INFORMATION SYSTEMS DEVELOPMENT

Paul Beynon-Davies

THIRD EDITION

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Information Systems Development

An Introduction to Information Systems Engineering

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For my Wife Gillian and my Children:
Rhydian, Ceri and Rhiannon

The idea is like grass.
It craves light,
likes crowds,
thrives on crossbreeding,
grows better for being stepped on.

Ursula Le Guin
The Dispossessed

Contents

Preface to the Third Edition

Changes

The third edition of this work displays much of its ancestry in the first and second editions. From the first edition, it inherits its non-deterministic character in avoiding the imposition of any one particular framework on the use of tools, techniques and approaches described. Instead, it provides a series of relatively discrete notebooks on important topics in the area of information systems development. From the second edition it takes its objective of presenting a balanced account of both technical as well as organisational issues in the information systems area. This means continually emphasising the importance of aligning information systems with the needs of organisations.

The third edition represents a less radical change than that which occurred between the first and second editions. The basic approach of parcelling up the field into a number of separate parts, primarily for the purposes of presentation has been maintained. Having said this, we have restructured two of the original parts and renamed them Management and Discipline, because we believe that these labels correspond more readily to accepted groupings of topics discussed in this field.

At the more detailed level a number of other changes include:

1. Updating the material on tools, techniques and methods to take account of modern developments.
2. The removal of some chapters either because of the feeling we get that they are becoming less, rather than more relevant to information systems engineering (e.g. formal methods), or because we now feel that the topic areas are better discussed in other chapters (e.g. social science concepts).
3. A number of other chapters have been re-worked in order to more effectively set IS development within its organisational context. We also include a discussion of IS management and planning issues, particularly as they affect the IS development process.

Strategy

The topic of Information Systems Development is a large one. It is a topic which is getting larger by the day as information systems impact more and more on our everyday and organisational lives.

Therefore, in this work we have parcelled up the field into several parts, primarily for the purposes of presentation.

1. *Context.* Here we discuss issues such as what is information, what is an information system, why we need information systems, how the concept of information is playing an ever more prevalent role in our lives, and how appropriate ways for developing information systems assume ever more importance.
2. *Tools.* Here we discuss some of the components with which, and from which, contemporary information technology systems are built.
3. *Techniques.* Here we describe some of the major techniques of analysis and design comprising the armoury of the information systems specialist.
4. *Methods.* Here we discuss some of the contemporary ideas which relate to a number of distinct approaches to building information systems.
5. *Management.* Here we discuss some of the current issues relating to the planning, management and support of IS projects. We also critically examine the role that quality and evaluation play within IS management.
6. *Discipline.* Here we conclude with an examination of four topics which help to define the discipline of information systems area. First, we raise the problem of the ubiquity of IS failure. Second, we re-iterate the importance of considering the fit between information systems and the organisations within which they work. Third, we describe the process of professionalisation which many within the information systems area are promoting. Fourth, we examine the issue of what constitutes the valid academic study of information systems development.

This work is subtitled *An Introduction to Information Systems Engineering.* My main aim in rewriting this work is to contribute to the development of the discipline of information systems in general and information systems engineering in particular. We use the term IS engineering here in the broad sense used by the British Computer Society (BCS). In one sense, IS engineering is a discipline which broadens the area of software engineering from 'programming in the large' to include issues of people and organisations. In another sense, IS engineering has a more specific focus than software engineering in concentrating on software written to support human activity (particularly decision-making) within organisations.

Casting the discipline as engineering, however, does not mean that I agree with the rather limited conception of engineering portrayed in many quarters of computing. Information systems are, by their very nature, open to interpretation from a number of different viewpoints. In this respect I am conducting a similar exercise to Ehn (1989) in trying to focus on a disciplinary base for the interdisciplinary subject matter of designing computer artefacts. It is hoped that some of this diversity is reflected in the current text.

As a final comment, it is hoped that further editions of this work will be produced to keep the text up-to-date with ongoing developments. Any suggestions concerning the current edition or material to be included in subsequent editions would be welcomed, and should be sent, addressed to the

author, care of the publisher. Also, a teaching pack to accompany this textbook, including sample solutions to the exercises, is available from the author.

Acknowledgements

My thanks to staff and students of the Department of Computer Studies, the University of Glamorgan, for providing many useful comments on various iterations of the material presented in this book. Thanks especially to Malcolm Stewart at Macmillan for managing the production of all three editions of this work. May I wish him a long, happy and well-deserved retirement.

Reference

Ehn P. (1989). The Art and Science of Designing Computer Artefacts. *Scandinavian Journal of Information Systems*. 1(1). 21-42.

Paul Beynon-Davies

Part One
Context

Context
General setting of experience. (*Oxford English Dictionary*)
Circumstances, factors, situation, milieu. (*Roget's Thesaurus*)

In this part, we discuss a number of issues that define the important context for information systems development work. Chapters 1 and 2 provide important definitions for the terms information and information systems. Chapter 3 discusses a number of different ways of defining the concept of organisation and also highlights the way in which different perspectives on what constitutes an organisation influences ways of conceiving of the utilisation of information technology. Chapter 4 addresses a number of issues surrounding the information society and chapter 5 introduces some of the primary component parts of information technology. Chapter 6 discusses that organisational function devoted to the planning, management and development of information systems. Chapter 7 concludes with a discussion of a number of different styles of information systems development.

1 Information

1.1 Introduction

The concept of information and its exploitation in information systems has been somewhat taken for granted in the contemporary practice of development. Information has been treated in many respects as a mystical fluid that emanates as if by magic from the development of computerised information systems.

As an attempt to combat this simplistic conception there has been a resurgence of interest in the philosophical and sociological underpinnings of information systems work. As such, a discipline of information systems is emerging which has boundaries with management, business studies, behavioural science, computing and many other areas. This chapter provides an introduction to this material. Many of the concepts discussed in this chapter will permeate the discussion of the chapters that follow.

1.2 What is Information?

The concept of information is an extremely vague one open to many different interpretations (Stamper, 1985). One conception popular in the computing literature is that information results from the processing of data: the assembly, analysis or summarisation of data. This conception of information as analogous to chemical distillation is useful, but ignores the important place of human interpretation.

In this section we shall define a workable definition of information based upon the distinction between data, information and knowledge. We shall then elaborate on this definition in further sections, in particular, adding people into the equation.

