should produce an invoice document which contains an invoice number, date, customer details, and details of items purchased (item description, quantity sold and value (quantity x price)). Pete will also keep a record of every product that he stocks (item description, quantity in stock, price). To assist you in getting started, the optimal solution will consist of 4 tables as labelled below. Complete the exercise by entering all the required fields in the tables and drawing lines to indicate the links between the tables. You can indicate primary keys by putting a "P" at one end of the line linking the appropriate fields in the tables.

Customer Table

Stock Table

Invoice Table

Invoice Details Table

CASE STUDY: GREENFINGERS GARDEN SERVICES

Refer back to the Greenfingers Garden Services case study that was introduced at the end of Chapter 3.

(a) Identify the business entities (people, objects or events) about which you would want to store data. List some of the data fields that would be appropriate for each of these entities, and their data type (eg text, number, graphic, etc).

(b) It is preferable to capture data as early in an automated business process as possible, since paper-based recording and later data capture can introduce human error. With this in mind, who are the people who would be responsible for data capture in a new computerised information system, and where and when should this data be captured. (Hint: consider the point at which data is currently first recorded on paper.)

(c) Apart from a standard PC with keyboard and mouse for office use, when would other devices such as PDAs or cellphones be appropriate, and what sort of interface would they use?

(d) The classification of applications by function distinguishes general-purpose applications, business applications, scientific applications and miscellaneous applications. Give examples of how each of these application types could be used within Greenfingers Garden Services to support business activities and planning.

(e) Communication of information between work teams, branches, consultants, clients and central administration is a major problem in the existing manual system. Use a diagram to show how a combination of data communication methods could support the exchange of information between them.

(f) Suggest a suitable email address for the business, and list the ways in which email could be used to enhance business communications.

(g) How would the implementation of a DBMS make Alice Cooper's business administration easier?

Section III: IS Applications

Although computer-based information systems are a relatively recent phenomenon, having been around less than half a century, we can already distinguish a number of stages through which they have progressed.

- During the nineteen fifties and sixties, the main focus of the systems was the automation of operational data flows: the era of *electronic data processing. (EDP)* These systems assisted operational (white collar) staff with their information work.

- In the seventies and early eighties, the extraction of the data for managerial decision making became much more pronounced and this introduced the need for *management information systems* and *decision support systems.* This was made easier by the maturing of the technology, in particular the existence of more powerful mainframe computers with plenty of disk storage that could support a database approach to applications. Information systems started to assist and improve the quality of managerial decision making.

- The late eighties and nineties saw the rise of *end user computing* which necessitated *distributed access* to data. This is also the period where the limitations of functionally oriented applications were being felt due to the increasing competitiveness in the markets, and to the associated rapid increase in required response time. Major redesigns resulted in the advent of more integrated, process-oriented enterprise systems. During this period, more and more organisations used the capabilities of systems based on innovative technologies to develop new products or services, or dramatically alter the way in which these were being delivered to the customer. This is the birth of strategic information systems: systems that are deployed to gain a competitive edge in the market.

- Increasing globalisation, coupled with the sustained increase in the capabilities of the computer and communications technologies, has led to more pronounced emphasis on the *integration* of information systems within (*intra*-) and between (*inter*-) organisations. There is much greater *convergence* between communications, computer and media technologies whereby a number of information processing technologies are linked internally and externally. The continued miniaturisation and networking is likely to make information systems much more mobile, embedded and *pervasive* in the work and home environment. The use of international standards and maturing of underlying technologies will shift the emphasis even further from the technology (the *how*) towards the management, human and deployment issues (the *what* and *where*).

With the growth of the internet, *electronic commerce* is playing an increasingly important role in linking organisations with their customers and their business partners, and is becoming an essential component of the IT strategy of modern businesses. E-commerce enables market expansion with minimal capital outlay, improves procurement and marketing and increases consumer choice; but there is still a need for universally accepted standards for information quality and security, and the provision of sufficient telecommunications bandwidth.

This section of the textbook will examine different types of IS applications in more detail, focusing on how they are used within and beyond organisational boundaries, as well as the

growing business importance of electronic commerce. Since these applications are used by human beings, and so are vulnerable to deliberate abuse or accidental misuse, we will also address a number of *security* related issues.

8. Business Support Systems

As discussed in Chapter 1, different types of information systems are used by the various management levels of an organisation. They support the objectives of the business by increasing the efficiency of business processes, cutting supply costs, improving levels of customer service and improving managerial decision-making.

- Transaction Processing Systems record routine transactions within the different departments of an organisation;
- Management Information Systems draw from the TPS to monitor and control business performance;
- Decision Support Systems and Executive Information Systems assist managers with complex decision-making tasks;
- Strategic Information Systems make use of information technology to gain competitive advantage;
- an increasing number of Intelligent Systems are being incorporated within business processes to extend IS capabilities;
- Data Mining and On-Line Analytical Processing can be used to search through organisational data to uncover previously unknown patterns and trends.

