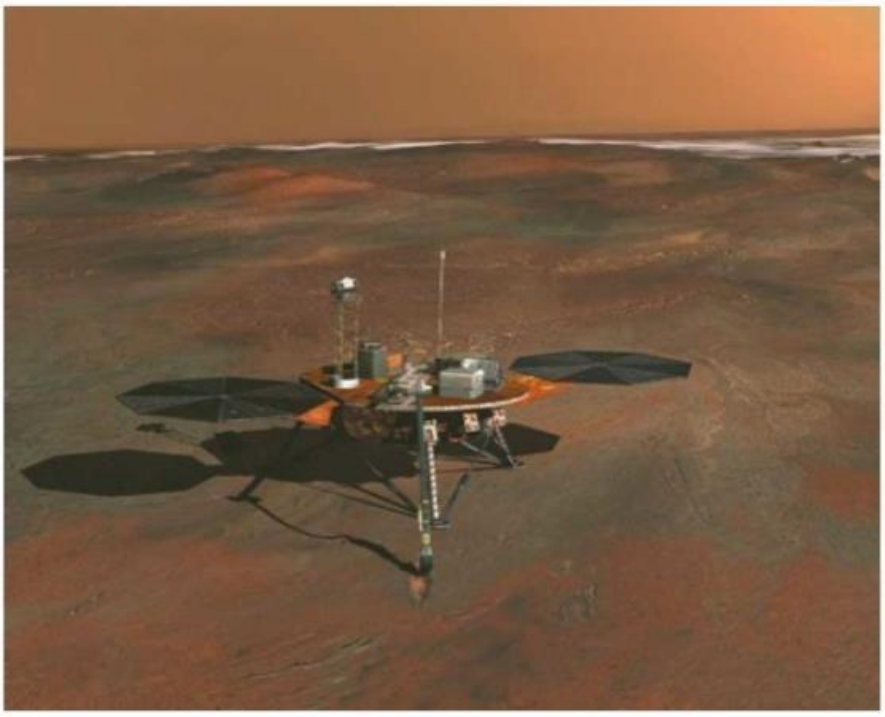
Expert Systems

An **expert system** consists of hardware and software that stores knowledge and makes inferences, similar to those of a human expert. Because of their many business applications, expert systems are discussed in more detail in their own section later in this chapter.

Robotics

It involves developing mechanical or computer devices that can paint cars, make precision welds and perform other tasks that require a high degree of precision or that are tedious or hazardous for human beings. Some robots are mechanical devices that don't use the AI features discussed in this chapter. Others are sophisticated systems that use one or more AI features or characteristics, such as the vision systems, learning systems or neural networks, discussed later in the chapter. For many businesses, robots are used to do the 'three Ds' – dull, dirty and dangerous jobs. Manufacturers use robots to assemble and paint products. The NASA shuttle crash of the early 2000s, for example, has led some people to recommend using robots instead of people to explore space and perform scientific research (see Figure 3.1). Some robots, such as Sony's Aibo, can be used for companionship. Contemporary robotics combine both highprecision machine capabilities and sophisticated controlling software. The controlling software in robots is what is most important in terms of AI.

Figure 3.1 Robots in Space Robots



The field of robotics has many applications, and research into these unique devices continues. The following are a few examples:

■ IRobot is a company that builds a number of robots, including the Roomba Floorvac for cleaning floors and the PackBot, an unmanned vehicle used to assist and protect soldiers.

■ The Porter Adventist Hospital in Denver, Colorado, uses a €67 959 Da Vinci Surgical System to perform surgery on prostate cancer patients. The robot has multiple arms that hold surgical tools. According to one doctor at Porter, 'The biggest advantage is it improves recovery time. Instead of having an eight-inch incision, the patient has a "band-aid" incision. It's much quicker'.

■ DARPA (the Defence Advanced Research Project Agency) sponsors the DARPA Grand Challenge, a 212 km (132 mile) race over rugged terrain for computer-controlled cars.22 ■ Because of an age limit on camel jockeys, the state of Qatar decided to use robots in its camel races.23 Developed in Switzerland, the robots have a human shape and only weigh 27 kg (59 lb). The robots use global positioning systems (GPS), a microphone to deliver voice commands to the camel and cameras. A camel trainer uses a joystick to control the robot's movements on the camel. Camel racing is very popular in Qatar.

■ In military applications, robots are becoming real weapons. The US Air Force is developing a smart robotic jet fighter. Often called 'unmanned combat air vehicles' (UCAVs), these robotic war machines, such as the X-45A, will be able to identify and destroy targets without human pilots. UCAVs send pictures and information to a central command centre and can be directed to strike military targets. These new machines extend the current Predator and Global Hawk technologies the military used in Afghanistan after the 11September 2001 terrorist attacks.

Although robots are essential components of today's automated manufacturing and military systems, future robots will find wider applications in banks, restaurants, homes, doctors' offices and hazardous working environments such as nuclear stations. The Repliee Q1 and Q2 robots from Japan are ultra-humanlike robots or androids that can blink, gesture, speak and even appear to breathe.24 Micro robotics is a developing area. Also called micro-electro- mechanical systems (MEMSs), micro robots are the size of a grain of salt and can be used in a person's blood to monitor the body, and for other purposes in air bags, mobile phones, refrigerators and more. If you would like to try to make a robot, LEGO Mindstorms is a good place to start (Figure 3.2).

Figure 3.2 Lego Mindstorms

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Vision Systems

Another area of AI involves **vision systems**. Vision systems include hardware and software that permit computers to capture, store and manipulate visual images. For example, vision systems can be used with robots to give these machines 'sight'. Factory robots typically perform mechanical tasks with no visual stimuli. Robotic vision extends the capability of these systems, allowing the robot to make decisions based on visual input. Generally, robots with vision systems can recognize black and white and some grey shades but do not have good colour or 3D vision. Other systems concentrate on only a few key features in an image, ignoring the rest. Another potential application of a vision system is finger- print analysis. Even with recent breakthroughs in vision systems, computers cannot see and understand visual images the way people can.

Natural Language Processing and Voice Recognition

As discussed in Chapter 4, **natural language processing** allows a computer to understand and react to statements and commands made in a 'natural' language, such as English. In some cases, voice recognition is used with natural language processing. Voice recognition involves

converting sound waves into words. Dragon Systems' Naturally Speaking uses continuous voice recognition, or natural speech, allowing the user to input data into the computer by speaking at a normal pace without pausing between words. The spoken words are transcribed immediately onto the computer screen. After converting sounds into words, natural language processing systems can be used to react to the words or commands by performing a variety of tasks. Brokerage services are a perfect fit for voice-recognition and natural language processing technology to replace the existing 'press 1 to buy or sell shares' touchpad telephone menu system. People buying and selling use a vocabulary too varied for easy access through menus and touchpads, but still small enough for software to process in real time. Several brokerages – including Charles Schwab & Company, Fidelity Investments, DLJdirect and TD Waterhouse Group – offer these services.

These systems use voice recognition and natural language processing to let customers access pension accounts, check balances and find stock quotes. Eventually, the technology may allow people to make transactions using voice commands over the phone and to use search engines to have their questions answered through the brokerage firm's call centre. One of the big advantages is that the number of calls routed to the customer service department drops considerably after new voice features are added. That is desirable to brokerages because it helps them staff their call centres correctly – even in volatile markets. Whereas a typical person uses a vocabulary of about 20 000 words or less, voice-recognition software can have a built-in vocabulary of 85 000 words. Some companies claim that voice-recognition and natural language processing software is so good that customers forget they are talking to a computer and start discussing the weather or sports results

Learning Systems

Another part of AI deals with **learning systems**, a combination of software and hardware that allows a computer to change how it functions or reacts to situations based on feedback it receives. For example, some computerized games have learning abilities. If the computer does not win a game, it remembers not to make the same moves under the same conditions again. Tom Mitchell, director of the Center for Automated Learning and Discovery at Carnegie Mellon University, is experimenting with two learning software packages that help each other learn.25 He believes that two learning software packages that cooperate are better than separate learning packages. Mitchell's learning software helps Internet search engines do a better job in finding information. Learning systems software requires feedback on the results of actions or decisions. As a minimum, the feedback needs to indicate whether the results are desirable (winning a game) or undesirable (losing a game). The feedback is then used to alter what the system will do in the future.

Neural Networks

An increasingly important aspect of AI involves **neural networks**, also called 'neural nets'. A neural network is a computer system that can act like or simulate the functioning of a human brain. The systems use massive parallel processors in an architecture that is based on the human brain's own mesh like structure. In addition, neural network software simulates a neural network using standard computers. Neural networks can process many pieces of data at the same time and learn to recognize patterns. Some of the specific abilities of neural networks include discovering relation- ships and trends in large databases, and solving complex problems for which all the information is not present. A particular skill of neural nets is analyzing detailed trends. Large amusement parks and banks use neural networks to determine staffing needs based on customer traffic – a task that requires precise analysis, down to the half-hour. Increasingly, businesses are using neural nets to help them navigate ever-thicker forests of data and make sense of myriad customer traits and buying habits. One application, for example, would be to track the habits of insurance customers and predict which ones will not renew a policy. Staff could then suggest to an insur- ance agent what changes to make in the policy to persuade the consumer to renew it. Some pattern-recognition software uses neural networks to analyze hundreds of millions of bank, brokerage and insurance accounts involving a trillion dollars to uncover money laundering and other suspicious money transfers.

Other Artificial Intelligence Applications

A few other artificial intelligence applications exist in addition to those just dis- cussed. A **genetic algorithm**, also called a genetic program, is an approach to solving large, complex problems in which many repeated operations or models change and evolve until the best one emerges. The first step is to change or vary competing solutions to the problem. This can be done by changing the parts of a program or by combining different program segments into a new program. The second step is to select only the best models or algorithms, which continue to evolve. Programs or program segments that are not as good as others are dis- carded, similar to natural selection or 'survival of the fittest', in which only the best species survive. This process of variation and natural selection continues until the genetic algorithm yields the best possible solution to the original problem. For example, some investment firms use genetic algorithms to help select the best stocks or bonds. Genetic algorithms are also used in computer science and mathematics.

Genetic algorithms can help companies determine which orders to accept for maximum profit. This approach helps companies select the orders that will increase profits and take full advantage of the company's production facilities. Genetic algorithms are also being used to make better decisions in developing inputs to neural networks. An **intelligent agent** (also called an 'intelligent robot' or 'bot') consists of programs and a knowledge base used to perform a specific task for a person, a process or another program. Like a sports agent who searches for the best sponsorship deals for a top athlete, an intelligent agent often searches to find the best price, schedule or solution to a problem. The programs used by an intelligent agent can search large amounts of data as the knowledge base re- fines the search or accommodates user preferences. Often used to search the vast resources of the Internet, intelligent agents can help people find information on an important topic or the best price for a new digital camera. Intelligent agents can also be used to make travel arrangements, monitor incoming email for viruses or junk mail, and coordinate meetings and schedules of busy executives. In the human resources field, intelligent agents help with online training. The software can look ahead in training materials and know what to start next.

3.3 Expert Systems

An expert system outputs a recommendation based on answers given to it by users (who are not experts in the field). The intention of the system is to capture the expert's knowledge and make it available to those who lack this knowledge. Expert systems have been developed to diagnose medical conditions, resolve engineering problems and solve energy problems. They have also been used to design new products and systems, develop innovative insurance products, deter- mine the best use of timber and increase the quality of healthcare. Like human experts, expert systems use heuristics, or rules of thumb, to arrive at conclusions or make suggestions. The research conducted in AI since the mid-1990s is resulting in expert systems that explore new business possibilities, increase overall profitability, reduce costs and provide superior service to customers and clients. When to Use Expert Systems Sophisticated expert systems can be difficult, expensive and time consuming to develop. The following is a list of factors that normally make expert systems worth the expenditure of time and money. Develop an expert system if it can do any of the following:

■ Provide a high potential payoff or significantly reduce downside risk.

■ Capture and preserve irreplaceable human expertise.

■ Solve a problem that is not easily solved using traditional programming techniques.

■ Develop a system which is more consistent than human experts.

■ Provide expertise needed at a number of locations at the same time or in a hostile environment that is dangerous to human health.

■ Provide expertise that is expensive or rare.

■ Develop a solution faster than human experts can.

■ Provide expertise needed for training and development to share the wisdom and experience of human experts with many people.

Components of Expert Systems

An expert system consists of a collection of integrated and related components, including a knowledge base, an inference engine, an explanation facility, a knowledge base acquisition facility and a user interface. A diagram of a typical expert system is shown in Figure 3.3.

Figure 3.3 Components of an Expert System

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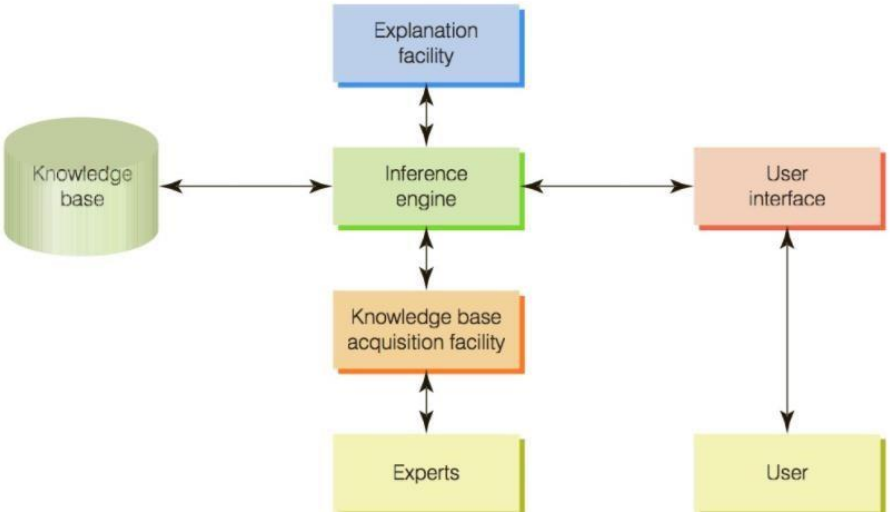


The Knowledge Base

The **knowledge base** stores all relevant information, data, rules, cases and relationships that the expert system uses. A knowledge base is a natural extension of a database and an information and decision support system . A knowledge base must be developed for each unique application. For example, a medical expert system contains facts about diseases and symptoms. The following are some tools and techniques that can be used to create a knowledge base.

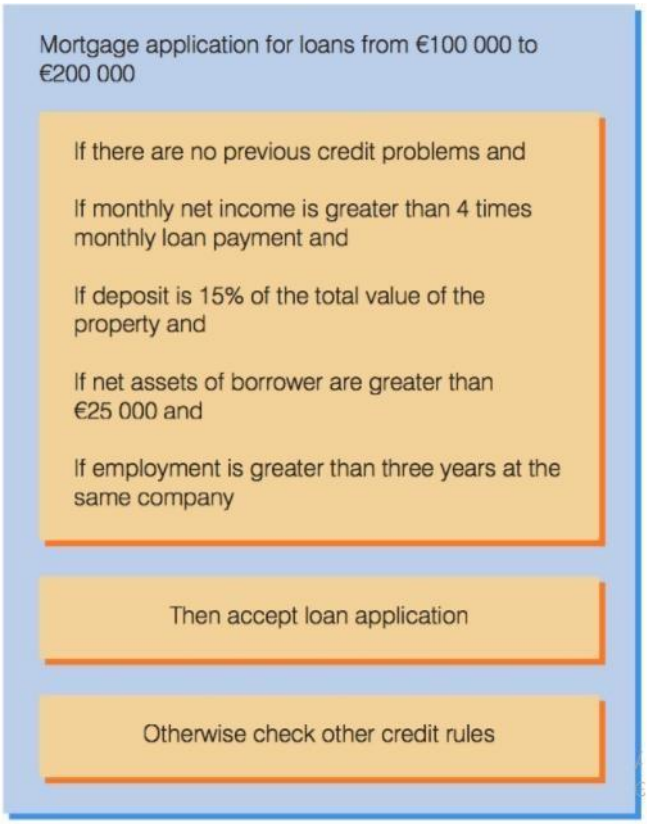
■ Assembling human experts. One challenge in developing a knowledge base is to assemble the knowledge of multiple human experts. Typically, the objective in building a knowledge base is to integrate the knowledge of people with similar expertise (for example, many doctors might contribute to a medical diagnostics knowledge base).

■ Fuzzy logic. Another challenge for expert system designers and developers is capturing knowledge and relationships that are not precise or exact. Instead of the yes/no, or true/ false conditions of typical computer decisions, fuzzy logic allows shades of grey, or what is known as ‘fuzzy sets’. Fuzzy logic rules help computers evaluate the imperfect or imprecise conditions they encounter and make educated guesses based on the probability of correctness of the decision.

■ Rules. A rule is a conditional statement that links conditions to actions or outcomes. In many instances, these rules are stored as IF-THEN statements, such as ‘IF a certain set of network conditions exists, THEN a certain network problem diagnosis is appropriate’. In an expert system for a weather forecasting operation, for example, the rules could state that if certain temperature patterns exist with a given barometric pressure and certain previous weather patterns over the last 24 hours, then a specific forecast will be made, including temperatures, cloud coverage and wind-chill factor. Figure 9.4 shows how to use expertsystem rules in determining whether a person should receive a mortgage loan from a bank. These rules can be placed in almost any standard program language discussed using ‘IF-THEN’ statements or into special expert systems shells, dis- cussed later in the chapter. In general, as the number of rules that an expert system knows increases, the precision of the expert system also increases.

■ Cases. An expert system can use cases in developing a solution to a current problem or situation. This process involves (1) finding cases stored in the knowledge base that are similar to the problem or situation at hand, and (2) modifying the solutions to the cases to fit or accommodate the current problem or situation.

Figure 3.4 Rules for a Credit Application



The Inference Engine

The overall purpose of an **inference engine** is to seek information and relationships from the knowledge base and to provide answers, predictions and suggestions the way a human expert would. In other words, the inference engine is the component that delivers the expert advice. To provide answers and give advice, expert systems can use backward and forward chaining. **Backward chaining** is the process of starting with conclusions and working backwards to the supporting facts. If the facts do not support the conclusion, another conclusion is selected and tested. This process is continued until the correct conclusion is identified. **Forward chaining** starts with the facts and works forwards to the conclusions. Consider the expert system that forecasts future sales for a product. Forward chaining starts with a fact such as 'The demand for the product last month was 20000 units'. With the forward-chaining approach, the expert system searches for rules that contain a reference to product demand. For example, 'IF product demand is over 15000 units, THEN check the demand for competing products'. As a result of this process, the expert system might use information on the demand for competitive products. Next, after searching additional rules, the expert system might use information on personal income or national inflation rates. This process continues until the expert system can reach a conclusion using the data supplied by the user and the rules that apply in the knowledge base.

The Explanation Facility

An important part of an expert system is the **explanation facility**, which allows a user or decision maker to understand how the expert system arrived at certain conclusions or results. A medical expert system, for example, might reach the conclusion that a patient has a defective heart valve given certain symptoms and the results of tests on the patient. The explanation facility allows a doctor to find out the logic or rationale of the diagnosis made by the expert system. The expert system, using the explanation facility, can indicate all the facts and rules that were used in reaching the conclusion. This facility allows doctors to deter- mine whether the expert system is processing the data and information correctly and logically.

The Knowledge Acquisition Facility

A difficult task in developing an expert system is the process of creating and updating the knowledge base. In the past, when more traditional programming languages were used, developing a knowledge base was tedious and time consuming. Each fact, relationship and rule had to be programmed into the knowledge base. In most cases, an experienced programmer had to create and update the knowledge base.

Today, specialized software allows users and decision makers to create and modify their own knowledge bases through the knowledge acquisition facility. The purpose of the knowledge acquisition facility is to provide a convenient and efficient means for capturing and storing all components of the knowledge base. Knowledge acquisition software can present users and decision makers with easy-to-use menus. After entering the appropriate at- tributes, the knowledge acquisition facility correctly stores information and relationships in the knowledge base, making the knowledge base easier and less expensive to set up and maintain. Knowledge acquisition can be a manual process or a mixture of manual and automated procedures. Regardless of how the knowledge is acquired, the knowledge base must be validated and updated frequently to make sure that it is still accurate.

The User Interface

Specialized user interface software is employed for designing, creating, updating and using expert systems. The main purpose of the user interface is to make an expert system easier for users and decision makers to develop and use. At one time, skilled computer personnel created and operated most expert systems; today, the user interface permits decision makers to develop and use their own expert systems. Because expert systems place more emphasis on directing user activities than do other types of systems, text-oriented user interfaces (using menus, forms and scripts) might be more common in expert systems than the graphical inter- faces often used with DSS. A typical user interface between a user and the expert system for a credit application is as follows:

EXPERT SYSTEM: Are there any previous credit problems?

USER: No.

EXPERT SYSTEM: Is the applicant's net income greater than four times the monthly loan payment?

USER: Yes.

EXPERT SYSTEM: Is the deposit greater than 15 per cent of the property value?

USER: Yes

EXPERT SYSTEM: Are the net assets of the borrower greater than €25 000?

USER: Yes.

EXPERT SYSTEM: Has the borrower worked more than three years at the same company?

USER: Yes.

EXPERT SYSTEM: Accept the loan application

Expert Systems Development

Like other computer systems, expert systems require a systematic development approach for best results. This approach includes determining the requirements for the expert system, identifying one or more experts in the area or discipline under investigation, constructing the components of the expert system, implementing the results, and maintaining and reviewing the complete system.

Participants in Developing and Using Expert Systems

Because of the time and effort involved in the task, an expert system is developed to address only a specific area of knowledge. This area of knowledge is called the domain. The domain expert is the person or group with the expertise or knowledge the expert system is trying to capture. The domain expert (individual or group) can usually do the following:

•Develop a general framework for problem solving.

•Formulate theories about the situation.

•Develop and use general rules to solve a problem.

•Know when to break the rules or general principles.

•Solve problems quickly and efficiently.

•Learn from experience.

•Know what is and is not important in solving a problem.

•Explain the situation and solutions of problems to others.

A **knowledge engineer** is a person who has training or experience in the de- sign, development, implementation and maintenance of an expert system, including training or experience with expert system shells. The knowledge user is the person or group who uses and benefits from the expert system. Knowledge users do not need any previous training in computers or expert systems

Theoretically, expert systems can be developed from any programming language. Since the introduction of computer systems, programming languages have become easier to use, more powerful and increasingly able to handle specialized requirements. In the early days of expert systems development, traditional high-level languages, including Pascal, FORTRAN and COBOL, were used (see Figure 3.5). LISP was one of the first special languages developed and used for expert system applications. PROLOG was also developed to build expert systems. Since the 1990s, however, other expert system products (such as shells) have become available that remove the burden of programming, allowing non-programmers to develop and benefit from the use of expert systems.

An expert system shell is a collection of software packages and tools used to design, develop, implement and maintain expert systems. Expert system shells are available for both personal computers and mainframe systems. Some shells are inexpensive, costing less than €400. In addition, off-the-shelf expert system shells are complete and ready to run. The user enters the appropriate data or parameters, and the expert system provides output to the problem or situation. Some expert system products can analyze LAN networks, monitor air quality in commercial buildings, and evaluate oil and drilling operations. Table 3.2 lists a few expert system products.

Figure 3.5 Expert Systems Development

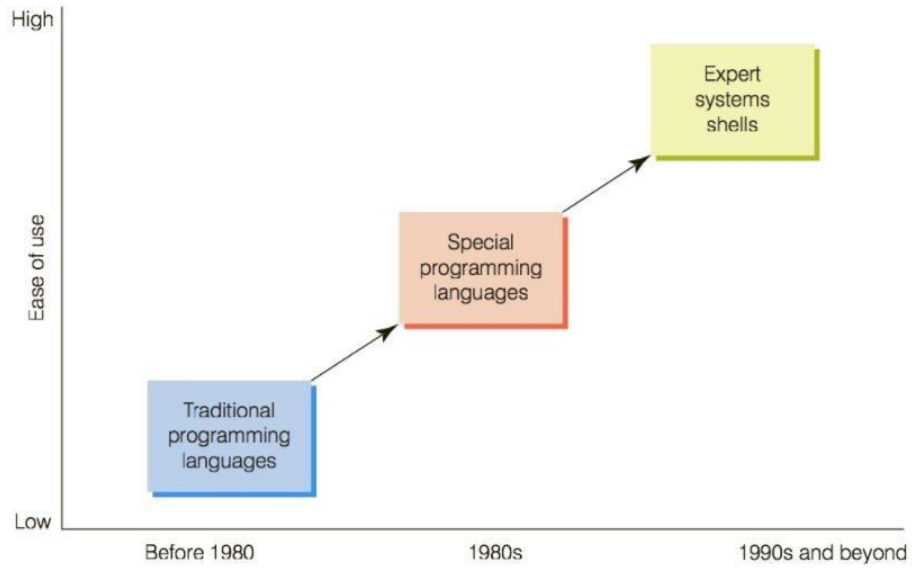


Table 3.2 Popular Expert System Products

Name of Product	Application and Capabilities
Financial Adviser	Analyzes financial investments in new equipment, facilities and the like; requests the appropriate data and performs a complete financial analysis
G2	Assists in oil and gas operations. Transco, a British company, uses it to help in the transport of gas to more than 20 million commercial and domestic customers
HazMat Loader	Analyzes hazardous materials in truck shipments
LSI Indicator	Helps determine property values; developed by one of the largest residential title and closing companies
MindWizard	Enables development of compact expert systems ranging from simple models that incorporate business decision rules to highly sophisticated models; PC-based and inexpensive
RAMPART	Analyzes risk. The US General Services Administration uses it to analyze risk to the approximately 8000 federal buildings it manages

Applications of Expert Systems and Artificial Intelligence Expert systems and artificial intelligence have wide applications in business and government. A list of applications, some of which have already been mentioned, is given next.

■ Credit granting and loan analysis. Many banks employ expert systems to review a customer's credit application and credit history data from credit bureaus to make a decision on whether to grant a loan or approve a transaction.

■ Stock picking. Some expert systems help investment professionals pick stocks and other investments.

■ Catching cheats and terrorists. Some gambling casinos use expert system software to catch cheats. The CIA is testing the software to see whether it can detect possible terrorists when they make hotel or airline reservations.

■ Budgeting. Car companies can use expert systems to help budget, plan and coordinate prototype testing programs to save hundreds of millions of euros.

■ Games. Some expert systems are used for entertainment. For example, 20Q (www.20Q.net).

■ Information management and retrieval. The explosive growth of information available to decision makers has created a demand for devices to help manage the information. Bots can aid this process. Businesses might use a bot to retrieve information from large distributed databases or a vast network like the Internet.

■ AI and expert systems embedded in products. The antilock braking system on today's cars is an example of a rudimentary expert system. A processor senses when the tyres are beginning to skid and releases the brakes for a fraction of a second to prevent the skid. AI researchers are also finding ways to use neural networks and robotics in everyday devices, such as toasters, alarm clocks and televisions.

■ Plant layout and manufacturing. FLEXPERT is an expert system that uses fuzzy logic to perform plant layout. The software helps companies determine the best placement for equipment and manufacturing facilities. Expert systems can also spot defective welds during the manufacturing process. The expert system analyzes radiographic images and suggests which welds could be flawed.

■ Hospitals and medical facilities. Some hospitals use expert systems to determine a patient's likelihood of contracting cancer or other diseases. Hospitals, pharmacies and other healthcare providers can use CaseAlert by MEDecision to determine possible high-risk or high-cost patients. MYCIN is an early expert system developed at Stanford University to analyze blood infections. UpToDate is another expert system used to diagnose patients. To help doctors in the diagnosis of thoracic pain, MatheMEDics has developed THORASK, a straightforward, easy-to-use program, requiring only the input of carefully obtained clinical information. The program helps the less experienced to distinguish the three principal categories of chest pain from each other. It does what a true medical expert system should do without the need for complicated user input. The user answers basic questions about the patient's history and directed physical findings, and the program immediately displays a list of diagnoses. The diagnoses are presented in decreasing order of likelihood, together with their estimated probabilities. The program also provides concise descriptions of relevant clinical conditions and their presentations, as well as brief suggestions for diagnostic approaches.

■ Help desk and assistance. Customer service help desks use expert systems to provide timely and accurate assistance. The automated help desk frees up staff to handle more complex needs while still providing more timely assistance for routine calls.

■ Employee performance evaluation. An expert system developed by Austin-Hayne, called Employee Appraiser, provides managers with expert advice for use in employee performance reviews and career development.

■ Virus detection. IBM is using neural network technology to help create more advanced software for eradicating computer viruses, a major problem in businesses. IBM's neural network software deals with 'boot sector' viruses, the most prevalent type, using a form of artificial intelligence that generalizes by looking at examples. It requires a vast number of training samples, which in the case of antivirus software are fragments of virus code.

■ Repair and maintenance. ACE is an expert system used by AT&T to analyze the maintenance of telephone networks. IET-Intelligent Electronics uses an expert system to diagnose maintenance problems related to aerospace equipment. General Electric Aircraft Engine Group uses an expert system to enhance maintenance performance levels at all sites and improve diagnostic accuracy.

■ Shipping. CARGEX cargo expert system is used by Lufthansa, a German airline, to help determine the best shipping routes.

■ Marketing. CoverStory is an expert system that extracts marketing information from a database and automatically writes marketing reports.

■ Warehouse optimization. United Distillers uses an expert system to determine the best combinations of liquour stocks to produce its blends of Scotch whisky. This information is then supplemented with information about the location of the casks for each blend. The system optimizes the selection of required casks, keeping to a minimum the number of 'doors'

(warehouse sections) from which the casks must be taken and the number of casks that need to be moved to clear the way. Other constraints must be satisfied, such as the current working capacity of each warehouse, and the maintenance and restocking work that may be in progress.