Tsitchizris and Lochovsky define information as being 'an increment of knowledge which can be inferred from data' (1982). Information therefore increases a person's knowledge of something. Note that this definition interrelates the concepts of data, information, knowledge and people (see figure 1.1):

1. Data is facts. A datum, a unit of data, is one or more symbols that are used to represent something.
2. Information is interpreted data. Information is data placed within a meaningful context.
3. Knowledge is derived from information by integrating information with existing knowledge.

4. Information is necessarily subjective. Information must always be set in the context of its recipient. The same data may be interpreted differently by different people, depending on their existing knowledge.

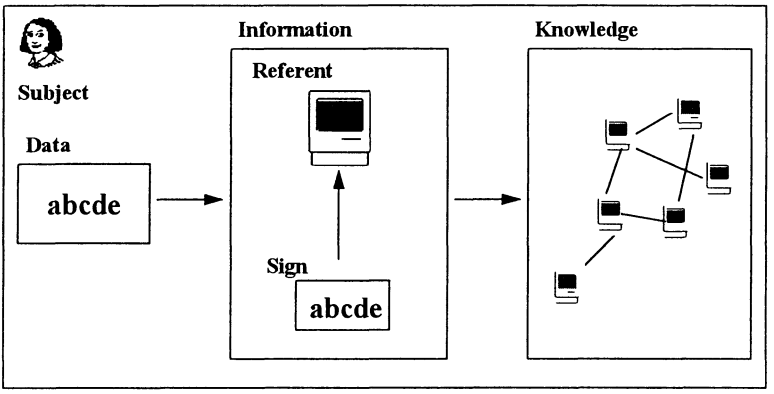

Figure 1.1: Data, Information and Knowledge

Example

Consider the string of symbols 43. Taken together these symbols form a datum, but by themselves they are meaningless. To turn these symbols into information we have to supply a meaningful context. We have to interpret them. This might be that they constitute an employee number, a person's age, or the quantity of a product sold. Information of this sort will contribute to our knowledge of a particular domain. It might, for instance, add to our understanding of the total number of products of a particular type sold.

Example

Another potent example of sign production is the cryptanalytic work conducted at Bletchley Park in the UK during the Second World War (Hodges, 1983). Here the data constituted encrypted radio signals from the German war machine. Decryption involved translating the signals into referents such as German U-boat positions and movements. The information gleaned was then incorporated into the total knowledge available to allied intelligence on military movements and strategy.

1.3 Semiotics

Liebenau and Backhouse (1990), following Stamper (1973, 1985), have discussed information in terms of semiotics. Semiotics or semiology is the study of signs.

A sign is anything that is significant. In a sense, everything which humans do is significant to some degree. The world within which humans find themselves is resonant with sign-systems. A sign-system is any organised collection of signs. Everyday spoken language is probably the most readily accepted and complex example of a sign-system. Signs however exist in most other forms of human activity, since signs are critical to the process of human communication and understanding.

Note the link between the words sign and significant in English. These words clearly have the same root. The concept of the significance of signs cannot be divorced from people. Different people find different things significant.

A sign can be broken down into three component parts:

1. The *symbol*, sometimes referred to as the signifier. That which is signifying.
2. The *referent*, sometimes known as the signified. That which is being signified.
3. The *concept*. The idea of significance.

Take the example of the symbols indicated in figure 1.2. The symbol in figure 1.2a has as its referent the male population; the symbol in figure 1.2b has as its referent the female population. 1.2a has as its concept the idea of maleness; 1.2b the concept of femaleness.

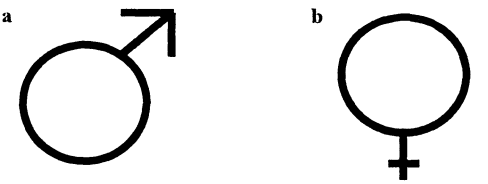

Figure 1.2: Two Symbols

The three components of a sign are related together in a meaning triangle (figure 1.3) (Sowa, 1984). The left corner of the triangle is the symbol; the peak is the concept; and the right corner is the referent. In this figure the symbol is the word 'Macintosh'; the referent is a particular range of electronic devices which are normally generalised in terms of the concept of a computer.

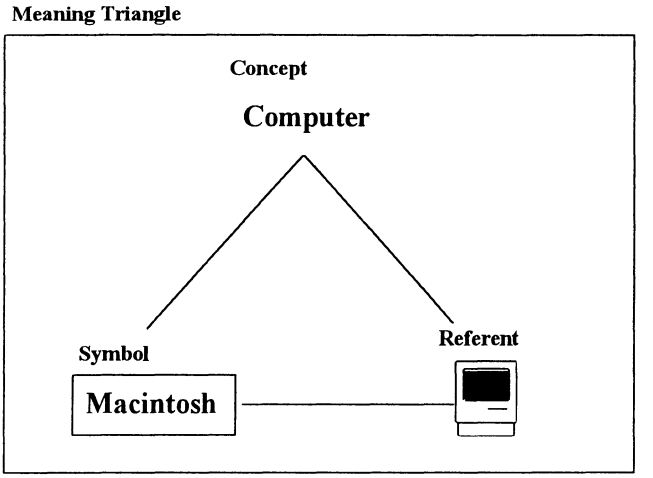

Figure 1.3: Components of a Sign

1.4 Social Systems

Signs are only significant in terms of some social system. A social system provides the context for the interpretation of signs. For instance, Dahlbohm and Mathiassen (1993) is a useful text which discusses how different perspectives on computing work (a social system) are crucial to understanding practice in this area. This accords with the call by Backhouse *et al.* (1991) for a focus for information systems research that draws on much of the work of Stamper. They have proposed an organising framework based on the disciplines of sociology and semiology:

> 'Two well-established areas of study provide us with a firm foundation on which to build. These are sociology on the one hand and semiology on the other. The former already constitutes the main thrust of research into social organisation, institutional dynamics, group interaction, working conditions and social policy. The latter brings together the range of studies associated with contexts of language and communication, meanings, grammars, signs and codes'. (Backhouse, *et al.* 1991)

A number of concepts borrowed from social science are useful in understanding signs and their relationship to social systems: culture, norm, role, power and status. These concepts are important in understanding human behaviour in organisations and hence will recur in the discussion of the chapters that follow.

1.4.1 Culture

A *culture* is the set of behaviours expected in a social group. A *social group* is any collection of people who regularly interact with one another. It is a truism that any long-standing social group develops its own expected set of behaviours. Such expectations are known as *norms* of human behaviour in the jargon of social science, to distinguish them from deterministic rules.

1.4.2 Roles

People make behaviour. But people package behaviour in collections which social scientists call social *roles*. The analogy here is clearly with the acting profession. To paraphrase Shakespeare – 'All the world is a stage, and we are merely players.' In other words, we all take on a number of different roles throughout our lifetime, and for each role different expectations are involved.