8.1 The Decision-Making Process

Across all levels of the organisation, information is used as the basis for decision-making by operational and management staff. Figure 8-1 illustrates the various steps of the typical decision making process.

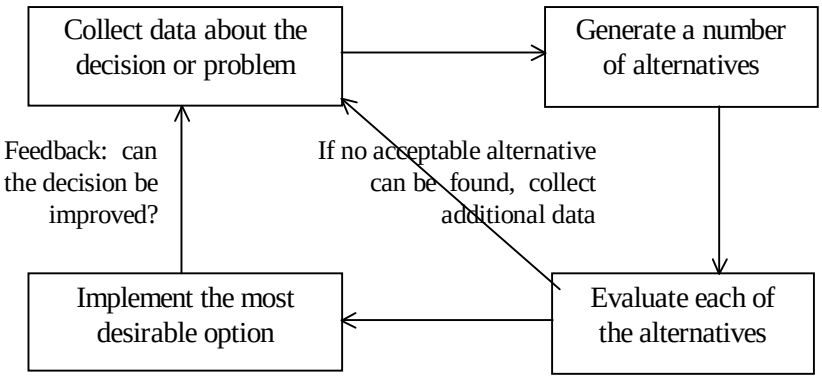

Figure 8-1: Steps in the decision-making process

The type of decision to be made generally depends on the level within the organisation. Clerks typically make routine decisions based on clear guidelines. Top-level managers are faced with more uncertainty and the decision process is correspondingly much more unstructured.

This *dichotomy of information work* is reflected in Figure 8-2, which contrasts the two extreme types of decision, sometimes referred to as Type I and Type II decisions. In practice, most decisions fall somewhere between these two extremes and share some characteristics of

both Types I and II, although decisions made by clerical staff are likely to be closer to Type I, and decisions made by senior management will incorporate more Type II characteristics. Because of this, the information systems used at higher levels of the organisation tend to be more complex: it is far simpler to automate the decision as to when paper for the photocopier should be re-ordered, than to decide whether to introduce a completely new product.

Although the different types of information systems may be described under separate headings, integration between them is vital if the information flows within the organisation are going to successfully meet the needs of a wide range of users, who may be making decisions affecting more than one functional area of the business, based on data from a variety of different sources.

Type I	Type II
Many transactions/decisions	Relatively few transactions/decisions
Low value or cost per transaction	High value or cost per transaction
Well-structured and detailed procedures and guidelines	Ill-structured and vague procedures and guidelines
Output, objectives and evaluation measures well defined or specified	Output, objectives and evaluation measures less defined
Process-oriented	Problem or goal oriented
Emphasis on efficiency: "*do the thing right*"	Emphasis on effectiveness: "*do the right thing"*
Processing of mainly structured data	Handling of concepts, information
Predominantly clerical workers	Managers and professionals
Examples: processing of orders, payments, first-line customer queries	Examples: planning, crisis management, design

Figure 8-2: The dichotomy of information work: two decision extremes

8.2 Batch vs Online Processing

In early commercial systems, data was usually entered into an organisational information system in **batch mode,** mainly because computer technology had not yet been developed to support more advanced systems. Here the practice was to manually record each business transaction, and then later enter the corresponding data into the computer. At regular intervals (e.g. at the end of each day) the master files would be updated to show the new balances, and related customer documents such as invoices would be generated. Management requests for information about the state of the business would be based on the most recently updated files. This approach gave rise to a number of problems: poor authorisation checks; incorrect data

recorded on the original invoice would only be picked up much later; new errors could be introduced at the data capture stage; documents could go missing before they were captured; and management information was usually out-of-date.

On-line entry systems overcame some of these problems. By capturing data electronically at the time that a transaction occurs, authorisation and data correctness can be automatically verified, and the opportunity for human errors to be introduced at a later stage is removed. However, updating of master files still takes place at predetermined intervals, and not at the time of each transaction, so management reporting remains unreliable. Nevertheless, this type of system remains popular for applications such as payroll, where information only needs to be produced periodically.

With decreasing computing costs and the need to remain competitive, **on-line update** (or **realtime**) systems have now become the norm. Each transaction is recorded directly on to the computer (often by means of a bar code scanner); the data is immediately validated and the relevant master files are updated. To achieve this, each point-of-sale (POS) terminal must be connected via a network to the central database containing customer records, stock records, and other sales-related data. As soon as the transaction has been completed, invoices and other documentation are produced. Opportunities for fraud are limited, since data is validated at the time of entry and source documents cannot disappear before their details are captured. Although some reports such as customer statements may only be needed periodically, the data in the database is always up to date and is available to managers at any time.

