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# USER PERCEPTIONS OF TECHNOLOGY AND THE OFFICE

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## ABSTRACT

There appears to be a lack of research into user perceptions of technology and the office. Five studies of user perceptions of technology and the office were completed using questionnaires devised by the author (Studies 1-3), evaluation of videos produced by manufacturers (Study 4), and content analysis of media articles about computer-based technology (Study 5). In Study 1 eight factors were identified: information-handling, human contact, paper-handling, financial security, communication, technology, work, and health preservation. These factors reflected key features mentioned by respondents and accounted for 80.4% of the variance. In Study 2 subjects perceived that they would choose technology significantly more often than non-technology for document preparation, information management, and communication, and non-technology significantly more often than technology for decision-making. In Study 3 it was found that users and the computer industry seem to share broadly similar views of the nature of the 'Ideal Office'. However, while users appeared to emphasize an enhanced version of existing systems current developments seem to have the potential to create radical changes in the way people work and live. In Study 4 evaluation of video presentations about two prototype computer systems suggested that user perceptions could be deployed to evaluate the suitability of computer systems for application in different situations. In Study 5 content analysis of media portrayal of the computer industry supported the idea that the perceptions of technology and the office held by both users and the computer industry can also be categorised according to the eight dimensions identified above - thus, showing some convergence between the findings of different studies using different methodological approaches. However, whereas the users regarded all the dimensions as of broadly similar importance, the computer industry as represented by journalists appeared to regard technical details and financial issues as paramount. The thesis highlights the role of understanding user perceptions when evaluating technology and considering office work.

# CHAPTER 1 - INTRODUCTION

## SUMMARY

The rationale for investigating user perceptions of technology and the office is discussed. Despite much research into issues related to human-computer interaction, problems are still encountered when technology is used in the office. There seems to be little published research into user perceptions of the nature of office work and the role of technology in the office. The content of later chapters in this thesis is outlined.

## INTRODUCTION

The fictional conversation below (Taylor, 1994) illustrates the perspective to be taken in this thesis - consideration of user perceptions of office work and the role of technology in the office. It also illustrates problems which users may encounter when completing work using computers.

**"Maureen speaking."**

*"Maureen, are you doing anything in particular?"*

**"Not really, Professor Lapping. I was merely tearing out a few more lumps of hair."**

*"I'm having a little trouble with the old computer. What I'm trying to do is to get the Mission Statement from that letter we sent to the vice chancellor and stick it into the Introduction I'm writing to the Departmental Prospectus."*

**"You're trying to merge two documents?"**

*"Speak up Maureen, I've got the phone balanced on my shoulder."*

**"YOU'RE TRYING TO MERGE TWO DOCUMENTS."**

*"Got it in one."*

**"Well, first of all you need to press SHIFT and F3. Now what do you see on the screen?"**

*"It says* WINDOW LINE DRAW and REWRITE."

**"You must have pressed CONTROL instead of SHIFT."**

*"So what happens now. I've not lost the whole lot? All that work. And I can't possibly recreate it. This is very serious, Maureen."*

**"Press OUT. What do you see?"**

*"There's two sorts of indent arrows and a line with little sort of Indian tepees. And it says* PRESS REVEAL CODES TO RESTORE SCREEN *but I can't find* REVEAL CODES *anywhere on the keyboard."*

**"Press OUT and F3."**

*"Good heavens, Maureen. I'm back where I started."*

**"Now press OUT and F4. Then DELETE to get rid of the block of text you want to merge. Then SHIFT and F3 to find the second document."**

*"Yes, here it comes."*

**"Then press F1 and the text you've deleted merges with the second document."**

*"It's actually there.* AMAZING. *I've got the Mission Statement into the Prospectus."*

**"Well done, Professor Lapping."**

*"My word, Maureen, it makes one realise how much time one wasted before this information technology came along."*

**"It does indeed Professor Lapping."**

(Taylor, 1994)

## RATIONALE FOR THESIS

### Why study the user interface and user perceptions?

There may be physical, psychological, financial, and environmental consequences if user perceptions and characteristics are ignored. In addition there are moral, social, and political reasons for considering user perceptions. Inadequate understanding of the user interface may cause problems ranging from relatively minor delays and inconvenience to major disasters causing death, environmental pollution, and severe financial losses. The reasons for studying the user interface and methods available for investigating user perceptions are considered in more detail in Chapter 4.

The main reasons for investigating user perceptions of technology and the office are listed below:

1) The use of technology in the office is increasing.

2) Despite extensive research which has been carried out in the area of human-computer interaction computers are still perceived to be hard to use. There is a need to

extend knowledge of user perceptions so that there is an improved match between user perceptions and the design of technology (Norman, 1986, 1988).

3) A review of the literature (see Chapter 2) indicated that the assumption is made by computer designers and some researchers into human-computer interaction that the concepts of 'office work' and 'office technology' are interchangeable. For example, the claim that multiple windowing systems can enable users to complete office tasks more efficiently. There is a need to understand the nature of office work and the nature of office technology. Does office work have an independent existence? What is the function, structure and purpose of the office? It seems likely that while technology assists in the completion of office work it does not equate totally to 'the office'. There may be characteristics of office work which cannot be supplied by technology.

4) There seems to be a lack of research into user perceptions of technology and the office (see Chapter 4).