1.4.3 Status

A complementary concept to that of social role is that of social status. A person's status implies some form of position is a social hierarchy. The formal hierarchy of an organisation may not be the most important one to know about. There are frequently one or more informal hierarchies that are more effective in organisational terms. Such hierarchies, for instance, frequently stimulate camouflage. Many people put up a 'front' in organisations to preserve their informal status. They may tell you that the organisation functions in such a way, when in fact it functions entirely differently.

1.4.4 Power and Authority

Power is the ability of a person or social group to control the behaviour of some other person or social group. Authority is legitimated power in that those over whom it is exercised accept the exercise of power. Organisational politics is the embodiment of power play within some organisation.

In many organisations there will be a mismatch between naked power and authority. Manager A may be the person in whom formal power is invested. Manager B however has the recognised authority, and it is this manager who actually controls staff.

There is a tendency to conceptualise power as a commodity owned by a particular individual or group. Power and authority are however not static entities. Power and authority are relationships between individuals and groups. They are fluid entities that are continuously negotiated within organisations.

1.5 Signs and Social Systems

All of the concepts discussed in relation to social systems above are clearly related to the concept of a sign:

1. If culture consists of shared understanding, such understanding must be communicated via a body of signs.
2. A person's role and indeed social status is frequently made apparent through signs. Corporate executives, for instance, will frequently signify their status in the organisation via a panoply of status 'symbols' such as expensive company cars, large offices and expensive furnishings.
3. Power has to be exercised through communication. People gain an idea of a person's authority through the significance of their ability to control the behaviour of others.

1.6 Data, Information and Signs

The distinction between data and information can be viewed from the perspective of signs and sign-systems. In terms of the meaning triangle, data is symbols. For instance, the symbols M and F might be significant in some information systems context. To speak of information we must supply some concept and/or referent for the symbols. M might have as its referent the male population; F might have as its referent the female population. Taken together, the meaning of these symbols is supplied by the concept of human gender.

1.7 Levels of Signs

Another way of considering signs and sign-systems is in terms of a number of levels of study (Stamper, 1973):

1. *Pragmatics.* The study of the general context and culture of communication. The shared assumptions that underlie human understanding. In order for communication to occur between human beings signs must exist in a context of shared understanding. There must be agreed expectations between the symbols and the referents or concepts that they signify. Pragmatics is the study of such mutual understanding. Much of pragmatics can be considered as the study of culture – the common expectations underlying human behaviour in a particular context.
2. *Semantics.* The study of the meaning of signs. The association between signs and behaviour. Semantics can be considered as the study of the link between symbols and their referents or concepts; particularly the way in which signs relate to human behaviour embodied in norms.

3. *Syntactics.* The logic and grammar of sign systems. Syntactics is devoted to the study of the physical form rather than the content of signs.
4. *Empirics.* The physical characteristics of the medium of communication. Empirics is devoted to the study of the medium of communication, e.g. sound, light, electronic transmission, etc.

Pragmatics and semantics study the purpose and content of communication. Syntactics and empirics study the forms and means of communication. Pragmatics and semantics clearly impinge upon other disciplines such as sociology and politics. Syntactics and empirics impinge upon the domain of psychology and indeed even electronics.

In information systems work the study of syntactics and empirics has traditionally dominated. The pragmatics and semantics levels have only recently begun to contribute to information systems development.

Example

Consider, for instance, a mail message transmitted on an electronic mail system. The mail message is something that exists within a social setting. It therefore exists within an environment of expectations, commitments and obligations. At the pragmatic level there must be some reason for sending the message which is presumably expressed in terms of the culture and context in which the information is used. At the semantic level the focus shifts to the subject matter of the message; what meaning is being transmitted by the message. At the syntactic level the language used to express the message is of concern. In so far as the communication takes place along electronic communication lines issues such as bandwidths and other properties of signal transmission will be the concern of the empirics level.

Example

Consider the icon in figure 1.4. At the level of empirics the medium of communication is clearly light and visual perception. Syntactics addresses the physical form of the sign, including in this case issues of colour and layout. Semantics concerns the meaning of the sign; in this case a prohibition not to smoke cigarettes. It involves the expectation that persons seeing this sign will modify their behaviour in response to its intended meaning. Pragmatics addresses the issues surrounding the general use of this sign in a human setting. In this case, it involves the general understandings concerning the link between cigarette smoking and ill health, as well as the debate about the effects of passive smoking.

Figure 1.4: A Sign

1.8 'Good' Information

There is a tendency to assume that all information is good information. This is particularly prevalent in the perspective that information supports decision-making; that information reduces the uncertainty in some domain, and that as a natural consequence the more information you have, the better the decisions you will make (chapter 3). This perspective suffers from a number of problems:

1. It ignores the fact that people can become overloaded with information. At some point, the more information a person has, the less effective he/she will be in making a decision.
2. Not all information reduces uncertainty, and more information certainly does not always reduce uncertainty. Some forms of information may actually increase uncertainty, in giving the decision-maker more options.

The important point is that we cannot divorce the concept of information from its use. 'Good' information can only be determined in the context in which it serves human action. Hence, the design and development of information systems must encompass the context of use.

Example

The Audit Commission (1995) report on information needs in hospitals identifies a number of ways in which information is essential to supporting clinical work. Implicitly these form definitions of what constitutes good information in this domain.

Supporting clinical decisions

1. assessing a patient's medical history for relevant problems

2. aiding the management of a patients' visit or stay
3. assisting with tasks such as producing order forms, discharge letters etc.
4. sharing information about the care and progress of the patient with other health care professionals

Monitoring clinical performance

1. providing information for the audit of individual clinical cases and for quality assurance relating to services and outcomes
2. providing information for research studies into best care practices

Evaluating clinical performance

1. monitoring the quality of care against standards specified in contracts
2. monitoring costs and taking measures to reduce them where appropriate
3. ensuring that bills are raised for services provided
4. making statutory returns to government and international bodies

1.9 Conclusion

In this chapter we have sought to examine some of the accepted wisdom surrounding the term information. Data is facts. Information is interpreted data. Information is data placed within a meaningful context. Information is signs. Signs are inherently associated with human interpretation, understanding, and communication. Social systems and signs are inherently interlinked. In semiotic terms, information can be considered at a number of different levels: pragmatics, semantics, syntactics and empirics. Not all information is necessarily good information.

1.10 References

Audit Commission. (1995). *For Your Information*. HMSO.