3.4 Virtual Reality

The term 'virtual reality' was initially coined by Jaron Lanier, founder of VPL Research, in 1989. Originally, the term referred to immersive virtual reality in which the user becomes fully immersed in an artificial, 3D world that is completely generated by a computer. Immersive virtual reality can represent any 3D setting, real or abstract, such as a building, an archaeological excavation site, human anatomy, a sculpture or a crime scene reconstruction. Through immersion, the user can gain a deeper understanding of the virtual world's behaviour and functionality. A virtual reality system enables one or more users to move and react in a computer- simulated environment. Virtual reality simulations require special interface devices that transmit the sights, sounds and sensations of the simulated world to the user. These devices can also record and send the speech and movements of the participants to the simulation program, enabling users to sense and manipulate virtual objects much as they would real objects. This natural style of interaction gives the participants the feeling that they are immersed in the simulated world. For example, a car manufacturer can use virtual reality to help it simulate and design factories. A related term is 'augmented reality', which refers to the combination of computer generated data (images, sounds, etc.) with stimuli from the real world. For example, an augmented reality system might project instructions onto the user's eye, on top of the real world images they are seeing, so they could look at both at the same time

Interface Devices

To see in a virtual world, often the user wears a head-mounted display (HMD) with screens directed at each eye. The HMD also contains a position tracker to monitor the location of the user's head and the direction in which the user is looking. Using this information, a computer generates images of the virtual world – a slightly different view for each eye – to match the direction that the user is looking and displays these images on the HMD. Many companies sell or rent virtual-reality interface devices, including Virtual Realities (www.vrealities.com), Amusitronix (www.amusitronix.com), Mindflux (www.mindflux.com.au) and others. With current technology,

Virtual-world scenes must be kept relatively simple so that the computer can update the visual imagery quickly enough (at least ten times per second) to prevent the user's view from appearing jerky and from lagging behind the user's movements. The Electronic Visualization Laboratory at the University of Illinois at Chicago introduced a room constructed of large screens on three walls and the floor on which the graphics are projected. The CAVE®, as this room is called, provides the illusion of immersion by projecting stereo images on the walls and floor of a room-sized cube. Several persons wearing lightweight stereo glasses can enter and walk freely inside the CAVE®. A head-tracking system continuously adjusts the stereo projection to the current position of the leading viewer. Users hear sounds in the virtual world through speakers mounted above or behind the screens. Spatial audio is possible, allowing for position tracking. When a sound source in virtual space is not directly in front of or behind the user, the computer transmits sounds to arrive at one ear a little earlier or later than at the other

and to be a little louder or softer and slightly different in pitch. The haptic interface, which relays the sense of touch and other physical sensations in the virtual world, is the least developed and perhaps the most challenging to create. Currently, with the use of a glove and position tracker, the computer locates the user's hand and measures finger movements. The user can reach into the virtual world and handle objects; however, it is difficult to realize sensations of a person tapping a hard surface, picking up an object or running a finger across a textured surface. Touch sensations also have to be synchronized with the sights and sounds of the user's experience. **Forms of Virtual Reality**

Aside from immersive virtual reality, virtual reality can also refer to applications that are not fully immersive, such as mouse-controlled navigation through a 3D environment on a graphics monitor, stereo viewing from the monitor via stereo glasses, stereo projection systems and others. Some virtual reality applications allow views of real environments with superimposed virtual objects. Motion trackers monitor the movements of dancers or athletes for subsequent studies in immersive virtual reality. Telepresence systems (such as telemedicine and tele robotics) immerse a viewer in a real world that is captured by video cameras at a distant location and allow for the remote manipulation of real objects via robot arms and manipulators. Many believe that virtual reality will reshape the interface between people and information technology by offering new ways to communicate information, visualize processes and express ideas creatively.

Virtual Reality Applications

You can find hundreds of applications of virtual reality, with more being developed as the cost of hardware and software declines and people's imaginations are opened to the potential of virtual reality. Having been inspired by the 2002 movie Minority Report, Pamela Barry of Raytheon is experimenting with a virtual reality system that uses 'gesture technology',26 and several commercial systems are now available from companies such as Solaris Labs. For example, by pointing an index finger towards a picture on a screen, the computer zooms in on the picture. Moving a hand in one direction causes the computer to scroll down through a video clip, and moving a hand in another direction clears the screen. Raytheon hopes 'gesture technology' will have applications in the military and space exploration. There are many other applications for virtual reality, including in the domains of medicine, education and entertainment.

Chapter Summary/Review

- Knowledge management systems allow organizations to share knowledge and experience among their managers and employees. Knowledge is an awareness and understanding of a set of information and the ways that information can be made useful to support a specific task or reach a decision.
- Artificial intelligence systems form a broad and diverse set of systems that can replicate human decision making for certain types of well-defined problems. The term artificial intelligence is used to describe computers with the ability to mimic or duplicate the functions of the human brain.
- Expert systems can enable a novice to perform at the level of an expert, but must be developed and maintained very carefully. An expert system consists of a collection of integrated and related components, including a knowledge base, an inference engine, an explanation facility, a knowledge acquisition facility and a user interface.
- Virtual reality systems can reshape the interface between people and information technology by offering new ways to communicate information, visualize processes and express ideas creatively. A virtual reality system enables one or more users to move and react in a computer-simulated environment.

Review Questions (Short)

1.Compare and contrast human and machine intelligence 2.Explain the main elements of an expert system

3. Give a definition of intelligent behavior.

4.What is the difference between a domain expert

5. List some applications for robots.

Review Questions (Long)

1. What is augumeted reality?
2. Explain the term ‘natural language processing’.
3. What does an expert system interface look like?
4. What is a CKO?
5. What could an organization do with virtual reality?

Review Questions (MCQ)

1. All systems demonstrate characteristics of_____
A. Assistance
B. Intelligence
C. Understanding
D. Knowledge

2. Two branches of Al are_____ _____ and
A. Virtual Reality Applications & Interphase Design
B. Expert systems, robotics, vision systems, natural language processing systems, learning systems or neural networks
C. Help Desk & Data manipulation
D. Primary KEY & Secondary Key

3. Systems like google research on a smartphone that allow users to give voice input are examples of_____
A. Forward Chaining
B. Commands
C. Natural Language processing
D. Backward Chaining

4. The component of an expert system that stores relevant data and rules is the _____
A. User Interphase
B. Explanation Facility
C. System Base
D. Knowledge Base

5. An application for an expert system is_____
A. For Example Credit Granting, Picking Stocks, identifying cheats and designing factories B. Genetic Algorithm
C. Voice Recognition
D. Language Processing

Case Studies / Projects

360° Video Makes Virtual Reality Accessible

There is a lot of jargon in the IT industry and most of it is not 'owned' by anyone. So when someone starts to redefine a term, who can say if they are right or wrong? In addition, many technologies naturally evolve into something that sometimes doesn't look much like the original idea. So it is with virtual reality. The original definition was a technology that fully immerses a user in an artificial, 3D world that is completely generated by computer. This immersion is typically created by wearing a headset that sends images to the user's eyes and adjusts these depending on the angle of the user's head. But what if the user was viewing the 3D computer generated world on an ordinary 2D monitor – would that count as VR?

Questions

1. What do you think is holding back full VR?
2. Could Google Cardboard help bring VR to the general public?
3. What applications can you think of for 360o video?
4. Why does Google allow employees to spendtime on personal projects?

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Case Studies / Projects

A 'Soft' Octopus Robot

When you think of robots, the images that come to mind are probably heavy bomb disposal units, expensive NASA equipment on Mars or even the Lego Mindstorms kit that was mentioned in this chapter. Octobot is nothing like these. Its designers sources to create a pliable robot that operates with- out rigid parts. Less than 10cm long and 2cm tall, Octobot is made of silicone rubber and is intended to squeeze into tight spaces, mould to its surroundings and handle delicate objects safely. Robot re- searcher Michael Wehner said that Octobot could 'either handle something that's very delicate, or move the body around to get into tight spaces in search and rescue, or maybe internal medicine.

Questions

1. Octobot is at least partly inspired by octopi. What other aspects of nature could inspire robot design and what would each of your ideas bring to robotics?
2. Why do you think the team used 3D printing technology?
3. What are the advantages and disadvantages of microfluidic logic?
4. What application can you think of for Octobot?

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LEARNING OUTCOMES

After reading this Section of the guide, the learner should be able to:

Learning Objectives

- Identify the range of devices that now incorporate computing power.
- Describe the business benefits of mobile devices.
- Discuss and evaluate the technologies that can be used to support teamwork when team members are separated by time and/or space.
- Describe how to select mobile systems to support business objectives.

4.1 Introduction

Information systems are no longer tied to a desk in an office. As we saw in the chapter on hardware, mobile devices are allowing computing power to be taken on the move. Increasingly, computers look less and less like the familiar picture shown in Figure 4.1. This change is moving in two directions. New devices are being developed that people are happy to carry with them – tiny devices such as the iPod or a smart-phone. Such devices do not have the functionality of a PC, but they are more convenient and can be taken anywhere. The other direction is that rather than a new device, computing power is being incorporated into existing devices and objects that are already well known to us, such as a jacket, a pair of glasses or a car. This move away from the desktop is known as pervasive computing, or ubiquitous computing: ubiquitous because computers are all around us, even if we don't always realize it. Perhaps from where you are sitting you can see a laptop, smartphone and a tablet computer.

Figure 4.1 The Conventional View of a Computer

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On any one of these devices you could read or post a blog entry, access the web, and pay for goods and services. People are using these devices to do all sorts of things on the move – buy cinema tickets to avoid queuing for them, check in for a flight, and pay for a taxi journey. In this chapter we will look at some of these technologies and examine their business potential. We will also meet a particular class of system use, **called computer supported** cooperative work, which is allowing teams to work together on projects, regardless of where they happen to be. Many of the technologies described in this chapter are waiting for a 'killer application' that will allow them to take off. Maybe you'll be able to think of one!

4.2 Wireless Internet Access

Central to being able to access information 'on the move' is wireless Internet access. The range of options available for wireless communication, but for many people the options they have currently are wi-fi and 3G mobile communications, with 4G rapidly becoming more available. A wi-fi **hotspot** is an area where wireless access is available. Many bars and cafés provide their customers with wi-fi, often charging by the half-hour, although sometimes access is free. TMobile has set up wi-fi hotspots in many airports, coffee houses and bookshops. This is useful for employees who are away from the office a lot. BT Fon uses wi-fi routers in its customer's homes to allow others to connect to the Internet. Fon works by having its routers broadcast two wi-fi signals – one private, just for use by the customer who owns the router, and one public and accessible to registered members of the Fon community. A wireless service is now

expected by customers in major hotels. Many city centres have free wi-fi access. In the UK, most cities have free wi-fi, as do other cities throughout Europe, such as Oulu in Finland. In Norwich, over 200 antennae are used to provide a hotspot blanket over the city. As a user walks out of range of one antenna and into the range of another, the system seamlessly hands over access between the two, in the same way that the mobile phone network does. Wi-Fi access speeds are slightly slower than broadband, although this is perhaps made up for in convenience. The first entire nation to be given free wireless Internet access was the tiny Polynesian island of Niue with a population of just 2000. The local authorities in the town of Knysna in South Africa have installed Wi-Fi to allow access to residents who have historically been cut off from Internet access because the town is so remote. Computers have been installed in the local library to give access to those who can't afford Wi-Fi-enabled devices.

The business benefits of wi-fi are clear – mobile access to information; employees away on business can easily send and receive email, using any one of a number of devices, some of which are discussed next. They can access information on company websites or read about local conditions on news services. They could also access sensitive information on company extranets.

4.3 Mobile Devices

The list of devices that can make use of wi-fi hotspots is growing. It now includes desk- top computers (useful if you happen to live within a hotspot), laptops, tablet PCs, mobile phones, mobile game consoles such as the Nintendo DS, pocket PCs and VoIP phones. As we will see, other mobile devices are stand alone and do not require Internet access to make them useful.

Figure 4.2 A Smartphone

Possibly the most useful accessory is a keyboard that can be attached to the smartphone so that data can be entered into it, as it could into a laptop or PC. Both fold up and roll up versions are available. These keyboards can be attached by a cable or wirelessly using the Bluetooth protocol described in Chapter 6. South Korean company Celluon manufactures a device that projects a laser keyboard onto a surface such as the tray table on a plane, and detects when you press one of the virtual keys. Attaching a keyboard to a smartphone pro- vides an extremely

portable word processor. Many workers in the western world would not be satisfied with such a tiny screen; however, such miniature devices are common in the Far East. It is true that you are unlikely to want to type at a smartphone for as long as you would a laptop; however, many people do prefer the light weight of a smartphone and keyboard to that of a laptop. If a smartphone and keyboard are combined with wi-fi access, the smartphone becomes a powerful tool to access all Internet services. Without the keyboard, a smartphone can be cumbersome to use.

Another useful accessory is a cable to enable the smartphone to be attached to a projector. Margi Presenter-to-Go can be used to project Microsoft PowerPoint slides from a smartphone. The system even comes with a remote control so that the speaker can progress from one slide to the next without having to be beside the device – functionality that few PCs provide. This is an extremely convenient way for business people to take a presentation with them. For example, a salesperson could present to clients all over the world and only have to carry a smartphone with accessories and, unless one was available at each location, a data projector. One drawback to using a smartphone to give presentations is that it is difficult to create or edit PowerPoint slides on them. Therefore they only become an alternative to carrying a laptop if the presentation is not going to change. If it is known that the presentation will not change, and it is known that there is the appropriate hardware at the presentation location, it becomes more convenient to simply carry the presentation files on a flash drive, or even simply upload them to the web, where they can be downloaded for the presentation. By connecting a **global positioning system (GPS)** receiver and installing map software such as TomTom, a smartphone can be used as a powerful navigational aid, either in a car or, if the GPS receiver is wireless (again using the bluetooth protocol), on foot. Fleet operators use GPS for vehicle tracking, safety and performance monitoring. GPS is also used by breakdown agencies such as the RAC and AA – the location of a broken down vehicle is fed into an information system which uses GPS information on the whereabouts of the fleet to make the decision on which patrol to send to the rescue.

A smartphone can also be used to play audio and video files. Many people use one instead of a dedicated music device such as an MP3 player or an iPod. Some people download news clips each night from a provider such as the BBC, and watch them on the train on the way to work the next morning. The BBC has launched a service called ‘iPlayer’, from which almost all of their programmes can be downloaded and watched at any time within 30 days. Watching news programmes in this way could replace the traditional activity of reading the morning newspaper, plus it takes up less space on crowded public transport than a newspaper, is cleaner, and arguably easier to digest and more interesting.

When the functionality of a pocket PC is combined with the functionality of a mobile phone, that is, when you can make phone calls on it, it is known as a ‘smartphone’.

Wearable Technology

Miniaturizing smartphone technology further allows it to become part of the clothes we wear, for example a jacket or belt. Coupled with other things we are comfortable wearing, for instance glasses with which to receive visual information or earphones for audio information, computing power can become something we routinely take with us and use everywhere. The term ‘wearable technology’ usually refers to computers that are worn on the body, although it could also be used to encompass non-computing technology such as mechanical watches and glasses. The term **wearable computing** is used to distinguish between the two.

If a smartphone is attached to a user's belt, it is being 'worn' by that user. However, wearable computing refers to something more than this. The term really means the use of largely invisible computing technology, to seamlessly augment a human's task. So far, there are few everyday applications for wearable computing, and many of the commercial examples available have more novelty value than business value. However, one application which is often mentioned is navigation, where the clothes you wear somehow tell you where to go. For example, a GPS receiver could be built into a special jacket, which could apply pressure on one side of the body to guide the wearer in that direction. The interface for telling the jacket where you want to go could be a smartphone with a bluetooth link between it and the jacket. A research group at the Massachusetts Institute of Technology (MIT) developed an early platform which can be used to experiment with potential applications. MIThril had a number of ways of interacting with the body.

Suggested uses for MIThril included navigation and accessing the Internet on the move. However, neither of these takes the unique nature of wearable computing into account, and using it like this gives little advantage over a smartphone. Google have experimented with wearable computing. Their most famous example is Google Glass, a pair of glasses they thought would replace the smartphone. They haven't fully given up on this product yet, but it is not currently generally available. Apple computers have recently launched a smart watch which has been described as an iPhone on the wrist. The launch follows a similar product from Samsung.

Some other potential applications for wearable computing are recording what the wearer sees and hears and how they move, and transmitting personal information between people, rather like an electronic business card. Indeed another device from MIT, the UberBadge, does exactly that. It can be worn as a name badge and used to transmit personal information. For instance, the system could be used at a business conference to collect information about all the people a delegate has spoken to throughout the day. The same device can collect information useful to conference organizers about where people spent the most time throughout the day. A business could adapt this to be able to locate its employees within its building, so that phone calls could be routed to the nearest phone. Perhaps wearable technology could be used to help judge a fencing or martial arts competition, or for recording dance moves, something that has been difficult in the past. There could also be applications for teaching – gloves that help teach someone how to play the piano. Another technology to come out of MIT, called Kameraflage, allows digital cameras to photograph colours in fabrics that the human eye cannot see. One possible use of this technology is to replace staff cards with invisible markers – a security guard could easily identify people who do not have authority to be in a certain area, by looking at his or her video monitor, which would pick up the marks on their clothes. A wearable application is shown in Figure 4.3.

Figure 4.3 Smartwatch

E-Money

E-money refers to the transfer of funds happening electronically rather than by handing over physical coins and notes. It can be implemented in a number of ways. The most common is paying for goods and services over the Internet; how- ever, it does take other forms. Mobile phones are now also being used to pay for goods and services. Contactless payment using near field communication, is becoming more common. Barclays Bank now offers customers a Pay-Tag which they can stick on their wallet or phone and can be used to pay for goods costing less than about €20. The same technology is used to pay for public transport. An example is Hong Kong's Octopus card, originally intended to be used to pay for public transport, but now used throughout Hong Kong in a range of shops. When used on the city's train service, a passenger 'swipes' their card when they enter the train station and they 'swipe' it again when they leave. The correct fare is then debited from their prepaid account. 'Swiping' the card merely involves waving it near a reader – direct contact is not required. In fact the card doesn't even have to be removed from the passenger's wallet! Octopus gadgets are now available such as the Octopus watch or Octopus ornaments. Whether using the card or a gadget, a chip in the device stores the amount that has been paid into the account. Similar systems have now been implemented throughout Europe and elsewhere, for example the Oyster Card in London. Systems such as these that implement the concept of e-money make paying for goods fast and convenient. LUUP10 is a payment system (the developers call it a 'digital wallet') that works using the text feature on mobile phones to transfer funds from buyer to seller (see Figure 4.4). The buyer sends LUUP a text with the format 'PAY USERNAME AMOUNT'. LUUP then transfers the specified amount from the buyer's account to the seller's ac- count. For example a buyer might text 'PAY 10943933 EUR10'. This would cause a transfer of €10 to be transferred to account 10943933. Both buyer and seller then receive a text message when payment has been made. LUUP and systems like it have the potential to negate the need for exact change when paying for things like taxi journeys. In Norway, where the system was developed, users can pay for food, public transport and shopping bills.

A similar system is being used in developing countries to provide financial services to the least well off. While the physical infrastructure in Kenya (road and rail) is in a poor state, in contrast

the country has excellent mobile phone coverage, provided by two companies, Celtel and Safricom. Safricom, part owned by Vodafone, provides a service called M-Pesa. M-Pesa lets customers borrow, withdraw and pay money using text messaging. In a culture where many people are unable to open bank accounts and must therefore carry cash, it has the potential to revolutionize lives. The system gives security, and allows easy and safe transfer of cash from relatives in the developed world. According to the World Bank, this happens a lot – over 200 million migrants worldwide sent €120 billion to their families in 2005, a figure which is more than double the volume of official aid.

Figure 4.4 Contactless Payment

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Another form of e-money is virtual currency such as bitcoin. There is a debate whether virtual currencies are a form of money or more like valuable collectibles – like old Star Wars toys or bottles of wine or similar objects you might collect and trade. Some big websites do accept bitcoins as a form of payment. Basically users are given bitcoins in exchange for using their computer to process the system that records bitcoin transactions. There is no physical unit – a bitcoin is literally just an entry in the transaction log (it's called a 'blockchain'). Whether these actually have any value is decided by the market, and bitcoins have seen huge swings in what they are worth, leading some economists to warn against them.

E-money has two implications for businesses. There is the convenience of employees using it themselves when on business trips. Perhaps more importantly, depending on the type of business, it may be that customers will come to expect to be able to pay for goods and services using e-money in the future. When this happens, the retailer needs to be ready for it.

Tangible Media

A new and interesting way to represent information stored on a computer is through the use of physical objects. Very few applications are currently commercially available; however, imagine that you have a bowl of plastic pebbles in your living room and each represents one of your favourite films. To view the film, you pick up one of the pebbles and wave it at your television screen. A moment later the film starts. This is more an artistic application than something most people would want, however a 'killer application' is perhaps just around the corner which will make this technology take off. Perhaps you could think of one yourself and capitalize on your idea.

Most people are comfortable with the concept of icons. An icon on your computer screen represents a file. The icon isn't the same thing as the file, it's more like a pointer to it. Double clicking on the icon opens up the file.

The plastic pebble representing the film is the same idea, only the pebble is a physical icon, or **phicon** (pronounced fi-con). The technology has been available for several years, but a 'killer application' for phicons has not yet been found. Some ideas are a business card which opens a personal home page automatically whenever it is held near a computer. Or a brochure, marketing literature for instance, that also contains additional electronic information within it. In the future your lecture handouts could also contain electronic resources built into them! This research area is known as tangible media.

Some companies are experimenting with sending touch over long distances. Such de- vices currently only have novelty value, but perhaps someone will soon come up with a useful business application. The Kiss Communicator and the Hug shirt are two such de- vices. The Kiss Communicator allows you to blow a kiss to someone wherever they are. The Hug Shirt allows you to send them a hug. To do this requires two hug shirts. You put on one of them and hug yourself. Sensors in the shirt detect what you have done and send the information needed to recreate this feeling via bluetooth, to your mobile phone. Your phone then transmits the information as a text message to the receiver of the hug. They get a text asking if they want to accept the hug. If they do, the signal gets passed to their hug shirt, again via bluetooth, which squeezes them in the same way that you hugged your own shirt. These devices both represent new ways of connecting people.

Personal Robotics

Robotics has been mentioned before in this text, mostly in the context of assembly plants, manufacturing and space exploration. In this section, we will look at some of the robots that are used, and could be used, in our everyday lives.

The Roomba is a robotic vacuum cleaner costing around €250. It can be released into a home where it spends its time continuously cleaning. When it needs a battery recharge, it can go to a base station and recharge itself. It cannot yet, however, empty itself, although it can navigate around furniture and other obstacles. A potential business application of this technology is in cleaning offices – an army of Roombas could be let loose overnight. However, at present, the technology is not really good enough for this. Those interested in studying robotics should con-

sider that the Roomba gives a cheap platform to experiment with – the makers of the Roomba, who are products of MIT's Artificial Intelligence Lab, have made it so that you can install your own software on it and modify its behaviour.

Quite a few attempts have been made to develop robots that have personality, to give them a more natural interface to interact with people. Minerva was a talking robot designed to accommodate people in public spaces. She was active in 1998 offering people at the Smithsonian's National Museum of American History tours and leading them from exhibit to exhibit. Minerva had moods – she could be happy and sing or get frustrated and blare her horn. Minerva was a personal robot. One of the world's leading centres in personal robotics is the Robotic Life Group (also known as the Personal Robotics Group) at MIT, led by Cynthia Breazeal. This team builds robots to study our socialization with them. The term personal robotics refers to robots that become part of our everyday lives. While currently of little relevance to most businesses, we shall see in the next section that this might change, when we examine, among other things, one of the most loved personal robots, Sony's Aibo.

Virtual Pets

During the late 1990s, Sony released Aibo, a robotic puppy intended as a replacement for a real puppy. Aibo explored its environment, and got tried, hungry, grumpy and sleepy. It sometimes craved attention and could get over excited. Sony sadly no longer manufactures Aibo, but many cheaper versions inspired by it remain on the market. Aibo is an example of a virtual pet.

Virtual pets started to gain worldwide popularity in the late 1990s when

Japanese toy manufacturer Bandai released the Tamagotchi. About the size of a key ring, a typical Tamagotchi had a small black and white screen, three buttons, a speaker, a motion sensor and a microphone. Users could feed, clean and play with their Tamagotchi, call it via the microphone and chase away predators by shaking the unit. The pet would evolve over time and would eventually either die or fly away. Many users became emotionally attached to their pet, which was the ultimate goal of the software designers.

Virtual pets are perhaps unique among information systems in that their goal is to get users to feel a sense of responsibility towards the system and become attached in some way to it. Virtual pets are very popular at the moment. One of the most popular games for the Nintendo DS mobile games console is Nintendogs, which is essentially a more sophisticated version of the Tamagotchi.

So why might businesses be interested in virtual pets? Some business tools (or at least software that could be used by businesses) have 'virtual-pet-like' personality built into them. 'Clippy' or 'Clipit', the Microsoft help agent, was one of the first. Clippy would cheer- fully offer to help users with their tasks. It was almost universally hated, but it is clear that Microsoft and others have not yet given up on software with personality. Other attempts have been made to infuse personality into everyday software. PostPet by Sony was an email application where an on-screen puppy would fetch your mail, just as some real dogs do for their owners, but only if you were nice to it. The Nabaztag Rabbit is a personal companion that sits beside you and reads you the news and tells you when you have a new email. Mrs. Dewey was a human interface to the Windows Live Search who would tell jokes to the user while they were running their search. Virtual pet designers are still trying to find new applications for them. Case One in this chapter showcases a recent example, and other developers are experimenting with using them as companions for the elderly.

It is clear that some software developers are interested in giving their products personality. It is also clear that today's teenagers are perfectly comfortable interacting with devices that have

personality. It may be that in the future when they become employees, they will expect their business software to come with personality built in.

4.4 Computer Supported Cooperative Work

Computer supported cooperative work (CSCW) refers to technologies that allow groups to work together to achieve goals. Individuals in the groups can be co-located (in the same place) or geographically separated. The work can happen synchronously (individuals at work at the same time) or asynchronously (they work at different times). Different CSCW technologies exist to support these different modes of work. In global companies, CSCW technology is a powerful tool enabling a company to make the best of its human resources no matter where they are located. In this section, we will look at some CSCW tools.

Videoconferencing

For a long time in science fiction, the public has seen the future of the telephone call where both audio and video are transmitted. The technology now exists to achieve this easily and cheaply, yet while Skype video calls are popular they don't seem to have replaced phone calls to any great extent, at least in the home environment.

A videoconference is a simultaneous communication between two or more parties where they both see and hear each other. A videoconference can be set up using instant messaging software. For businesses, videoconferences are useful to hold global meetings. Visual cues are available to help everyone understand what other people are really feeling – a yawn, a nod of the head, a smile, etc. None of these can be transmitted down a telephone line. However, running a videoconference does take discipline as it is easy for more than one person to talk at once and even a slight delay in transmission time can cause chaos. TKO Video Communications has video conferencing facilities all over the world which can be rented out by businesses who do not want to set up their own. A business in South Africa can hold a meeting with partners in Egypt and the United Arab Emirates by travelling to TKO offices in Cape Town, while their partners go to Cairo and Dubai. This is a shorter and cheaper journey than for them all having to physically meet.

Messaging

Messaging technology includes email, instant messaging and web chat rooms. Email has been discussed before. It is useful for asynchronous text-based communication. Instant messaging is used for synchronous communication – two (or more) people are communicating at the same time, usually typing short sentences to build up a conversation. Instant messaging is extremely useful and can be used by employees to work on a problem together. Instant messaging versus a telephone call is largely a matter of personal preference. One advantage messaging has is that the text can be easily saved and re-read at a later date. A chat room is a facility that enables two or more people to engage in interactive 'conversations' over the web. When you participate in a chat room, dozens of people might be participating from around the world. Multi-person chats are usually organized around specific topics, and participants often adopt nicknames to maintain anonymity.

Instant messaging technology is now being used by a diverse range of companies including Zurich Insurance and Ikea, as an alternative to making customers telephone a call centre.

Customers often prefer clicking on the chat icon on a company website and waiting for the 'operator' to respond, than having to phone and wait in a queue. When phoning a call centre you often have to hold the phone to your ear, so at least one hand is tied up, and listen to (usually awful) music until someone answers. With messaging technology you can continue working at your computer until someone answers. You know when this happens as the task bar on your computer screen will start flashing.

Interactive Whiteboards

Essentially, an interactive whiteboard is a combination of a whiteboard and a PC. It can be used in a number of ways. Users can write on the white- board and then save what has been written as an image on their computer. This negates the need to take notes about what has been written after a meeting has finished. What is saved on the PC needn't be a static image – it could be an animation of everything that was written, including things that were rubbed out. Alternatively, two whiteboards at different locations could be used by people at these different locations to see what the other is writing. Combined with videoconferencing, this can be a powerful way of running meetings when not everyone is present. An interactive whiteboard is shown in

Figure 4.5. Interactive whiteboard

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Wikis

A wiki is a web page that can be edited by anyone with the proper authority. The most famous example is Wikipedia, which can be edited by any web user – very few restrictions are put in place. To see the usefulness of wikis, have a look at Wikipedia. Its content is breathtaking, considering that all of it was created by volunteers. You might try editing an article you know something about; how- ever, consider this: there is no way to know if the information has been edited by an expert or by a joker, so think twice before you rely on anything you read there. Wikis are clearly a good way of sharing knowledge and are being used by a large number of research groups and businesses to allow employees to share their thoughts and ideas, and post up good practice.

MMOGs

Look for information about MMOGs using a search engine and you may be hit with a confusing array of acronyms including MMORTS, MMOFPS and MMORPGs. MMOG stands for 'massively multiplayer online game'. They have a long history, but today they exist as 3D virtual worlds. Users are represented in the world by an avatar, which interacts with other avatars typically by text, but voice is starting to be used. From a business point of view, we are not primarily interested in virtual worlds as games, but as a platform for holding meetings and for their marketing potential. Probably the best virtual world for these activities is Second Life. Owned by San Francisco-based Linden Lab, Second Life is a huge virtual world where residents meet socially and commercially. It has its own currency, the Linden dollar, which has a floating exchange rate with the US dollar. This means you can make (and spend) real money in Second Life. Several people are making a good living there (mostly by land speculation and by creating and selling animations), and big businesses are starting to get involved. IBM and Dell have already held global meetings in Second Life, and you can test drive Toyota cars there. (Note, however, that IBM and Dell were researching the usefulness of using this platform to hold meetings – they were not actually holding a board meeting there; that has yet to happen.) Some commentators are saying that 3D interfaces such as this will become the main way we access information over the Internet in the future. As an example of the direction Linden Lab may be planning for their technology, Jeff Bezos, the founder of Amazon, is one of the financial backers of Second Life, and Philip Rosedale, CEO of Linden Lab, has pointed out that whenever someone visits Amazon, there are thousands of other shoppers on the site with them. He has expressed the opinion that it would be a good thing if all those shoppers could both see and interact with each other. Business uses of virtual worlds have tailed off recently as the initial hype has worn off, but some commentators are still predicting they will play a part in future business communications.