## ASSUMPTIONS MADE IN THE THESIS

### Terminology

**User**: A user is considered to be anyone who comes into contact with technology either directly or indirectly. Direct use could involve sending a message using electronic mail. Indirect use could involve being watched by an electronic surveillance camera.

**Perceptions**: These are considered to be thoughts and constructs concerning the nature of a phenomenon rather than merely attitudes that something is good, bad or indifferent. The author's definition of perceptions is considered further in Chapter 4.

**Technology**: Equipment, machines and mechanical devices. Emphasis in the thesis is on computer-based technology but other office equipment such as filing cabinets is also considered.

**Office**: Office work and the environment in which that work is completed. Office work may take place not only in a physical office but also in other locations such as on a train, walking along the street, at home, in the kitchen or living room, and so on.

**Office workers** include anyone who completes office work. That is, anyone who uses resources such as telephones, word processors, electronic mail, faxes, photocopiers and databases. Using this definition a wide range of people including academics, sports

managers, and doctors may be regarded as office workers. This differs from the narrow stereotypes in which office workers are considered to consist mainly of female secretaries who are either young "dollybirds" or "old dragons" (Thompson, 1989).

**Computer industry:** The manufacturers and suppliers of computer-based technology including software suppliers. People who work in occupations such as programming and interface design are also considered to be part of the computer industry.

**The nature of office work remains constant while technology changes**

As there are continual changes in the technology available for use in the office, specific types of technology may rapidly become obsolete (Oborne, 1985). One way to express the transitory nature of some technological developments is "*piscis cratinus papylo qui sapientum hodiernam continent*" - 'today's fish supper paper was yesterday's news' (Pennington, 1994). However, the basic features of office work seem to have remained constant throughout history. It therefore seems more useful to concentrate research on office work and office technology in general rather than on specific types of office technology.

This thesis aims to demonstrate the value of considering user perceptions. User perceptions are likely to affect their use of technology and should therefore be considered when assessing the acceptability, usefulness, and impact of office technology even though it may sometimes be hard to establish whether or not a particular perception reflects 'reality'. For example, imagine a glass with 100cl capacity containing 50cl of water. The optimist says the glass is half full, the pessimist says that it is half empty. Both viewpoints are correct but reflect different perceptions of the same 'reality'.

Greater knowledge of user perceptions of technology and the office may result in increased understanding of why technology is sometimes considered hard to use. The extent of the match between user perceptions and the perceptions of the computer industry concerning the role of technology in the office could provide an indication of the level of acceptability and perceived usefulness of particular technology. A high level of acceptability would be expected where there is a high level of agreement between users and the computer industry and a low level of acceptability where there is a low level of agreement.

## AIMS

The main aims of the thesis are:

1) To investigate user perceptions of technology and the office.

2) To investigate the relationship between information derived from the author's studies and existing knowledge of user perceptions of technology and the office.

3) To consider how knowledge of user perceptions of technology and the office can be applied to:

a) understanding office technology

b) understanding technology in general

c) understanding office work

d) user interface design.

4) To investigate the extent to which users and the computer industry share perceptions of the nature of office work and the role of technology in the office.

5) To consider perceptions in general:

a) **Why** should perceptions be studied?

b) **How** should perceptions be studied?

6) To produce research which may be of interest both to fellow researchers and to the general reader ('the public').

## INTRODUCTION TO THE THESIS

Chapters 1 to 4 include a review of the main issues related to user perceptions of technology and the office. Chapters 5-9 describe the author's empirical research. Chapter 10 discusses the thesis as a whole.

### Background to empirical research (Chapters 2-4)

### CHAPTER 2

In Chapter 2 ('The Office') it is suggested that the impact of technology on the office is an important area to study since "blessing or curse, IT is bringing about a drastic change in the business environment to which companies must adapt or die" (Lloyd, 1994). Key theories of the nature of office work and of the role of technology in the office are considered. The author concludes that it may be more appropriate to view office work and the role of technology in a multi-dimensional way than to concentrate on a single dimension such as paper-handling. It is argued that research should

emphasise the nature of office work rather than specific types of technology since technology becomes obsolete but the fundamental nature of work remains largely the same.

**CHAPTER 3**

In Chapter 3 ('Approaches to understanding human-computer interaction') various approaches to the study of human-computer interaction are considered with emphasis on how these approaches can be applied to the office. Office applications are given priority due to the widespread use of computers in the office although certain principles will be common to computer use whatever the particular application. The interaction between people and computers is an important research area: "throughout academia, industry and government there is an increasing awareness of the importance of human-computer interaction" (Booth, 1989). While there may be some overlap in the issues considered by different approaches, the scope and limitations of a particular approach need to be clearly defined.

There are two main types of model relevant to the study of human-computer interaction - the user's model of the system and the designer's model of the system. The empirical research described in Chapters 5-9 emphasises user perceptions.

**CHAPTER 4**

In Chapter 4 ('The role of user perceptions in investigations of human-computer interaction') the need to gain increased understanding of user perceptions is considered. It is suggested that even though user perceptions will affect their reactions to, and acceptance of, technology, user perceptions seem to be given insufficient emphasis by designers of technology. "User interface designs fail not just because of technical errors but because of failures of communication between user and designer and because of different perspectives of the role of systems" (Thimbleby, 1990). Lingaard (1992) suggests that "the focus of design and development of computer systems is changing" resulting in increased concern with "the appropriateness of the systems developers produce to the tasks and the users they are intended to support".