Backhouse J., Liebenau J. and Land F. (1991). 'On the Discipline of Information Systems'. *Journal of Information Systems*. 1(1). January. 19-27.

Dahlbohm B. and Mathiassen L. (1993). *Computers in Context: the philosophy and practice of systems design*. NCC/Blackwell.

Hodges A. (1983). *Alan Turing: the Enigma*. Hutchinson, London.

Liebenau J. and Backhouse J. (1990). *Understanding Information: An Introduction*. Macmillan Press, Houndmills, Basingstoke.

Sowa J.F. (1984). *Conceptual Structures: Information Processing in Mind and Machine*. Addison-Wesley. Reading, Mass.

Stamper R.K. (1973). *Information in Business and Administrative Systems*. Batsford, London.

Stamper R.K. (1985). Information: Mystical Fluid or a Subject for Scientific

Enquiry? *The Computer Journal*. 28(3).
Tsitchizris D.C. and Lochovsky F.H. (1982). *Data Models*. Prentice-Hall, Englewood Cliffs, NJ.

1.11 Exercises

1. An insurance society wishes to produce a list of all the claims made against policies. Analyse this report in terms of the distinction between data, information and knowledge.
2. Analyse the claims report in terms of Stamper's distinction between semantics, syntactics, pragmatics and empirics.
3. If all the products of information systems can be regarded as signs, discuss the problems involved in individuals and groups misinterpreting certain of these signs.
4. Discuss the effectiveness of the Highway Code as a sign system.

2 *Information Systems*

2.1 Introduction

The term information system is used in a number of different contexts in the literature. This chapter attempts to build a workable definition of the term and in the process introduces a number of important distinctions which impinge on the material in further chapters.

2.2 Systems

A system might be defined as a coherent set of interdependent components which exists for some purpose, has some stability, and can be usefully viewed as a whole. Systems are generally portrayed in terms of an input-process-output model existing within a given environment. The environment of a system might be defined as anything outside a system that has an effect on the way the system operates. The inputs to the system are the resources that it gains from its environment or other systems. The outputs from the system are that which it supplies back to its environment or other systems. The process of the system is the activity that transforms the system inputs into system outputs. Most organisations are open systems in that they are affected by their environment and other systems.

The idea of a system has been applied in many fields as diverse as physics, biology and electronics. The class of systems to which information systems are generally applied have been referred to as human activity systems (Checkland, 1980). Such systems have an additional component added to the input-process-output model described above: people. Human activity systems consist of people, conventions and artefacts designed to serve human needs.

Every human activity system will have one or more information systems. The purpose of these information systems is to help manage the human activity system.

2.3 A Simple Human Activity System

Take the example of a simple business that handles claims made against insurance companies as the result of motor accidents. The environment of this system comprises its relationship to its parent company, other insurance companies and the financial industry at large. The main inputs to the system are the claims made against insurers. The main outputs from the system are payments made to other insurers. The main activity of the system is the

resolution of claims. The primary people involved in the system are the claims clerks that take a particular claim from inception through to resolution. The system is also made up of a vast range of conventions governing the appropriate ways of processing claims. Most of these conventions govern the flow of information through the system: the information system.

2.4 Information Systems and Human Activity Systems

The primary purpose for creating an organised information system is to serve real-world action. The provision of information in organisations is always linked to action: to deciding to do things, accomplishing them, observing and recording the results and if necessary iteratively repeating this process. From the definition of information as data to which meaning has been attributed (chapter 1) and the objective of information systems as servers for action a number of consequences follow:

1. The boundary of information systems will always have to include the attribution of meaning, which is a uniquely human act. An information system will consist of both data manipulation and the attribution of meaning by humans (see figure 2.1).
2. The process of developing an information system requires explicit attention to the purposeful action that the information system is meant to serve. This involves understanding how the people in the organisation conceptualise their world: how they attribute meaning, and how this meaning drives their action.

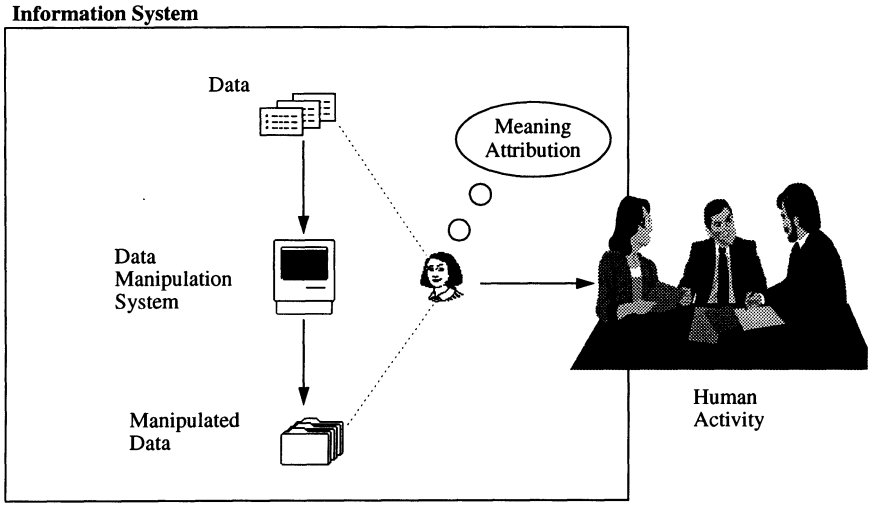

Figure 2.1: Information Systems and Human Activity Systems

These tenets have important consequences in terms of how we approach the development of computerised information systems. Information systems cannot be constructed until some agreement has been reached about appropriate forms of understanding and action within organisations. We cannot separate information and information systems from human activity. In other words, any developer of computerised information systems has to address the important human dimension of organisations.

2.5 Formal, Informal and Technical Information Systems

Stamper makes the useful distinction between three levels of information system within organisations. Information systems may be formal, informal, or technical (see figure 2.2). Stamper (1973) cogently defines the differences between these three levels as follows:

> 'To understand an organisation we must recognise three layers corresponding to the formal, informal and technical levels at which culture is transmitted and behaviour determined. At the formal level are the explicitly recognised precepts of behaviour which may be a part of the wider culture in which the organisation operates; on the other hand they may be expressed in the rules, regulations and official structure of authority. At the informal level, an organisation will gradually evolve complex patterns of behaviour which are never formulated, but which must be learnt by newcomers. The informal culture will be vital to the effectiveness of the organisation; in some respects it may aid, and in others impede, the attainment of organisational objectives.... At the technical level an organisation must be described in terms of its flows of messages about the transactions performed, plans made, problems investigated, and in terms of the data-processing activities necessary to accomplish organisational tasks.'