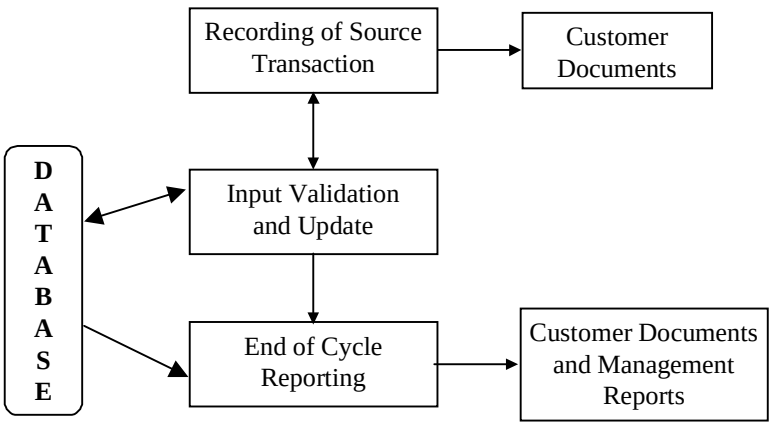

Figure 8-3: On-line transaction flow

In recent years, online transaction processing has broadened to include transactions entered via the Internet.

8.3 Applications at Different Management Levels

8.3.1 Transaction Processing Systems

Transaction Processing Systems support simple processing of large amounts of structured data. This data is mainly of internal origin, resulting from numerous routine transactions that occur in many different business areas. Common modules of a TPS include:

- Order processing: orders for goods or services can enter the system from customers, salespeople, or other internal departments.

- General ledger: details of all transactions affecting the accounts of the company are recorded to simplify bookkeeping and reporting.
- Accounts payable and receivable: data generated from sales journals or purchase orders can be used to improve debt collection and cash flow.
- Inventory management: along with updating of stock levels, IS is commonly used for tracking of materials and for linking the organisation to suppliers and purchasers.
- Payroll: employee details, earnings, deductions, leave accrual etc.

8.3.2 Management Information Systems

Management Information Systems (MIS) are systems that use the data generated by the TPS to help lower and middle management in their decision making. MIS use a variety of techniques to process, summarise and present the information in the form of useful reports: tables, statistics, graphics, etc. Many MIS can easily be customised and new reports are readily created on demand. Because many businesses are still organised on a functional basis, many MIS tend to focus on specific functional areas e.g. a marketing MIS, a human resources MIS etc. The decisions taken by middle management are more complex than pure operational decisions. They involve a longer, medium-term time span (typically looking several months ahead), influence a large number of individual operational decisions (e.g. price setting, carrying or dropping new stock items, changing procedures etc.) and are less structured than operational decisions, though they do tend to follow certain patterns and be of a recurrent nature. These decisions are called *tactical management decisions.* They typically affect the whole or a major part of a functional department (e.g. the entire marketing department) and involve more significant resources than operational decisions.

A particularly useful feature of MIS are the so-called *"exception reports"* which list only unusual or abnormal transactions, namely those that fall outside the normal pattern; instead of many, many pages of detailed data, the manager sees only those items which may require special attention or corrective action. An exception report for a bank manager might list all transactions exceeding one million rand; or those bank departments who have exceeded their budget by more than 10%.

Organisational support provided to business managers by the MIS commonly includes financial planning and budgeting, investment management, financial controls, marketing management and the provision of customer service.

8.3.3 Decision Support Systems

Decision Support Systems (DSS) are systems that assist managers with very specific types of decision-making situations. Though they are often used by the same managers who also rely on MIS, a distinguishing feature is their modelling capability. DSS use various mathematical and statistical models to help the manager generate alternative decision options and evaluate their outcomes. Another difference between DSS and MIS is their time perspective: an MIS typically produces reports based on *historical* information where a DSS allows the manager to see the *future* impact of his decision. Table 8-4 lists some more differences between MIS and DSS.

	MIS	DSS
Problem type	Mainly for more structured problems or *programmed decision-making*.	Good at handling unstructured problems.
Support	Provides only the information necessary to make a decision.	Supports all stages in the decision making process, including the modelling and evaluation of various decision alternatives.
Approach	Typically based on regular, structured reports.	Excels at interactive and ad-hoc queries.
System	Often based on printed reports, via batch mode, delivered to managers on a regular basis.	On-line and real-time interaction, mainly screen oriented.
Speed	Requires a greater turn-around time and is less flexible in terms of report format changes.	Quick
Development	By IS staff.	Often by end users.

Table 8-4: Some differences between MIS and DSS

When information is required to support management decision making, the user of the DSS is able to interact directly with the computer via a graphical user interface or control language to request the relevant data, select and operate the appropriate decision model and generate the output report in the format required. The following diagram of a DSS shows the three main components; the database, model base and user interface.