There is a discussion of the need for user-centred research, and an overview of user-centred methods of investigation and major issues in experimental design. The empirical research described in detail in Chapters 5 to 9 is introduced. This research consists of five main studies. Studies 1 and 2 investigate user perceptions of existing office technology, Studies 3 and 4 investigate user perceptions of trends in the development of technology, and Study 5 compares information derived from the earlier

studies with computer journalists' portrayal of the computer industry.

**Empirical research (Chapters 5-9)**

**CHAPTER 5 (STUDY 1)**

In Study 1 ('An investigation of user perceptions of the nature of office work') it is noted that while attitude research has investigated general issues related to human-computer interaction such as computerphobia (Brosnan and Davidson, 1994) there seems to be little research into user perceptions of the nature of office work and the role of technology in the office.

The aims of Study 1 are to investigate user perceptions of the activities which occur in a 'typical' office, the advantages and disadvantages of using computer systems in the office, and the features which people would allocate to a computer in their ideal office. Do the subjects share a common understanding of office work and the role of technology in the office? Do user perceptions of the nature of work reflect the author's view that office work may be described by a small number of basic elements?

**CHAPTER 6 (STUDY 2)**

In Study 2 ('The effect of situation characteristics on user perceptions of their use of technology') the perceived use of technology in 'typical' office situations is investigated. It is hypothesised that user perceptions of the methods they would use in office situations depend on their perceptions of 1) the characteristics of a particular situation and 2) the options available for a particular situation.

The use of technology is likely to be influenced by the specific situation and user perceptions of the characteristics of different forms of technology as well as by the actual characteristics of the technology available. User attitudes towards technology are likely to affect their use of technology. "A key variable in determining acceptance of new technology seems to be whether users have control over the decision of when and where to use it" (Spacapan and Oskamp, 1990).

**CHAPTER 7 (STUDY 3)**

In Study 3 ('User perceptions of the Ideal Office') it is noted that while the future of office technology is often considered, little reference to user perceptions of the 'Ideal Office' is found in the literature. User estimates of when the 'Ideal Office' will be implemented at reasonable cost are studied as well as their perceptions of the nature of the 'Ideal Office'. One of the aims is to determine the extent to which the perceptions of users and the computer industry coincide by considering current developments in office

technology.

Although current developments in office technology and 'the office of the future' may not necessarily be perceived to be 'ideal' such developments are considered to provide an indication of computer industry perceptions of the 'ideal' office and to provide a basis for comparison between user and computer industry perceptions.

Toffler (1970) mentioned *probable* futures, *possible* futures, and *preferable* futures. Using Toffler's classification, current developments in office technology may be regarded as the probable future, user perceptions of the 'Ideal Office' may be regarded as the preferable future from the viewpoint of the users, and technology designed by the computer industry taking note of user perceptions could be regarded as the possible future of office technology.

Literature relating to the impact of current developments in technology on society in general is also considered as computers are increasingly used at home as well as in the office and the distinction between 'home' and 'office', 'work' and 'leisure' and even 'human' and 'non-human' is becoming less distinct.

**CHAPTER 8 (STUDY 4)**

In Study 4 ('An evaluation of current developments in computer-based office systems') it is noted that user perceptions of the efficiency and ease-of-use of technology need to be assessed. The merits and limitations of various evaluation options are discussed. The choice of options will depend on the purpose of the evaluation, resources available (e.g. facilities, money, number of researchers), and so on. Reiterer and Oppermann (1993) note that each evaluation method has advantages and disadvantages and that no one method is sufficient if used in isolation. Since the emphasis in this thesis is on user perceptions attitude measures are considered to be a suitable method of evaluation. The use of video for evaluation is discussed. A weighted factors evaluation method is used and related to the expectancy-value model of attitude formation (Fishbein and Ajzen, 1975).

A questionnaire (the Evaluation Questionnaire) derived by the author from the results of earlier studies (Study 1, Study 2) is used to evaluate videos produced by two leading companies to describe the systems they were developing. (Products reflecting similar research and development have subsequently appeared on the market.) Subjects are asked to evaluate the suitability of the systems for use in specific situations using rating scales. The aims are to assess user perceptions of the usability of specific systems in

specific situations and to see whether the method used discriminates between different computer systems. That is, are different usability evaluations produced for different systems? If so, this demonstrates that the Evaluation Questionnaire can be used to determine whether one system is perceived to be more suitable for use in specific situations than another system.

**CHAPTER 9 (STUDY 5)**

In Study 5 ('Content analysis of computer journalists' portrayal of the computer industry') the merits and limitations of content analysis are discussed. Content analysis of computer publications is considered a relevant technique to employ because the media may influence and/or reflect user perceptions and newspapers provide up-to-date coverage of computer industry developments and perceptions.

Study 5 is considered to provide a basis for comparison with the results of the author's earlier studies (Study 1-Study 4). Content analysis of the computer pages of two publications (*The Guardian* and *PC Week)* for the period January 1991-June 1993 is carried out to determine the extent to which user perceptions of technology and the office identified earlier in this thesis are shared by the computer industry as portrayed by journalists. It is thought that the content of computer publications provides information on computer industry perceptions since the media are expected to report items regarded as important by the industry. The media content is also expected to reflect computer industry perceptions of user perceptions.