Blogs and Podcasts

While not strictly a CSCW technology, blogs still allow for the sharing of in- formation from one to many people. A blog, short for 'weblog', is a website that people create and use to write about their observations, experiences and feelings on a wide range of topics. Technically, it is identical to any other web page, although the content of a blog is updated much more frequently, typically every day. The community of blogs and bloggers is often called the

'blogosphere'. A 'blogger' is a person who creates a blog, while 'blogging' refers to the process of placing entries or 'posts' on a blog site. A blog is like a diary. When people post information to a blog, it is placed at the top of the blog. Blogs can contain links to other material, and people can usually comment on posts. Blogs are easy to post to, but they can cause problems when people tell or share too much. People have been fired for blogging about work, and the daughter of a politician embarrassed her father when she made personal confessions on her blog. Blog sites, such as www.blogger.com, include information and tools to help people create and use weblogs. The way blogs are structured, with the most recent post appearing at the top, can make it extremely difficult to read and understand what it is all about – imagine you visit a blog, which you know (from an Internet search) talks about a product you are having problems with. Let's say the first post you come to starts: 'Today's fresh hell – ABC company rep John replied and said it would work. I tried it and ended up breaking the stupid thing. Just my luck'. The blogger is presumably making reference to something written about yesterday or before. It may take you a while to track down what they did to break the product, something you probably want to know about to avoid doing yourself. Go to blogger.com, select a blog at random (there is a feature to do this) and you will see the problem – it can be difficult to start reading a blog. If you keep a blog, you might want to think about this and how you can keep new and irregular readers interested.

Microblogs are currently extremely popular with Twitter being the most common example. They have much the same goals as the blogs described above except that posts are limited in size. In the case of Twitter's, the limit is 140 characters. Microblogs have many uses. They are often used by celebrities to keep in close contact with their fans.

A podcast is an audio broadcast over the Internet. The term 'podcast' comes from the word iPod, Apple's portable music player, and the word 'broadcast'. A podcast is essentially an audio blog, like a personal radio station on the Internet, and extends blogging by adding audio messages. Using a computer and microphone, you can record audio messages and place them on the Internet. You can then listen to the podcasts on your computer or download the audio material to a music player, such as Apple's iPod. You can also use podcasting to listen to TV programmes, your favourite radio personalities, music and messages from your friends and family at any time and place. Finding good podcasts, however, can be challenging. Apple's new version of iTunes allows you to download free software to search for podcasts by keyword. People and corporations can use podcasts to listen to audio material, increase revenues or advertise products and services. Colleges and universities often use blogs and podcasts to deliver course material to students.

Many blogs and podcasts offer automatic updates to a computer using a technology called Really Simple Syndication (RSS). RSS is a collection of web formats to help provide web content or summaries of web content. With RSS, you can get a blog update without actually visiting the blog web- site. RSS can also be used to get other updates on the Internet from news websites and podcasts

4.5 More Applications of Electronic and Mobile Commerce

Lastly in this chapter we will examine how e-commerce and m-commerce are being used in innovative and exciting ways. This section examines a few of the many B2B, B2C, C2C and m-commerce applications in the retail and wholesale, manufacturing, marketing, investment and finance, and auction arenas

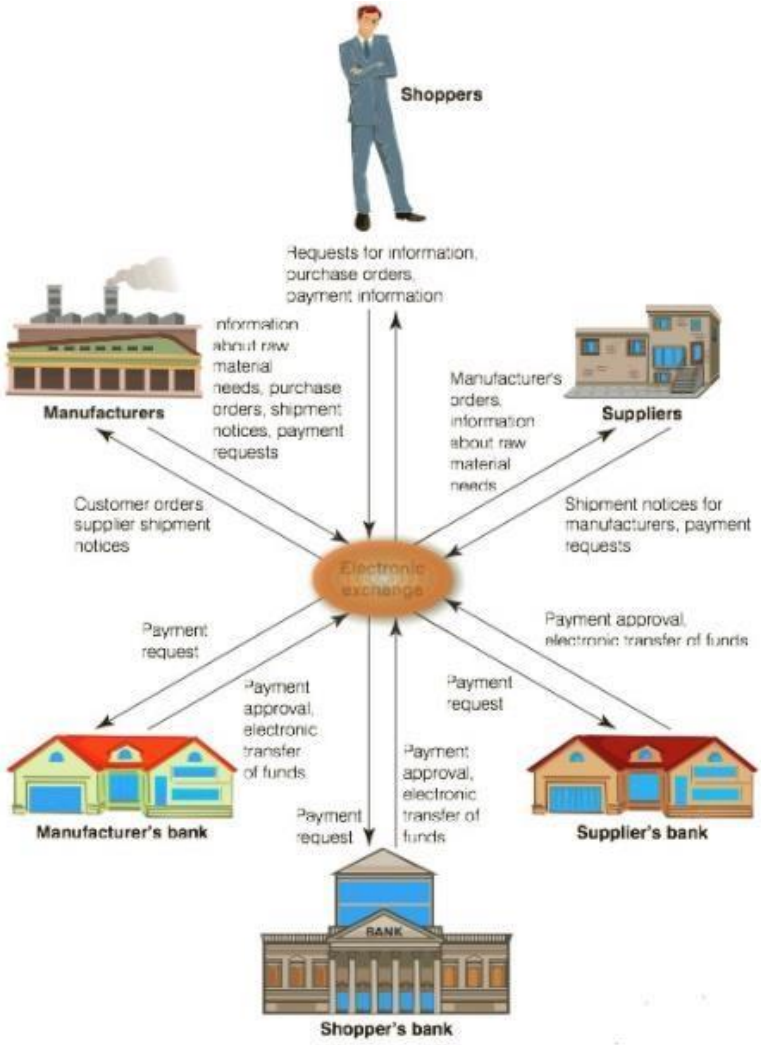
Retail and Wholesale

E-commerce is being used extensively in retailing and wholesaling**. Electronic retailing,** sometimes called e-tailing, is the direct sale of products or services by businesses to consumers through electronic shops, which are typically designed around the familiar electronic catalogue and shopping cart model. Tens of thou- sands of electronic retail websites sell a wide range. In addition, cyber shopping centres, or 'cybermalls', are another means to support retail shopping. A cyber- mall is a single website that offers many products and services at one Internet location. An Internet cybermall pulls multiple buyers and sellers into one virtual place, easily reachable through a web browser. For example, Cybermall New Zealand (www.cybermall.co.nz) is a virtual shopping mall that offers retail shopping, travel and infotainment products and services. A key sector of wholesale e-commerce is spending on manufacturing, repair and operations (MRO) of goods and services – from simple office supplies to mission-critical equipment, such as the motors, pumps, compressors and instruments that keep manufacturing facilities running smoothly. MRO purchases often approach 40 per cent of a manufacturing company's total revenues, but the purchasing system can be haphazard, without automated controls. In addition to these external pur- chase costs, companies face significant internal costs resulting from outdated and cumbersome MRO management processes. For example, studies show that a high percentage of manufacturing downtime is often caused by not having the right part at the right time in the right place. The result is lost productivity and capacity. E-commerce software for plant operations provides powerful comparative searching capabilities to enable managers to identify functionally equivalent items, helping them spot opportunities to combine purchases for cost savings. Comparing various suppliers, coupled with consolidating more spending with fewer suppliers, leads to decreased costs. In addition, automated workflows are typically based on industry best practices, which can streamline processes.

Manufacturing

One approach taken by many manufacturers to raise profitability and improve customer service is to move their supply chain operations onto the Internet. Here they can form an electronic exchange to join with competitors and supplier's alike, using computers and websites to buy and sell goods, trade market information and run back-office operations, such as inventory control, as shown in Figure 4.6. With such an exchange, the business centre is not a physical building but a network-based location where business interactions occur. This approach has greatly speeded up the movement of raw materials and finished products among all members of the business community, thus reducing the amount of inventory that must be maintained. It has also led to a much more competitive marketplace and lower prices. Private exchanges are owned and operated by a single company. The owner uses the exchange to trade exclusively with established business partners. Public exchanges are owned and operated by industry groups. They provide services and a common technology platform to their members and are open, usually for a fee, to any company that wants to use them.

Figure 4.6 Model of an Electronic Exchange



Several strategic and competitive issues are associated with the use of exchanges. Many companies distrust their corporate rivals and fear they might lose trade secrets through participation in such exchanges. Suppliers worry that the online marketplaces and their auctions will drive down the prices of goods and favour buyers. Suppliers also can spend a great deal of money in the setup to participate in multiple exchanges. For example, more than a dozen new exchanges have appeared in the oil industry, and the printing industry has more than 20 online marketplaces. Until a clear winner emerges in particular industries, suppliers are more or less forced to sign on to several or all of them. Yet another issue is potential government scrutiny of exchange participants – when competitors get together to share information, it raises questions of collusion or antitrust behaviour.

Many companies that already use the Internet for their private exchanges have no desire to share their expertise with competitors. At the US shopping giant Wal-Mart, the world's number- one retail chain, executives turned down several invitations to join exchanges in the retail and consumer goods industries. Wal-Mart is pleased with its in-house exchange, Retail Link, which connects the company to 7000 worldwide suppliers that sell everything from toothpaste to furniture.

Marketing

The nature of the web allows firms to gather much more information about customer behaviour and preferences than they could use other marketing approaches. Marketing organizations can measure many online activities as customers and potential customers gather information and make their purchase decisions. Analysis of this data is complicated because of the web's interactivity and because each visitor voluntarily provides or refuses to provide personal data such as name, address, email address, telephone number and demographic data. Internet advertisers use the data they gather to identify specific portions of their markets and target them with tailored advertising messages. This practice, called **market segmentation**, divides the pool of potential customers into sub- groups, which are usually defined in terms of demographic characteristics, such as age, gender, marital status, income level and geographic location.

Technology-enabled relationship management is a new twist on establishing direct customer relationships made possible when firms promote and sell on the web. Technology-enabled relationship management occurs when a firm obtains detailed information about a customer's behaviour, preferences, needs and buying patterns, and uses that information to set prices, negotiate terms, tailor promotions, add product features and otherwise customize its entire relationship with that customer.

DoubleClick is a leading global Internet advertising company that leverages technology and media expertise to help advertisers use the power of the web to build relationships with customers. The DoubleClick Network is its flagship product, a collection of high-traffic and well-recognized sites on the web, including MSN, Sports Illustrated, Continental Airlines, the Washington Post, CBS and more than 1500 others. This network of sites is coupled with DoubleClick's proprietary DART targeting technology, which allows advertisers to target their best prospects based on the most precise profiling criteria available. DoubleClick then places a company's ad in front of those best prospects. DART powers over 60 billion ads per month and is trusted by top advertising agencies. Comprehensive online reporting lets advertisers know how their campaign is performing and what type of users are seeing and clicking on their ads. This high-level targeting and real-time reporting provide speed and efficiency not available in any other medium. The system is also designed to track advertising transactions, such as impressions and clicks, to summarize these transactions in the form of reports and to compute DoubleClick Network member compensation.

Investment and Finance

The Internet has revolutionized the world of investment and finance. Perhaps the changes have been so great because this industry had so many built-in inefficiencies and so much opportunity for improvement.

The brokerage business adapted to the Internet faster than any other arm of finance. The allure of online trading that enables investors to do quick, thorough research and then buy shares in any company in a few seconds and at a fraction of the cost of a full-commission firm has brought many investors to the web. In spite of the wealth of information available online, the average consumer buys stocks based on a tip or a recommendation rather than as the result of research and analysis. It is the more sophisticated investor that really takes advantage of the data and tools available on the Internet.

Online banking customers can check balances of their savings, current and loan/mortgage accounts; transfer money between accounts; and pay their bills. These customers enjoy the

convenience of not writing cheques by hand, tracking their current balances and reducing expenditures on envelopes and stamps.
All of the country's major banks and many of the smaller banks enable their customers to pay bills online; many support bill payment via a mobile phone or other wireless device. Banks are eager to gain more customers who pay bills online because such customers tend to stay with the bank longer, have higher cash balances and use more of the bank's products.
The next advance in online bill paying is **electronic bill presentment**, which eliminates all paper, right down to the bill itself. With this process, the vendor posts an image of your statement on the Internet and alerts you by email that your bill has arrived. You then direct your bank to pay it.

Auctions

eBay has become synonymous with online auctions for both private sellers and small companies. However, hundreds of online auction sites cater to newcomers to online auctions and to unhappy eBay customers. The most frequent complaints are increases in fees and problems with unscrupulous buyers. As a result, eBay is constantly trying to expand and improve its services. eBay spent €1.8 billion to acquire Skype, a pioneer in voice over IP (VoIP) services with the goal of improving communications between sellers and potential buyers for 'high-involvement' items such as cars, business equipment and high-end collectibles. eBay might also provide a pay-for- call service to provide a lead generation service for sellers based on the Skype technology. eBay purchased the payment gateway system of security company VeriSign to provide a payment solution to tens of thousands of new SME businesses. Under the deal, eBay will also receive two million VeriSign security tokens, physical devices like keychain-sized USB plug-ins, that are used to create two-factor security where users must provide both a security password and the physical token.

Anywhere, Anytime Applications of Mobile Commerce
Because m-commerce devices usually have a single user, they are ideal for accessing personal information and receiving targeted messages for a particular consumer. Through m-commerce, companies can reach individual consumers to establish one-to-one marketing relationships and communicate whenever it is convenient – in short, anytime and anywhere. The following are just a few examples of potential m-commerce applications:

- Banking customers can use their wireless handheld devices to access their accounts and pay their bills.
- Clients of brokerage firms can view stock prices and company research as well as conduct trades to fit their schedules.
- Information services such as financial news, sports information and traffic updates can be delivered to people whenever they want.
- On-the-move retail consumers can place and pay for orders instantaneously.
- Telecommunications service users can view service changes, pay bills and customize their services.
- Retailers and service providers can send potential customers advertising, promotions or coupons to entice them to try their services as they move past their place of business**.**

The most successful m-commerce applications suit local conditions and people's habits and preferences. Most people do their research online and then buy offline at a local retailer. As a result, a growing market for local search engines is designed to answer the question, 'where do I buy product x at a brick-and-mortar retailer near me?' Consumers provide their post code and begin by asking a basic question, 'What local stores carry a particular category of items' (e.g. flat- screen televisions). Consumers typically don't start searching knowing that they want a specific model of Panasonic flat-screen TV. The local search engine then provides a list of local stores, including those with a website and those without, which sell this item.
As with any new technology, m-commerce will only succeed if it provides users with real benefits. Companies involved in m-commerce must think through their strategies carefully and ensure that they provide services that truly meet customers' needs.

Advantages of Electronic and Mobile Commerce

According to the Council of Supply Chain Management Professionals, 'Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers'. Conversion to an e-commercedriven supply chain provides businesses with an opportunity to achieve operational excellence by enabling consumers and companies to gain a global reach to worldwide markets, reduce the cost of doing business, speed the flow of goods and information, increase the accuracy of order processing and order fulfilment, and improve the level of customer service.

- Global reach. E-commerce offers enormous opportunities. It allows manufacturers to buy at a low cost worldwide, and it offers enterprises the chance to sell to a global market right from the very start-up of their business. Moreover, e-commerce offers great promise for developing countries, helping them to enter the prosperous global marketplace and hence helping reduce the gap between rich and poor countries.
- Reduce costs. By eliminating or reducing time-consuming and labour-intensive steps throughout the order and delivery process, more sales can be completed in the same period and with increased accuracy. With increased speed and accuracy of customer order informa tion, companies can reduce the need for inventory – from raw materials, to safety stocks, to finished goods – at all the intermediate manufacturing, storage and transportation points.
- Speed the flow of goods and information. When organizations are connected via ecommerce, the flow of information is accelerated because of the already established electronic connections and communications processes. As a result, information can flow easily, directly and rapidly from buyer to seller.
- Increased accuracy. By enabling buyers to enter their own product specifications and order information directly, human data-entry error on the part of the supplier is eliminated.
- Improve customer service. Increased and more detailed information about delivery dates and current status can increase customer loyalty. In addition, the ability to consistently meet

customers' desired delivery dates with high-quality goods and services eliminates any incentive for customers to seek other sources of supply.

Chapter Summary/Review

- The term 'computing' no longer refers to a com- puter on a desk. Mobile devices are letting employees access information from wherever they happen to be. In addition, the same technologies are allowing customers to interact with businesses in new ways.
- Teams made up of people living in different geographical regions are able to work together efficiently and effectively, without ever having to meet. This work is facilitated by a range of technologies. Computer supported cooperative work (CSCW) refers to technologies that allow groups to work together to achieve goals. Individuals in the groups can be co- located (in the same place) or geographically separated. The work can happen synchronously (individuals work at the same time) or asynchronously (they work at different times).
- E-commerce and m-commerce can be used in many innovative ways to improve the operations of an organization. Electronic retailing (e-tailing) is the direct sale from a business to consumers through electronic storefronts designed around an electronic catalogue and shopping cart model.

Review Questions (Short)

1. What is a hotspot?
2. 'Smart shoes' would be an example of _____.
3. Paying without cash is often labelled _____.
4. M-Pesa is attempting to replace a bank account with a _____.
5. An online diary is often called a _____

Review Questions (Long)

1. Explain three examples of CSCW technologies 2. Explain two examples of e-money.
3. What applications exist for wearable technology?
4. Why would a business offer free wi-fi?
5. List three mobile devices that can access wi-fi

Review Questions (MCQ's)

1. . What is a hotspot _____

A. Beam of light

B. Switch

C. An area where wireless internet access is available

D. Near field communication

2. 'Smart shoes' would be an example of

A. Prototyping

B. Neural network

C. M-commerce

D. Wearable technology

3. Paying without cash is often labelled _____

A. Collect or input

B. E-money

C. Brainstorming

D. Cloud computing

4. M-Pesa is attempting to replace a bank account with a_____

A. Mobile phone

	B. Customer relationship management
	C. E-government D. C2C

5. A_____ attempts to get a user to feel emotionally attached with it and so continue to interact with it

A. Knowledge base

B. Group

C. Warehouse

D. Virtual pet

Case Studies / Projects

Someone to Share a Journey With

Over the years, a number of companies have tried to create artificial companions. Attempts have in- cluded an on-screen dog that fetches your email, the Tamagotchi game and Sony's beautiful Aibo robot puppy. The latest comes from car maker Toyota. Set to be released in 2017, Kirobo Mini is described as a 'communication partner' capable of holding a basic conversation. It is embodied and can make hand gestures, and can recognize and respond to human emotion. About the size of an apple and looking like a character from an anime movie, it seems to be primarily intended for use as a travel companion on car journeys, to give users who are driving alone someone to talk to.

Questions

1. Let's say Kirobo detects that its user is angry. How should it respond? Should it attempt to soothe and calm them, or stoke the anger with a 'best to get it all out' attitude?
2. Is your answer to Question1 dependent on the context of use – does it matter if a user is in a car, on a date or just about to go into an interview.
3. Thinking about any reaction made by Kirobo – how would designers know what the 'right'response is? Is there even a right response? Is there a wrong response?
4. What else could technology such as Kirobo be used for?

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Case Studies / Projects

Kids Finally Get a Real Magic Wand at Disney

OK it's not a wand, it's a wrist band, but it still feels magic. Called the MagicBand, it is the central part of Disney's MyMagic+ system. MyMagic+ is a tool for planning and enhancing guest experiences. It is built around three technologies: a smartphone app, the FastPass+ system and the MagicBand. With typical Disney colourful style and stamped with their ubiquitous Mickey Mouse logo, the band is wearable technology – a bracelet – that contains a Radio Frequency ID (RFID) tag to uniquely identify each guest that wears one. RFID is the use of radio waves to read and capture information stored on a tag attached to an object, in this case the magic band.

Questions

1. Why a bracelet and not a magic wand? How else could the RFID tag be packaged?
2. What could Disney do with data on how people move around their parks?
3. What could another organization do with this technology?
4. Why do you think Disney does not identify the current shortest ride queues on the app? Is there any way they could introduce the feature, but deal with any objections you have listed?

Read

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LEARNING OUTCOMES

After reading this Section of the guide, the learner should be able to:

Learning Objectives

- Identify the key participants in the systems development process and discuss their roles.
- Define the term 'information systems' and 'planning' and list several reasons for initiating a systems project.
- Discuss three trends that illustrate the impact of enterprise resource planning software packages on systems development.
- Discuss the key features, advantages and disadvantages of the traditional, prototyping, rapid application development and end-user systems development lifecycles.
- Identify several factors that influence the success or failure of a systems development project.
- Discuss the use of CASE tools and the object-oriented approach to systems development.
- State the purpose of systems investigation.
- Discuss the importance of performance and cost objectives.
- State the purpose of systems analysis and discuss some of the tools and techniques used in this phase of systems development.

Introduction

Throughout guide you have seen many examples of the use of information systems. But where do these systems come from? How can you work with IS personnel, such as systems analysts and computer programmers, to get what you need to succeed on the job? This chapter gives you the answer.

5.1 An Overview of Systems Development

In today's businesses, managers and employees in all functional areas work together and use business information systems. Because they are central to project success, users are helping with development and, in many cases, leading the way. Users might request that a systems de-

velopment team determine whether they should purchase a few PCs, update an existing order processing system, develop a new medical diagnostic or design and implement a new website.

In other cases, systems development might involve purchasing or leasing a system such as an enterprise resource planning (ERP) package.

This chapter and the next provide you with a deeper appreciation of the systems development process and show how businesses can avoid costly failures. Calculating the cost of an IT project is difficult and a number of high-profile mistakes have been made. Most of these are from the public sector (as any mistakes from the private sector are quickly covered up!). In the UK there have been IT problems and soaring costs with the system for issuing passports, the system managing benefit payments and the system managing patient data in the National Health Service. Not all of these problems have been technical. The new National Health Service information sharing system has been delayed because of problems caused by a lack of communication with patients.There was widespread criticism that the public had been left in the dark about the project. Participants in systems development, in this case government health ministers, hospital managers, doctors and patient groups, are critical to systems development success.

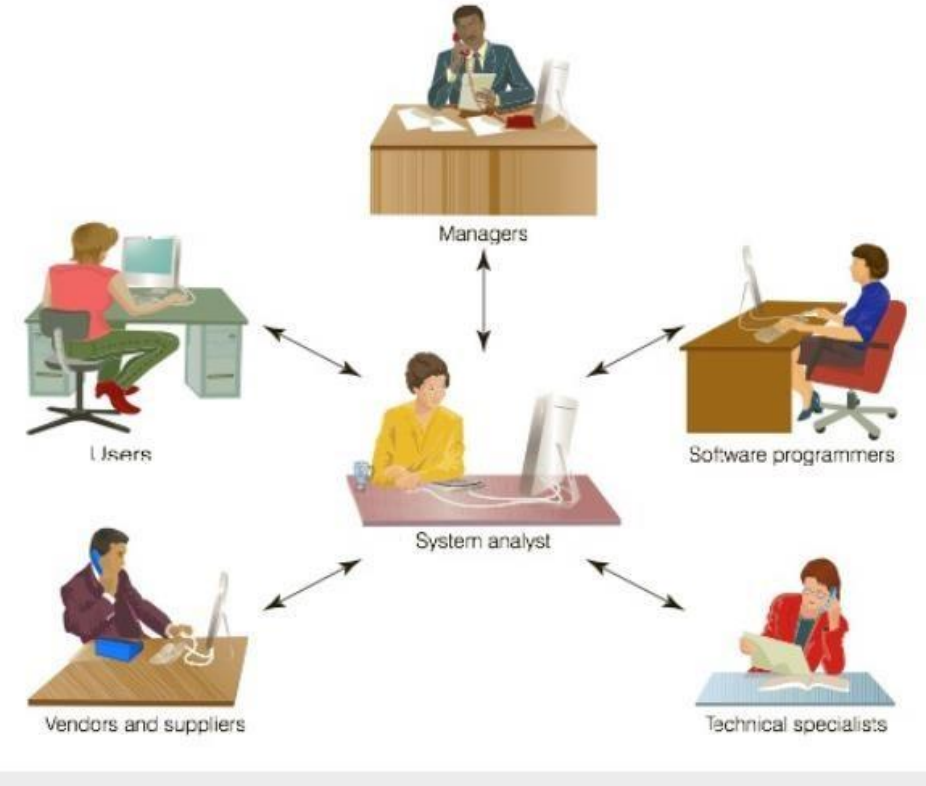
Participants in Systems Development

Active systems development requires a team effort. The team usually consists of users, managers, systems development specialists, various support personnel and other stakeholders. This team, called the development team, is responsible for determining the objectives of the new information system and delivering a system that meets these objectives. Many development teams use a project manager to head the systems development effort and to help coordinate the systems development process. A project is a planned collection of activities that achieves a goal, such as constructing a new manufacturing plant or developing a new decision support system. All projects should have a defined starting point and ending point, normally given as a specific date. Most have a set budget, such as €150 000. The project manager is responsible for coordinating all people and resources needed to complete the project on time. In systems development, the project manager can be an IS person inside the organization or an external consultant hired to see the project to completion. Project managers need technical, business and people skills. In addition to completing the project on time and within the specified budget, the project manager is usually responsible for controlling project quality, training personnel, facilitating communication, managing risks and acquiring any necessary equipment, including office supplies and sophisticated computer systems. One study reported that almost 80 per cent of responding IS managers believe that it is critical to keep project planning skills in-house instead of outsourcing them.3 Research studies have shown that project management success factors include good leadership from executives and project managers, a high level of trust in the project and its potential benefits, and the commitment of the project team and organization to successfully complete the project and implement its results.

In the context of systems development, stakeholders are people who, either themselves or through the area of the organization they represent, ultimately benefit from the systems development project. Users are people who will interact with the system regularly. They can be employees, managers or suppliers. For large-scale systems development projects, where the investment in and value of a system can be high, it is common for senior-level managers,

including the heads of functional areas (finance, marketing and so on), to be part of the development team. Depending on the nature of the systems project, the development team might include systems analysts and programmers, among others. A systems analyst is a professional who specializes in analyzing and designing business systems. Systems analysts play various roles while interacting with the users, management, vendors and suppliers, external companies, programmers and other IS support personnel (see Figure 5.1). Sometimes system analyst's work with specialist business analysts, experts in the business who try to identify ways in which new in- formation systems can improve the current business processes. Like an architect developing blueprints for a new building, a systems analyst develops detailed plans for the new or modified

Figure 5.1 Role of the Systems Analyst



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System. The programmer is responsible for modifying or developing programs to satisfy user requirements. Like a contractor constructing a new building or renovating an existing one, the

programmer takes the plans from the systems analyst and builds or modifies the necessary software.

The other support personnel on the development team are mostly technical specialists, including database and telecommunications experts, hardware engineers and supplier representatives. One or more of these roles might be outsourced to outside experts. Depending on the magnitude of the systems development project and the number of IS systems development specialists on the team, one or more IS managers might also belong to the team. The composition of a development team can vary over time and from project to project. For small businesses, the development team might consist of a systems analyst and the business owner as the primary stakeholder. For larger organizations, IS staff can include hundreds of people involved in a variety of activities, including systems development. Every development team should have a team leader. This person can be from the IS department, a manager from the company or a consultant from outside the company. The team leader needs both technical and people skills.

Regardless of the specific nature of a project, systems development creates or modifies systems, which ultimately means change. Managing this change effectively requires development team members to communicate well. Because you probably will participate in systems development during your career, you must learn communication skills. You might even be the individual who initiates systems development. Typical reasons for initiating IS projects are given in Table 5.1.

Table 5.1 Typical Reasons to Initiate a Systems Development Project

Reason	Example
Problems with existing system	Not processing orders fast enough
Desire to exploit new opportunities	M-commerce
Increasing competition	New competitor enters industry
Desire to make more effective use of information	Wanting to set up a customer relationship management system to expand and exploit information stored on customers
Organizational growth	Expanding customer base
Merger or acquisition	Buying out a competitor
Change in the environment	New regulations imposed by government

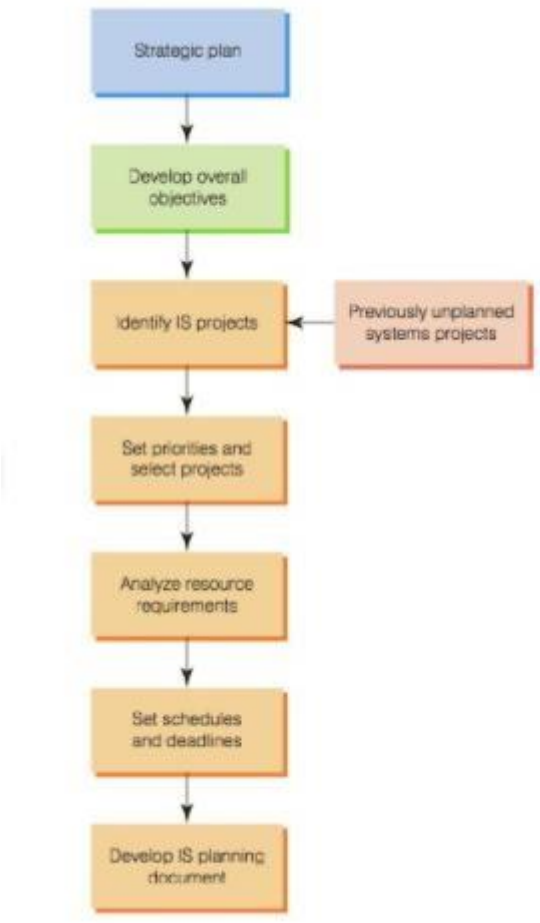
Information Systems Planning and Aligning Organization and IS Goals

The term information systems planning refers to translating strategic and organizational goals into systems development initiatives. The chief information officer (CIO) of the Marriott Hotel chain, for example, attends board meetings and other top-level management meetings so that

the he is familiar with, and can contribute to, the firm's strategic plan. According to Doug Lewis, former CIO for many Fortune 100 companies, 'Strategic goals must be finite, measurable and tangible'. Proper IS planning ensures that specific systems development objectives support organizational goals. Aligning organizational goals and IS goals is critical for any successful systems development effort.4 because information systems support other business activities, IS staff and people in other departments need to understand each other's responsibilities and tasks. Determining whether organizational and IS goals are aligned can be difficult.