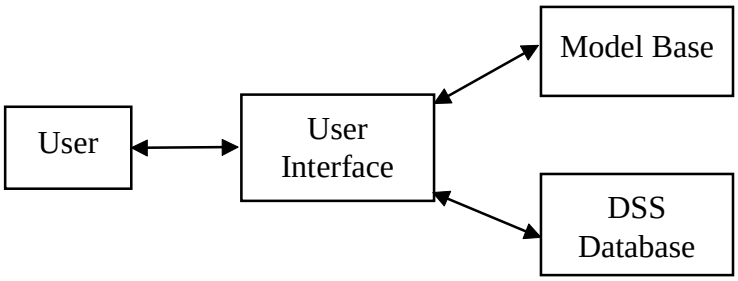

Figure 8-5: Components of a Decision Support System

DSS Database. This database contains current and historical data from all the relevant business applications. However there are a number of good reasons why organisations do not allow the DSS to access the operational database used by the transaction processing systems, but rather construct another database for this purpose. One key reason for limiting access to the operational database is that DSS requests often require many passes of the database to select the required data. This activity will impact on the service the DBMS can provide to on-line applications in areas where response times are critical. In addition, while DSS systems normally download a copy of data for analysis and seldom update the database, management is always concerned about the security and integrity of the operational database and prefers to limit access to a minimum. Finally it makes good sense to maintain a database specifically for DSS queries. In the DSS database, some data need be held only in summary form while certain historical records must be retained for a five year period to allow for trend analysis. In some cases the data may come from different databases, sometimes held on different

hardware and software platforms, and the transfer (and potential reformatting) of data to a common DSS database enables queries to be generated combining data from these varied sources. With the demand for end-user access to current and historical information, many organisations are building *data warehouses*, which store large quantities of data obtained from different functional areas of the organisation.

Model base. This is a library of analytical tools that can be used to evaluate and represent data. Typical examples are the standard business functions (for example to calculate discounted cash flows and depreciation), statistical functions (means, standard deviation and variance), data retrieval tools to select, sort and summarise, and the ability to test possible scenarios through sensitivity analysis and goal seeking.

User Interface. In the past managers communicated their report requirements to programmers who coded the request and delivered the required output. The nature of management decision making is such that response time is often critical. In addition the solution to problems of this nature is iterative, as one report may trigger the need for alternate investigations into other areas of the business. Often senior managers use a 'chauffeur', an analyst or skilled end user to assist them in developing the required DSS output. Obviously the most suitable DSS environment is to have the decision maker interface directly with the DSS. Graphic user interfaces and the increased level of computer literacy within the management hierarchy, have made this possible.

When a user requires a report or enquiry to be performed by the DSS, he or she will enter the request in a high level, user friendly business language. For example, by clicking the mouse on options and items in list boxes, the user can pick fields, choose selection criteria, detail sequence and request the level of detail for a particular report. The user interface software will then translate this request into the code required to perform the process using the required data and business rules. These user interfaces also offer sophisticated output formatting with, for example, the results being presented in text format or as business charts.

8.3.4 Executive Information Systems

Decisions made by top-level executives are often too unstructured to be adequately supported by a DSS. For this reason, Executive Information Systems (EIS) have been developed, which provide rapid access to both internal and external information, often presented in graphical format, but with the ability to present more detailed underlying data if it is required.

An EIS will continuously monitor selected key performance indicators that have been identified as critical to the success of the organisation. The user will be alerted to any significant changes that occur, and "drill-down" capabilities will then provide further levels of detail underlying this information. Trend analysis can be done using forecasting models, usually through the integration of the EIS with a DSS system.

8.4 Strategic Systems

An important special type of organisational information system is used to secure or sustain competitive advantage in the market place: strategic information systems. Although these systems generally form part of a more generic business marketing strategy, the information

technology is actually a critical enabler or support element to achieving success in the market. The following three possible strategies are typically distinguished.

- **Low-cost strategy**: use of the information systems to produce significant cost-savings and thus offer services/products at a lower price than competitors (or increase profit margins). One typical example is the use of alternative marketing or distribution channels such as using the *Internet* for receiving orders and eliminating middlemen such as wholesalers and retailers. Another example is having more integrated or even completely redesigned logistics processes such as having a fully automated on-demand production line where parts and components are supplied on a *just-in-time (**JIT**)* basis by the suppliers, often using an *Electronic Data Interchange (**EDI**)* system.

- **A differentiation strategy**: use of information systems to provide a distinctive quality or otherwise add value to your products or services. Technology can enhance quality through better manufacturing processes (e.g. a quality control system or automated manufacturing) or add value by increasing the information content or *information intensity* of the service/product. Other possibilities are the use of computer and communication technologies to enhance after-sales support e.g. automated (self-)diagnostics, remote diagnostics, direct internet support and help-line.

- **A niche marketing strategy**: using information systems technology to service very small, isolated or exclusive markets that have specific demands. A good example is the publishing industry: the ability of the internet to reach individuals with extremely specific interests for whom there would otherwise be no cost-effective marketing or distribution channel allows the marketing of extremely specialised books. Another example in the publishing technology is the production of small print runs of "customised textbooks on demand" whereby course lecturers can compile individually customised textbooks made up of different modules tailored to their specific curriculum requirements.