The important point about this definition is that computerisation normally addresses only a limited part of the formal information systems of organisation. Note, however, that this distinction between technical, formal and informal information systems is useful for conceptual purposes. It is a distinction that is frequently difficult to maintain in practice.

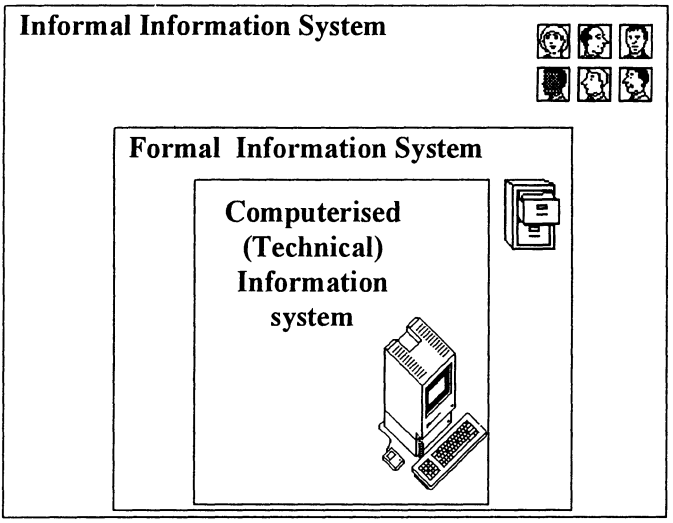

Figure 2.2: Levels of Information System

2.6 Formal Information Systems

Formal information systems are particularly prevalent in bureaucratic forms of organisation (Weber, 1947). A bureaucracy is a form of organisation in which human activity is highly regulated. Conventions are written down; control is exercised by formal hierarchies; communication is vertical in the sense of information travelling upwards from subordinates to superiors and decisions travelling in the opposite direction.

Many public-sector organisations are usually considered archetypal bureaucracies, although bureaucracies are also highly prevalent in the private sector as well.

2.7 Technical Information Systems

By a technical information system we normally mean the representation of some part of a formal information system using information technology. The term Information Technology (IT) is generally used to describe hardware and software for supporting information work, e.g. computers, communication networks, operating systems, database management systems etc. We shall use the term IT system as a synonym for the term technical information system.

One of the main points arising from figure 2.2 is that since technical information systems are conventionally built for supporting some of the formal information systems activity of a given organisation, a technical information system usually cannot be constructed until there is some agreement concerning

human activity and this activity has been formalised in the sense that it is specified and/or documented. The frequent difficulty in IS development is obtaining and maintaining such agreement.

2.8 Informal Information Systems

An informal information system can be considered as a corpus of expectations about how people should communicate in some setting. These expectations are by their very nature never written down or formalised. People learn the expected way of doing things in the process of being socialised into the organisation. However, such expectations are merely guides for action. People are able to adapt their behaviour in the light of changed circumstances.

The main importance of informal information systems is that they can be more robust than information systems established on formal and particularly technical grounds. An informal information system, because of its very nature, is likely to be better able to adapt to the changes in the external environment of the organisation.

Example

Consider the case where in some organisation clerks are conventionally expected to issue purchase orders to established suppliers. However, this expectation is an informal one. No regulation has been established within the organisation to this effect. An established supplier for a particularly critical resource now goes out of business. If the expectation described above had been formalised then the clerks would probably have to go out to tender for a new supplier for the resource – a process which could take some considerable time. Because the expectation is an informal one clerks can immediately go out and look for a new supplier and adjust their decision-making on this basis.

2.9 Systems Analysis

The term systems analysis is normally used to describe the process of analysing aspects of formal information systems. Systems analysis is the precursor to systems design, which is the activity devoted to developing the plan for some information technology system.

A typical scenario is one in which the systems analyst is expected to go into an organisation and document all or part of the bureaucratic practices existing in that organisation. This typical conception of systems analysis we might call formal or 'hard' systems analysis.

2.10 Soft Systems Analysis

In the same way that we distinguish between a formal and an informal information system we may likewise distinguish between formal and informal systems analysis. Formal or 'hard' systems analysis is the process of investigating and documenting the formal information systems of organisations. Informal or 'soft' systems analysis is the process of investigating and documenting the informal information systems of organisations.

Soft systems analysis equates quite closely with the idea of business analysis: of analysing the overall objectives and needs of an organisation and identifying the place of the organisation within its environment (Checkland and Scholes, 1990). The topic of business analysis is discussed in chapters 25 and 26. The importance of business analysis for IS work lies particularly in the identification of the appropriate place for information systems within organisations.

2.11 The Importance of Considering Informal Information Systems

On the morning of 27th October 1986 the new computerised price and dealing information system of the London stock market crashed. Breakdowns and suspensions of trading occurred on the system for the following month. When an evaluation was conducted the source of the problem proved to be a massive underestimation of the volume and timing of system usage. On the first day, everybody logged onto the system out of curiosity. Thereafter, regular massive early loading of the system was commonplace as dealers struggled to get their share prices right as early in the day as possible (Willcocks and Mason, 1987).

The analysis of the formal system of stock market information was done well. The price and dealing information system (the IT system) was produced on time, to specification and within budget. However, the analysis of the informal system of share dealing appears to have been done badly. Analysts failed to get an appreciation of the importance of timely share information for brokers.

2.12 The Information Systems Specialist

Institutions such as the British Computer Society have recently become interested in broadening the skills expected of information systems engineers. The idea of a hybrid manager – a person with both business and technical knowledge – has been much discussed (Palmer, 1990). In a sense, this initiative is merely echoing a sentiment first expressed by Stamper in the 1970s:

> 'The demands of society and the opportunities of technology are now changing so quickly that we must learn to construct organisations that are responsive to our needs. Organisations cannot be left to evolve; as far as it

is possible they must be designed. Many people are working on these problems: managers, administrators and staff specialists. In one way or another they are all trying to make organisations use information effectively. It is information that holds organisations together and drives them along. What we urgently need therefore, are information specialists who are as thoroughly acquainted with the information needs of organisations as they are with the capabilities of modern information technology.' (Stamper, 1973)

2.13 Goronwy Galvanising: A Case Study

To provide some context for many aspects of the discussion of information systems development, which follows, we begin portraying here the elements of a central case study. The aim is to illustrate how an information system that is to be developed for a small manufacturing company can be viewed from a number of different perspectives. In particular, the case study forms a central part of the techniques section where we illustrate the application of each technique to an aspect of the system. In this chapter we mainly consider the broad implications of the informal and formal information systems at the company. In chapter 2 we inspect the detail of the formal system specific to the proposed technical information system.