One of the primary benefits of IS planning and alignment of business goals is a long-range view of information systems use in the organization. The IS plan should guide the development of the IS infrastructure over time. IS planning should ensure better use of IS resources including funds, personnel and time for scheduling specific projects. The steps of IS planning are shown in Figure 5.2.

Figure 5.2 The Steps of IS Planning Some



In today's business environment, many companies seek systems development projects that will provide them with a competitive advantage. Thinking competitively usually requires creative and critical analysis. For example, a company might want to achieve a competitive advantage by improving its customer–supplier relationship. Linking customers and suppliers electronically can result in more efficient communication and, ultimately, superior products and services. By looking at problems in new or different ways and by introducing innovative

methods to solve them, many organizations have gained significant advantages. In some cases, these new solutions are inspired by people and things not directly related to the problem. ■Questioning statements and assumptions. Questioning users about their needs and clarifying their initial responses can result in better systems and more accurate predictions. Too often, stakeholders and users specify certain system requirements because they assume that their needs can only be met that way. Often, an alternative approach would be better. For example, a stakeholder might be concerned because there is always too much of certain items in stock and not enough of other items. So, the stakeholder might request a new and improved inventory control system. An alternative approach is to identify the root cause for poor inventory management. This latter approach might determine that sales forecasting is inaccurate and needs improvement or that production cannot meet the set production schedule. All too often, solutions are selected before understanding the complete nature of the problem.

■Identifying and resolving objectives and orientations that conflict. Each department in an organization can have different objectives and orientations. The buying department might want to minimize the cost of spare parts by always buying from the lowest-cost supplier, but engineering might want to buy more expensive, higher quality spare parts to reduce the frequency of replacement. These differences must be identified and resolved before a new purchasing system is developed or an existing one modified.

Establishing Objectives for Systems Development

The overall objective of systems development is to achieve business goals, not technical goals, by delivering the right information to the right person at the right time. The impact a particular system has on an organization's ability to meet its goals determines the true value of that system to the organization. Although all systems should support business goals, some systems are more pivotal in continued operations and goal attainment than others. These systems are called 'key operational'. An order processing system, for example, is key operational. Without it, few organizations could continue daily activities, and they clearly would not meet set goals.

The goals defined for an organization also define the objectives that are set for a system. A manufacturing plant, for example, might determine that minimizing the total cost of owning and operating its equipment is critical to meeting production and profit goals. Critical success factors (CSFs) are factors that are essential to the success of certain functional areas of an organization. The CSF for manufacturing – minimizing equipment maintenance and operating costs – would be converted into specific objectives for a proposed system. One specific objective might be to alert maintenance planners when a piece of equipment is due for routine preventative maintenance (e.g. cleaning and lubrication). Another objective might be to alert the maintenance planners when the necessary cleaning materials, lubrication oils or spare parts inventory levels are below specified limits. These objectives could be accomplished either through automatic stock replenishment or through the use of exception reports. Regardless of the particular systems development effort, the development process should define a system with specific performance and cost objectives. The success or failure of the systems development effort will be measured against these objectives.

Performance Objectives

■The quality or usefulness of the output. Is the system generating the right information for a value-added business process or by a goal-oriented decision maker?

■The accuracy of the output. Is the output accurate and does it reflect the true situation? As a result of the Enron accounting scandal in the US and similar instances when some companies overstated revenues or understated expenses, accuracy is becoming more important, and business leaders throughout the world are being held responsible for the accuracy of all corporate reports.

■The quality or usefulness of the format of the output. Is the output generated in a form that is usable and easily understood? For example, objectives often concern the legibility of screen displays, the appearance of documents and the adherence to certain naming conventions.

■The speed at which output is generated. Is the system generating output in time to meet organizational goals and operational objectives? Objectives such as customer response time, the time to determine product availability and throughput time are examples.

■The scalability of the resulting system. Scalability allows an information system to handle business growth and increased business volume. For example, if a mid-sized business realizes an annual 10 per cent growth in sales for several years, an information system that is scalable will be able to efficiently handle the increase by adding processing, storage, software, database, telecommunications and other information systems resources to handle the growth.

■The degree to which business risk is reduced. One important objective of many systems development projects is to reduce risk. The BRE Bank in Poland, for example, used systems development to create a model-based decision support system to analyze and reduce loan risk and a variety of related risks associated with bank transactions. The new project uses a mathematical algorithm, called FIRST (financial institutions risk scenario trends), to reduce risk.

In some cases, the achievement of performance objectives can be easily measured (e.g. by tracking the time it takes to determine product availability). In other cases, it is sometimes more difficult to ascertain in the short term. For example, it might be difficult to determine how many customers are lost because of slow responses to customer enquiries regarding product availability. These outcomes, however, are often closely associated with business goals and are vital to the long-term success of the organization. Senior management usually dictates their attainment.

Cost Objectives

Organizations can spend more than is necessary during a systems development project. The benefits of achieving performance goals should be balanced with all costs associated with the system, including the following: ■Development costs. All costs required to get the system up and running should be included. Some computer vendors give cash rewards to companies using their systems to reduce costs and as an incentive.

■Costs related to the uniqueness of the system application. A system's uniqueness has a profound effect on its cost. An expensive but reusable system might be preferable to a less costly system with limited use.

■Fixed investments in hardware and related equipment. Developers should consider costs of such items as computers, network-related equipment and environmentally controlled data centres in which to operate the equipment.

■Ongoing operating costs of the system. Operating costs include costs for personnel, software, supplies and resources such as the electricity required to run the system.

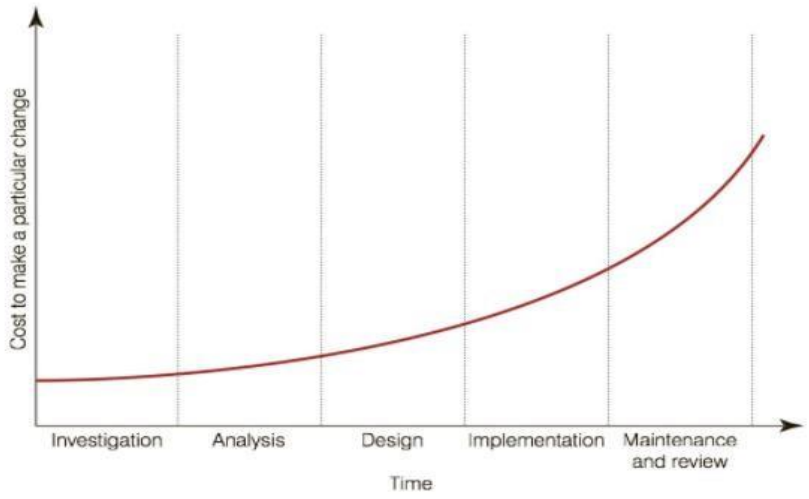
Balancing performance and cost objectives within the overall framework of organizational goals can be challenging. Setting objectives is important, however, because they allow an organization to allocate resources effectively and measure the success of a systems development effort.

5.2 Systems Development Lifecycles

The systems development process is also called the 'systems development lifecycle' (SDLC) be- cause the activities associated with it are ongoing. As each system is built, the project has timelines and deadlines, until the system is installed and accepted. The life of the system then continues as it is maintained and reviewed. If the system needs significant improvement beyond the scope of maintenance, if it needs to be replaced because of a new generation of technology, or if the IS needs of the organization change significantly, a new project will be initiated and the cycle will start over.

A key fact of systems development is that the later in the SDLC an error is detected, the more expensive it is to correct (see Figure 5.3). One reason for the mounting costs is that if an error which occurred in a early stage of the SDLC isn't found until a later phase, the previous phases must be reworked to some extent. Another reason is that the errors found late in the SDLC affect more people. For example, an error found after a system is installed might require retraining users when a 'work-around' to the problem has been found. Thus, experienced systems developers prefer an approach that will catch errors early in the project lifecycle.

Figure 5.3 Relationship Between Timing of Errors and Costs



Several common systems development lifecycles exist: the traditional or waterfall approach, prototyping, rapid application development (RAD) and end-user development. In addition, companies can outsource the systems development process. With many companies and most public sector organizations, these approaches are formalized and documented so that systems developers have a well-defined process to follow; in other companies, less formalized approaches are used. Keep Figure 5.3 in mind as you are introduced to alternative SDLCs in the sections that follow.

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The Traditional Systems Development Lifecycle

Traditional systems development efforts can range from a small project, such as purchasing an inexpensive computer program, to a major undertaking. The steps of traditional systems development might vary from one company to the next, but most approaches have five common phases: investigation, analysis, design, implementation, and maintenance and review.

In the systems investigation phase, potential problems and opportunities are identified and considered in light of the goals of the business. Systems investigation attempts to answer the questions, 'what is the problem?' and 'is it worth solving?' The primary result of this phase is a defined development project for which business problems or opportunity statements have been created, to which some organizational resources have been committed, and for which systems analysis is recommended. Systems analysis attempts to answer the question, 'what must the information system do to solve the problem?' This phase involves studying existing systems and work processes to identify strengths, weaknesses and opportunities for improvement. The major outcome of systems analysis is a list of requirements and priorities.
Systems design seeks to answer the question, 'how will the information system do what it must do to obtain the problem solution?' The primary result of this phase is a technical design that either describes the new system or describes how existing systems will be modified. The system design details system out- puts, inputs and user interfaces; specifies hardware, software, database, telecommunications, personnel and procedure components; and shows how these components are related.

Systems implementation involves creating or buying the various system components detailed in the systems design, assembling them and placing the new or modified system into operation. An important task during this phase is to train the users. Systems implementation results in an installed, operational information system that meets the business needs for which it was developed. The purpose of systems maintenance and review is to ensure that the system operates as intended and to modify the system so that it continues to meet changing business needs. As shown in Figure 5.4, a system under development moves from one phase of the traditional SDLC to the next. The traditional SDLC allows for a large degree of management control. However, a major problem is that the user does not use the solution until the system is nearly complete.

Table 5.2 lists advantages and disadvantages of the traditional SDLC.

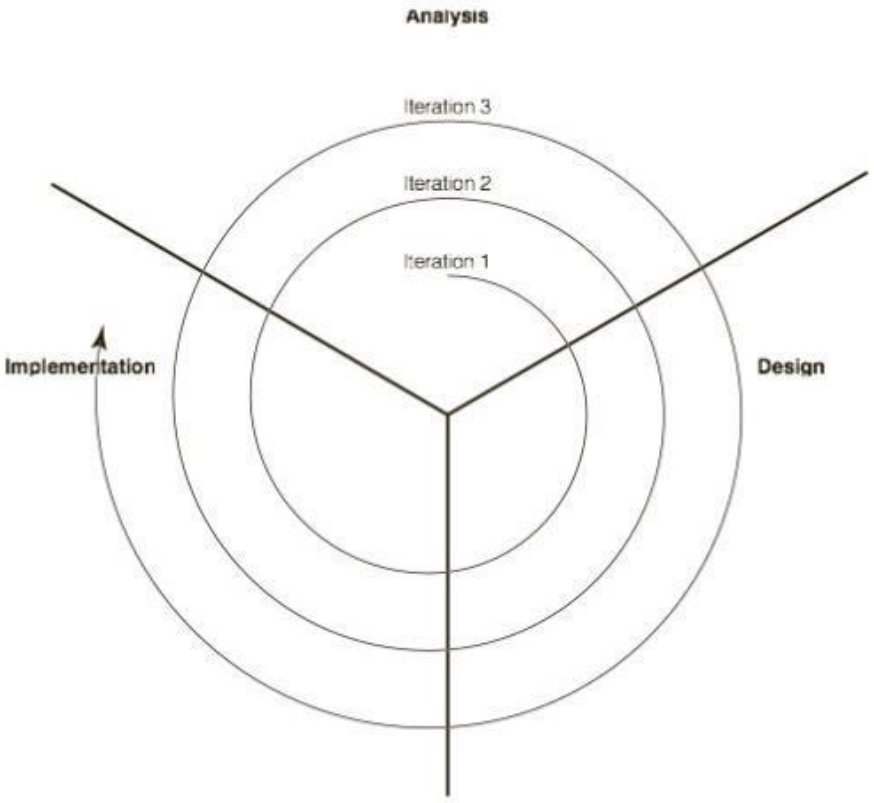
Advantages	Disadvantages
Formal review at the end of each phase allows maximum management control	Users get a system that meets the needs as understood by the developers; this might not be what is really needed
This approach creates considerable system documentation	Documentation is expensive and time consuming to create. It is also difficult to keep current
Formal documentation ensures that system requirements can be traced back to stated business needs	Often, user needs go unstated or are misunderstood
It produces many intermediate products that can be reviewed to see whether they meet the users' needs and conform to standards	Users cannot easily review intermediate products and evaluate whether a particular product (e.g. a data flow diagram) meets their business requirements

Prototyping

Prototyping, also known as the evolutionary lifecycle, takes an iterative approach to the systems development process. During each iteration, requirements and alternative solutions to the problem are identified and analyzed, new solutions are designed and a portion of the system is implemented. Users are then encouraged to try the prototype and provide feedback (see Figure 5.5). Prototyping begins with creating a preliminary model of a major subsystem or a scaled-down version of the entire system. For example, a prototype might show sample report formats and input screens. After they are developed and refined, the prototypical reports and input screens are used as models for the actual system, which can be developed using an end- user programming language such as Visual Basic. The first preliminary model is refined to form the second- and third-generation models and so on until the complete system is developed. One potential problem with prototyping is knowing when the system is finished as people can always think of extra refinements they would like.

Prototypes can be classified as operational or non-operational. An operational prototype is a prototype that has functionality – it does something towards solving the problem. It may accept input, partially process it and output the results. Then, perhaps in the second iteration, the processing is refined and expanded. A non-operational prototype is a mock-up or model. It typically includes output and input specifications and formats. The outputs include mocked up reports and the inputs include the layout of the user interface either on paper or on a computer screen. The primary advantage of a non-operational prototype is that it can be developed much faster than an operational prototype. Non-operational prototypes can be discarded, and a fully operational system can be built based on what was learned from the prototypes

Figure 5.5 Prototyping



The advantages and disadvantages of prototyping are summarized in Table 5.3. Prototypes can be useful communication tools – imagine asking a user what they need the new system to do. Many people may find it difficult to verbalize what they want. However, if you show them a prototype, they will soon be able to say what is right and wrong with it.

Table 5.3 Advantages and Disadvantages of Prototyping

Advantages	Disadvantages
Users can try the system and provide constructive feedback during development	Each iteration builds on the previous one. The final solution might be only incrementally better than the initial solution
An operational prototype can be produced in weeks	Formal end-of-phase reviews might not occur. Thus, it is very difficult to contain the scope of the prototype, and the project never seems to end
As solutions emerge, users become more positive about the process and the results	System documentation is often absent or incomplete because the primary focus is on development of the prototype
Prototyping enables early detection of errors and omissions	System backup and recovery, performance and security issues can be overlooked in the haste to develop a prototype

Rapid Application Development, Agile Development, Joint Application Development and Other Systems Development Approaches

Rapid application development (RAD) employs tools, techniques and methodologies designed to speed up application development. Some people consider it to be the same as prototyping. Vendors, such as Computer Associates International, IBM and Oracle, market products targeting the RAD market. Rational Software, a division of IBM, has a RAD tool, called Rational Rapid Developer, to make developing large Java programs and applications easier and faster. Locus Systems, a program developer, used a RAD tool called Optimal to generate more than 60 per cent of the computer code for three applications it developed. Advantage Gen is a RAD tool from Computer Associates International. It can be used to rapidly generate computer code from business models and specifications.

RAD reduces paper-based documentation, automatically generates program source code and facilitates user participation in design and development activities. It makes adapting to changing system requirements easier.

Other approaches to rapid development, such as agile development, allow the systems to change as they are being developed. Agile development requires frequent face-to-face meetings with the systems developers and users as they modify, refine and test how the system meets users' needs and what its capabilities are. Extreme programming (XP), a form of agile development, uses pairs of programmers who work together to design, test and code parts of the systems they develop. The iterative nature of XP helps companies develop robust systems, with fewer errors.

RAD makes extensive use of the joint application development (JAD) process for data collection and requirements analysis. Originally developed by IBM Canada in the 1970s, JAD involves group meetings in which users, stakeholders and IS professionals work together to analyze existing systems, propose possible solutions and define the requirements of a new or modified system. JAD groups consist of both problem holders and solution providers. A group normally requires one or more top-level executives who initiate the JAD process, a group leader for the meetings, potential users and one or more individuals who act as secretaries and clerks to record what is accomplished and to provide general support for the sessions. Many companies have found that groups can develop better requirements than individuals working independently and have assessed JAD as a very successful development technique. Today, JAD often uses group support systems (GSS) software to foster positive group interactions, while suppressing negative group behaviour.

RAD should not be used on every software development project. In general, it is best suited for DSSs and MISs and less well suited for TPS. During a RAD project, the level of participation of stakeholders and users is much higher than in other approaches.

Table 5.4 lists advantages and disadvantages of RAD

Advantages	Disadvantages
For appropriate projects, this approach puts an application into production sooner than any other approach	This intense SDLC can burn out systems developers and other project participants
Documentation is produced as a by-product of completing project tasks	This approach requires systems analysts and users to be skilled in RAD systems development tools and RAD techniques
RAD forces teamwork and lots of interaction between users and stakeholders	RAD requires a larger percentage of stakeholders' and users' time than other approaches

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The End-User Systems Development Lifecycle

The term end-user systems development describes any systems development project in which business managers and users assume the primary effort. Rather than ignoring these initiatives, astute IS professionals encourage them by offering guidance and support. Providing technical assistance, communicating standards and sharing 'best practices' throughout the organization are some ways IS professionals work with motivated managers and employees undertaking their own systems development. In this way, end-user-developed systems can be structured as complementary to, rather than in conflict with, existing and emerging information systems. In addition, this open communication among IS professionals, managers of the affected business area, and users allows the IS professionals to identify specific initiatives so that additional organizational resources, beyond those available to business managers or users, are provided for its development.

User-developed systems range from the very small (such as a software routine to merge data from Microsoft Excel into Microsoft Word to produce a personalized letter for customers) to those of significant organizational value (such as a customer contact database). Initially, IS professionals discounted the value of these projects. As the number and magnitude of these projects increased, however, IS professionals began to realize that for the good of the entire organization, their involvement with these projects needed to increase.

End-user systems development does have some disadvantages. Some end users don't have the training to effectively develop and test a system. Expensive mistakes can be made using faulty spreadsheets, for example, that have never been tested. Most end-user systems are also poorly

documented and therefore difficult to maintain. When these systems are updated, problems can be introduced that make the systems error-prone. In addition, some end users spend time and corporate resources developing systems that are already available.

A survey of South African employers found that the IS skills they want in their new employees are the ability to type, create documents and having a basic working knowledge of computer applications.

Outsourcing and On-Demand Computing

Many companies hire an outside consulting firm or computer company that specializes in systems development to take over some or all of its development and operations activities.7 some companies, such as General Electric, have their own outsourcing subunits or have spun off their outsourcing subunits as separate companies.8 Outsourcing can be a good idea under the following circumstances:

■When a company believes it can cut costs.

■When a firm has limited opportunity to distinguish itself competitively through a particular

IS operation or application.

■When uninterrupted IS service is not crucial.

■When outsourcing does not strip the company of technical know-how required for future IS innovation.

■When the firm's existing IS capabilities are limited, ineffective or technically inferior.

■When a firm is downsizing

The decision to outsource systems development is often a response to downsizing, which reduces the number of employees or managers, equipment and systems, and even functions and departments. Outsourcing allows companies to downsize their IS department and alleviate difficult financial situations by reducing payroll and other expenses.

Organizations can outsource any aspect of their information system, including hardware maintenance and management, software development, database systems, networks and tele-communications, Internet and intranet operations, hiring and staffing, and the development of procedures and rules regarding the information system. Eurostar, for example, hired the outsourcing company Occam to develop a new website and back-end database to give its travel customers

Greater travel information.According to Scott Logie, managing director of Occam, 'The quality and volume of data that Eurostar possesses is extremely valuable. By working together we will allow the firm to develop real insight into its customers. This can be used to drive a strong customer acquisitions strategy, which will enhance its business and customer relationships'.

Reducing costs, obtaining state-of-the-art technology, eliminating staffing and personnel problems, and increasing technological flexibility are reasons that companies have used in the outsourcing and on-demand computing approaches. A number of companies offer outsourcing and on-demand computing services – from general systems development to specialized services. IBM's Global Services, for example, is one of the largest full-service outsourcing and consulting services.12 IBM has consultants located in offices around the world. Electronic Data Systems (EDS) is another large company that specializes in consulting and outsourcing. EDS has approximately 140 000 employees in almost 60 countries and more than 9000 clients worldwide. Accenture is another company that specializes in consulting and outsourcing the company has more than 75 000 employees in 47 countries.

Organizations can use a number of guidelines to make outsourcing a success, including the following:

■Keep tight controls on the outsourcing project.

■Treat outsourcing companies as partners.

■Start with smaller outsourcing jobs.

■Create effective communications channels between the organization and the outsourcing company.

■Carefully review legal outsourcing contracts, including rights and remedies clauses.

Old Mutual South Africa has outsourced its IS infrastructure to T-Systems, to control its costs and access T-System's expertise.

Outsourcing has some disadvantages, however. Internal expertise can be lost and loyalty can suffer under an outsourcing arrangement. When a company outsources, key IS personnel with expertise in technical and business functions are no longer needed. When these IS employees leave, their experience with the organization and expertise in information systems are lost. For some companies, it can be difficult to achieve a competitive advantage when competitors are using the same computer or consulting company. When the outsourcing or on-demand computing is done offshore or in a foreign country, some people have raised security concerns. How will important data and trade secrets be guarded?

5.3 Factors Affecting System Development Success

Successful systems development means delivering a system that meets user and organizational needs – on time and within budget. There is no formula for achieving this, but the following factors are known to have an impact on success.

Involvement

Getting users and other stakeholders involved in systems development is critical for most systems development projects. Having the support of top-level managers is also important. The involvement of users throughout the development will mean they are less likely to resist the software when it is delivered. Historically, communication between people on the domain side (users, managers and other stakeholders) and on the systems side (systems analysts,

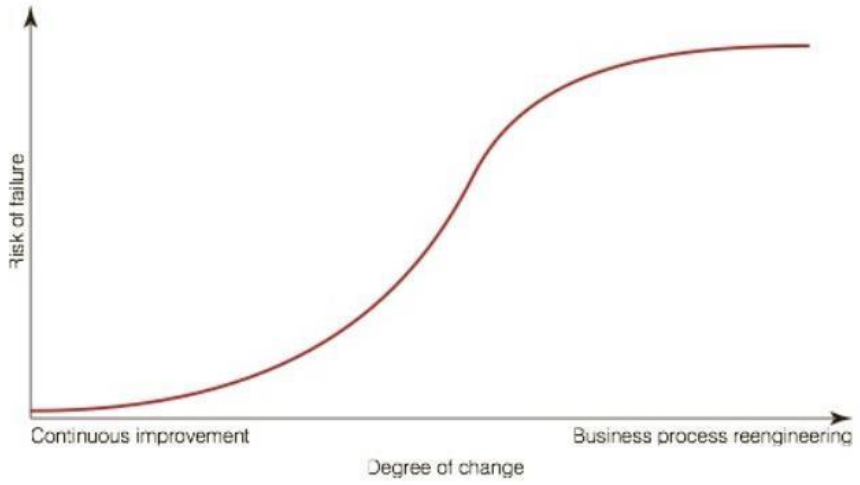
programmers and other technical people) has been problematic, with there being little common ground between them. Each group has its own set of terminology and its own culture. Getting users and managers involved in systems development is one way of building bridges between the two and kick-starting dialogue. This may be done simply by inviting them to development meetings, organizing social gatherings, producing a questionnaire to survey user views, running interviews, etc. or by using joint application development. If users have been involved throughout development, they will be less likely to resist the changes the new system brings when it is implemented.

Degree of Change

A major factor that affects the quality of systems development is the degree of change associated with the project. The scope can vary from implementing minor enhancements to an existing system, up to major reengineering. The project team needs to recognize where they are on this spectrum of change.

Continuous improvement projects do not require significant busi- ness process or IS changes, or retraining of people; thus, they have a high degree of success. Typically, because continuous improvement involves minor improvements, these projects also have relatively modest benefits. On the other hand, reengineering involves fundamental changes in how the organization conducts business and completes tasks. The factors associated with successful reengineering are similar to those of any development effort, including top management support, clearly defined corporate goals and systems development objectives, and careful management of change. Major reengineering projects tend to have a high degree of risk but also a high potential for major business benefits (see Figure 5.6)

Figure 5.6 Degree of Change



Managing Change

The ability to manage change is critical to the success of systems development. New systems inevitably cause change. For example, the work environment and habits of users are invariably affected by the development of a new information system. Unfortunately, not everyone adapts easily, and the increasing complexity of systems can multiply the problems. Managing change requires the ability to recognize existing or potential problems (particularly the concerns of

users) and deal with them before they become a serious threat to the success of the new or modified system. Here are several of the most common problems:

■Fear that the employee will lose his or her job, power or influence within the organization.

■Belief that the proposed system will create more work than it eliminates.

■Reluctance to work with 'computer people'.

■Anxiety that the proposed system will negatively alter the structure of the organization.

■Belief that other problems are more pressing than those solved by the proposed system or that the system is being developed by people unfamiliar with 'the way things need to get done'.

■Unwillingness to learn new procedures or approaches.

Preventing or dealing with these types of problems requires a coordinated effort from stakeholders and users, managers and IS personnel. One remedy is simply to talk with all people concerned and learn what their biggest concerns are. Management can then deal with those concerns and try to eliminate them. After immediate concerns are addressed, people can become part of the project team.

Quality and Standards

Another key success factor is the quality of project planning. The bigger the project, the more likely that poor planning will lead to significant problems. Many companies find that large systems projects fall behind schedule, go over budget and do not meet expectations. A systems development project for the UK Child Support Agency, for example, fell behind schedule and over £250 million over budget.17 when it was delivered, two years late, there were interference problems – screens took too long to refresh and there was no delete key to undo accidental typing mistakes; staff training was also ineffective and inappropriate. The delayed project may have hurt the agency's ability to deliver important services to children. Although proper planning cannot guarantee that these types of problems will be avoided, it can minimize the likelihood of their occurrence. Good systems development is not automatic. Certain factors contribute to the failure of systems development projects. These factors and countermeasures to eliminate or alleviate the problem are summarized in Table 5.5.

Table 5.5 Project Planning Issues Frequently Contributing to Project Failure

Factor	Countermeasure
Solving the wrong problem	Establish a clear connection between the project and organizational goals
Poor problem definition and analysis	Follow a standard systems development approach
Poor communication	There is no easy answer to this common problem
Project is too ambitious	Narrow the project focus to address only the most important business opportunities
Lack of top management support	Identify the senior manager who has the most to gain from the success of the project and recruit this person to champion the project
Lack of management and user involvement	Identify and recruit key stakeholders to be active participants in the project
Inadequate or improper system design	Follow a standard systems development approach
Lack of standards	Implement a standards system, such as ISO 9001
Poor testing and implementation	Plan sufficient time for this activity
Users cannot use the system effectively	Develop a rigorous user-training programme and budget sufficient time in the schedule to execute it
Lack of concern for maintenance	Include an estimate of employee effort and costs for maintenance in the original project justification

The development of information systems requires a constant trade-off of schedule and cost versus quality. Historically, the development of application software has overemphasized schedule and cost to the detriment of quality. Techniques, such as use of the ISO 9001 standards, have been developed to improve the quality of information systems. ISO 9001 is a set of international quality standards originally developed in Europe in 1987. These standards address customer satisfaction and are the only standards in the ISO 9001 family where thirdparty certification can be achieved. Adherence to ISO 9001 is a requirement in many international markets (see Figure 5.7)

Figure 5.7 ISO Home Page

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This screenshot, taken from the ISO webstore, is reproduced with the permission of the International Organization for Standardization, ISO. It can be obtained from the website of the ISO Central Secretariat under: www.iso.org. Copyright remains with ISO.

Organizational experience with the systems development process is also a key factor in systems development success. The capability maturity model (CMM) is one way to measure this experience. It is based on research done at Carnegie Mellon University and work by the Software Engineering Institute (SEI).CMM is a measure of the maturity of the software development process in an organization. CMM grades an organization's systems development maturity using five levels: initial, repeatable, defined, managed and optimized.

Use of Project Management Tools

Project management involves planning, scheduling, directing and controlling human, financial and technological resources for a defined task whose result is achievement of specific goals and objectives. Even small systems development projects must employ some type of project management.