8.5 Intelligent Systems

The traditional approach to solving problems using a computer is to provide instructions to the machine (in the form of a program) detailing exactly how the task is to be performed. However, some tasks are seen as too unstructured (ill-defined) to be programmable. For example imagine writing a program to control a robot housekeeper. The number of possible situations the robot needs to identify and respond to are so great that conventional programming techniques are totally inadequate. Add to these problems the concept of approximate or fuzzy logic. Pure propositional logic (things are either true or false) is too exact for real world problems where humans are required to make guesstimates based on probabilities.

The ability of computers to work intelligently (and not just follow a set of standard instructions) has fascinated scientists, researchers and sci-fi writers since the early 1950s, and *artificial intelligence* (AI) is the branch of computer science concerned with understanding the nature of human intelligence with the goal of simulating aspects of it with a computer.

While we still know very little about how the brain functions, there are four areas of AI research that have made some progress towards the goal of an intelligent machine:

- **Natural languages:** the ability for computers to understand the spoken word
- **Robotics:** where machines perform co-ordinated physical tasks
- **Visual perception:** the ability of machines to recognise visually shapes and objects
- **Expert Systems:** systems developed to simulate the decision-making behaviour of humans in a narrow area of expertise.

8.5.1 Expert Systems

Expert systems (often termed knowledge-based systems) are the category of AI which has been used most successfully in building commercial applications. As discussed earlier, attempting to provide computers with the intelligence to handle complex real world environments is beyond our current capabilities. However expert systems are knowledge intensive programs that capture the expertise of a human within a narrow problem domain.

In order to address a particular problem area (for example to diagnose a disease in a sick patient) the expert system must have a knowledge base (a database of facts, intuition and rules about the knowledge domain) and an inference engine (software capable of manipulating knowledge contained in the knowledge base). Since knowledge takes many forms and shapes (facts, rules, relationships between facts and rules, probabilities, defaults and exceptions, models, contradictory statements and many other non-structured items), standard database models such as the relational model are not always suitable. Several different *knowledge-based databases* have been developed for use in expert systems, although despite attempts at standardisation, most of them use their own proprietary ways of representing and dealing with the data.

There are already many commercial examples of expert systems being used across a range of applications such as the diagnosis and treatment of medical conditions, the evaluation of loan applications, and the identification of mineral deposits.

8.6 Data Mining and OLAP

8.6.1 Data warehouses

Business managers have only recently started to realise how much valuable information is hidden inside the many different databases underlying their information systems. Data warehouses can be used to correlate and analyse the information contained in different databases within the same organisation. Usually, a copy of the continuously changing transaction data within the various operational databases is made periodically into one single, huge database: the data warehouse. This data warehouse then contains detailed historical data for all or most of the organisation's operations. Powerful statistical and charting tools assist managers in comparing and analysing the data.

Effective construction of a data warehouse must provide facilities to integrate data from different functional areas of the business, which may be represented using different formats. Software programs will extract data from its original source, convert it into a uniform format and then store it in the warehouse.

Sometimes it is technically not feasible or it is too expensive to merge the data from many databases. In those cases, some benefit can already be had from focussing on the organisation's most important databases, usually the ones relating to customers and sales. Such a mini data warehouse focussed on one particular functional area is called a ***data mart***.

8.6.2 On-line analytical processing

Imagine a marketing manager trying to analyse this quarter's sales to discern trends and pinpoint problem areas. How can the data be analysed? There are many possible views.

- According to different product groups.
- Using the time dimension, comparing the different months.
- Looking at the cost components and contribution to income.
- Comparing sales budgets, projections, actual sales and variances.
- Analysing sales according to geographic region.
- Evaluating the various marketing channels: wholesales, sales force, brokers and the corporate market.

On-line analytical processing (OLAP) is concerned with the real-time analysis of large corporate databases to find trends and inter-relationship by managers and decision-makers. The user formulates complex queries and searches by means of sophisticated, interactive front-end applications such as statistical packages, spreadsheets or decision support systems.

Because traditional database models are not very good at handling and displaying many different dimensions of business data for simultaneous analysis, **multidimensional** analysis technologies are used to filter and aggregate subsets of the data. Advanced statistical analysis tools and graphical interfaces are incorporated to facilitate data visualisation, often using *hypercubes* to display multidimensional information.