Goronwy Galvanising Ltd are a small company specialising in treating steel products such as lintels, crash barriers and palisades etc., produced by other manufacturers. Goronwy are a subsidiary of a large multi-national whose primary business is the production of various alloys. The multi-national maintains 10 plants on similar lines to Goronwy around the UK. Each plant is relatively autonomous in terms of managing its day-to-day business. Head office co-ordinates administrative activities such as accounting, finance and the dissemination of information.

Galvanising, in very simplistic terms, involves dipping steel products into baths of molten zinc to provide a rustproof coating. Untreated steel products are described as being 'black'. Treated steel products are referred to as 'white'. There is a slight gain in weight as a result of the galvanising process.

Goronwy mainly process steel for a major manufacturer known as Blackheads. More than 80% of their business is with Blackheads which places a regular set of orders with Goronwy. Other manufacturers, such as Pimples, order galvanised steel on an irregular basis.

The staff at Goronwy consists of a plant manager, a production controller, an office clerk, 3 shift foremen and 50 shop-floor workers. The plant remains open 24 hours per day, seven days a week. Most of the production workers including the foremen work a shift-pattern.

2.14 Conclusion

To summarise, a system might be defined as a coherent set of interdependent components which exists for some purpose, has some stability, and can be usefully viewed as a whole. Systems have inputs, outputs and processes. They work within a given environment. Human activity systems or 'soft' systems are systems with people. Every human activity system has one or more information systems. Information systems can be distinguished in terms of their level of formality: technical, formal, and informal. Conventional systems analysis is normally devoted analysing formal information systems. Soft systems analysis is devoted to analysing informal information systems.

2.15 References

Checkland P. (1980). *Systems Thinking, Systems Practice*. John Wiley, Chichester.

Checkland P. and Scholes J. (1990). *Soft Systems Methodology in Action*. John Wiley, Chichester.

Wilcocks L. and Mason D. (1987). *Computerising Work: People, Systems Design and Workplace Relations*. Paradigm, London.

Palmer C. (1990). Hybrids – a growing initiative. *The Computer Bulletin*. 2(6). August.

Stamper R.K. (1973). *Information in Business and Administrative Systems*. Batsford, London.

Weber M. (1947) *The Theory of Social and Economic Organisation*. Free Press.

2.16 Exercises

1. Characterise an information system known to you in terms of the features of a human activity system.
2. Describe an example of an informal, formal and technical information system in some organisation known to you.

3 *Information Systems and Organisations*

3.1 Introduction

Information systems are used in the context of organisations. It has become very much of a truism to state that in modern Western economies the success of organisations is frequently very much dependent on the success of its information systems. In this chapter we discuss a number of models for organisations and how the concept of an information system and the development of such information systems fits within the framework of each model.

3.2 Organisation Theory

Researchers have been debating the issue of what constitutes an organisation constitute for at least a hundred years. Much of this debate can be discussed in terms of a number of distinct perspectives on organisations. In this chapter we call each such perspective a model of organisations (Jirotka *et al.*, 1992). Each model determines its own particular slant on the use and utility of information systems.

3.2.1 Organisations as Structures

The most pervasive model of organisations sees them as structures that are divided into parts or functional departments. Each department is characterised by a pattern of precisely defined jobs. Jobs are organised in a clear hierarchical fashion with designated lines of authority from superior to subordinate. This hierarchical structure is so well formalised that it can be captured in an 'organisational chart' (Fayol, 1949).

This classical account of organisations is related to the ideas underlying the idea of 'scientific management' popularised by Frederick Taylor in the US in the early years of this century (Taylor, 1911). Scientific management focuses on three principles:

1. Managers should be given total responsibility for the organisation of work; workers should concentrate on manual tasks. A 'thinking' department of managers should be set up to be responsible for task planning and design.
2. All tasks should be examined and if necessary redesigned to improve efficiency. By studying the approach adopted, the tools utilised and the fatigue generated for any task, an optimum procedure for the task can be generated.

3. Methods should be adopted for the selection, training and monitoring of labour to ensure that work is done efficiently.

The underlying assumption of this approach is that the actions of people can be rationalised and closely defined. This model is clearly associated with that type of organisation known as a bureaucracy (chapter 2).

3.2.2 Organisations as Networks

As a reaction to Taylorism, attention shifted within organisation theory from a focus on tasks to a focus on 'human' issues. The famous Hawthorne studies of the 1920s and 1930s were initially concerned with discovering the effects of fatigue, accidents and labour turnover on rest pauses and the physical conditions of work (Mayo, 1933). However, as they progressed the studies became broader in outlook and investigated other aspects of the work situation such as workers' attitudes and their social environment and the effect of such factors on worker productivity.

The significance of the Hawthorne studies is their interest in informal organisations based on friendship networks and spontaneous, unplanned interactions between members of such networks. This informal organisation is seen as working in parallel with, and sometimes opposed to, the formal organisation (chapter 2).

3.2.3 Organisations as Environments

Many organisational theorists have insisted that the environment of an organisation is essential to understanding how an organisation is defined both in terms of its relationships with the outside world and in terms of its internal structure. The organisation itself is seen as an open system made up of a series of interdependent subsystems with problematic interfaces. This means that organisations need sensitive management in order to balance internal needs with external environmental changes. It is management's responsibility to obtain a good fit between the task of the organisation, the environment in which the task will be performed and the style of management.

One variant of this approach is to try to identify various relationships between successful organisational forms and different environments. Burns and Stalker (1961), for instance, suggest that mechanistic or bureaucratic forms of organisation are appropriate in stable environments; organic, or less formalised organisations are more appropriate in uncertain environments. Hence, in public sector environments where change is relatively slow one would expect mechanistic forms to thrive; in private sector environments that are more volatile one would expect more organic forms to exist.

3.2.4 Organisations as Information Processors

This view of organisations emphasises the importance of studying decision making, and more generally information processing, on the part of management.

Simon (1960) explores the parallels between human and organisational decision making. He maintains that organisations can never be truly rational, because members of organisations have limited information-processing abilities. Individuals have to take decisions on the basis of limited information about possibilities and consequences, They are also limited in the number of alternatives they can consider at any one time, and cannot accurately predict the outcomes of their actions. Individuals can therefore only achieve a bounded rationality in their decision-making. They *satisfice*, that is, they plan a course of action based upon good-enough decisions informed by rules-of-thumb and limited information. According to Simon, the concept of bounded rationality is institutionalised in the structure of decision-making in organisations and such decision-making is routinised and fragmented to make it more manageable. Hierarchies of control within organisations are there to simplify communication channels.