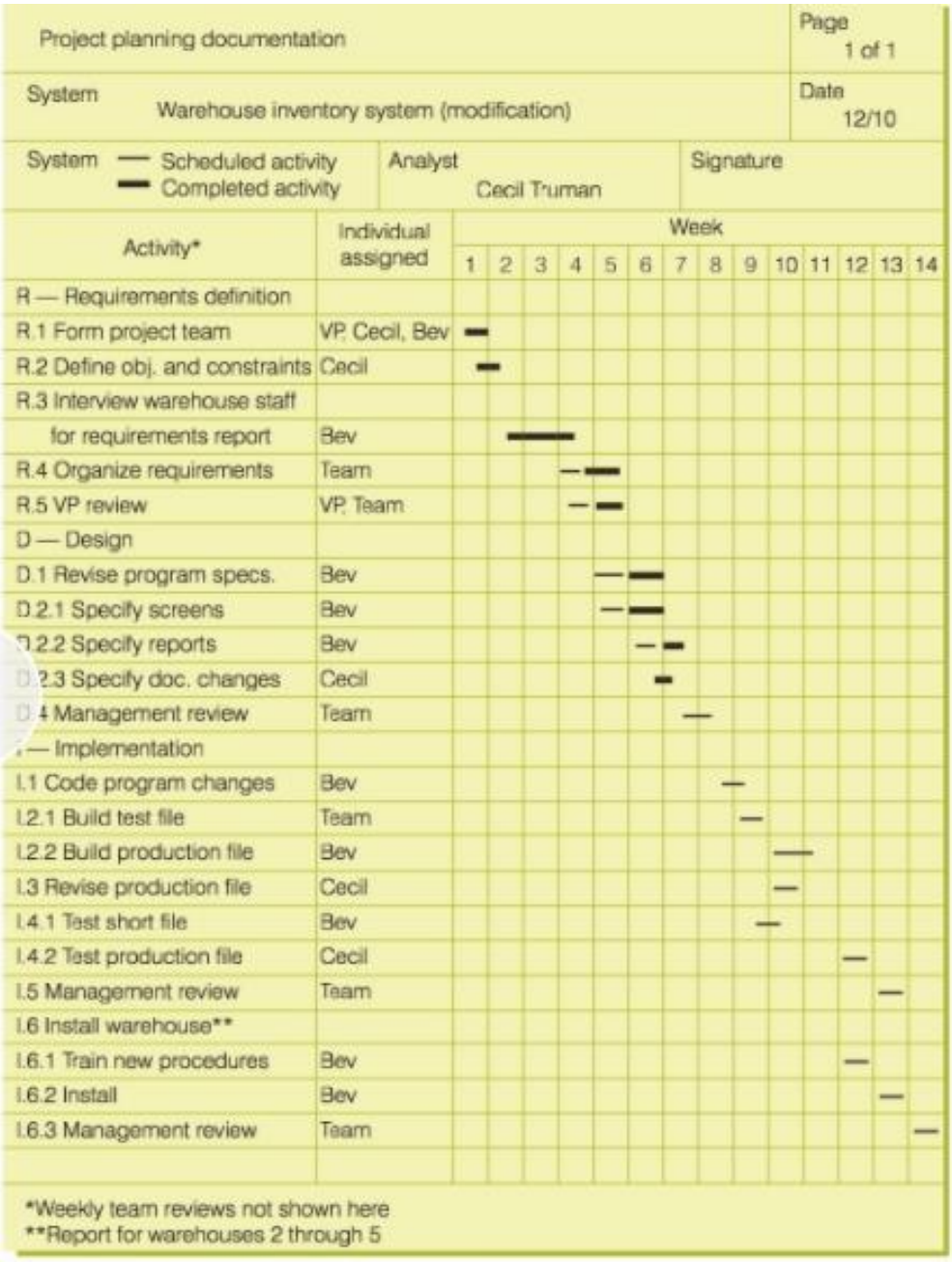
A project schedule is a detailed description of what is to be done. Each project activity, the use of personnel and other resources, and expected completion dates are described. A project milestone is a critical date for the completion of a major part of the project. The completion of program design, coding, testing and release are examples of milestones for a programming project. The project deadline is the date the entire project is to be completed and operational – when the organization can expect to begin to reap the benefits of the project.

In systems development, each activity has an earliest start time, earliest finish time and slack time, which is the amount of time an activity can be delayed without delaying the entire project. The critical path consists of all activities that if delayed, would delay the entire project. These activities have zero slack time. Any problems with critical-path activities will cause problems for the entire project. To ensure that critical-path activities are completed in a timely fashion, formalized project management approaches have been developed. Tools such as Microsoft Project are available to help compute these critical project attributes.

Although the steps of systems development seem straightforward, larger projects can become complex, requiring hundreds or thousands of separate activities. For these systems development efforts, formal project management methods and tools become essential. A formalized approach called the program evaluation and review

Technique (PERT) creates three time estimates for an activity: shortest possible time, most likely time and longest possible time. A formula is then applied to determine a single PERT time estimate. A Gantt chart is a graphical tool used for planning, monitoring and coordinating projects; it is essentially a grid that lists activities and deadlines. Each time a task is completed, a marker such as a darkened line is placed in the proper grid cell to indicate the completion of a task (see Figure 5.8)

Figure 5.8 Sample Gantt Chart



Both PERT and Gantt techniques can be automated using project management software. Several project management software packages are identified in Table 5.6. This software monitors all project activities and determines whether activities and the entire project are on time and within budget. Project management software also has workgroup capabilities to handle multiple projects and to allow a team to interact with the same software. Project management software helps managers determine the best way to reduce project completion time at the least cost. Many project managers, however, fear that the quality of a systems development project will suffer with shortened deadlines and think that slack time should be added back to the schedule as a result.

Table 5.6 Selected Project Management Software Packages

Software	Vendor
AboutTime	NetSQL Partners
Job Order	Management Software
OpenPlan	Welcom
Microsoft Project	Microsoft
Project Scheduler	Scitor
Super Project	Computer Associates

Use of Computer-Aided Software Engineering (CASE) Tools

Computer-aided software engineering (CASE) tools automate many of the tasks required in a systems development effort and encourage adherence to the SDLC, thus instilling a high degree of rigour and standardization to the entire systems development process. VRCASE, for example, is a CASE tool that a team of developers can use when developing applications in C++ and other languages. Prover Technology has developed a CASE tool that searches for programming bugs. The CASE tool searches for all possible design scenarios to make sure that the program is error free. Other CASE tools include Visible Systems

(www.visible.com) and Bubble Software (www.bubble.is). Bubble is a specialist language for creating web applications and is designed for users with zero programming knowledge. Other CASE-related tools include Rational Rose from IBM and Visio, a charting and graphics program from Microsoft. Other companies that produce CASE tools include Accenture and Oracle. Oracle Designer and Developer CASE tools, for example, can help systems analysts automate and simplify the development process for database systems. See Table 5.7 for a list of CASE tools and their providers. The advantages and disadvantages of CASE tools are listed in Table 5.8. CASE tools that focus on activities associated with the early stages of systems development are often called ‘upper-case tools’. These packages provide automated tools to assist with systems investigation, analysis and design activities. Other CASE packages, called ‘lower-case tools’, focus on the later implementation stage of systems development and can automatically generate structured program code.

Table 5.7 Typical CASE Tools

CASE Tool	Vendor
Oracle Designer	Oracle Corporation www.oracle.com
Visible Analyst	Visible Systems Corporation www.visible.com
Rational Rose	Rational Software www.ibm.com
Embarcadero Describe	Embarcadero Describe www.embarcadero.com

Table 5.8 Advantages and Disadvantages of CASE Tools

Advantages	Disadvantages
Produce systems with a longer effective operational life	Increase the initial costs of building and maintaining systems
Produce systems that more closely meet user needs and requirements	Require more extensive and accurate definition of user needs and requirements
Produce systems with excellent documentation	Can be difficult to customize
Produce systems that need less systems support	Require more training of maintenance staff
Produce more flexible systems	Can be difficult to use with existing systems

5.4 Systems Investigation

As discussed earlier in the chapter, systems investigation is the first phase in the traditional SDLC of a new or modified business information system. The purpose is to identify potential problems and opportunities and consider them in light of the goals of the company. In general, systems investigation attempts to uncover answers to the following questions:

■What primary problems is the new system to solve?

■What opportunities might a new or enhanced system provide?

■What new hardware, software, databases, telecommunications, personnel or procedures will improve an existing system or are required in a new system?

■What are the potential costs (variable and fixed)?

■What are the associated risks?

Initiating Systems Investigation

Because systems development requests can require considerable time and effort to implement, many organizations have adopted a formal procedure for initiating systems development, beginning with systems investigation. The systems request form is a document that is filled out by someone who wants the IS department to initiate systems investigation. This form typically includes the following information:

■Problems with or opportunities for the system.

■Objectives of systems investigation.

■Overview of the proposed system.

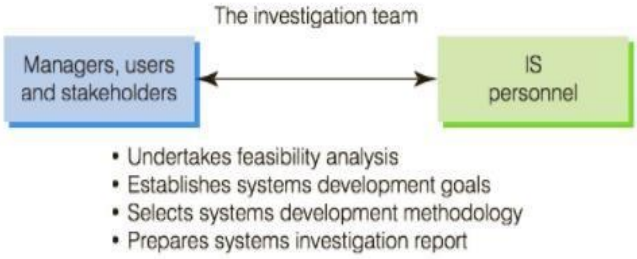
■Expected costs and benefits of the proposed system.

The information in the systems request form helps to rationalize and prioritize the activities of the IS department. Based on the overall IS plan, the organization's needs and goals, and the estimated value and priority of the proposed projects, managers make decisions regarding the initiation of each systems investigation for such projects.

Participants in Systems Investigation

After a decision has been made to initiate systems investigation, the first step is to determine what members of the development team should participate in the investigation phase of the project. Members of the development team change from phase to phase (see Figure 5.9)

Figure 5.9 The Systems Investigation Team



Ideally, functional managers are heavily involved during the investigation phase. Other members could include users or stakeholders outside management, such as an employee who helps initiate systems development. The technical and financial expertise of others participating in investigation help the team to determine whether the problem is worth solving. The members of the development team who participate in investigation are then responsible for gathering and analyzing data, preparing a report justifying systems development and presenting the results to top-level managers.

Feasibility Analysis

A key step of the systems investigation phase is feasibility analysis, which assesses technical, economic, legal, operational and schedule feasibility. Technical feasibility is concerned with

whether the hardware, software and other system components can be acquired or developed to solve the problem.

Economic feasibility determines whether the project makes financial sense and whether predicted benefits offset the cost and time needed to obtain them. One securities company, for example, investigated the economic feasibility of sending research reports electronically instead of through the mail. Economic analysis revealed that the new approach could save the company up to €370 000 per year. Economic feasibility can involve cash flow analysis such as that done in net present value or internal rate of return (IRR) calculations.

Net present value is an often-used approach for ranking competing projects and for determining economic feasibility. The net present value rep- resents the net amount by which project savings exceed project expenses, after allowing for the cost of capital and the passage of time. The cost of capital is the average cost of funds used to finance the operations of the business. Net present value takes into account that a euro returned at a later date is not worth as much as one received today, because the euro in hand can be invested to earn profits or interest in the interim. Spreadsheet programs, such as Lotus and Microsoft Excel, have built-in functions to compute the net present value and internal rate of return.

Legal feasibility determines whether lows or regulations can prevent or limit a systems development project. For example, some music sharing websites got into trouble for infringing of copyright. If legal feasibility had been con- ducted, it would have identified this vulnerability during the website development phase. Legal feasibility involves an analysis of existing and future laws to determine the likely hood of legal action against the systems development project and the possible consequences.

Operational feasibility is a measure determines whether the projects can be put into action or operation. It can include logistical and motivational (acceptance of change) considerations. Motivational considerations are important because new systems affect people and data flows and can have unintended con- sequences. As a result, power and politics might come into play, and some people might resist the new system. On the other hand, recall that a new system can help avoid major problems. For example, because of deadly hospital errors, a healthcare consortium looks into the operational feasibility of developing a new computerized physician order-entry system to require that all prescriptions and every order a doctor gives to staff are entered into the computer. The computer then checks for drug allergies and interactions between drugs. If operationally feasible, the new system could save lives and help avoid lawsuits.

Schedule feasibility determines whether the project can be completed in a reasonable amount of time – a process that involves balancing the time and resource requirements of the project with other projects.

The Systems Investigation Report

The primary outcome of systems investigation is a systems investigation report, also called a feasibility study. This report summarizes the results of systems investigation and the process of feasibility analysis and recommends a course of action: continue on into systems analysis,

modify the project in some manner or drop it. A typical table of contents for the systems investigation report is shown in Figure 5.10

Figure 5.10 A Typical Table of Contents for a Systems Investigation Report

The systems investigation report is reviewed by senior management, often organized as an advisory committee, or steering committee, consisting of senior management and users from the IS department and other functional areas. These people help IS personnel with their decisions about the use of information systems in the business and give authorization to pursue further systems development activities. After review, the steering committee might agree with the recommendation of the systems development team or suggest a change in project focus to concentrate more directly on meeting a specific company objective. Another alternative is that everyone might decide that the project is not feasible and cancel the project.

5.4 Systems Analysis

After a project has been approved for further study, the next step is to answer the question, 'what must the information system do to solve the problem?' The process needs to go beyond mere computerization of existing systems. The entire system, and the business process with which it is associated, should be evaluated. Often, a firm can make great gains if it restructures both business activities and the related information system simultaneously. The overall emphasis of analysis is gathering data on the existing system, determining the requirements for the new system, considering alternatives within these constraints and investigating the feasibility of the solutions. The primary outcome of systems analysis is a prioritized list of systems requirements.

General Considerations

Systems analysis starts by clarifying the overall goals of the organization and determining how the existing or proposed information system helps meet them. A manufacturing company, for example, might want to reduce the number of equipment breakdowns. This goal can be translated into one or more informational needs. One need might be to create and maintain an

accurate list of each piece of equipment and a schedule for preventative maintenance. Another need might be a list of equipment failures and their causes.

Analysis of a small company's information system can be fairly straightforward. On the other hand, evaluating an existing information system for a large company can be a long, tedious process. As a result, large organizations evaluating a major information system normally follow a formalized analysis procedure, involving these steps:

1. Assembling the participants for systems analysis.

2. Collecting appropriate data and requirements.

3. Analyzing the data and requirements.

4. Preparing are port on the existing system, new system requirement sand project priorities.

Participants in Systems Analysis

The first step in formal analysis is to assemble a team to study the existing system. This group includes members of the original investigation team – from users and stakeholders to IS personnel and management. Most organizations usually allow key members of the development team not only to analyze the condition of the existing system but also to perform other aspects of systems development, such as design and implementation.

After the participants in systems analysis are assembled, this group develops a list of specific objectives and activities. A schedule for meeting the objectives and completing the specific activities is also devised, along with deadlines for each stage and a statement of the resources required at each stage, such as administrative personnel, supplies and so forth. Major mile-stones are normally established to help the team monitor progress and determine whether problems or delays occur in performing systems analysis.

Data Collection and Analysis

The purpose of data collection is to seek additional information about the problems or needs identified in the systems investigation report. During this pro- cess, the strengths and weaknesses of the existing system are emphasized.

Data collection begins by identifying and locating the various sources of data, including both internal and external sources (see Figure 5.11).

After data sources have been identified, data collection begins. Figure 5.12 shows the steps involved. Data collection might require a number of tools and techniques, such as interviews, direct observation and questionnaires.

Interviews can either be structured or unstructured. In a structured interview, the questions are written in advance. In an unstructured interview, the questions are not written in advance; the interviewer relies on experience in asking the best questions to uncover the inherent problems of the existing system. An advantage of the unstructured interview is that it allows the interviewer to ask follow-up or clarifying questions immediately.

Figure 5.11 Internal and External Sources of Data for Systems Analysis

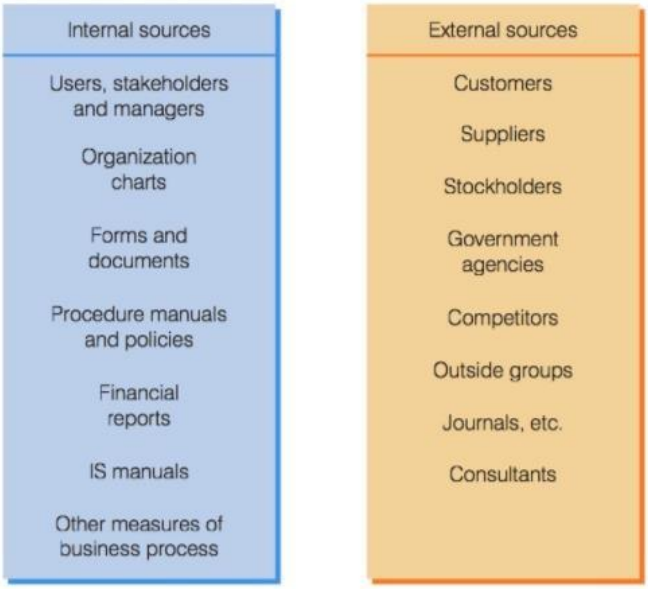
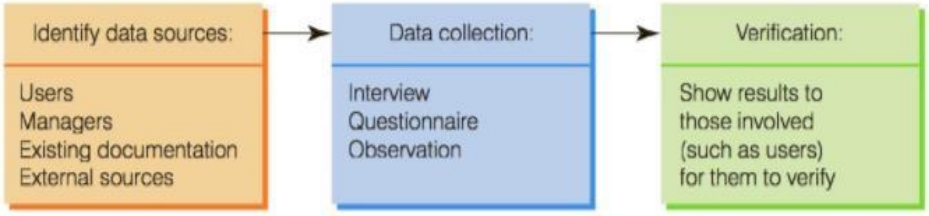


Figure 5.12 The Steps in Data Collection



With direct observation, one or more members of the analysis team directly observe the existing system in action. One of the best ways to understand how the existing system functions is to work with the users to discover how data flows in certain business tasks. Determining the data flow entails direct observation of users' work procedures, their reports, current screens (if automated already) and so on. From this observation, members of the analysis team determine which forms and procedures are adequate and which are inadequate and need improvement. Direct observation requires a certain amount of skill. The observer must be able to see what is really happening and not be influenced by attitudes or feelings. In addition, many people don't like being observed and may change their behaviour when they are. However, observation can reveal important problems and opportunities that would be difficult to obtain using other data collection methods.

When many data sources are spread over a wide geographic area, questionnaires sent to all stakeholders might be the best method. Like interviews, questionnaires can be either structured or unstructured. In most cases, a pilot study is conducted to fine-tune the questionnaire. A follow-up questionnaire can also capture the opinions of those who do not respond to the original questionnaire. Questionnaires can be used to collect data from a large number of users and make them feel part of systems development. As stated earlier, this feeling of involvement will make users less likely to resist the new system when it is installed.

Other data collection techniques can also be employed. In some cases, telephone calls are an excellent method. Activities can also be simulated to see how the existing system reacts. Thus, fake sales orders, stock shortages, customer complaints and data-flow bottlenecks can be recreated to see how the existing system responds to these situations. Statistical sampling, which involves taking a random sample of data, is another technique. For example, suppose that you want to collect data that describes 10000 sales orders received over the last few years. Because it is too time consuming to analyze each of the 10 000 sales orders, you could collect a random sample of around 200 sales orders from the entire batch. You can assume that the characteristics of this sample apply to all 10 000 orders

Data Analysis

The data collected in its raw form is usually not adequate to determine the effectiveness of the existing system or the requirements of the new system. The next step is to manipulate the collected data so that the development team members who are participating in systems analysis can use the data. This manipulation is called data analysis.

Data and activity modelling and using data-flow diagrams and entity-relationship diagrams are useful during data analysis to show data flows and the relation- ships between various objects, associations and activities. Other common tools and techniques for data analysis include application flowcharts, grid charts, CASE tools and the object-oriented approach. Often two versions of the models are created – a version showing how things happen currently in the organization and another showing how they will happen after the new system has been installed.

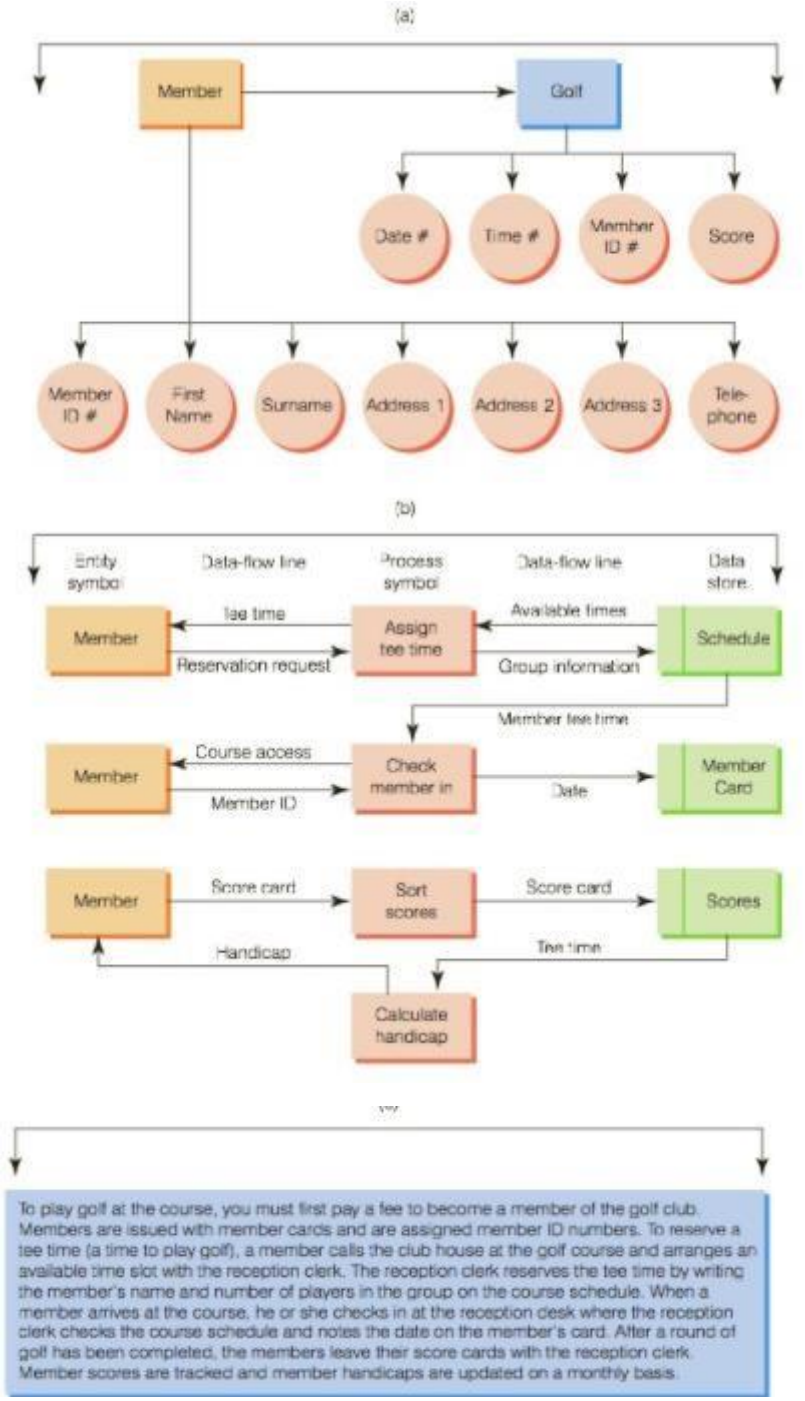
Data Modelling

Data modelling, along with a technique you can use to create a data model. The purpose of this model is to visualize and structure the data that the organization stores. An example data model is shown in Figure 5.13

Activity (or Process) Modelling

To fully describe a business problem or solution, the related objects, associations and activities must be described. Activities in this sense are events or items that are necessary to fulfil the business relationship or that can be associated with the business relationship in a meaningful way.

Figure 5.13 Sample Data Model, Data-Flow Diagram and Description



ty modelling is sometimes accomplished through the use of data-flow diagrams or use case models. A data-flow diagram (DFD) models objects, associations and activities by describing how data can flow between and around various objects. DFDs work on the premise that every activity involves some communication, transference or flow that can be described as a data element. DFDs describe the activities that fulfil a business relationship or accomplish a business task, not how these activities are to be performed. That is, DFDs show the logical sequence of associations and activities, not the physical processes. A system modelled with a

DFD could operate manually or could be computer based; if computer based, the system could operate with a variety of technologies.

A use case model consists of two parts – a diagram showing each process and the 'actors' who use them. An actor is someone who gets something out of the process. Typical actors are customers and suppliers. 'Buy a product' is a typical process, or 'Reorder stock'. The second part of the model is a text description of each process broken down into numbered steps.

Comparing entity-relationship diagrams with data-flow diagrams provides insight into the concept of top-down design. Figures 5.13a and b show a data model and a data-flow diagram for the same business relationship – namely, a member of a golf club playing golf. Figure 5.13c provides a brief description of the business relationship for clarification.

Application Flowcharts

Application flowcharts show the relationships between applications or systems. Let's say that a small business has collected data about its order processing, inventory control, invoicing and marketing analysis applications. Management is thinking of modifying the inventory control application. The raw facts collected, however, do not help in determining how the applications are related to each other and the databases required for each. These relationships are established through data analysis with an application flowchart (see Figure 5.14). Using this tool for data analysis makes clear the relationships between the order processing functions.

In the simplified application flowchart in Figure 5.14, you can see that the telephone order administrator provides important data to the system about items such as versions, quantities and prices. The system calculates sales tax and order totals. Any changes made to this order processing system could affect the company's other systems, such as inventory control and marketing.

Grid Charts

A grid chart is a table that shows relationships between various aspects of a systems development effort. For example, a grid chart can reveal the databases used by the various applications (see Figure 5.15).

Figure 5.15 A Grid Chart

Databases → / Applications ↓	Customer database	Inventory database	Supplier database	Accounts receivable database
Order processing application	X	X		
Inventory control application		X	X	
Marketing analysis application	X	X		
Invoicing application	X			X

The simplified grid chart in Figure 5.15 shows that the customer database is used by the order processing, marketing analysis and invoicing applications. The inventory database is used by the order processing, inventory control and marketing analysis applications. The sup- plier database is used by the inventory control application, and the accounts receivable data- base is used by the invoicing application. This grid chart shows which applications use common databases and reveals that, for example, any changes to the inventory control application must investigate the inventory and supplier databases.

CASE Tools

As discussed earlier, many systems development projects use CASE tools to complete analysis tasks. Most computer-aided software engineering tools have generalized graphics programs that can generate a variety of diagrams and figures. Entity-relationship diagrams, data-flow diagrams, application flowcharts and other diagrams can be developed using CASE graphics programs to help describe the existing system. During the analysis phase, a CASE repository – a database of system descriptions, parameters and objectives – will be developed.

Figure 5.14

(Refer from text book)

Requirements Analysis

The overall purpose of requirements analysis is to determine user, stakeholder and organizational needs. For an accounts payable application, the stakeholders could include suppliers and members of the purchasing department. An accounts payable manager might want a better procedure for tracking the amount owed by customers. Specifically, the manager wants a weekly report that shows all customers who owe more than €1000 and are more than 90 days past due on their account. A financial manager might need a report that summarizes total amount owed by customers to consider whether to loosen or tighten credit limits. A sales manager might want to review the amount owed by a key customer relative to sales to that same customer. The purpose of requirements analysis is to capture these requests in detail. Questions that should be asked during requirements analysis include the following:

■Are these stakeholders satisfied with the current accounts payable application?

■What improvements could be made to satisfy suppliers and help the purchasing department?

One of the most difficult procedures in systems analysis is confirming user or systems requirements. In some cases, communications problems can interfere with determining these requirements. Numerous tools and techniques can be used to capture systems requirements. In addition to the data collection techniques already discussed (interview, questionnaire, etc.), others can be used in the context of a JAD session to determine system requirements. **Critical Success Factors**

Managers and decision makers are asked to list only the factors that are critical to the success of their area of the organization. A critical success factor (CSF) for a production manager might be adequate raw materials from suppliers; a CSF for a sales representative could be a list of

customers currently buying a certain type of product. Starting from these CSFs, the system inputs, outputs, performance and other specific requirements can be determined.

The IS Plan

As we have seen, the IS plan translates strategic and organizational goals into systems development initiatives. The IS planning process often generates strategic planning documents that can be used to define system requirements. Working from these documents ensures that

Requirements analysis will address the goals set by top-level managers and decision makers (see Figure 5.16). There are unique benefits to applying the IS plan to define systems requirements. Because the IS plan takes a long-range approach to using information technology within the organization, the requirements for a system analyzed in terms of the IS plan are more likely to be compatible with future systems development initiatives.

Figure 5.16 Converting Organizational Goals into Systems Requirements

Screen and Report Layout

Developing formats for printed reports and screens to capture data and display information are some of the common tasks associated with developing systems. Screens and reports relating to systems output are specified first to verify that the desired solution is being delivered. Manual or computerized screen and report layout facilities are used to capture both input and output requirements.

Using a screen layout, a designer can quickly and efficiently design the features, layout and for- mat of a display screen. In general, users who interact with the screen frequently can be presented with more data and less descriptive information; infrequent users should have more descriptive information presented to explain the data they are viewing (see Figure 5.17).

Figure 5.17 Screen Layouts

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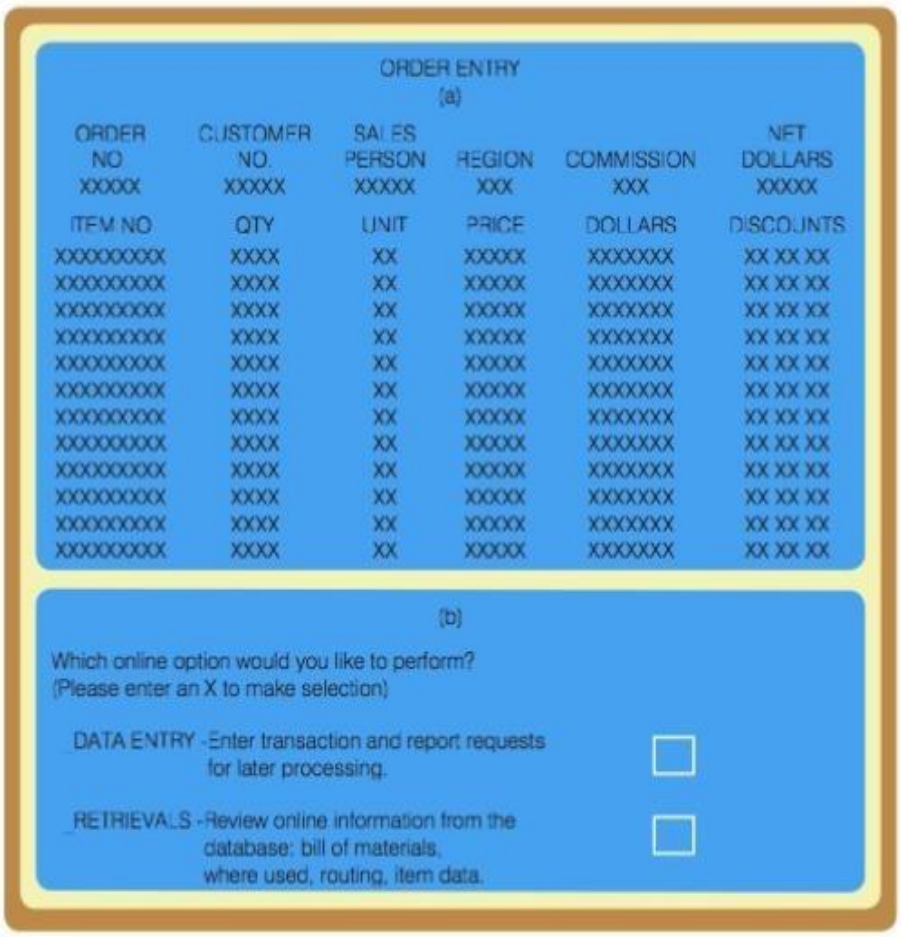


Report layout allows designers to diagram and format printed reports. Reports can contain data, graphs or both. Graphic presentations allow managers and executives to quickly view trends and take appropriate action, if necessary.