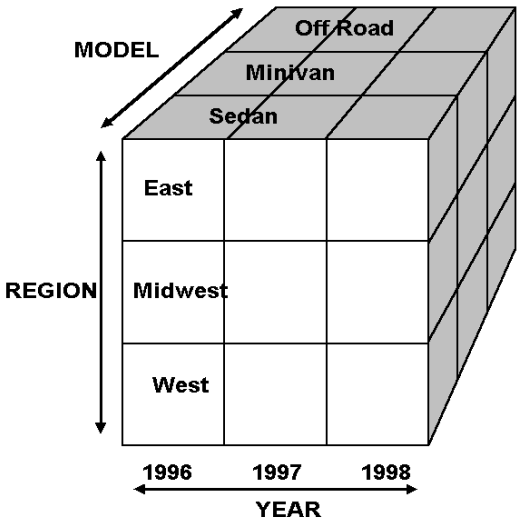

Figure 8-6. Example of a hypercube (www.ssa-lawtech.com/ wp/wp2-3.htm)

The raw data is often derived from traditional application databases, but because of the huge amounts of data processing involved, a separate server may be used to store and process the data subsets being used for analysis. This approach gives rise to a *three-tier* model, which includes the server or mainframe which hosts the organisational database, the workstation on the manager's desk through which queries are submitted, plus a dedicated OLAP server holding relevant subsets of data in multidimensional databases. Unlike an executive information system, this does not usually provide the ability to "drill down" to the level of the original transactions underlying a query result.

8.6.3 Data mining

The huge amount of information and the many possible different perspectives often make it very difficult for humans to discern meaningful trends within the masses of data in the data warehouse. Statisticians have developed a number of methods that automate the discovery of non-random trends and significant inter-relations. *Data mining* is the use of these statistical methods, packaged in a single computer package and let loose on their own, without human intervention, to discover deep or hidden data interrelationships.

8.7 South African Perspective

An example of a locally developed system that supports business transactions, management control and decision-making is Digitot, a computerised beverage-dispensing system. Traditionally, the hospitality industry loses between 10% and 25% of revenue on alcoholic drinks, due to spillage, pilferage and "freebies", and frequent manual stocktakes are necessary. The Digitot system, which is integrated with a point-of-sale system, uses electronic tot measures to digitally dispense and count each tot and automatically update stock levels. Flexible reporting over selected periods can analyse this data to determine when stock has gone missing and who was responsible for the loss. Data analysis can also reveal patterns in customer preferences and identify products that offer value for money, which can be used as the basis for promotional marketing.

8.8 Beyond the Basics

Neural networks are proving increasingly valuable in complex decision-making, where a large number of factors must be simultaneously considered and human inconsistency or prejudice could affect the decision outcome. Furthermore, they are able to adapt to changes in the business environment over time. The neural network consists of many cooperative processing elements, that are "trained" using a large number of historical transactions (the data that was evaluated and the outcome that was reached) in order to establish criteria that can be applied to future decisions. The weighting of these criteria will subsequently change over time, since each new application of the neural network may affect the previous relationship between elements.

Neural networks are particularly useful when processing complex data for which no established decision rule is known, or when there are too many variables to consider. In this case, it is easier to let the network learn from examples.

Neural networks are being used:

- in investment analysis: to attempt to predict the movement of stocks currencies etc., from previous data. There, they are replacing earlier simpler linear models.
- in monitoring: neural networks have been used to monitor the state of aircraft engines. By monitoring vibration levels and sound, early warning of engine problems can be given.
- in marketing: neural networks have been used to improve marketing mailshots. One technique is to run a test mailshot, and look at the pattern of returns from this. The idea is to find a predictive mapping from the data known about the clients to how they have responded. This mapping is then used to direct further mailshots.

8.9 Exercises

8.9.1 Processing methods

Compare a batch processing system (such as might be found in a hardware store) with a realtime processing system (e.g. in a bank), in terms of the authorisation methods used to check the identity of the customer, how the initial transaction details are captured, the completeness of transaction data, opportunities for human error to enter the process, availability of data for managerial decision-making.

8.9.2 Organisational information flows

Construct a diagram to show how data and information flow between the different types of organisational information systems (TPS, MIS, DSS, EIS), and their users, data stores and environment.

8.9.3 Fuzzy logic

Fuzzy logic refers to a type of expert system which caters for non-binary decision-making (i.e. not simply a yes/no answer). For example, when you buy a car, you might be satisfied (in varying degrees) with petrol consumption falling within a *range*, rather than arbitrarily selecting a cutoff point below which it is okay and above which it is unacceptable. Search on the Internet or in an IS textbook to find a simple explanation of the concept of fuzzy logic, and an example of how it has been implemented in commercial devices.

9. E-Commerce

Business was quick to grasp the marketing and business potential offered by the Internet. Initially, businesses used the Internet to facilitate communication by means of e-mail. This was quickly followed by tapping the web's potential for the dissemination of product and other marketing information. The provision of advertising space (*banners*) on frequently visited *web sites* is the main source of income for *search engines* (sites allowing you to search the Internet for information) and *web portals* (web sites that provide additional value-added personal services such as news, financial information, weather forecasts, items of interest etc.)

A number of specialised companies have realised that the Internet can be a direct and extremely cost-effective channel of distribution. Some companies already have a physical infrastructure and use the web to enhance their distribution channel e.g. you can now order your pizza, bank statements or movie tickets via the web. Other, *virtual* companies have almost no physical infrastructure and are mere "conductors" for the flow of products of services.