3.2.5 Organisations as Constructions

This perspective visualises organisations as social constructions. Organisations are seen as emerging from the day-to-day accomplishment of the tasks and responsibilities undertaken by participants (Silverman, 1982). Organisational theorists using this particular perspective are concerned with the relationship between work and an individual's self and identity. They are particularly interested in how participants account for their actions and present themselves and others. For instance, researchers have particularly elucidated the way in which members of distinct occupational groups and professions within health-care organisations use a particular ideology to establish a working consensus and co-ordinate their activities in terms of patient care.

3.2.6 Organisations as Productions

Several researchers have sought to detail the methods that members in settings use to account for their work (Garfinkel, 1967). Such researchers are particularly interested in how participants achieve their work and reason practically about their work. For instance, recent studies of air traffic controllers have revealed the important information embedded in the physical movement of artefacts in the control setting.

3.3 Models of the Organisation and Information Systems

In this section we illustrate how each model of organisations critically affects the way in which we perceive the character and place of information systems within organisations. Note that the models are not independent, and hence certain models overlap in their conception of information systems.

3.3.1 Organisations as Structures

The structural or systems model of organisations has been a particularly dominant model of organisations for information systems work. As we have seen in chapter 2 the idea of an information system and a human activity system have been inextricably interlinked by Checkland. Every organisation can be considered as a human activity system or as a series of human activity systems. This means that every organisation will have a number of information systems of some form.

An organisation can be considered on the macro level as a system. On the micro level, a business organisation can be considered to be made up of a number of subsystems or functional areas. For example:

1. *Marketing.* The area concerned with advertising, selling, pricing and distribution.
2. *Accounting and Finance.* The area concerned with generating and investing money and its accounting.
3. *Production.* The area concerned with purchasing raw materials, inventory control and manufacture.
4. *Research and Development.* The area concerned with developing new products or services and improving existing products or services.

The systems model of organisations has also particularly affected the way in which many information systems engineers (chapter 7) traditionally conceive of appropriate ways for constructing information technology systems. A long-standing problem in software engineering is to identify the functions that an information technology system should perform. One solution is to analyse organisational work in terms of tasks and specify the functions of an information system in terms of these tasks. Such task analysis may also later be used as a basis for deciding on an appropriate division of labour between computerised systems and the users of such systems.

3.3.2 Organisations as Networks

This perspective emphasises the importance of informal organisation. It crucially determines the rationale for approaches such as Soft Systems analysis (chapter

26). The importance of human interaction to effective work in organisations has also particularly determined the socio-technical approach to developing information systems (chapter 28). This approach emphasises the importance of user participation and co-operation to the design, implementation and use of computerised information systems. As a guiding principle, social systems are designed in parallel and in correspondence with technical systems.

3.3.3 Organisations as Environments

Information is not only of internal relevance to organisations. In many domains the information flowing between organisations is a significant force in the economy. Consider the case of the Stock Market in the UK. The Stock Market can be conceived of as a vast information system concerned with the management of monetary relations between organisations. The very stuff of Stock Market activity is the management of exchange relations via information.

The importance of environment in the 'health' of organisations has become a particularly important emphasis in ideas underlying strategic information systems (chapter 33). Strategic information systems are those information systems that have an effective part to play in improving the interface between an organisation and its environment. For instance, many strategic information systems have been built which attempt to improve the relationship of customers with an organisation. For instance, American Hospital Supply placed information technology into its customers at no charge in order to capture the lucrative medical supplies market in the US.

The rationale for business process reengineering (chapter 25) is also frequently cast in terms of restructuring the way in which an organisation works, the purpose being to make the organisation more effective in terms of rapid changes in its environment (Hammer and Champy, 1993).

3.3.4 Organisations as Information Processors

In the systems approach each of the subsystems making up an organisation must be managed. The primary activity of management is decision-making. Business decision-making can be broken down into five areas: planning, organising, controlling, communicating, and staffing. All such activities are reliant on information.

Probably in this perspective above all others the importance of information as the life-blood of the organisation is pre-eminent. Information systems of whatever form are seen as being normally put in place to facilitate the process of decision-making within organisations. Decision-making in organisations is frequently divided into three levels: the strategic level, the administrative level and the operational level. Data flows through operational to the administrative to the strategic levels and feeds the decision-making process at each level.

Consider a food supermarket chain. At the operational level sales data is recorded at checkouts. This data allows administrative staff to record the amount of each type of product sold. In turn, a decision such as the amount of stock to reorder can be made. At the strategic level, the staff at headquarters can record nationally or perhaps internationally their sales performance in certain areas. This helps them to make decisions as to what they should be selling, where to site their stores, etc.

Information technology systems were first employed in the administrative level of organisations. In business organisations, the first functional area normally to employ computers was accounting and finance. Computers were used to record primarily administrative data related to the financial well being of organisations.

Information technology systems have now come to be employed not only in many other administrative areas but also in the operational and strategic levels of organisations. Point of sale and computer-aided manufacturing systems are two types of information system employed at the operational level. Many operational level systems are what we might call transaction-processing systems. Such systems are characterised by a heavy throughput of small changes (called transactions) made against a database. Management information systems (MIS) are probably the most prevalent form of information system employed at the strategic level. A classic MIS will be involved in producing summary information from mass transaction data. More recently the idea of a decision support system (DSS) or executive information system (EIS) has evolved. Such systems differ from an MIS in that they enable managers to more flexibly structure the information needed to make strategic decisions.

3.3.5 Organisations as Constructions and Productions

The model of an organisation as a social construction and as a production has only recently begun to inform the literature on information systems work. However, there are certainly difficulties inherent in the mismatch between the rich accounts of organisational life produced by researchers using these approaches and the pragmatic needs of information systems engineers. Nevertheless, such approaches have begun to inform the discipline of computer-supported co-operative work (Winograd and Flores, 1986). Here, the emphasis is on building computer systems that aid, support and enhance the process of human communication rather replacing it. It has been particularly discussed in the context of flatter, more democratic, forms of organisational structure. Many people have suggested that this looser form of organisational structure is more likely to prove successful in modern information economies because of its ability to adapt in times of rapid change.