Screen layout diagrams can document the screens, users, desire for the new or modified application. Report layout charts reveal the format and content of various reports that the application will prepare. Other diagrams and charts can be developed to reveal the relationship between the application and outputs from the application.

Requirements Analysis Tools

A number of tools can be used to document requirements analysis, including CASE tools. As requirements are developed and agreed on, entity-relationship diagrams, data-flow diagrams, screen and report layout forms, and other types of documentation are stored in the CASE repository. These requirements might also be used later as a reference during the rest of systems development or for a different systems development project.

Object-Oriented Systems Analysis

An alternative to analyzing the existing system using data-flow diagrams and flowcharts is the object-oriented approach to systems analysis. Like traditional analysis, problems or potential

opportunities are identified during object-oriented analysis. Identifying key participants and collecting data are still performed.

With the object-oriented approach, systems analysts are looking for classes – things within the system that have data and action – rather than entities. These classes are then modelled with the messages and data that flow between them, and this model is used to capture the requirements of the new system. An order processing administrator might be a class – they have data (the order) and action (they input the data into the computer). The term 'object' refers to an instance of a class; in this case, the class is order processing administrator, whereas 'Bill Jones', who happens to be an order processing administrator, is an object.

In object-oriented systems analysis, all the classes in the system are identified and how they work together to solve a problem is documented. A class could be a piece of software or a human.

The Systems Analysis Report

Systems analysis concludes with a formal systems analysis report. It should cover the following elements:

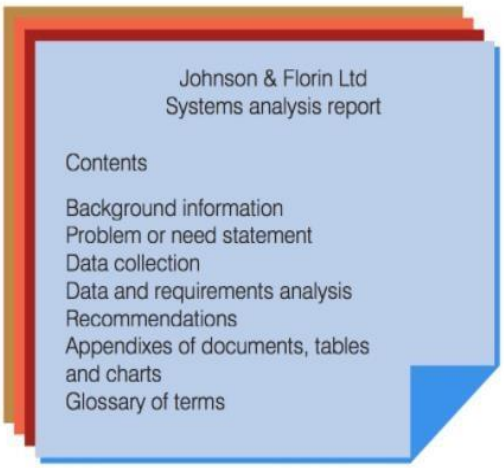
■The strengths and weaknesses of the existing system from a stakeholder's perspective. ■The user/stakeholder requirements for the new system (also called the functional requirements).

■The organizational requirements for the new system.

■A description of what the new information system should do to solve the problem.

Suppose analysis reveals that a marketing manager thinks a weakness of the existing sys- tem is its inability to provide accurate reports on product availability. These requirements and a preliminary list of the corporate objectives for the new system will be in the systems analysis report. Particular attention is placed on areas of the existing system that could be improved to meet user requirements. The table of contents for a typical report is shown in Figure 5.18.

Figure 5.18 A Typical Table of Contents for a Report on an Existing System



The systems analysis report gives managers a good understanding of the problems and strengths of the existing system. If the existing system is operating better than expected or the necessary changes are too expensive relative to the benefits of a new or modified system, the systems development process can be stopped at this stage. If the report shows that changes to another part of the system might be the best solution, the development process might start over, beginning again with systems investigation. Or, if the systems analysis report shows that it will be beneficial to develop one or more new systems or to make changes to existing ones, systems design, which is discussed in the next chapter, begins.

Chapter Summary/Review

- Effective systems development requires a team effort from stakeholders, users, managers, systems development specialists and various support personnel, and it starts with careful planning. The systems development team consists of stakeholders: users, managers, systems development specialists and various support personnel.
- Systems development often uses tools to select, implement and monitor projects, including prototyping, rapid application development, CASE tools and object-oriented development. The five phases of the traditional SDLC are investigation, analysis, design, implementation, and maintenance and review.
- Systems development starts with investigation and analysis of existing systems. In most organizations, a systems request form initiates the investigation process. The systems investigation is designed to assess the feasibility of implementing solutions for business problems, including technical, economic, legal, operations and schedule feasibility.

Review Questions (Short)

1.What is an IS stakeholder?

2.What is the goal of IS planning? What steps are involved in IS planning?

3.Identify four reasons that a systems development project might be initiated.

4.What is the difference between systems investigation and systems analysis

5. Describe some of the models that are used to document systems analysis.

Review Questions (Long)

1. Explain the activity of creating or modifying existing business systems. It refers to all aspects of the process – from identifying problems to be solved or opportunities to be exploited, to the implementation and refinement of the chosen solution.
2. Discuss takes an iterative approach to the systems development process. During each iteration, requirements and alternative solutions to the problem are identified and analysed, new solutions are designed and a portion of the system is implemented
3. Why Joint application development is involves group meetings in which users, stakeholders and IS professionals work together to analyse existing systems, propose possible solutions and define the requirements for a new or modified system.
4. System performance is usually determined by factors such as fixed investments in hardware and related equipment explain
5. What is the overall purpose of requirements analysis is to determine user, stakeholder and organizational needs

Review Questions (MCQ)

1. _____ is the activity of creating or modifying existing business systems. it refers to all aspects of the process-from identifying problems to be solved or opportunities to be exploited, to the implementation and refinement of the chosen solution.

A. Stakeholders
B. System development
C. Programmers
D. Network angeneering

2. What factors are essential to the success of the certain functional areas of an organization?

A. critical success factors
B. system analyses factors
C. creative goal factors
D. systems development factors

3. What employs tools, techniques and methodologies designed to speed application development?

A. rapid application development
B. joint optimization
C. prototyping
D. extended application development

4. . _____ takes an iterative approach to the systems development process. During each iteration, requirements and alternative solutions to the problem are identified and analysed, new solution are designed and a portion of the system is implemented

A. Prototyping
B. Network analyst
C. Information system
D. Extended application

5. Data modelling is most often accomplished through the use of _____whereas activity modelling is often accomplished through the use of_____

A. Design
B. Entity-relationship(ER) diagrams
C. Knowledge base
D. Data -flow diagrams

Case Studies / Projects

Hackathon Culture

A large room – a bit like (or perhaps exactly like) a school gym – is full of tables laden with laptops and empty cans of Red Bull. People – invariably young people – are sleeping against the walls and in corners while others are tapping at keyboards, like they have been since 10am. It's now 2.30am the following morning and there's still a long way to go before the final pitch. There have been social activities to ease the stress, but not now. Now is the time to code, assuming you still can. This is a 'hackathon'. 'It's a big party,' says Mr Rajagopalan, who directs the University of Michigan's hackathon, MHacks. 'At MHacks, we had therapy dogs come just so people could pet puppies.' Hackathons have evolved and continue to do so, but most com- monly they are software contests: pitch, program and present a working system in a matter of hours.404

Questions

1. Why would professional developers get involved in hackathons?
2. Other than producing software, what else could hackathons produce?
3. Is the event not desperately unhealthy?
4. Would this be a good way to recruit other roles, ot just developers?

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Case Studies / Projects

Failover from Amazon

As one of the most recognized Internet brands in the world, Amazon's web technology has to be as bullet proof as it possibly can be. With two decades of experience delivering this, Amazon's Relational Database Service brings their technology and expertise to other companies. Amazon RDS is a web service that allows customers to set up, operate and scale a relational database in the Amazon cloud. It provides a cost-efficient, resizable capacity for an industry-standard relational database and manages common database administration tasks. There are no setup fees and customers are charged based on the amount of storage and number of read/write requests per month.

Questions

1. Why would you want to store databases in physically separate zones?
2. List some industries where automatic failover is important.
3. What are some of the problems Amazon would face if their databases went down?
4. Do you think this system would be suitable for small businesses?

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LEARNING OUTCOMES

After reading this Section of the guide, the learner should be able to:

Learning Objectives

- State the purpose of systems design and discuss the differences between logical and physical systems design.
- Describe some considerations in design modelling and diagrams used during object oriented design.
- List the advantages and disadvantages of purchasing versus developing software
- Discuss the software development process and some of the tools used in this process, including object oriented program development tools.
- Describe the systems review process.

Introduction

The previous chapter talked about how problems are analyzed. This chapter looks at how this analysis can be used to design and build IT solutions. The chapter mainly looks at developing a new system but also examines solving a problem by buying an existing information system that has already been developed. Information systems are used in every industry and almost every career. A manager at a hotel chain can use an information system to look up client preferences. An accountant at a manufacturing company can use an information system to analyze the costs of a new plant.

6.1 Systems Design

The purpose of **systems design** is to answer the question 'how will the information system solve the problem?' The primary result of the systems design phase is a technical design that details system inputs and the processing required to produce outputs, user interfaces, hardware, software, databases, telecommunications, personnel and procedures, and shows how these components are related. The system that is designed should meet all the requirements specified during the analysis phase (explained in the previous chapter), overcome the shortcomings of the existing system and help the organization achieve its goals. Two key aspects of systems design are logical and physical design. The logical design refers to what the system will do.

Logical design describes the functional requirements of a system. That is, it conceptualizes what the system will do to solve the problems identified through earlier analysis. Without this step, the technical details of the system (such as which hardware devices should be acquired) often obscure the best solution. Logical design involves planning the purpose of each system element, independent of hardware and software considerations. The logical design specifications that are determined and documented include output, input, process, file and database, telecommunications, procedures, controls and security, and personnel and job requirements.

The physical design refers to how the tasks are accomplished, including how the components work together and what each component does. Physical design specifies the characteristics of the system components necessary to put the logical design into action. In this phase, the characteristics of the hardware, software, database, telecommunications, personnel, and procedure and control specifications must be detailed. There are a number of notations that can be used to document the design stage. Data flow diagrams and class diagrams (mentioned in the previous chapter) are used, as is the notation shown for illustrating a data model. Sequence diagrams are used in object-oriented systems design to illustrate how messages pass between objects and to show the sequence of events in a process. Programmers use various notations to design the code that they will write.

Interface Design and Controls

Some special system characteristics should be considered during both logical and physical design. These characteristics relate to how users access and interact with the system. For example, with a menu-driven system (see Figure 6.1), users simply pick what they want to do from a list of alternatives. Most people can easily operate these types of systems and are familiar with them. They select an option or respond to questions (or prompts) from the system, and the system does the rest. An alternative is a command line interface such as that shown in Figure 6.2. Command line interfaces involve users typing commands at a prompt. For example, typing the name of a software package opens it.

Figure 6.1 Menu-Driven System

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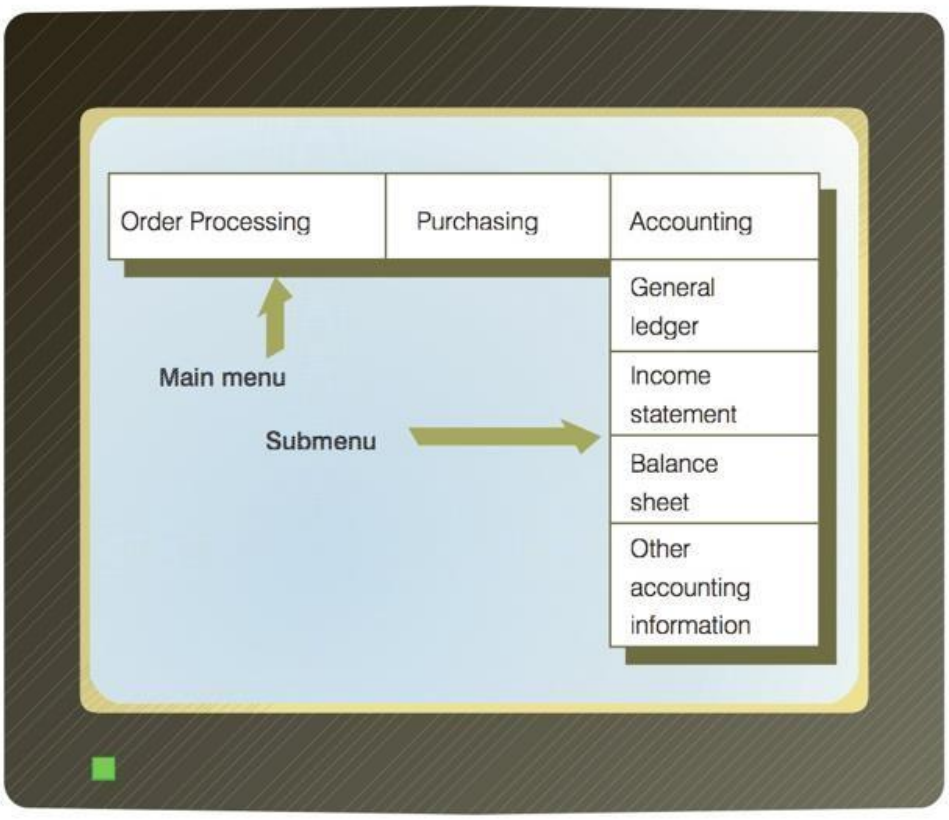
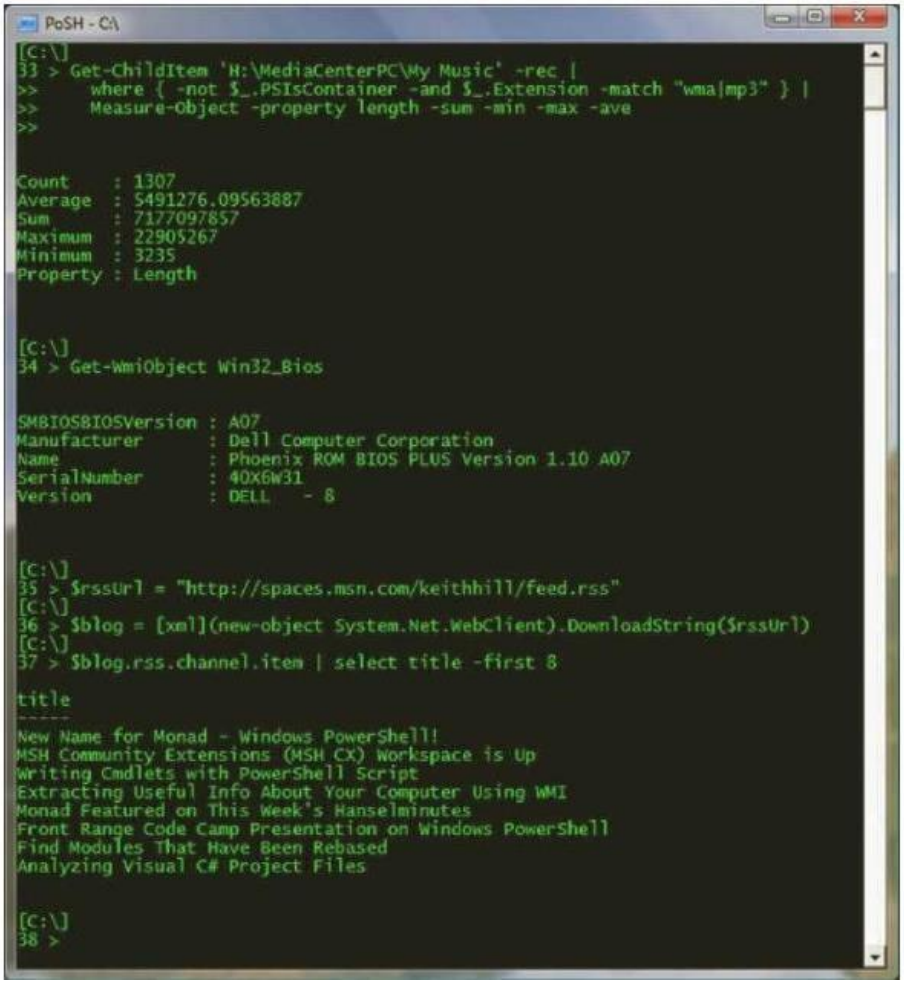


Some other interface considerations are whether or not to include interactive help, whether the interface should be 2D or 3D, whether or not to use virtual reality, a touch screen or a keyboard, and whether to include procedures to help with data entry. Such procedures include spell checking and lookup tables. For example, if you are entering a sales order for a company, you can type its abbreviation, such as ABCO. The program will then go to the customer table, normally stored on a disc, and look up all the information pertaining to the company abbreviated ABCO that you need to complete the sales order. Other data
entry control includes a presence check, which you may have experienced when you've tried to submit an order to an e-commerce website but forgot to enter your email address – the system makes you enter this information before it lets you proceed, and a range check which makes sure the data you enter is within a sensible range, perhaps disallowing any year of birth before 1910.

Figure 12.2 Command Line Interface



The interface can be documented simply with a drawing of what it is to look like. Designing a good interface is an art that few people seem to possess. It's easy to find numerous examples of bad (annoying, frustrating, non-intuitive) interface design. Table 6.1 lists some characteristics that many interfaces should have. This list, however, does not apply to all systems. We looked at virtual pets – to keep the user interested, a virtual pet should not consistently have the same response time or respect for the user.

Design of System Security and Controls

In addition to considering the system's interface and user interactions, designers must also develop system security and controls for all aspects of the system, including hardware, software, database systems, and telecommunications and Internet operations. These key considerations involve error prevention, detection and correction; system controls; and disaster planning and recovery.

Table 6.1 The Elements of Good Interactive Dialogue

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Element	Description
Clarity	The computer system should ask for information using easily understood language. Whenever possible, the users themselves should help select the words and phrases used for dialogue with the computer system
Response time	Ideally, responses from the computer system should approximate a normal response time from a human being carrying on the same sort of dialogue
Consistency	The system should use the same commands, phrases, words and function keys for all applications. After a user learns one application, all others will then be easier to use
Format	The system should use an attractive format and layout for all screens. The use of colour, highlighting and the position of information on the screen should be considered carefully and applied consistently
Jargon	All dialogue should be written in easy-to-understand terms. Avoid jargon known only to IS specialists
Respect	All dialogue should be developed professionally and with respect. Dialogue should not talk down to or insult the user. Avoid statements such as 'You have made a fatal error'

Error Prevention, Detection and Correction

A new information system can be designed to check for certain errors itself. When users input values, the system can check that the values entered make sense and if not the user is alerted. For instance, the system can check whether the user enters a word when the system is expecting a number. Or if the user enters a number, the computer can check it lies within a sensible range – that small items don't cost over €10 000 or that customers weren't born in the 18th century, for example. In these cases the user must fix the error themselves.

An alternative is to avoid the user entering data themselves. In a factory and many shops, for instance, workers will rarely enter product numbers manually – the number can be read from a barcode or an RFID chip. If the reader doesn't detect the number properly the user is alerted and must scan the item again – this will have happened to you many times at a supermarket check-out.

Disaster Planning and Recovery

Disaster planning is the process of anticipating and providing for disasters. A disaster can be an act of nature (a flood, fire or earthquake) or a human act (terrorism, error or a deliberate sabotage by a disgruntled employee). Disaster planning often focuses primarily on two issues: maintaining the integrity of corporate information, and keeping the information system running until normal operations can be resumed. **Disaster recovery** is the implementation of the disaster plan. When Hurricane Katrina hit New Orleans in the US, investment and trading company Howard Weil Inc. had a plan to keep the firm operating – it would move its employees to Houston, Texas. But when Houston also had to be evacuated, the company had to move its employees to another location – Stamford, Connecticut – according to its disaster plan. The company was able to rapidly recreate its trading desk and IS infrastructure to continue trading. According to Jefferson Parker, president of Howard Weil, 'You don't normally develop a backup plan for the backup plan'**.**

Although companies have known about the importance of disaster planning and recovery for decades, many do not adequately prepare. The primary tools used in disaster planning and recovery are back-ups. Hardware, software and data can all be 'backed up'. For example, hot and cold sites can be used to back-up hardware and software.

A **hot site** is a space, usually some distance away from the main operation, where spare computers with the appropriate telecommunication links are set up and software installed, along with any associated pereriphals such as printers, in case some problem occurs to disrupt the technology in the main location.

The hot site is physically separate in case the problem is something like a flood, which would damage a wide area. If a disaster occurs, all that is needed is transportation to take staff to the hot site, along with the latest data back-up. As soon as the data is uploaded, operations can continue. Another approach is to use a cold site, also called a shell, which is a computer environment that includes rooms, electrical service, telecommunication links but no hardware. If a primary computer has a problem, back-up computer hard- ware is brought into the cold site, and the complete system is made operational. A warm site sits somewhere between the two (see Figure 6.3).

Figure 6.3 A Hot Site

Databases can be backed up by making a copy of all files and data- bases changed during the last few days or the last week, a technique called **incremental back-up**. One approach to backup uses a transaction log, which is a separate file that contains only changes to the database and is backed up more frequently than the database itself (which is much bigger). If a problem occurs with a current database, the transaction log and the last back-up of the database, can be used to recreate the current database.

Systems Controls

Security lapses, fraud and the invasion of privacy can present disastrous problems. For example, because of an inadequate security and control system, a futures and options trader for a British bank lost almost £1 billion. A simple systems control might have prevented a problem that caused the 200-year-old Barings Bank to collapse. In addition, from time to time, tax officials have been caught looking at the returns of celebrities and others. Preventing and detecting these problems is an important part of systems design. Prevention includes the following:

- Determining potential problems.
- Ranking the importance of these problems.
- Planning the best place and approach to prevent problems.
- Deciding the best way to handle problems if they occur.

Every effort should be made to prevent problems, but companies must establish procedures to handle problems if they occur, including **system controls**.

Most IS departments establish tight systems controls to maintain data security. Systems controls can help prevent computer misuse, crime and fraud by managers, employees and others. The accounting scandals in the early 2000s caused many IS departments to develop systems controls to make it more difficult for executives to mislead investors and employees. Some of these scandals involved billions of euros.

Most IS departments have a set of general operating rules that help protect the system. Some of these are listed below.

- Input controls: Maintain input integrity and security. Their purpose is to reduce errors while protecting the computer system against improper or fraudulent input. Input controls range from using standardized input forms to eliminating data-entry errors and using tight password and identification controls.
- Processing controls: Deal with all aspects of processing and storage. The use of passwords and identification numbers, backup copies of data and storage rooms that have tight security systems are examples of processing and storage controls.
- Output controls: Ensure that output is handled correctly. In many cases, output generated from the computer system is recorded in a file that indicates the reports and documents that were generated, the time they were generated and their final destinations.
- Database controls: Deal with ensuring an efficient and effective database system. These controls include the use of identification numbers and passwords, without which a user is denied access to certain data and information. Many of these controls are provided by database management systems.
- Telecommunications controls: Provide accurate and reliable data and information transfer among systems. Telecommunications controls include firewalls and encryption to ensure correct communication while eliminating the potential for fraud and crime.
- Personnel controls: Make sure that only authorized personnel have access to certain systems to help prevent computer-related mistakes and crime. Personnel controls can involve the use of identification numbers and passwords that allow only certain people access to particular data and information. ID badges and other security devices (such as smart cards) can prevent unauthorized people from entering strategic areas in the information systems facility.

Generating Systems Design Alternatives

The development team will want to generate different designs. One approach is to come up with a basic, cheaper solution; or a top-of-the-range solution at the edge of what can be afforded; or a mixed solution sitting somewhere between the two. If the new system is complex, it might want to involve personnel from inside and outside the firm in generating alternative designs. If new hardware and software are to be acquired from an outside vendor, a formal **request for proposal (RFP**) can be made.

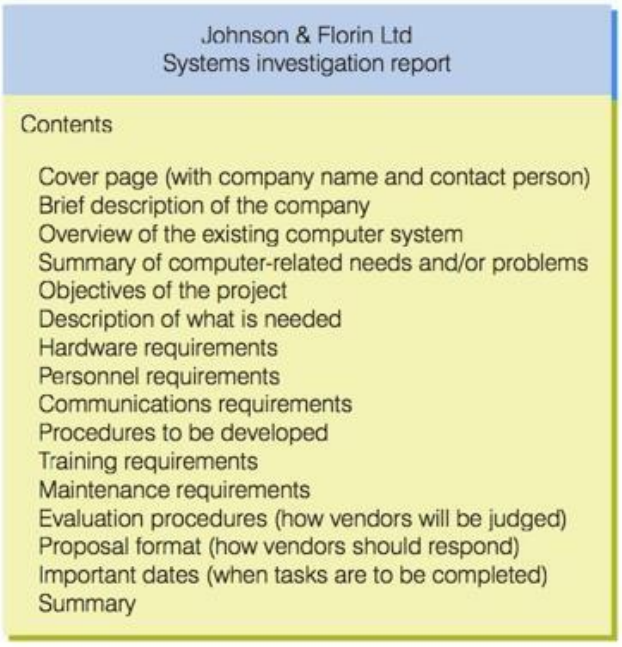
Request for Proposals

The RFP is an important document for many organizations involved with large, complex systems development efforts. Smaller, less complex systems often do not require an RFP. A company that is purchasing an inexpensive piece of software that will run on existing hardware, for ex- ample, might not need to go through a formal RFP process.
When an RFP is used, it often results in a formal bid that is used to determine who gets a contract for new or modified systems. The RFP specifies in detail the required resources such as hardware and software.Although it can take time and money to develop a high-quality RFP, it can save a company in the long run. Companies that frequently generate RFPs can automate

the process. Software such as the RFP Machine from Pragmatech Software can be used to improve the quality of RFPs and reduce the time it takes to produce them. The RFP Machine stores important data needed to generate RFPs and automates the process of producing RFP documents.

In some cases, separate RFPs are developed for different needs. For example, a company might develop separate RFPs for hardware, software and database systems. The RFP also communicates these needs to one or more vendors, and it provides a way to evaluate whether the vendor has delivered what was expected. In some cases, the RFP is part of the vendor contract. The table of contents for a typical RFP is shown in Figure 6

Figure 6.4 A Typical Table of Contents for a Request for Proposal



Financial Options

When acquiring computer systems, several choices are available, including purchase, lease or rent. Cost objectives and constraints set for the system play a significant role in the choice, as do the advantages and disadvantages of each. In addition, traditional financial tools, including net present value and internal rate of return, can be used. Table 6.2 summarizes the advantages and disadvantages of these financial options.

Determining which option is best for a particular company in a given situation can be difficult. Financial considerations, tax laws, the organization's policies, its sales and transaction growth, marketplace dynamics and the organization's financial resources are all important factors. In some cases, lease or rental fees can amount to more than the original purchase price after a few years. As a result, some companies prefer to purchase their equipment.

Table 6.2 Advantages and Disadvantages of Acquisition Options

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Renting (Short-Term Option)	
Advantages	**Disadvantages**
No risk of obsolescence	No ownership of equipment
No long-term financial investment	High monthly costs
No initial investment of funds	Restrictive rental agreements
Maintenance usually included	
Leasing (Longer-Term Option)	
Advantages	**Disadvantages**
No risk of obsolescence	High cost of cancelling lease
No long-term financial investment	Longer time commitment than renting
No initial investment of funds	No ownership of equipment
Less expensive than renting	
Purchasing	
Advantages	**Disadvantages**
Total control over equipment	High initial investment
Can sell equipment at any time	Additional cost of maintenance
Can depreciate equipment	Possibility of obsolescence
Low cost if owned for a number of years	Other expenses, including taxes and insurance

On the other hand, constant advances in technology can make purchasing risky. A company would not want to purchase a new multimillion-dollar computer only to have newer and more powerful computers available a few months later at a lower price, unless the computer can be easily and inexpensively upgraded. Some servers, for example, are designed to be scalable to allow processors to be added or swapped, memory to be upgraded and peripheral devices to be

installed. Companies often employ several people to determine the best option based on all the factors. This staff can also help negotiate purchase, lease or rental contracts.

Evaluating and Selecting a Systems Design

The final step in systems design is to evaluate the various alternatives and select the one that will offer the best solution for organizational goals. Depending on their weight, any one of these objectives might result in the selection of one design over another. For example, financial concerns might make a company choose rental over equipment purchase. Specific performance objectives – for example, that the new system must perform online data processing – might result in a complex network design for which control procedures must be established. Evaluating and selecting the best design involves achieving a balance of system objectives that will best support organizational goals. Normally, evaluation and selection involves both a preliminary and a final evaluation before a design is selected.

The Preliminary Evaluation

A **preliminary evaluation** begins after all design proposals have been submitted. The purpose of this evaluation is to dismiss unwanted proposals. If external vendors have submitted proposals, some of them can usually be eliminated by investigating their proposals and comparing them with the original criteria. Those that compare favourably are often asked to make a formal presentation to the analysis team. The vendors should also be asked to supply a list of companies that use their equipment for a similar purpose. The organization then contacts these references and asks them to evaluate their hardware, their software and the vendor.

The Final Evaluation

The **final evaluation** begins with a detailed investigation of the proposals offered by the remaining vendors. The vendors should be asked to make a final presentation and to fully demonstrate the system. The demonstration should be as close to actual operating conditions as possible. Applications such as payroll, inventory control and billing should be tested using a large amount of test data. After the final presentations and demonstrations have been given, the organization makes the final evaluation and selection. Cost comparisons, hardware performance, delivery dates, price, flexibility, back-up facilities, availability of software training and maintenance factors are considered. In addition to comparing computer speeds, storage capacities and other similar characteristics, companies should also carefully analyze whether the characteristics of the proposed systems meet the company's objectives. In most cases, the RFP captures these objectives and goals.

Group Consensus Evaluation

In **group consensus**, a decision-making group is appointed and given the responsibility of making the final evaluation and selection. Usually, this group includes the members of the development team who participated in either systems analysis or systems design. This approach might be used to evaluate which of several screen layouts or report formats is best.

Cost–Benefit Analysis Evaluation

Cost–benefit analysis is an approach that lists the costs and benefits of each proposed system. After they are expressed in monetary terms, all the costs are compared with all the benefits. Table 6.3 lists some of the typical costs and benefits associated with the evaluation and

selection procedure. This approach is used to evaluate options whose costs can be quantified, such as which hardware or software vendor to select.

Benchmark Test Evaluation

A benchmark test is an examination that compares computer systems operating under the same conditions. Most computer companies publish their own benchmark tests, but some forbid disclosure of benchmark tests without prior written approval. Thus, one of the best approaches is for an organization to develop its own tests and then use them to compare the equipment it is considering. This approach might be used to compare the end-user system response time on two similar systems. Several independent companies also rate computer systems. Computerworld, PC Week and many other publications, for example, not only summarize various systems, but also evaluate and compare computer systems and manufacturers according to a number of criteria.