Important categories of e-commerce include:

- Business-to-consumer (B2C) in which organisations provide information online to customers, who can in turn place orders and make payments via the internet
- Business-to-business (B2B) in which business partners collaborate electronically
- Consumer-to-consumer (C2C) in which individuals sell products or services directly to other individuals.

The technologies that are needed to support electronic commerce include the network infrastructure (Internet, intranets, extranets), software tools for web site development and maintenance, secure ordering and payment methods, and resources for information sharing, communication and collaboration. When e-commerce is done in a wireless environment, such as through the use of cellphones, this is referred to as **mobile commerce** (m-commerce).

9.1 B2C e-Commerce

Electronic retailing is similar in principle to home shopping from catalogues, but offers a wider variety of products and services, often at lower prices. Search engines make it easy to locate and compare competitor's products from one convenient location and without being restricted to usual shopping hours. Electronic malls provide access to a number of individual shops from one website. On-line auctions have also proved a popular way of disposing of items that need a quick sale.

Business-to-consumer commerce allows customers to make enquiries about products, place orders, pay accounts, and obtain service support via the Internet. Since customers can enter transactions at any time of the day or night, and from any geographical location, this can be a powerful tool for expanding the customer base of a business. However, the existence of a website does not guarantee that customers will use it, or that they will return to it after a first visit. Firms investing in electronic commerce need to consider a number of factors in developing and maintaining their e-commerce sites.

A successful web site should be attractive to look at and easy to use. In addition, it should offer its customers good performance, efficient service, personalisation, incentives to purchase and security. Inadequate server power and communications capacity may cause customers to become frustrated when browsing or selecting products.

Many sites record details of their customers' interests, so that they can be guided to the appropriate parts of the site. Customer loyalty can also be developed by offering discussion forums and links to related sites, and by providing incentives such as discounts and special offers for regular customers. And if you expect customers to purchase goods, and not just browse, then it is vital that customers should have complete confidence in the security of their personal information, and in the ability of the web store to deliver the goods as requested.

Much of the business value of the Internet lies in the ability to provide increased value to customers, with the focus on quality of service rather than simply price. By opening additional channels of communication between the business and its customers, businesses can find out the preferences of their customers, and tailor products to their needs. Customers can use the Internet to ask questions, air complaints, or request product support, which increase customer involvement in business functions such as product development and service.

However, although businesses may increase their markets while gaining from reduced advertising and administration costs, problems that have emerged include alienation of regular distributors, difficulty in shipping small orders over large distances, fierce competition and inadequate profit margins. Because of the delivery problem for physical products, many successful e-commerce firms have focused on the delivery of services, such as banking, securities trading, employment agencies and travel bureaus. Of course, every problem can be regarded as an opportunity – a local software developer has created and marketed a route scheduling application which provides optimised route sheets, with maps for individual routes and step-by-step driving instructions for effective and timeous order management, based on powerful geographical information systems to provide a user-friendly interface.

B2C e-commerce has also made it easier for firms to conduct market research, not only by collecting shopping statistics, but also by using questionnaires to find out what specific groups of customers want. This in turn has enabled the personalisation of products to meet customer preferences.

9.2 B2B e-Commerce

Business-to-business e-commerce comprises the majority of electronic transactions, involving the supply chain between organisations and their distributors, resellers, suppliers and other partners. Efficient management of the supply chain can cut costs, increase profits, improve relationships with customers and suppliers, and gain competitive advantage. To achieve this, firms need to

- Get the right product to the right place at the least cost;
- Keep inventory as low as possible while meeting customer requirements;
- Reduce cycle times by speeding up the acquisition and processing of raw materials.

Information technologies used to support business-to-business e-commerce include email, EDI and EFT, product catalogues, and order processing systems. These functions may be linked to traditional accounting and business information systems, to ensure that inventory and other databases are automatically updated via web transactions. **Intranets** provide a facility for members of an organisation to chat, hold meetings and exchange information, while at the same time sensitive information is protected from unauthorised access by means of a firewall. An **extranet** provides a means of access to the intranet for authorised users such as business consultants.

Electronic data interchange (EDI) involves the electronic exchange of business transaction documents over computer networks, between organisations and their customers or suppliers. Value-added networks provided by third parties are frequently used for this purpose. Documents such as purchase orders, invoices and requests for quotations are electronically interchanged using standard message formats, which are specified by international protocols. EDI eliminates printing, postage and manual handling of documents, reducing time delays and errors, and thus increasing productivity. It also provides support for implementing a Just-in-Time approach, which reduces lead time, lowers inventory levels, and frees capital for the business.

Marketing to other businesses is done by means of electronic catalogues and auction sites, which can increase sales while reducing advertising and administrative costs. From the buyer's perspective, reverse auctions can be used to advertise *requests for quotation* in a bidding marketplace in order to attract potential suppliers. Third party vendors can make use of *group purchasing* to aggregate a number of separate small orders in order to increase negotiating power.