**Conclusions and recommendations**

**CHAPTER 10**

In Chapter 10 ('User perceptions of technology and the office: Discussion and conclusions') the author provides a critique of the thesis. The value of studying user perceptions of technology and the office is considered in the light of both the findings of the thesis and existing knowledge. The applicability of the author's research to emerging research issues is discussed.

**Relationship between the author's empirical studies and existing knowledge**

This section elaborates the relationship between the author's empirical studies and existing knowledge.

**Existing knowledge:** Chapters 2 to 4 consider background literature relevant to the study of user perceptions of technology and the office. Chapter 2 considers theories of office work and the role of office technology, Chapter 3 approaches to the study of human-computer interaction, and Chapter 4 the need to understand user perceptions.

**The author's empirical studies:** The author's empirical studies of user perceptions of technology and the office are described in Chapters 5 to 9 (Studies 1-5). Study 1 considers user perceptions of office work and office technology in general ('the office as it is at present'), Study 2 is derived from the results of Study 1 and considers user perceptions of their use of currently available technology in 'typical' office situations. Study 3 evaluates current developments in office technology ('the office as it is likely to be') and relates these to user perceptions of the 'ideal office' ('the office as it could be'). In Study 4 situations derived from Study 2 form the basis of a questionnaire to enable the evaluation of two prototype systems designed by leading companies to take place. In Study 5 content analysis of portrayal of the computer industry by computer journalists is used to determine the extent of agreement between knowledge of user perceptions gained from Studies 1-4 and the perceptions of the computer industry as portrayed by computer journalists.

## SOURCES CONSULTED

Although thousands of references exist relating to the broad topics of 'human-computer interaction', 'attitudes', and so on, little research directly relevant to 'user perceptions of technology and the office' was identified (see Chapter 4). However, information was collected from a wide variety of sources. These sources may be broadly categorised into 'academic reports' (CD-ROM databases, journals, books, and conferences in the areas of human-computer interaction, psychology, and ergonomics, and so on) and 'non-academic reports' (newspapers, magazines, television, radio, and so on). Although the dependability of different references may vary, all sources are considered to provide valuable information in the context of gaining knowledge about user perceptions. A discussion of the merits of different sources of information and criteria for deciding on the dependability of a particular reference are provided in Chapter 4.

The references which were included in the thesis are considered to be indicative of the key issues rather than exhaustive. For example, the number of articles in newspapers relating to information technology is such that it was not feasible to include every article.

### Criteria for the inclusion of references in the thesis

Available articles appear in a variety of sources: psychological journals, newspapers and elsewhere. These will vary in academic rigour, the data on which they are based, the quality of the argument and the ease with which authors are willing to reach conclusions.

The following criteria were used in the present case: immediate relevance to the thesis, dependability of the source bearing in mind issues such as academic rigour, the potential influence of the author, recency of publication, nature and quality of the evidence, and the extent to which the source or article is seen to be representative of contemporary views in the field in question. The use of stringent criteria enabled the author to be selective in deciding whether to include or exclude references. Only references considered to meet the above criteria were included.

**Potential influence of the author:** Although some authors may have dubious credentials and produce controversial material (whether verbal or written), their ideas may have an enormous influence on the perceptions and, possibly, the behaviour of society. Other authors may be both reputable and influential.

**Recency of publication:** On the whole recent references (the last 5-10 years) were given priority. However, the importance of the age of a reference depends on the context. If describing current developments in technology and current perceptions up-to-date references were preferred. Nevertheless, older references may still be pertinent. Examples of ancient ideas and publications which have not ceased to be influential because of their age include Pythagoras' theorem and The Bible.

**Provision of a wide variety of sources of 'evidence' for particular ideas:** Reliance on a single source of evidence such as 'reputable' academic journals could result in overlooking important sources of information.

The decision to include or exclude a reference may not always be easy. A tradeoff may be necessary between including various types of reference and ensuring that the sources quoted have scientific dependability. However, the bibliography cited by the author and the extent of cross-citation, often provided a clue to aid the decision. No thesis will be exhaustive in its referencing except when it addresses a narrow and focused field of research. In the present case the author has sought to err on the side of economy.

The sources consulted were considered appropriate since the emphasis of this thesis was on user perceptions. A wide variety of people are potential or actual users of office technology and would therefore be expected to have perceptions relating to technology. They also have access to media sources of information which in turn may influence their judgements and purchasing decisions.

## CONCLUSION

Technology has both strengths and weaknesses. Effective use of technology in the office involves exploiting the strengths of technology while minimizing the weaknesses. There is a need to gain increased understanding of user perceptions of technology and the office in order to add to knowledge of the user's model of technology. This thesis aims to investigate user perceptions of technology and the office and to compare these with existing theories of office work and the role of technology.

# CHAPTER 2 - THE OFFICE

## SUMMARY

This chapter provides an overview of the main theories of the nature of office work and of the role of technology in the office. Existing theories of office work often stress the role of computer-based technology. However, the author suggests that it may be more important to understand the nature of work rather than concentrate on specific forms of technology. The fundamental nature of work is thought to remain the same while the technology used to complete that work is constantly changing. Although computer-based technology has a powerful role in modern offices, an understanding of technology does not suffice to explain all facets of office work.