Table 6.3 Cost–Benefit Analysis Table

Costs	Benefits
Development costs	Reduced costs
Personnel	Fewer personnel
Computer resources	Reduced manufacturing costs Reduced inventory costs More efficient use of equipment Faster response time Reduced downtime or crash time Less spoilage
Fixed costs	**Increased Revenues**
Computer equipment	New products and services
Software	New customers
One-time licence fees for software and maintenance	More business from existing customers Higher price as a result of better products and services
Operating costs	**Intangible benefits**
Equipment lease and/or rental fees	Better public image for the organization
Computer personnel (including salaries, benefits, etc.)	Higher employee morale Better service for new and existing customers
Electric and other utilities	The ability to recruit better employees
Computer paper, tape and discs	Position as a leader in the industry
Other computer supplies	System easier for programmers and users
Maintenance costs	
Insurance	

Point Evaluation

One of the disadvantages of cost–benefit analysis is the difficulty of determining the monetary values for all the benefits. An approach that does not employ monetary values is a **point evaluation system**. Each evaluation factor is as- signed a weight, in percentage points, based on importance. Then each proposed information system is evaluated in terms of this factor and given a score, such as one ranging from 0 to 100, where 0 means that the alternative does not address the feature at all and 100 means that the alternative addresses that feature perfectly. The scores are totalled, and the system with the greatest total score is selected. When using point evaluation, an organization can list and evaluate literally hundreds of factors. Figure 6.5 shows a simplified version of this process. This approach is used when there are many options to be evaluated, such as which software best matches a particular business's needs.

Figure 6.5 An Illustration of the Point Evaluation System

		System A		System B	
Factor's importance		Evaluation	Weighted evaluation	Evaluation	Weighted evaluation
Hardware	35%	95 35%	33.25	75 35%	26.25
Software	40%	70 40%	28.00	95 40%	38.00
Vendor support	25%	85 25%	21.25	90 25%	22.50
Totals	100%		82.5		86.75

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Freezing Design Specifications

Near the end of the design stage, some organizations prohibit further changes in the design of the system. Freezing systems design specifications means that the user agrees in writing that the design is acceptable. Other organizations, however, allow or even encourage design changes. These organizations often use the rapid systems development approaches.

The Contract

One of the most important steps in systems design, if new computer facilities are being acquired, is to develop a good contract. Finding the best terms where everyone makes a profit can be difficult. Most computer vendors provide standard contracts; however, such contracts are designed to protect the vendor, not necessarily the organization buying the computer equipment.

Organizations often use outside consultants and legal firms to help them develop their contracts. Such contracts stipulate exactly what they expect from the system vendor and what interaction will occur between the vendor and the organization. All equipment specifications, software, training, installation, maintenance and so on are clearly stated. Also, the contract stipulates deadlines for the various stages or milestones of installation and implementation, as well as actions that the vendor will take in case of delays or problems. Some organizations include penalty clauses in the contract, in case the vendor does not meet its obligation by the specified date. Typically, the request for proposal becomes part of the contract. This saves a considerable amount of time in developing the contract, because the RFP specifies in detail what is expected from the vendors.

The Design Report

System specifications are the final results of systems design. They include a technical description that details system outputs, inputs and user interfaces, as well as all hardware, software, databases, telecommunications, personnel and procedure components, and the way these components are related. The specifications are contained in a design report, which is the primary result of systems design. The design report reflects the decisions made for systems design and prepares the way for systems implementation.

6.2 Systems Implementation

After the information system has been designed, systems implementation involves a number of tasks which lead to the system being installed and ready to operate. These include hardware acquisition, software acquisition or development (programming), user preparation, documentation preparation, hiring and training of personnel, site and data preparation, installation, testing, start-up and user acceptance. Spending on systems implementation is on the rise.

The typical sequence of systems implementation activities is shown in Figure 6.6.

Figure 6.6 Typical Steps in Systems Implementation

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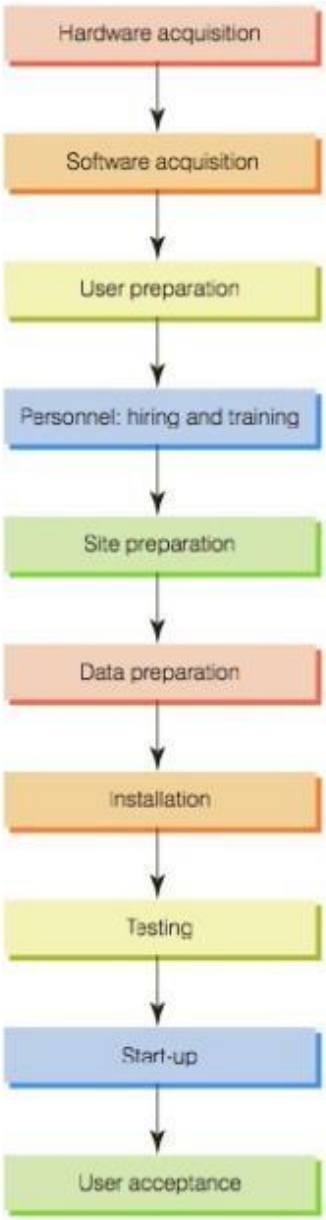


Acquiring Hardware from an IS Vendor

To obtain the components for an information system, organizations can purchase, lease or rent computer hardware and other resources from an IS vendor.An IS vendor is a company that offers hardware, software, telecommunications systems, databases, IS personnel or other computer-related resources. Types of IS vendors include general computer manufacturers (such as IBM and Hewlett-Packard), small computer manufacturers (such as Dell and Gateway), peripheral equipment manufacturers (such as Epson and Cannon), computer dealers and distributors (such as PC World) and leasing companies (such as Hamilton Rentals and Hire Intelligence).

In addition to buying, leasing or renting computer hardware, companies can pay only for the computing services that they use. Called ‘pay-as-you-go’, ‘on-demand’ or ‘utility’ computing, this approach requires an organization to pay only for the computer power it uses, as it would pay for a utility such as electricity. Hewlett-Packard offers its clients a ‘capacity-on-demand’ approach, in which organizations pay according to the computer resources actually used, including processors, storage devices and network facilities.

Companies can also purchase used computer equipment. This option is especially attractive to firms that are experiencing an economic slowdown. Companies often use traditional Internet auctions to locate used or refurbished equipment. Popular Internet auction sites sometimes sell millions of euros of computer-related equipment annually. However, buyers need to beware: prices are not always low and equipment selection can be limited on Internet auction sites. In addition, companies are increasingly turning to service providers to implement some or all of the systems they need.An application service provider (ASP) can help companies implement software and other systems. The ASP can provide both user support and the computers on which to run the software. ASPs often focus on high-end applications, such as database systems and enterprise resource planning packages. As mentioned in Chapter 6, an Internet service provider (ISP) assists a company in gaining access to the Internet. ISPs can also help a company in setting up an Internet site. Some service providers specialize in specific systems or areas, such as marketing, finance or manufacturing.

Acquiring Software: Make or Buy?

As with hardware, application software can be acquired in several ways. As previously mentioned, it can be purchased from external developers or developed in-house. This decision is often called the make-or-buy decision. A comparison of the two approaches is shown in Table 6.4. Today, most

Table 6.4 Comparison of Off the Shelf and Developed Software

Factor	Off the Shelf (Buy)	Bespoke (Make)
Cost	Lower cost	Higher cost
Needs	Might not exactly match needs	Software should exactly match needs
Quality	Usually high quality	Quality can vary depending on the programming team
Speed	Can acquire it now	Can take years to develop
Competitive advantage	Other organizations can have the same software and same advantage	Can develop a competitive advantage with good software

software is purchased ‘off the shelf’. SAP, the large international software company headquartered in Germany, produces modular software which it sells to a variety of companies. The approach gives its customers using the software more flexibility in what they use and what they pay for SAP’s modules. The key is how the purchased systems are integrated into an effective system.

Off the shelf software should be of higher quality than developed, or ‘bespoke’, software, as it will have been tested ‘in the field’ by other users. Often those users form an online community, which can be of help to new users. New users often go to online discussion groups to ask questions about the software, rather than calling the developer’s own hotline. The audio soft-

ware Cakewalk, for example, used by amateur and professional musicians, has a thriving forum where beginners and experienced users can post questions and answer other peoples' questions. Off the shelf software will likely be better documented than bespoke software.

In some cases, companies use a blend of external and internal software development. That is, in-house personnel modify or customize off the shelf or proprietary software programs. Software can also be rented. Salesforce.com, for example, rents software online that helps organizations manage their sales force and internal staff. Increasingly, software is being viewed as a utility or service, not a product you purchase.

System software, such as operating systems or utilities, is typically purchased from a soft- ware company. Increasingly, however, companies are obtaining open-source systems software, such as the Linux operating system, which can be obtained free or for a low cost

Externally Acquired Software

A company planning to purchase or lease software from an outside company has many options. Commercial off the shelf (COTS) development is often used. The COTS development process involves the use of commonly available products from software vendors. It combines software from various vendors into a finished system. In many cases, it is necessary to write some original soft- ware from scratch and combine it with purchased or leased software. For example, a company can purchase or lease software from several software vendors and combine it into a finished software program. COTS can be less expensive than developing an application from scratch. It can stream- line and shorten the time needed to develop software. The other steps of the systems development lifecycle, such as requirements analysis, testing and implementation, must still be carefully done. A major challenge with COTS development is integrating all the off the shelf components into a unified software package. Other potential problems of the COTS development approach can include no access to the source code, the inability to make changes or updates, and the possibility of quality and security problems concerning the COTS software or components.

Developing Software

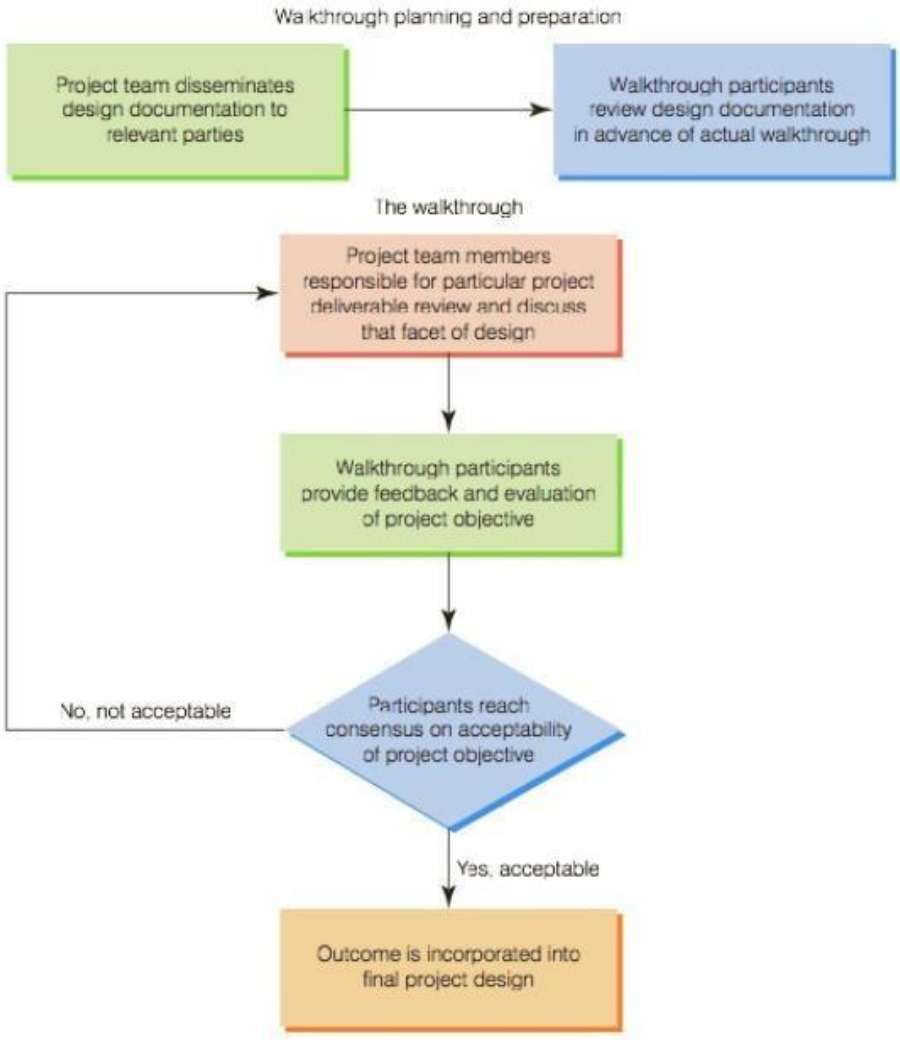
Another option is to develop software internally or hire a software house to develop it. Some advantages inherent with developing software include meeting user and organizational requirements and having more features and increased flexibility in terms of customization and changes.

Such software programs also have greater potential for providing a competitive advantage because competitors cannot easily duplicate them in the short term. If software is to be developed, there should be a chief programmer team. The chief programmer team is a group of skilled IS professionals with the task of designing and implementing a set of programs. This team has total responsibility for building the best software possible. Individuals on a chief programmer team often have excellent programming skills. The following tools and techniques may also be used:

- CASE and object-oriented approaches
- Cross-platform development: One software development technique, called **cross-platform development**, allows programmers to develop programs that can run on computer systems that have different hardware and operating systems or platforms. Web service tools, such as .NET by Microsoft, are examples. With cross-platform development, for example, the same program can run on both a PC and a mainframe or on two different types of PCs.

- Integrated development environment: **Integrated development environments (IDEs)** combine the tools needed for programming with a programming language in one integrated package. An IDE allows programmers to use simple screens, customized pull-down menus and graphical user interfaces. Visual Studio 2005 from Microsoft is an example of an IDE. Oracle Designer, which is used with Oracle's data- base system, is another example of an IDE.
- Structured walkthroughs: As shown in Figure 6.7 a **structured walkthrough** is a planned and pre-announced review of the progress of a program or program module. The walkthrough helps team members review and evaluate the progress of components of a project. The structured walk- through approach is also useful for programming projects that do not use the structured design approach.

Figure 12.7 Structured Walkthrough



- Documentation: With developed software, documentation is always important. **Technical documentation** is used by computer operators to execute the program, and by analysts and programmers to solve problems or modify the program. In technical documentation, the purpose of every major piece of computer code is written out and explained. Key variables are also described. User documentation might be developed for the people who use the program. This type of documentation shows users, in easy-to-understand terms, how the program can and should be used, although an alternative such as a demonstration video may be created instead.

Acquiring Database and Telecommunications Systems

Because databases are a blend of hardware and software, many of the approaches discussed earlier for acquiring hardware and software also apply to database systems. For example, an upgraded inventory control system might require database capabilities, including more hard disc storage or a new DBMS. If so, additional storage hardware will have to be acquired from an IS vendor. New or upgraded software might also be purchased or developed in-house. With the increased use of e-commerce, the Internet, intranets and extranets, telecommunications is one of the fastest-growing applications for today's businesses and people. Like database systems, telecommunications systems require a blend of hardware and software. Again, the

earlier discussion on acquiring hardware and software also applies to the acquisition of telecommunications hardware and software.

User Preparation

User preparation is the process of readying managers, decision makers, employees, other users and stakeholders for the new systems. This activity is an important but often ignored area of systems implementation. For example, if a small airline does not adequately train employees with a new software package, the result could be a grounding of most of its flights and the need to find hotel rooms to accommodate unhappy travellers who are stranded.

Without question, training users is an essential part of user preparation, whether they are trained by internal personnel or by external training firms. In some cases, companies that provide software also train users at no charge or at a reasonable price. The cost of training can be negotiated during the selection of new software. Other companies conduct user training throughout the systems development process. Concerns and apprehensions about the new system must be eliminated through these training programmes. Employees should be acquainted with the system's capabilities and limitations by the time they are ready to use it.

IS Personnel: Hiring and Training

Depending on the size of the new system, an organization might have to hire and, in some cases, train new IS personnel. An IS manager, systems analysts, computer programmers, data- entry operators and similar personnel might be needed for the new system.

As with users, the eventual success of any system depends on how it is used by the IS personnel within the organization. Training programmes should be conducted for the IS personnel who will be looking after the new computer system. These programs are similar to those for the users, although they can be more detailed in the technical aspects of the systems. Effective training will help IS personnel use the new system to perform their jobs and support other users in the organization.

Site Preparation

The location of the new system needs to be prepared, a process called **site preparation**. For a small system, site preparation can be as simple as rearranging the furniture in an office to make room for a computer. With a larger system, this process is not so easy because it can require special wiring and air conditioning. One or two rooms might have to be completely renovated, and additional furniture might have to be purchased. A special floor might have to be built, under which the cables connecting the various computer components are placed, and a new security system might be needed to protect the equipment. For larger systems, additional power circuits might also be required.

Data Preparation

Data preparation, or data conversion, involves making sure that all files and databases are ready to be used with the new computer software and systems. If an organization is installing a new payroll program, for instance, the old employee payroll data might have to be converted into a

format that can be used by the new computer software or system. After the data has been prepared or converted, the computerized database system or other software will then be used to maintain and update the computer files.

Installation

Installation is the process of physically placing the computer equipment on the site and making it operational. Although normally the hardware manufacturer is responsible for installing computer equipment, someone from the organization (usually the IS manager) should oversee the process, making sure that all equipment specified in the contract is installed at the proper location. After the system is installed, the manufacturer performs several tests to ensure that the equipment is operating as it should. After this, the acquired software can be installed on the new hardware and the system is again tested.

Testing

Good testing procedures are essential to make sure that the new or modified information system operates as intended. Inadequate testing can result in mistakes and problems. A popular tax preparation company in the US, for example, implemented a web-based tax preparation system, but people could see one another's tax returns. The president of the tax preparation company called it 'our worst-case scenario'. Better testing can prevent these types of problems.site preparation

Several forms of testing should be used, including testing each program **(unit testing)**, testing the entire system of programs (**system testing**), testing the application with a large amount of data (**volume testing**) and testing all related systems together (**integration testing**), as well as conducting any tests required by the user (**acceptance testing**).

Alpha testing involves testing an incomplete or early version of the system, while **beta testing** involves testing a complete and stable system by end- users. Alpha-unit testing, for example, is testing an individual program before it is completely finished. Beta-unit testing, on the other hand, is performed after alpha testing, when the individual program is complete and ready for use by end-users.

Unit testing is accomplished by developing test data that will force the computer to execute every statement in the program. In addition, each program is tested with abnormal data to determine how it will handle problems.

Finally, acceptance testing makes sure that the new or modified system is operating as intended. Run times, the amount of memory required, disc access methods and more can be tested during this phase. Acceptance testing ensures that all performance objectives defined for the system or application are satisfied. Involving users in acceptance testing can help them understand and effectively interact with the new system. Acceptance testing is the final check of the system before start-up.

Start-Up

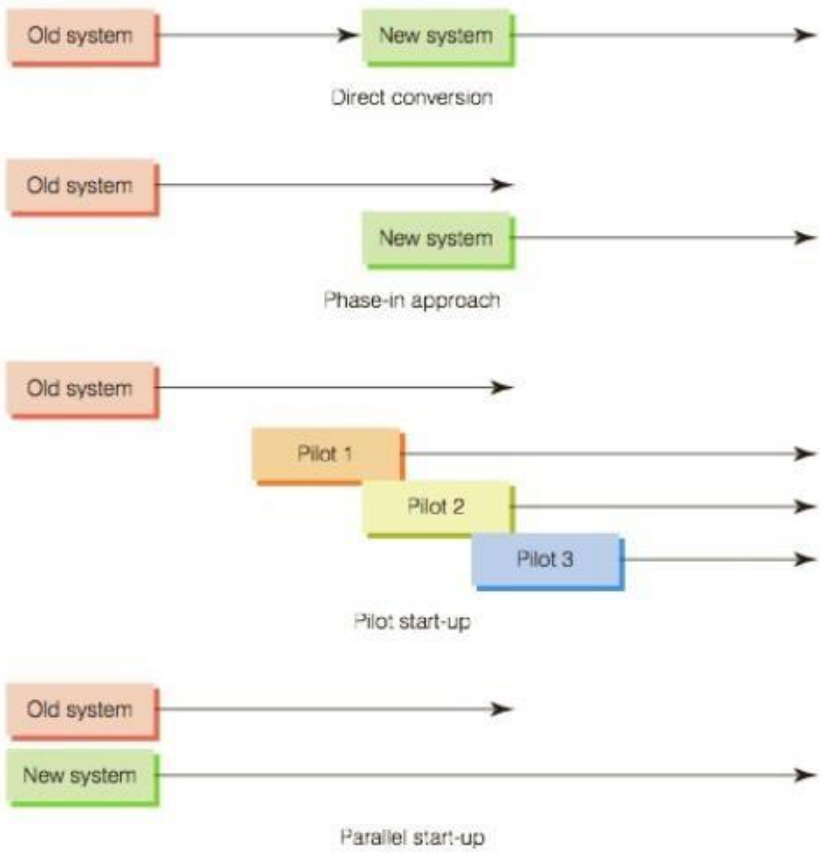
Start-up, also called cutover, begins with the final tested information system. When start-up is finished, the system is fully operational. Start-up can be critical to the success of the organization. If not done properly, the results can be disastrous. One of the authors is aware of a small manufacturing company that decided to stop an accounting service used to send out bills on the same day they were going to start their own program to send out bills to customers.

The manufacturing company wanted to save money by using their own billing program developed by an employee of the company. The new program didn't work, the accounting service wouldn't help because they were upset about being terminated, and the manufacturing company wasn't able to send out any bills to customers for more than three months. The company almost went bankrupt.

Various start-up approaches are available (see Figure 6.8). **Direct conversion** (also called plunge, big bang or direct cutover) involves stopping the old system and starting the new system on a given date. Direct conversion is usually the least desirable approach because of the potential for problems and errors when the old system is shut off and the new system is turned on at the same instant.

The **phase-in approach** is a popular technique preferred by many organizations. In this approach, sometimes called a piecemeal approach, components of the new system are slowly phased in while components of the old one are slowly phased out. When everyone is confident that the new system is performing as expected, the old system is completely phased out. This gradual replacement is repeated for each application until the new system is running every application. In some cases, the phase-in approach can take months or years.

Figure 6.8 Start-Up Approaches



Pilot running involves introducing the new system with direct conversion for one group of users rather than all users. For example, a manufacturing company with many retail outlets throughout the country could use the pilot start-up approach and install a new inventory control system at one of the retail outlets. When this pilot retail outlet runs without problems, the new

inventory control sys- tem can be implemented at other retail outlets. The National Health Service Cancer Registry in England, for example, used a pilot start-up approach to implement and test a new system to manage and integrate hundreds of cancer-related data sources. Parallel running involves running both the old and new systems for a period of time. The output of the new system is compared closely with the output of the old system, and any differences are reconciled. When users are comfortable that the new system is working correctly, the old system is eliminated.

User Acceptance

Most mainframe computer manufacturers use a formal user acceptance document – a formal agreement the user signs stating that a phase of the installation or the complete system is approved. This is a legal document that usually removes or reduces the IS vendor's liability for problems that occur after the user acceptance document has been signed. Because this document is so important, many companies get legal assistance before they sign it. Stakeholders can also be involved in acceptance testing to make sure that the benefits to them are indeed realized.

6.3 Systems Operation and Maintenance

Systems operation involves all aspects of using the new or modified system in all kinds of operating conditions. Getting the most out of a new or modified system during its operation is the most important aspect of systems operations for many organizations. Throughout this book, we have seen many examples of information systems operating in a variety of settings and industries. Thus, we will not cover the operation of an information system in detail in this section. The operation of any information system, how- ever, does require adequate training and support before the system is used and continual sup- port while the system is being operated. This training and support is required for all stakeholders, including employees, customers and others. Companies typically provide training through seminars, manuals and online documentation. To provide adequate support, many companies use a formal help desk. A help desk consists of people with technical expertise, computer systems, manuals and other resources needed to solve problems and give accurate answers to questions. With today's advances in telecommunications, help desks can be located around the world. If you are having trouble with your PC and call a freephone number for assistance, you might reach a help desk in India or China. For most organizations, operations costs over the life of a system are much greater than the development costs.

Systems maintenance involves checking, changing and enhancing the system to make it more useful in achieving user and organizational goals. Maintenance is important for individuals, groups and organizations. Organizations often have personnel dedicated to maintenance. The maintenance process can be especially difficult for older software. A legacy system is an old system that might have been patched or modified repeatedly over time. An old payroll program written in COBOL decades ago and frequently changed is an example of a legacy system. Legacy systems can be very expensive to maintain. At some point, it becomes less expensive to switch to new programs and applications than to repair and maintain the legacy system. Maintenance costs for older legacy systems can be 50 per cent of the total operating costs in some cases.

Software maintenance is a major concern for organizations. In some cases, organizations encounter major problems that require recycling the entire systems development process. In other situations, minor modifications are sufficient to remedy problems. Hardware maintenance

is also important. Companies such as IBM have investigated autonomic computing, in which computers will be able to manage and maintain themselves.The goal is for computers to be self-configuring, self-protecting, self-healing and self-optimizing. Being self-configuring allows a computer to handle new hardware, software or other changes to its operating environment. Being self-protecting means a computer can identify potential attacks, prevent them when possible and recover from attacks if they occur. Attacks can include viruses, worms, identity theft and industrial espionage. Being 'self-healing' means a computer can fix problems when they occur, and being 'self-optimizing' allows a computer to run faster and get more done in less time. Getting rid of old equipment is an important part of maintenance. The options include selling it on web auction sites such as eBay, recycling the equipment at a computer recycling centre, and donating it to a charitable organization, such as a school, library or religious organization. When discarding old computer systems, it is always a good idea to permanently remove sensitive files and programs. Companies, including McAfee, have software to help people remove data and programs from old computers and transfer them to new ones.

Reasons for Maintenance

After a program is written, it will need ongoing maintenance. To some extent, a program is similar to a car that needs oil changes, tune-ups and repairs at certain times. Experience shows that frequent, minor maintenance to a program, if properly done, can prevent major system failures later. Some of the reasons for program maintenance are the following:

- Changes in business processes.
- New requests from stakeholders, users and managers.
- Bugs or errors in the program.
- Technical and hardware problems.
- Corporate mergers and acquisitions.
- Government regulations.
- Change in the operating system or hardware on which the application runs.
- Unexpected events, such as severe weather or terrorist attacks.

Most companies modify their existing programs instead of developing new ones because existing software performs many important functions, and companies can have millions of dollars invested in their old legacy systems. So, as new systems needs are identified, the burden of fulfilling the needs most often falls on the existing system. Old programs are repeatedly modified to meet ever-changing needs. Yet, over time, repeated modifications tend to interfere with the system's overall structure, reducing its efficiency and making further modifications more burdensome.

Types of Maintenance

Software companies and many other organizations use four generally accepted categories to signify the amount of change involved in maintenance. A **slipstream upgrade** is a minor upgrade – typically a code adjustment or minor bug fix. Many companies don't announce to users that a slipstream upgrade has been made. A slipstream upgrade usually requires recompiling all the code, so it can sometimes create entirely new bugs. This maintenance practice can explain why the same computers sometimes work differently with what is supposedly the same software. A **patch** is a minor change to correct a problem or make a small enhancement. It is usually an addition to an existing program. That is, the programming code

representing the system enhancement is usually 'patched into', or added to, the existing code. Although slipstream upgrades and patches are minor changes, they can cause users and support personnel big problems if the programs do not run as before. A new **release** is a significant program change that often requires changes in the documentation of the software. Finally, a new **version** is a major program change, typically en- compassing many new features.

The Request for Maintenance Form

Because of the amount of effort that can be spent on maintenance, many organizations require a **request for maintenance form** to authorize modification of programs. This form is usually signed by a business manager, who documents the need for the change and identifies the priority of the change relative to other work that has been requested. The IS group reviews the form and identifies the programs to be changed, determines the programmer who will be assigned to the project, estimates the expected completion date and develops a technical description of the change. A cost–benefit analysis might be required if the change requires substantial resources.

Performing Maintenance

Depending on organizational policies, the people who perform systems maintenance vary. In some cases, the team who designs and builds the system also performs maintenance. This ongoing responsibility gives the designers and programmers an incentive to build systems well from the outset: if there are problems, they will have to fix them. In other cases, organizations have a separate **maintenance team**. This team is responsible for modifying, fixing and updating existing software.

In the past, companies had to maintain each computer system or server separately. With hundreds or thousands of computers scattered throughout an organization, this task could be very costly and time consuming. Today, the maintenance function is becoming more automated. Some companies, for example, use maintenance tools and software that will allow them to maintain and upgrade software centrally.

A number of vendors have developed tools to ease the software maintenance burden. Relativity Technologies has developed RescueWare, a product that converts third-generation code such as COBOL to highly maintainable C++, Java or Visual Basic object-oriented code. Using RescueWare, maintenance personnel download mainframe code to Windows NT or Windows 2000 workstations. They then use the product's graphical tools to analyze the original system's inner workings. RescueWare lets a programmer see the original system as a set of object views, which visually illustrate module functioning and program structures. IS personnel can choose one of three levels of transformation: revamping the user interface, converting the database access and transforming procedure logic

The Financial Implications of Maintenance

The cost of maintenance is staggering. For older programs, the total cost of maintenance can be up to five times greater than the total cost of development. In other words, a program that originally cost €25 000 to develop might cost €125 000 to maintain over its lifetime. The average programmers can spend more than half their time on maintaining existing programs instead of developing new ones. In addition, as programs get older, total maintenance expenditures in time and money increase. With the use of newer programming languages and approaches, including object-oriented programming, maintenance costs are expected to decline. Even so, many organizations have literally millions of euros invested in applications written in older languages (such as COBOL), which are both expensive and time consuming to

maintain. The financial implications of maintenance mean companies must keep track of why systems are maintained, instead of simply keeping cost figures. This is another reason that documentation of maintenance tasks is so crucial. A determining factor in the decision to replace a system is the point at which it is costing more to fix it than to replace it.

The Relationship Between Maintenance and Design

Programs are expensive to develop, but they are even more expensive to maintain. Programs that are well designed and documented to be efficient, structured and flexible are less expensive to maintain in later years. Thus, there is a direct relationship between design and maintenance. More time spent on design up front can mean less time spent on maintenance later.