Collaborative commerce involves long-term relationships between organisations in areas such as demand forecasting, inventory management, and product design and manufacture. However, this presents a number of business challenges such as software integration, compatibility of technologies, and building of trust between firms.

9.3 C2C e-Commerce

Auctions are the most popular method of conducting business between individuals over the Internet. (Unfortunately, auction fraud was also the most common type of crime reported to the Internet Fraud Complaint Centre in 2002.) Other C2C activities include classified advertising, selling of personal services such as astrology and medical advice, and the exchange of files especially music and computer games.

9.4 Electronic funds transfer

Electronic payment systems can be used to transfer funds between the bank accounts of a business and its suppliers, or from a customer to the business. In retail stores, wide area networks may connect POS terminals in retail stores to bank EFT systems. In most cases, an intermediary organisation acts as an automated clearinghouse, which debits and credits the relevant accounts.

The most popular payment method used by individual consumers is the credit card, which

requires the merchant to pay a commission to the bank on each transaction. For transactions involving small amounts that do not justify the payment of commission, merchants may accept electronic money in the form of digital cash. In this case, the customer "buys" money from the bank in the form of a unique cash number, which is transmitted to the merchant at the time of purchase and "deposited" in an account at a participating bank. In South Africa several banks have developed their own forms of digital cash, such as e-bucks from First National Bank.

Figure 9-1. Stages in an e-commerce transaction (www.artboomer.com/images/commerce.asp)

An important issue in electronic commerce is the security of Internet transactions. Data is commonly encrypted to reduce the vulnerability of credit card transactions. Secure Sockets Layer (SSL) and Secure Electronics Transaction (SET) are two of the standards used to secure electronic payments on the Internet. Secure sites usually have URLs that begin with *https* instead of the usual *http*.

9.5 Current issues in e-commerce

For e-commerce to succeed, companies need to make large investments in hardware and telecommunications infrastructures that will be up and running 100% of the time, and software that is easy to use and reliable. A number of early participants in the e-commerce market suffered financial losses because their technology was not able to handle the huge numbers of transactions to be processed. Internet customers are often impatient, and will move to a competing site if the response is too slow.

Gaining the trust of customers can be difficult - the seller is often reluctant to despatch goods before payment, and the buyer may be reluctant to pay before receiving the goods. In South Africa, the speed of electronic ordering is often negated by delays in physical delivery.

Societal problems have also emerged, with children, gamblers and shopping addicts enjoying unrestricted access to electronic commerce sites. A German cannibal posted a web advertisement seeking a victim who was willing to be killed, sliced and eaten – and apparently found one! (reported in www.iol.co.za, 18 December 2002). The laws governing electronic commerce are still in their infancy, and international standards need to be

developed in areas such as information privacy and taxation.

Since e-commerce supports global business transactions, it presents the challenge of customising web sites to appeal to people of different nationalities and cultures (and even different languages). South Africa's leading role in e-commerce in Africa can probably be attributed to the fact that it has a relatively advanced telecommunication infrastructure and a large number of English-speaking users.

9.6 South African Perspective

Because a website can easily be developed as a front for a fraudulent company, businesses need a way to guarantee their authenticity to potential customers. Thawte Consulting, the company established by Mark Shuttleworth after graduating from UCT and later sold to market leader Verisign, provided (among other products) *digital certificates* which serve two purposes: to ensure that no sensitive information can be viewed by unauthorised users, and to provide users with assurance regarding the ownership of the site. By providing certificates at a lower cost than its competitors, but with similar technological and security standards, Thawte rapidly established itself as the second largest provider of digital certificates.

These non-forgeable Secure Sockets Layer (SSL) certificates are issued and digitally signed by a company such as Thawte, which has verified that the website really is owned by the organisation requesting the certificate. Once the digital certificate has been installed on the site, the SSL uses complex encryption techniques to scramble confidential information.

9.7 Beyond the Basics

Encryption is the process of converting readable data into unreadable characters to prevent unauthorised access. Encrypted data can be safely transmitted or stored, but must be decrypted before it can be read, by using an *encryption key*, which is sometimes the same formula that was used to scramble it in the first place. Simple encryption methods include:

- Transposition: in which the order of characters is switched, for example each pair of adjacent characters is swapped.
- Substitution: in which each character is replaced by some other predetermined character.
- Expansion: additional letters are inserted after each of the characters in the original text.
- Compaction: characters are removed from specific positions and then stored or transmitted separately.

Most encryption programs use a combination of all four methods.

Private key encryption relies on both sender and recipient having access to the same encryption key. *Public key encryption* makes use of two keys: a message encrypted with your public key can only be decrypted using your private key. This means that you can safely communicate your public key to business contacts, who are then able to send you confidential data that can only be read using your private key. Security agencies in the United States have