## INTRODUCTION

The impact of technology on the office is considered an important area to study since the office "is where most people at work will be employed during the 1990s and beyond" (Christie, 1987). "Just over half of the entire working population in Britain will go to work in an office today. Nearly 14 million people..." (Myerson, 1993). In 1989 it was estimated that by 1993 around 52 per cent of white collar workers would be using a personal computer or workstation (ESPRIT - European Strategic Programme for Research and Development in Information Technology, 1989). Panko (1989) claimed that "the use of computers is exploding in almost every industrialised country. It is hard to find an office anywhere that does not have at least one computer, and many companies have almost as many personal computers and terminals as they have employees."

The office may be considered in various ways, with a broad emphasis on the administrative and information-handling aspects of an organization. An office may be defined according to the type of people who are classified as 'office workers', the furniture and equipment used by those people, and the nature of the work undertaken. There will be basic similarities in these areas although the term 'office' is not restricted to a physical office in an office block. It includes hospitals, airports and academic establishments, and anywhere else where information is used, including the 'mobile' office and the office of the homeworker.

While modern research into the office stresses information technology, it can be argued that investigation of information technology per se is less important than gaining an understanding of what people do in the office. Technology becomes obsolete (Oborne, 1985) but the basic tasks remain the same. Papyrus is no longer used but the desire of

people to 'write down' and communicate information still exists thousands of years later. Manual typewriters were superceded by electric and electronic typewriters which in turn were replaced by the word processor, and so on (Smith, 1991).

Various terms can be used to refer to the application of computer technology to improve office efficiency: **office automation, the electronic office, the office of the future, the paperless office, office systems** (Stewart, 1984). However, the distinction between the 'traditional' and the 'electronic' office is regarded as unnecessary - the term 'office' is considered sufficient and is chosen to illustrate the stability and continuity of core office work.

While models such as the desktop metaphor indicate that 'The Office' is considered to be synonymous with 'Office Technology' and 'Office Automation' it is felt that while technology is an integral, and increasingly influential, part of the office it does not equate to office work. For this reason, a distinction is made below between 'Office Work' and 'Office Technology'. The references included in this chapter are thought to represent influential theories of office work and the role of office technology. The modal dependability rating for the references is 5 (see Chapter 4).

## PART 1 - OFFICE WORK

### HISTORY OF OFFICE WORK

It can be argued that the office has existed ever since people began to work and that the basic nature of the office has not changed much over the centuries. What has changed are the mechanisms for completing that work. Stewart (1985) suggests that the history of the office dates from "the monks in their cells copying religious texts". Certain aspects of office work such as communication of information and money-handling may date back even further than this - for example to the time of the Greeks and Romans with the marathon runner in Ancient Greece being regarded as an early form of long distance communication superceded today by the telephone and facsimile. Field (1985) describes an office from Egyptian times and compares the use of papyrus and calculating frames with modern use of computers for data input.

The term 'office' was used as early as the seventeenth century. Many of the entries in the diary kept by Samuel Pepys refer to his work as secretary and clerk in the Admiralty: "...then to the office, where I and Sir W. Penn only did meet and despatch business" (3 August 1660), "This morning I was busy looking over papers in my

office..." (4 October 1660), "At the office ... I took much pains in sorting and folding of papers" (12 March 1662) (Pepys in Latham, 1985).

## CURRENT MODELS OF OFFICE WORK

Various models of office work exist such as the functional/activity view and communication view. Models of office work such as the desktop metaphor, information-handling view, and multiple-task view, which stress the use of technology are discussed in Part 2 - Office Technology.

### The 'Paperwork factory'

Prior to Victorian times it is thought that the prevalent office mode was pen and ink and face to face (Field, 1985). Stewart (1985) suggests that since Victorian times the formal office as we know it today has been organized around paper as "the vehicle for information" with the role of office workers being to create, collect, store, assimilate, communicate, and process the information. The term "paperwork factory" is used by Stewart (1984, 1985) to indicate that paperwork is assimilated in the same way as raw materials are processed in a factory. Field (1985) comments that "as in the factory" the ideas of Frederick Taylor concerning scientific management were applied.

### Functional/Activity view

The functional view emphasises the structure of office work and the tasks which comprise office work. Office work may be described as a set of activities or tasks (Hirschheim, 1985; Hines, 1985 - cited by Christie, 1987). Such functions may include purchasing, sales, accounts, and reports (Field, 1985). The office is not regarded as a place but as an environment where specific activities or tasks which support the operation of the organization take place.

The tasks users are most likely to perform include creating and modifying documents, filing and retrieving documents (such as files, reports, memos, papers, etc.) and records, preparing presentations, planning schedules, manipulating spreadsheets (for accounting and performing calculations) and vaguely defined tasks such as analysis (Herbach, 1983).

While developments in office technology seem to reflect the activity view of office work (Christie, 1987), the activity view seems limited in that it applies only to routine work and cannot be used to understand non-routine work, particularly collaborative work (Bjørn-Andersen, 1986). This limitation is likely to become more apparent as the interest in computer-supported cooperative work grows. Another limitation of the

activity view is that it considers **what** activities are performed and by whom without considering **why** those activities take place (Hirschheim, 1985).

### Communication view

Office work can be regarded as more than a set of activities. It has **structure** based on networks of **communication** and on **time** - events do not occur at random but in accordance with meaningful sequences. It also has **functionality** (purpose) - that is, office work is, to a significant extent, based on the achievement of a hierarchy of goals. Bjørn-Andersen (1986) noted "the enormous importance of informal networks and human adaptability which are part and parcel of getting any office system to work." Conrath et al. (1981, cited by Christie, 1987) suggested that office work consisted of communication and processing.