3.4 Conclusion

People in modern western societies live out a substantial part of their lives in one form of organisation or another. The idea of an organisation can be considered from a number of different perspectives:

1. organisation as system
2. organisation as network
3. organisation as environment
4. organisation as information processor
5. organisation as construction
6. organisation as production

The first four perspectives have crucially informed the idea of information systems and their relevance to organisations. The last two approaches are beginning to have an influence, particularly in the context of more radical forms of organisational structures that we discuss in more detail in chapter 37.

3.5 References

Burns T. and Stalker G.M. (1961). *The Management of Innovation*. Tavistock. London.

Fayol H. (1941). *General and Industrial Management*. Pitman. London.

Garfinkel H. (1967). *Studies in Ethnomethodology*. Polity, Cambridge.

Hammer M. and Champy J. (1993). *Reengineering the Corporation: a manifesto for business revolution*. Nicholas Brearley, London.

Jirotka M., Gilbert N. and Luff P. (1992). 'On the Social Organisation of Organisations'. *Computer Supported Co-operative Work*. 1(1). 95-118. Kluwer Academic.

Mayo E. (1933). *The Human Problems of an Industrial Civilisation*. Macmillan, New York.

Silverman D. (1982). *The Theory of Organisations*. Macmillan.

Taylor F.W. (1911). *Principles of Scientific Management*. Harper and Row, New York.

Winograd T. and Flores F. (1986). *Understanding Computers and Cognition: a new foundation for design*. Ablex, Norwood, NJ.

3.6 Exercises

1. Consider an organisation known to you. Use one or more of the perspectives above to characterise the organisation. For instance, would you class it as a bureaucratic or an organic organisation?

2. Which are the dominant perspectives employed by information systems people within the chosen organisation? In what way are information systems characterised in the organisation: e.g. as support systems, as decision-making tools, as co-ordination systems or as strategic weapons?

4 *Information Society and Economy*

4.1 Introduction

In the previous chapter we discussed how the shape of an organisation is affected by its environment. In the normal sense of the term used within the Information Systems area, environment means the competitive marketplace. In this chapter we broaden the meaning of this term to include the way in which information and information systems are affecting societies and economies.

4.2 The Information Society

In the 1970s Daniel Bell (1970), a US sociologist, wrote an influential book entitled *The Coming of Post-Industrial Society*. In this work, Bell made a series of predictions about the state of Western societies. His major premise is now generally accepted that Western societies are becoming information societies. He maintained that whereas the revolution of the latter part of the nineteenth century was an industrial revolution, the revolution of the latter part of the twentieth century is an information revolution.

However, there is some debate about whether information technology will bring about the same level of changes in society as characterised by the industrial revolution. One school of thought believes that we are clearly moving out of the stage of an industrial society and into the stage of a post-industrial society. Members of this school point to a number of indicators present in contemporary Western societies that support this thesis: the change from a goods-producing society to a service society; that information is becoming a major commodity for organisations; that there has been an information explosion.

The second school of thought believes that the magnitude and speed of changes in society have been heavily exaggerated. They maintain that we are seeing just one more stage in the development of industry comparable to developments that have gone before. Although the growth in the service sector in Western economies is significant, it has not removed the need for goods-producing industries. Gershuny (1978), for instance, analysed employment and consumption patterns in the UK during the 1970s and found evidence that the gradual emergence of a service society was a myth. He finds that a fall in service consumption is balanced by a rise in the consumption of durable goods, which in effect allows consumers to produce services for themselves.

4.3 Information as a Commodity

Much discussion has been made of the commoditisation of information. However, Bell (1979) believes that information is not a commodity in the sense of industrial commodities. Industrial commodities are produced in discrete, identifiable units, and are exchanged and sold to be consumed. Classic industrial commodities are loaves of bread and automobiles. Such commodities are characterised by the fact that one buys the product from a seller and thereby take physical possession of it. The exchange is also governed by legal rules of contract.

Bell bundles together questions of information with those pertaining to knowledge. The problem with information or knowledge is that even when it is sold, it remains with the producer. Bell sees it as a collective commodity in that when it is created it is by its very nature available to all. For information to be a commodity, information must have value. Not all information may be valuable or useful. What determines the value or utility of information is clearly dependent on the particular perspective of some individual or group. The idea of determining the use-value of information is one approach to attempt to commoditise information.

The use-value of some types of information as a commodity for social control has caused concern amongst civil liberties groups in many countries. Modern information technology permits organisations to collate together information from various sources to form profiles of individuals or groups.

4.4 Transactional Information

Information technology systems have altered the nature of society's records. Burnham (1983) particularly illustrates the way in which transactional information can be used to record the daily lives of almost every person in the United States. This information can be combined with more traditional kinds of information such as people's age and place of birth to permit organisations to make decisions about the planning of their work.

Case

The American Telephone and Telegraphic Company (AT&T) has built a large network of linked databases recording information on the telephone calls that people make in the United States.

Access to this database gave a senate committee of the US Congress additional ammunition in its investigation of the relationship between President Carter's brother Billy and the government of Libya. Almost every page of the final report to the Senate Committee contains footnotes to the precise time and day of calls made by Billy Carter and his associates.

AT&T itself used the database to keep track of the companies that decided to hook into the long-distance facilities offered by one of its competitors. It also appears to have used the database as a means of determining the customer profile of its competitors.

Case

One of the major UK supermarket chains maintains a large database of retail transactional information produced from its point-of-sale machines in each supermarket. This information is used not only to automatically determine stock reordering but also to determine the major purchasing strategy for the chain as well as the siting of new stores.

4.5 Data Protection

The rise of transactional information has brought to the fore the issue of ensuring the privacy of data held about an individual. In the UK, for instance, the Data Protection Act 1984 lays down a number of principles that maintain that personal data must be:

1. obtained and processed, fairly and lawfully
2. held for the lawful purposes described in the data user's register entry
3. used for those purposes and disclosed only to those people, described in the register entry
4. adequate, relevant and not excessive for the purposes for which it is held
5. accurate, and where necessary, kept up to date
6. held for no longer than is necessary for the registered purposes
7. accessible to the individual concerned who, where appropriate, has the right to have the information corrected or erased
8. surrounded by proper security

All organisations that maintain personal data must register the data held with the data protection register and are obliged to ensure that their use of such data conforms to the principles above.

Many other European countries such as those in Scandinavia also have data protection legislation in place. In 1998 the UK government intends to implement new legislation to bring the act in line with the data protection directive of the European Union. The new law will include an extension to a number of data subject's rights such as the processing of special categories of data will be subject to more restrictive rules. An example here is data revealing racial or ethnic origins. Also, some coverage of manual records will be included in the new act (Hinde, 1998).