In most cases, it is worth the extra time and expense to design a good system. Consider a system that costs €250 000 to develop. Spending 10 per cent more on design would cost an additional €25 000, bringing the total design cost to €275 000. Maintenance costs over the life of the program could be €1 000 000. If this additional design expense can reduce maintenance costs by 10 per cent, the savings in maintenance costs would be €100 000. Over the life of the program, the net savings would be €75 000 (€100 000 – €25 000).

The need for good design goes beyond mere costs. Companies risk ignoring small system problems when they arise, but these small problems can become large in the future. As mentioned earlier, because maintenance programmers spend an estimated 50 per cent or more of their time deciphering poorly written, undocumented program code, they have little time to spend on developing new, more effective systems. If put to good use, the tools and techniques discussed in this chapter will allow organizations to build longer-lasting, more reliable systems.

6.4 Systems Review

The final step of system development, is the process of analyzing systems to make sure that they are operating as intended. This process often compares the performance and benefits of the system as it was designed with the actual performance and benefits of the system in operation.18 A payroll application being developed for the Irish Health Service, for example, was almost €120 million over budget.19 As a result, work on the application that serves about 37 000 workers was halted so the entire project could be reviewed in detail. The purpose of the systems review is to make sure that any additional work will result in a program that will work as intended.

Problems and opportunities uncovered during systems reviews trigger systems development and begin the process anew. For example, as the number of users of an interactive system increases, it is not unusual for system response time to increase. If the increase in response time is too great, it might be necessary to redesign some of the system, modify databases or increase the power of the computer hardware. When faced with a possible patent infringement problem, RIM, the maker of the popular BlackBerry phone and email service, developed back-up software that could be used in case the courts ruled against the company. Even though RIM was able to settle the suit out of court, BlackBerry users were happy that the company had a back-up plan.

Internal employees, external consultants, or both, can perform systems review. When the problems or opportunities are industry-wide, people from several firms can get together. In some cases, they collaborate at an IS conference or in a private meeting involving several firms.

Types of Review Procedures

There are two types of review procedures: event-driven and time-driven (see Table 6.5). An **event-driven review** is triggered by a problem or opportunity such as an error, a corporate merger or a new market for products.21 Natural disasters often revealed flaws in older systems, causing many companies and organizations to review their existing systems. Recent floods in the UK, for example, caused insurance companies to introduce flood maps to their quotation systems.

Table 6.5 Examples of Review Types

Event-Driven	Time-Driven
Problem with an existing system	Monthly review
Merger	Yearly review
New accounting system	Review every few years
Executive decision that an upgraded Internet site is needed to stay competitive	Five-year review

In contrast, some companies use a continuous improvement approach to systems development. With this approach, an organization makes changes to a system even when small problems or opportunities occur. Although continuous improvement can keep the system current and responsive, repeatedly designing and implementing changes can be both time consuming and expensive.

A **time-driven review** is performed after a specified amount of time.

Many application programs are reviewed every six months to one year. With this approach, an existing system is monitored on a schedule. If problems or opportunities are uncovered, a new systems development cycle can be initiated. A payroll application, for example, can be reviewed once a year to make sure that it is still operating as expected. If it is not, changes are made.

Most companies use both approaches. A billing application, for example, might be reviewed once a year for errors, inefficiencies and opportunities to reduce operating costs. This is a time-driven approach. In addition, the billing application might be redone after a corporate merger if one or more new managers require different information or reports, or if laws on bill collecting and privacy change. This is an event-driven approach.

Factors to Consider During Systems Review

Systems review should investigate a number of important factors, such as the following:

- Mission: Is the computer system helping the organization achieve its overall mission? Are stakeholder needs and desires satisfied or exceeded with the new or modified system?
- Organizational goals: Does the computer system support the specific goals of the various areas and departments of the organization?

- Hardware and software: Are hardware and software up to date and adequate to handle current and future processing needs?
- Database: Is the current database up to date and accurate? Is database storage space adequate to handle current and future needs?
- Telecommunications: Is the current telecommunications system fast enough, and does it allow managers and workers to send and receive timely messages? Does it allow for fast order processing and effective customer service?
- Information systems personnel: Are there sufficient IS personnel to perform current and projected processing tasks?
- Control: Are rules and procedures for system use and access acceptable? Are the existing control procedures adequate to protect against errors, invasion of privacy, fraud and other potential problems?
- Training: Are there adequate training programmes and provisions for both users and IS personnel?
- Costs: Are development and operating costs in line with what is expected? Is there an adequate IS budget to support the organization?
- Complexity: Is the system overly complex and difficult to operate and maintain?
- Reliability: Is the system reliable? What is the mean time between failures (MTBF)?
- Efficiency: Is the computer system efficient? Are system outputs generated by the right amount of inputs,
- Response time: How long does it take the system to respond to users during peak processing times?
- Documentation: Is the documentation still valid? Are changes in documentation needed to reflect the current situation?

System Performance Measurement

Systems review often involves monitoring the system, called **system performance measurement**. The number of errors encountered, the amount of memory required, the amount of processing or CPU time needed and other problems should be closely observed. If a particular system is not performing as expected, it should be modified, or a new system should be developed or acquired.

Setting up benchmarks for performance measurement can be critical. **System performance products** have been developed to measure all components of the information system, including hardware, software, database, telecommunications and network systems. When properly used, system performance products can quickly and efficiently locate actual or potential problems.

A number of products have been developed to assist in assessing system performance. OMEGAMON from IBM can monitor system performance in real time. Precise Software Solutions has system performance products that provide around-the-clock performance monitoring for Oracle database applications. Mercury Interactive offers a software tool called Diagnostic to help companies analyze the performance of their computer systems, diagnose potential problems and take corrective action if needed.

Measuring a system is, in effect, the final task of systems development. The results of this process can bring the development team back to the beginning of the development lifecycle, where the process begins again.

6.5 Computer Waste and Mistakes

Computer-related waste and mistakes are major causes of computer problems, contributing as they do to unnecessarily high costs and lost profits. Computer waste involves the inappropriate use of computer technology and resources. It includes employees wasting computer resources and time by playing games and surfing the web, sending unnecessary email, prining documents and other material that is then not read, developing systems that are not used to their full extent, and discarding old hardware when it could be recycled or given to charity. UK-based Computers for Charities, for instance, will collect old technology, wipe clean any data stored on them and deliver them to charities where they are still useful. Junk email, also called spam, and junk faxes also cause waste.

Preventing Computer-Related Waste and Mistakes

To remain profitable in a competitive environment, organizations must use all resources wisely. Preventing computer-related waste and mistakes like those just described should therefore be a goal. To achieve it involves (1) establishing, (2) implementing, (3) monitoring and (4) reviewing effective policies and procedures.

Establishing Policies and Procedures

The first step to prevent computer-related waste is to establish policies and procedures regarding efficient acquisition, use and disposal of systems and devices. Most companies have implemented stringent policies on the acquisition of computer systems and equipment, including requiring a formal justification statement before computer equipment is purchased, definition of standard computing platforms (operating system, type of computer chip, minimum amount of RAM, etc.) and the use of preferred vendors for all acquisitions.

Implementing Policies and Procedures

Implementing policies and procedures to minimize waste and mistakes varies according to the type of business. Most companies develop such policies and procedures with advice from the firm's internal auditing group or its external auditing firm. The policies often focus on the implementation of source data automation and the use of data editing to ensure data accuracy and completeness, and the assignment of responsibility for data accuracy within each information system. Some useful policies to minimize waste and mistakes include the following:

Monitoring Policies and Procedures

To ensure that users throughout an organization are following established procedures, the next step is to monitor routine practices and take corrective action if necessary. By under- standing what is happening in day-to-day activities, organizations can make adjustments or develop new procedures. Many organizations implement internal audits to measure actual results against established goals, such as percentage of end-user reports produced on time, percentage of datainput errors detected, number of input transactions entered per eight-hour shift and so on.

6.6 Computer Crime

According to Financial Fraud Action UK, in 2012 credit card fraudsters stole nearly €400 million in the UK alone, with €163 million of this happening through e-commerce transactions.4 In 2013, Internet security experts Kaspersky Lab detected almost 3 billion malware attacks on user computers and 104 427 new malicious programs aimed at mobile

devices. The term computer crime covers a wide variety of activities, including these. Some more examples are listed next and then some types of computer crime are discussed.

■The largest consumer fraud in the US was committed by the Gambino crime family involving two different computer-related ploys and resulted in a loss to the public of over €200 million. One of the schemes offered 'free' tours of adult Internet sites but required the victim to provide a credit card supposedly for age-verification purposes. Victims took the free tours and then their credit cards were hit for charges over and over again. The second prong to this scheme involved the use of a third-party billing provider to add charges on people's telephone bills for services not provided.

■A 20-year-old man was sentenced to 57 months in prison for hijacking more than 400 000 PCs over the Internet and turning them into a 'botnet' or 'zombie network', a network of personal computers used to perform a task without the owner's knowledge. He would then rent the zombie network out to spyware distributors, hackers and spammers to use in performing their work.

Identify Theft

Identity theft is one of the fastest growing crimes. It is a crime where an imposter obtains key pieces of personal identification information, such as date of birth, address, national insurance number and mother's maiden name, and uses them to open bank accounts, get credit cards, loans, benefits and documents such as passports and driving licences in the victim's name. In other cases, the identity thief uses personal information to gain access to the person's existing accounts. Typically, the thief changes the mailing address on an account and runs up a huge bill before the person whose identity has been stolen realizes there is a problem. The Internet has made it easier for an identity thief to use the stolen information because trans- actions can be made without any personal interaction. The UK Home Office has a website, www.identitytheft.org.uk/, to advise its citizens and help victims. A wide range of methods are

Another popular method to get information is 'shoulder surfing' – the identity thief simply stands next to someone at a public office, such as the passport office or even when filling in a form to join a customer loyalty programme, and watches as the person fills out personal information on a form. The same thing can happen at a bank ATM where the attacker simply watches the person enter their PIN, or at a shop when the victim is using their credit card to make a purchase (see Figure 6.9).

Figure 6.9 Shoulder Surfing

Read

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Consumers can help protect themselves by regularly checking their credit reports, following up with creditors if their bills do not arrive on time, not revealing any personal information in response to unsolicited email or phone calls, and shredding bills and other documents that contain sensitive information.

Cyberterrorism

Government officials and IS security specialists have documented a significant increase in Internet probes and server scans since early 2001. A growing concern among authorities is that such intrusions are part of an organized effort by cyberterrorists to map potential security holes in critical systems. A cyberterrorist is someone who

A variant is a modified version of a virus that is produced by the virus's author or another person who amends the original virus code. If changes are small, most antivirus products will also detect variants. However, if the changes are significant, the variant might go undetected by antivirus software.

In some cases, a virus or a worm can completely halt the operation of a computer system or network for days or longer until the problem is found and repaired. In other cases, a virus or a worm can destroy important data and programs. If back-ups are inadequate, the data and programs might never be fully functional again. The costs include the effort required to identify

and neutralize the virus or worm and to restore computer files and data, as well as the value of business lost because of unscheduled computer downtime.

As a result of the increasing threat of viruses and worms, most computer users and organizations have installed **antivirus programs** on their computers. Such software runs in the background to protect your computer from dangers lurking on the Internet and other possible sources of infected files. Some antivirus software is even capable of repairing common virus infections automatically, without interrupting your work. The latest virus definitions are downloaded automatically when you connect to the Inter- net, ensuring that your PC's protection is current. To safeguard your PC and prevent it from spreading viruses to your friends and co-workers, some antivirus software scans and cleans both incoming and outgoing email messages

Equipment Theft

During illegal access to computer systems, data can be stolen. In addition to theft of data and software, all types of computer systems and equipment have been stolen from offices. Mobile computers such as laptops and smartphones are especially easy for thieves to take. Very often the data stored on these devices is more valuable than the device itself. An MI5 agent's laptop containing sensitive government information was stolen at Paddington train station in London, and a senior British Army official's laptop was taken at Heathrow Airport. To fight computer crime, many companies use devices that disable the disc drive and/or lock the computer to the desk.

Software and Internet Software Piracy

Like books and movies – and other intellectual properties – software is protected by copyright laws. Often, people who would never think of plagiarizing another author's written work have no qualms about using and copying software programs they have not paid for. Such illegal duplicators are called 'pirates'; the act of illegally duplicating software is called **software piracy.**

Technically, software purchasers are granted the right only to use the software under certain conditions; they don't really own the software. Licences vary from program to program and can authorize as few as one computer or one person to use the software or as many as several hundred network users to share the application across the system. Making additional copies or loading the software onto more than one machine might violate copyright law and be considered piracy.

Computer-Related Scams

People have lost hundreds of thousands of euros on property, travel, stock and other business scams. Now, many of these scams are being perpetrated with computers. Using the Internet, scam artists offer get-rich-quick schemes involving bogus property deals, tout 'free' holidays with huge hidden costs, commit bank fraud, offer fake telephone lotteries, sell worthless penny stocks and promote illegal tax-avoidance schemes.

The following is a list of tips to help you avoid becoming a scam victim:

■ Don't agree to anything in a high-pressure meeting or seminar. Insist on having time to think it over and to discuss things with your spouse, your partner or even your solicitor. If a company won't give you the time you need to check it out and think things over, you don't want to do business with them. A good deal now will be a good deal tomorrow; the only reason for rushing you is if the company has something to hide.

■Don't judge a company based on appearances. Professional-looking websites can be created and published in a matter of days. After a few weeks of taking money, a site can vanish without a trace in just a few minutes. You might find that the perfect money- making opportunity offered on a website was a money-maker for the crook and a money-loser for you.

6.7 Preventing Computer-Related Crime

Because of increased computer use, greater emphasis is placed on the prevention and detection of computer crime. Many countries have passed data laws governing how data can be stored, processed and transferred, and laws on computer crime. Some believe that these laws are not effective because companies do not always actively detect and pursue computer crime, security is inadequate and convicted criminals are not severely punished. However, all over the world, private users, companies, employees and public officials are making individual and group efforts to curb computer crime, and recent efforts have met with some success.

Crime Prevention by the State

In the UK, the Computer Misuse Act of 1990, which criminalizes unauthorized access to computer systems, and the Data Protection Act of 1984 (expanded in 1998), which governs when and how data about individuals can be stored and processed, have been passed. Many countries have passed similar laws.

In the UK, the Home Office is charged with tackling computer crime with some police forces having a 'cybercrime' unit. The Information Commissioner's Office is in charge of the UK's independent authority set up to protect personal information (and as we shall see later in this chapter, to promote access to official information). The UK also has an organization dedicated to fighting specific types of computer crime. The Child Exploitation and Online Protection

Centre (CEOP) tackles child sex abuse, especially where it has been facilitated in some way by the Internet.

Crime Prevention by Organizations

Companies are also taking crime-fighting efforts seriously. Many businesses have designed procedures and specialized hardware and software to protect their corporate data and systems. Specialized hardware and software, such as encryption devices, can be used to encode data and information to help prevent unauthorized use. Encryption is the process of converting an original electronic message into a form that can be understood only by the intended recipients. A key is a variable value that is applied using an algorithm to a string or block of unencrypted text to produce encrypted text or to decrypt encrypted text. Encryption methods rely on the limitations of computing power for their effectiveness – if breaking a code requires too much computing power, even the most determined code crackers will not be successful. The length

of the key used to encode and decode messages determines the strength of the encryption algorithm.

Public-key infrastructure (PKI) enables users of an unsecured public

Network such as the Internet to securely and privately exchange data through the use of a public and a private cryptographic key pair that is obtained and shared through a trusted authority. PKI is the most common method on the Internet for authenticating a message sender or encrypting a message. PKI uses two keys to encode and decode messages. One key of the pair, the message receiver's public key, is readily available to the public and is used by anyone to send that individual encrypted messages. The second key, the message receiver's private key, is kept secret and is known only by the message receiver. Its owner uses the private key to decrypt messages – convert encoded messages back into the original message. Knowing a person's public key does not enable you to decrypt an encoded message to that person.

Using biometrics is another way to protect important data and information systems. Biometrics involves the measurement of one of a person's traits, whether physical or behavioural. Biometric techniques compare a person's unique characteristics against a stored set to detect differences between them. Biometric systems can scan fingerprints, faces, handprints, irises and retinal images to prevent unauthorized access to important data and computer resources. Most of the interest among corporate users is in fingerprint technology, followed by face recognition. Fingerprint scans hit the middle ground between price and effectiveness (see Figure 13.2). Iris and retina scans are more accurate, but they are more expensive and involve more equipment.

Co-op Mid Counties is the first UK retailer to implement a payment by biometrics system with fingerprint readers supplied by the US Company Pay by Touch. The system is installed in just three of its stores in Oxford, but, if successful, the system will be expanded to all of its 150 stores. To use the system, customers must register with Co-op Mid Counties by providing a photo ID and submit to fingerprinting. In addition to providing improved security, the system takes less time to process a payment – three seconds compared with seven seconds for traditional payment approval methods.

As employees move from one position to another at a company, they can build up access to multiple systems if inadequate security procedures fail to revoke access privileges. It is clearly not appropriate for people who have changed positions and responsibilities to still have access to systems they no longer use. To avoid this problem, many organizations create role-based system access lists so that only people filling a particular role (e.g. line manager) can access a specific system.

Figure 6.10 Fingerprint Authentication

Crime-fighting procedures usually require additional controls on the information system. Before designing and implementing controls, organizations must consider the types of computer-related crime that might occur, the consequences of these crimes, and the cost and complexity of needed controls. In most cases, organizations conclude that the trade-off between crime and the additional cost and complexity weighs in favour of better system controls. Having knowledge of some of the methods used to commit crime is also helpful in preventing, detecting and developing systems resistant to computer crime. Some companies actually hire former criminals to thwart other criminals.

Crime Prevention by Individuals

A number of individuals – victims, former criminals, concerned parents – have set up websites offering support for those worried about computer crime, and advice on how to fight it.

Using Intrusion Detection Software

An **intrusion detection system (IDS)** monitors system and network resources and notifies network security personnel when it senses a possible intrusion. Examples of suspicious activities include repeated failed logon attempts, attempts to download a program to a server and access to a system at unusual hours. Such activities generate alarms that are captured on log files. Intrusion detection systems send an alarm, often by email or page, to network security personnel when they detect an apparent attack. Unfortunately, many IDSs frequently provide false alarms that result in wasted effort. If the attack is real, network security

personnel must make a decision about what to do to resist the attack. Any delay in response increases the probability of damage from a criminal hacker attack. Use of an IDS provides another layer of protection in the event that an intruder gets past the outer security layers – passwords, security procedures and corporate firewall.

Preventing Crime on the Internet

Internet security can include firewalls and many methods to secure financial transactions. A firewall can include both hardware and software that act as a barrier between an organization's information system and the outside world. Some systems have been developed to safeguard financial transactions on the Internet.

To help prevent crime on the Internet, the following steps can be taken:

1 Develop effective Internet usage and security policies for all employees.

2 Use a stand-alone firewall (hardware and software) with network monitoring capabilities.

3 Deploy intrusion detection systems, monitor them and follow up on their alarms.

4 Monitor managers and employees to make sure that they are using the Internet for business purposes.

5 Internet security specialists to perform audits of all Internet and network activities.

Even with these precautions, computers and networks can never be completely protected against crime. One of the biggest threats is from employees. Although firewalls provide good perimeter control to prevent crime from the outside, procedures and protection measures are needed to protect against computer crime by employees. Passwords, identification numbers and tighter control of employees and managers also help prevent Internet-related crime.

6.8 Privacy

Privacy is a big issue for many people. When information is computerized and can be processed and transferred easily, augmented and collated, summarized and reported, privacy concerns grow. The European Union has a data-protection directive that requires firms transporting data across national boundaries to have certain privacy procedures in place. This directive affects virtually any company doing business in Europe, and it is driving much of the attention being given to privacy in the US.

Privacy and the Government

Many people are suspicious of the government when it comes to information that is stored about them. In the UK, the government wanted an identity card scheme which, it is claimed, will help fight international terrorism and identify theft and other fraud. The card would be linked to a database, which would hold names, addresses and biometric information on all citizens. Expected to cost many billions of euros, some people have pledged never to carry them, claiming that the scheme would create a 'big brother' society. Many of these fears are unfounded, although the debate does highlight a lack of trust in the state and the scheme has not been implemented.

Many governments are in fact quite open about the information that they store. Numerous countries have implemented some sort of freedom of information legislation. In South Africa, it is the Promotion of Access to Information Act. In the UK it is the Freedom of Information Act. Similar laws have been passed throughout Europe.

Privacy at Work

The right to privacy at work is an important issue. Currently, the rights of workers who want their privacy and the interests of companies that demand to know more about their employees are in conflict. Recently, companies that have been monitoring their workers have raised concerns. For example, workers might find that they are being closely monitored via computer technology. These computer-monitoring systems tie directly into workstations; specialized computer programs can track every keystroke made by a user. This type of system can determine what workers are doing while at the keyboard. The system also knows when the worker is not using the keyboard or computer system. These systems can estimate what people are doing and how many breaks they are taking. Needless to say, many workers consider this close supervision very dehumanizing.

Email Privacy

Email also raises some interesting issues about work privacy. A company has the right to look at any data stored on its servers, which includes its email servers and therefore all messages sent by or to its employees. Many companies routinely store all emails sent or received for several years and many employees have lost their jobs for forwarding inappropriate messages. Others have sent embarassing messages that have been forwarded exponentially by recipients who pass the 'joke' on to their friends. A solicitor at a London firm, for example, sent one message to some friends about his girlfriend's sexual preferences and a week later the message had been distributed to over a million people, through many blue chip firms.

Privacy and the Internet

Some people assume that there is no privacy on the Internet and that you use it at your own risk. Others believe that companies with websites should have strict privacy procedures and be accountable for privacy invasion. Regardless of your view, the potential for privacy invasion on the Internet is huge. People wanting to invade your privacy could be anyone from criminal hackers to marketing companies to corporate bosses. Email is a prime target, as discussed previously. When you visit a website, information about you and your computer can be captured. When this information is combined with other information, companies can know what you read, what products you buy and what your interests are. According to an executive of an Internet software monitoring company, 'It's a marketing person's dream'.

These same questions can be asked of Internet chat rooms that require you to register before you can post messages. It is important for the forum moderators to know who is posting, but users should also have confidence that their information will not be misused.

Fairness in Information Use

Selling information to other companies can be so lucrative that many companies will continue to store and sell the data they collect on customers, employees and others. When is this information storage and use fair and reasonable to the people whose data is stored and sold? Do people have a right to know about data stored about them and to decide what data is stored and used? As shown in Table 13.3, these questions can be broken down into four issues that should be addressed: knowledge, control, notice and consent.

Right to Forget

In May 2014, an EU court ruling took a step towards giving people the 'right to be forgot- ten' by forcing Google and other search engines to remove certain links from search results. The content itself will still be available on the web, but it will just be more difficult to find. The implications of this have not yet sunk in, and Google's response has been to produce a form that people can use to request that search results be removed. Each request they receive will be assessed and a balance sought between the 'privacy rights of the individual and the pub- lic's right to know and distribute information'. It is thought that among those most likely to use the form will be people with spent convictions, victims of domestic violence and students wishing to tidy up their online image before submitting job applications.21

Individual Efforts to Protect Privacy

Many people are taking steps to increase their own privacy protection. Some of the steps that you can take to protect personal privacy include the following:

■ if you are concerned about what information a company is holding on you, use the Data Protection Act (or your country's equivalent) to find out what is stored about you in existing databases.

■ be careful when you share information about yourself. Don't share information unless it is absolutely necessary.

■ be vigilant in insisting that your doctor, bank or financial institution does not share information about you with others without your written consent.

6.9 The Work Environment

The use of computer-based information systems has changed the makeup of the workforce. Jobs that require IS literacy have increased, and many less-skilled positions have been eliminated. Corporate programs, such as reengineering and continuous improvement, bring with them the concern that as business processes are restructured and information systems are integrated within them, the people involved in these processes will be removed.

However, the growing field of computer technology and information systems has opened up numerous avenues to professionals and non-professionals of all backgrounds. Enhanced telecommunications has been the impetus for new types of business and has created global markets in industries once limited to domestic markets. Even the simplest tasks have been aided by computers, making cash registers faster, smoothing order processing and allowing people with disabilities to participate more actively in the workforce. As computers and other IS components drop in cost and become easier to use, more workers will benefit from the increased productivity and efficiency provided by computers. However, information systems can raise other concerns.

Health Concerns

Organizations can increase employee effectiveness by paying attention to the health concerns in today's work environment. For some people, working with computers can cause occupational stress. Anxieties about job insecurity, loss of control, incompetence and demotion

are just a few of the fears workers might experience. In some cases, the stress can become so severe that workers might sabotage computer systems and equipment. Monitoring employee stress can alert companies to potential problems. Training and counselling can often help the employee and deter problems.

Computer use can affect physical health as well. Strains, sprains, tendonitis, tennis elbow, the inability to hold objects and sharp pain in the fingers can result. Also common is repetitive strain injury (RSI), including carpal tunnel syndrome (CTS), which is the aggravation of the path- way for nerves that travel through the wrist (the carpal tunnel). CTS involves wrist pain, a feeling of tingling and numbness, and difficulty grasping and holding objects. It can be caused by many factors, such as stress, lack of exercise and the repetitive motion of typing on a computer keyboard. Decisions on workers' compensation related to RSI have been made both for and against employees.

Avoiding Health and Environmental Problems

Many computer-related health problems are caused by a poorly designed work environment. The computer screen can be hard to read, with glare and poor contrast. Desks and chairs can also be uncomfortable. Keyboards and computer screens might be fixed in place or difficult to move. The hazardous activities associated with these unfavourable conditions are collectively referred to as 'work stressors'. Although these problems might not be of major concern to casual users of computer systems, continued stressors such as repetitive motion, awkward posture and eyestrain can cause more serious and long-term injuries. If nothing else, these

Problems can severely limit productivity and performance. The science of designing machines, products and systems to maximize the

Safety, comfort and efficiency of the people who use them, called ergonomics, has suggested some approaches to reducing these health problems. The slope of the keyboard, the positioning and design of display screens, and the placement and design of computer tables and chairs have been care- fully studied. Flexibility is a major component of ergonomics and an important.

Chapter Summary/Review

- Designing new systems or modifying existing ones should always help an organization achieve its goals. The purpose of systems design is to pre- pare the detailed design needs for a new system or modifications to the existing system.
- The primary emphasis of systems implementation is to make sure that the right information is delivered to the right person in the right format at the right time.
- Maintenance and review add to the useful life of a system but can consume large amounts of resources. These activities can benefit from the same rigorous methods and project management techniques applied to systems development.
- Policies and procedures must be established to avoid computer waste and mistakes. Computer waste is the inappropriate use of computer technology and resources in both the public and private sectors.
- Computer crime is a serious and rapidly growing area of concern requiring management attention.
- Jobs, equipment and working conditions must be designed to avoid negative health effects.

Review Questions (Short)

1. Software can be purchased from external developers or developed in house. This decision is often called the _____ decision.
2. What type of documentation is used by computer operators to execute a program, and by analysts and programmers? a. unit documentation
b. integrated documentation
c. technical documentation
d. user documentation

3. Corporate mergers and acquisitions can be are reason for systems maintenance. True or false?
4. What are the advantages that cyber war has over a 'real' war?
5. What is identity theft?

Review Questions (Long)

1. Identify several potential sources of computer-related waste.
2. Who can prevent computer crime?
3. List several examples of computer-related mistakes.
4. What are some tools and techniques for software development?
5. What are the major steps of systems implementation?

Review Questions (MCQ)

1. What term is used to describe rules and procedures that prevent problems before they occur?

A. Testing procedure

B. deterrence controls

C. Acquiring Software D. Data Preparation

2. _____ is the process of anticipating and providing for disasters.

A. Disaster handling

B. Disaster anticipation

C. Disaster management

D. Disaster planning

3. Software can be purchased from external developers developed in house. This decision is often called the decision

A. Freezing design

B. Database

C. Interactive

D. Make-or-buy

4. Near the end of the design stage, an organisation prohibits further changes in the design of the system. This is called_____

A. User documentation

B. Interactive design

C. Network analyst

D. Freezing design specifications

5. The_____ often results I a formal bid that is used to determine who gets a contracts for designing new or modifying existing systems. It specifies in detail the required resources such as hardware software.

A. Interactive design

	B. Unit documentation C. Physical design D. Request for proposal(RFP)

Case Studies / Projects

Open Source Project Aims to Create Artificial Life

C.elegans is a tiny worm, about 1mm in length which lives in the soil in many parts of the world. It is a non-hazardous, non-infectious, non-pathogenic, non-parasitic organism and only has about 1000 cells and exactly 302 neurons. Despite its small size (or perhaps because of it), it is also one of the most studied creatures in nature. In fact, thousands of scientists are working full time to try to understand it. Between October 1994 and January 1995, 73scientific articles about C. elegans appeared in international science journals. Three different Nobel prizes have been awarded for work on the worm, and it was the first multicellular organism to have its whole genome sequenced and the wiring between its neurons (its 'connectome') completely mapped out.

Questions

1. What could a virtual worm be used for?

2. What other software could an open science team use to co-ordinate their work?

3 How could visuals inspire people to get involved in OpenWorm?

4. Why would a neuroscientist get involved in an open source software project?

Read

Principles Of Business Information Systems 3rd Edition, Ralph Stair,George Reynolds and Thomas Chesney Chapter 12 Page Number 440

Case Studies

Open Access Pirates

The world of research publishing is a strange place. Scholars are often employed by universities to create (research) and share (teach) knowledge. Often they are paid at least in part by the tax payer. The knowledge that they create is published in a number of places including academic journals. Scholars write the papers which are then reviewed and edited by other scholars. None of this is paid for by the journal's publisher. The publisher then publishes the journal and sells it back to university libraries who often subscribe to many hundreds such journals. Many see the fees that they charge as being so high they are obscene. Tax payers, most of whom do not have access to university libraries and who paid for the research in the first place, have to purchase access to individual papers for over €30 if they want to read them.

Questions

1. In what ways might Sci-Hub disrupt traditional journal publishing?
2. How can international website be policed?
3. Why are researches at well-resourced universities using Sci-Hub?
4. What lessons can all publishers learn from Sci-Hub?

Read

Principles Of Business Information Systems 3rd Edition, Ralph Stair,George Reynolds and Thomas Chesney Chapter 13 Page Number 475