### Workflows

An organization may be described as a network of interleaved 'workflows' in which organizations consist of "observable events which occur when people take certain classes of linguistic actions which have the effects of defining and fulfilling conditions of satisfaction with the organization's internal and external customers" (Winograd, 1992 - cited in Baecker, 1993). The emphasis on language in this model makes it appear uni-dimensional as while language may be important, it is not the only feature of work.

### Overview of models of office work

While all the views of office work mentioned above stress important aspects of the office, they seem to have limited applicability in that they do not adequately explain **all** aspects of office work. The emphasis in these models seems to be on a single dimension of office work such as paper-handling or communication.

## FUTURE MODELS OF OFFICE WORK

There is likely to be less emphasis on individuals working in an organization on tasks such as document production using word processors and increased interest in issues related to communication, group dynamics and team working as the number of organizations using technology which facilitates computer-supported cooperative work grows.

Two other significant areas are likely to be the physical and psychological consequences of using virtual reality and the social impact of teleworking. Teleworking

and computer-supported cooperative work are considered in more detail in Chapter 6 and virtual reality is discussed in Chapter 7.

## RESEARCH ISSUES RELATED TO OFFICE WORK

Can office work be classified in terms of core dimensions and described independently from the technology used to complete that work? It has been suggested that "understanding what people do in offices is not an easy task, since office work is so diverse and ill-defined" (Czaja, 1987). However, in later chapters the author proposes that office work can be described in terms of a few universal dimensions. User perceptions of the nature of office work and the role of technology in the office are investigated in Chapter 5 (Study 1) and compared with existing models of office work and the role of office technology.

# PART 2 - OFFICE TECHNOLOGY

This section provides an overview of the major trends in the development of office technology. A more detailed discussion of the impact of particular types of products can be found elsewhere in this thesis (see Chapter 6 and Chapter 7).

## HISTORY OF OFFICE TECHNOLOGY

A forerunner of the modern computer is considered to be the 'Analytical Engine' designed by Charles Babbage (1792-1871) (Gilchrist, 1993). The tabulation machine developed by IBM for the 1890 U.S. census was an early type of computer. In 1945 computer design was revolutionised by the invention of the transistor and since then computers have become quicker, smaller and more powerful (Gilchrist, 1993).

The typewriter developed by Desmore and Scholes in 1873 may be regarded as an early form of technology intended specifically for use in the 'modern' office (Stewart, 1985). Other technology available at this time included the telephone and duplicator. In the 1920's the electric typewriter, a predecessor of the modern word processor, was introduced. In 1951 the Lyons Teashop Company began using a computer called LEO (the Lyons Electronic Office) for data processing (Stewart, 1984, 1985).

Despite the observation of Poppel (1982) that "the office seems to be the last outpost of resistance to automation, if one can judge by the small amount of money companies are now spending on it", a few years later Christie (1987) stated that the office had become the "single largest market for information technology". Lloyd (1994) wrote that "blessing or curse, IT is bringing about a drastic change in the business environment to which companies must adapt or die".

User interfaces in early computer systems often depended on line printers or teletype printers with output consisting of a linear sequence of printed pages or lines. As the use of screens increased, designers often applied highlighting and two-dimensional interactions with sections of the screen devoted to specific fields such as a title, error messages, instructions, online help or data blocks. An early recognition of the need for some sort of windowing system was made by Page and Walsby (1979): "A mechanism for keeping several distinct items of information on the screen simultaneously is required".

Eventually, designers began to assign meaningful groups of information to specific windows (Shneiderman, 1987, 1992). The first commercially-available windowing system was created by Dan Ingalls and formed part of the Smalltalk programming environment developed at the Xerox Palo Alto Research Centre (PARC) in 1975 (Billingsley, 1988).

In 1981 personal workstations called ALTOs were developed which use software such as Smalltalk for window management. Each window may be regarded as a variable-size virtual screen which reflects the progress of an activity. The effect "is one of looking at a small desk with papers of varying sizes lying partially on top of one another" (Foley and Van Dam, 1982). When multiple activities are in progress simultaneously, their results can be displayed in their respective windows on the screen.

The use of specific windows was followed by the development of **independent** windows. Independent windows allow separate processes to be executed and permit windows to overlap. Overlapping windows increased in popularity through the Xerox Star "a multifunction system combining document creation, data processing, and electronic mailing, filing, and printing" (Smith et al., 1982) and later on the Apple Lisa and Macintosh (Shneiderman, 1987).

An example of a multiple windows system is Rooms. The intention of Rooms is to facilitate task switching by providing an integrated work environment (Card and Henderson, 1987a). Users switch from one window ('Room') to another using icons ('Doors') (Card and Henderson, 1987b; Schofield, 1991).

The growth in use of graphical user interfaces (GUIs) and systems allowing the use of multiple windows has continued in recent years to the extent that it was suggested that they are "taking over the PC world" (Schofield, 1991). Microsoft Windows has become a great commercial success.

Bolt (1987), a principal research scientist at the Massachusetts Institute of Technology (MIT) Media Laboratory, predicted that eventually "supreme usability" will be attained by making the computer "as easy and as interesting to talk to as another person, for the novice or occasional user as well as the computer veteran". In the Media Room at MIT the whole room serves as a computer terminal with one wall acting as the screen. The user can create and move objects by talking and pointing. Currently, Bolt, Koons, and colleagues at the Media Lab are building systems that take inputs in the form of speech, gesture, and eye gaze in an attempt to mimic human patterns of communication (Voss, 1995).

As developments in technology occurred and people other than computer specialists began to use computers, the need to provide more accessible and usable interfaces was recognised. Some early interfaces were notoriously difficult to use. In the early 1980s the author experienced an interface where an error message would print over and over again until an 'expert' could be found to diagnose the problem. The machine could not be switched off in case the hard disc was damaged. Although usability problems are still found today and a whole human-computer 'industry' has emerged, computers have become more usable. However, Negroponte, the director of the Media Studies Laboratory at the Massachusetts Institute of Technology, argues that while enormous improvements have been made in input from machine to human, difficulties still arise in input from human to machine and comments that: "So we have sound, colour, video, and so on. But, the other half that goes from the person into the machine is still bankrupt. We have the same crummy interface, comprising mainly of the keyboard and mouse." (Patel, 1995).

## CURRENT MODELS OF THE ROLE OF TECHNOLOGY IN THE OFFICE

Various views of the application of technology to office work exist including the widely-used 'desktop' metaphor, the 'information-handling view', and the 'communication' view.

### Desktop metaphor (Paper-handling view)

The desktop metaphor has, perhaps, been one of the most influential views in the development of office technology. The aim of the desktop metaphor is to provide similar flexibility to a traditional desk so that it is possible to "shuffle the papers on the desk" to make it easier to swop from one task to another (Coats and Vlaeminke, 1987). The idea of designing a system using the desktop metaphor is to represent computer concepts such as files, directories of files, and command names on the screen

as objects with which users are familiar "in their everyday work" (England, 1987). The contents of an electronic "desk" may be said to correspond to multiple files and processes which can be changed dynamically and independently (Foley and Van Dam, 1982).

Page and Walsby (1979) suggested that workstations would be the main component of the automated office and predicted that: "Workstations will be highly intelligent and highly interactive computer systems intended to replace the traditional desk, filing cabinet, and other information-handling aspects of office work." Coulouris (1979) also mentioned an office information system which could replace the typewriter, filing cabinet and desk.

In the Star user interface Smith et al. (1982) created electronic counterparts to the physical objects in an office such as paper, folders, filing cabinets, and so on in order to "make the electronic 'world' seem more familiar, less alien, and require less training". Although Smith et al. state that their initial experiences with users have confirmed this assumption, (Reichman,1986) suggests that unlike a conventional desk, where a system has been designed according to the desktop metaphor, the user is required to remember how he/she has organized their electronic desk as the main interrelationship between the contents of the desk is that which exists in the mind of the user.

The desktop metaphor seems to stress information-handling capability and paper-handling but ignore other aspects of office work such as communication, decision-making, and human contact.

**Information-handling view**

The information-handling aspects of office work are emphasised in many theories. "Offices are essentially information processing and transformation systems" (Oborne, 1985). "The functions of the office are thus concerned with meeting information needs" (Wainwright and Francis, 1984). According to Herbach (1983) the main use for computers in the office is increased information-management efficiency. Armour (1986) stated that information processing is the main purpose of office work. Coulouris (1979) suggested that office work is concerned primarily with the acquisition, storage, transformation and presentation of information.

Stewart (1984) described offices as "information-processing systems comprising people, equipment and procedures". Thompson (1989) suggested that "... there is very

little difference in function between the old fashioned office and the fully-automated version - both are concerned with the input, processing, and output of information."

The Functional Analysis of Office Requirements project (FAOR), considered in detail later in this thesis (see Chapters 4 and 5), concluded that the office consists of "persons engaged in interrelated, partially deterministic and partially independent functions using technology for generating, handling, communicating and filing information" (Schäfer et al., 1988).

The idea that information-handling plays a vital role in office work also appears to be apparent in the frequent reference to computers in the office as 'information systems' and in the term 'information technology'. While a broad definition of information-handling might include dimensions such as decision-making and communication, the use of terms such as 'storing' and 'filing' implies a narrow emphasis on only the paper-handling aspects of information management.

**Communication view**

In addition to supporting a **variety of individual tasks** or activities, a major function of the 'electronic office' is to provide appropriate **communications support** as procedures and higher level units of work involve communication between different office workers and between organizations (Christie, 1987).

Advances in networking technology mean that users now have to communicate **through** the screen with the **organization** in addition to **with** the screen (Gardiner, 1986). The increasing use of teleworking (e.g. Huws et al., 1990) is likely to increase interest in telecommunications and support for distributed working. Teleworking is discussed in greater detail in Chapter 6 .

**Decision-making view**

The interest in the application of artificial intelligence and development of expert systems and decision-support systems implies a view of office work in which decision-making is considered to be paramount. Barber (1983 - cited by Christie, 1987) used ideas from artificial intelligence to describe office work as a goal-directed problem-solving activity.

Negroponte (1989) suggested that the desktop metaphor would be replaced by a **theatrical metaphor** involving speech, animation, and a society of intelligent agents.

The growth in use of multimedia and virtual reality indicates that Negroponte's prediction may be correct.

As with other views described above the 'decision-making' view is valid for a limited application but does not suffice to describe all aspects of office work.

**Multiple-task view**

The multiple-task view is considered to be particularly relevant due to the current widespread use of systems offering graphical user interfaces and multiple windows. It has been claimed that graphical user interfaces "are based on the way people use their offices" (Schofield, 1991). Smith (1990a, 1990b, 1991) discussed the advantages and limitations of using multiple windows.

Office workers, including secretaries, clerks, executives and managers, undertake a wide range of activities. For example, the office worker may wish to send an item of electronic mail while simultaneously using a word processor. This problem was mentioned by several authors. Coulouris (1982) noted that no fully-developed interactive systems existed that could meet the needs of workers requiring facilities other than word processing.

Traditional computer terminals or office work stations only allow one job at a time to be displayed on the VDT screen limiting their usefulness as an all-purpose office and professional worker's tool (Card, 1985). Marshall et al. (1987) noted the lack of "serious attempts to integrate the entire office environment in a coherent context".

Windowing is the main method of providing support for multiple tasks so that people can work on several different jobs at once. It has been suggested that windowing enables user-system interaction to become more natural so that it can support the way people really work (Reichman, 1986; Billingsley, 1988) and that the use of multiple windows allows the screen to emulate the office desk more closely and to 'fit in with a worker's daily routine' so that the user can interact with the workstation more effectively (Card, 1985).

Another claim for systems using multiple windows is that windowing systems enable human-computer interaction to approximate everyday types of interaction among people, unlike early communication procedures between people and computers which were quite limited, linear, and constrained (Reichman, 1986). The above comments can be questioned - what is the 'way people really work', what is 'a worker's daily routine',

and do windowing systems really 'enable human-computer interaction to approximate everyday types of interaction among people'?

The growth in use of multimedia and increase in interest in computer-supported cooperative work mean that the effect of technological developments on physical and psychological aspects of communication needs to be carefully considered. In Chapter 6 the effect of computer technology on communication is considered further.

One of the limitations of windowing systems is a potential mismatch between the user's and designer's model of the system. It is important to have an adequate understanding of the user when designing windowing software. This includes consideration of the characteristics of the user and the structure of the tasks to be performed (Norman et al., 1986). If an inappropriate model is used when developing the interface problems may arise.

Software designers should concentrate on what the user can do with a window rather than on how the window can be accessed (Card et al., 1985). Shneiderman (1987, 1992) commented that there was a great need for testing to evaluate window design concepts. Marshall et al. (1987) mentioned that little empirical data exist on which to base design decisions and Billingsley (1988) stated that: "In spite of the number and variety of existing windowing systems we know very little about the impact of windowing on users ... much research remains to be done in this domain". The emergence of de facto standards for windows such as those established by Microsoft has lessened the need to concentrate on technical issues relating to the use of windows.

**Overview of key views of the office**

The extent to which key views of the office meet the criteria regarded by the author as essential for understanding office work and the role of technology in the office is considered below.

The comment made by Hurwitz (1991) in connection with the desktop metaphor that "if one desktop tries to be all things to all users it will not survive" seems to be equally applicable to other views of office work described above. That is, while each view seems appropriate for some aspects of office work, no one view seems applicable to all aspects of the office. Bjørn-Andersen (1986) argued that "technologists have ... a uni-dimensional perception of what constitutes an office". It may be that no single view could describe office work adequately and that it is more appropriate to view office work and the role of technology in a multi-dimensional way. If this is the case then the

advocates of a particular approach need to recognise the strengths and weaknesses of that approach rather than implying that one approach is all-inclusive. None of the views described above met all the criteria considered essential by the author (see Table 1). The views which met most of the criteria, and may therefore be the most appropriate for describing office work and the role of technology in the office were the multiple-task view and the communication view.

**TABLE 1 - EXTENT TO WHICH ESSENTIAL CRITERIA ARE MET**

| VIEW OF OFFICE WORK | ARE CRITERIA MET? | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| "Paperwork factory" | X | X | X | ✔ |
| Functional/activity view | X | ✔ | X | ✔ |
| Communication view | ✔ | X | ✔ | ✔ |
| Workflows | ✔ | X | X | ✔ |
| Desktop metaphor | X | ✔ | ✔ | X |
| Information-handling view | X | ✔ | X | ✔ |
| Decision-making view | X | X | ✔ | ✔ |
| Multiple-task view | X | ✔ | ✔ | ✔ |

**NOTES**
**Essential criteria:**
1. Person-centred rather than Technology-Centred.
2. Recognises the complexity of office work. Is the view multi-dimensional rather than concentrating on a single dimension or limited number of dimensions?
3. Emphasises the role of computer-based technology.
4. Are office functions and activities stressed rather than office equipment and technology?
✔ = Criterion met
X = Criterion not met

### Current developments in office technology

Current developments in computer-based technology, particularly virtual reality, increasing use of computer networks, and multimedia systems comprise a huge change in comparison with earlier computer-based systems which tended to be restricted to glorified adding/calculating machines and enhanced typewriters. This has the potential to have a far-reaching impact not only on the techniques available for completing particular tasks but on the whole way in which people live and work. The pace of change appears to be accelerating to such an extent that society as a whole may be affected by current technological developments. Trends in the development of office technology are considered in greater detail in Chapter 7.

## FUTURE TRENDS IN OFFICE TECHNOLOGY

Predictions for the future are difficult unless one has access to a crystal ball! However, judging by current trends, there will be greater emphasis on the use of networks and

communications technology for computer-supported cooperative work, further growth in the use of CD-ROM for information management, more use of multimedia and an increasing interest in virtual reality and artificial intelligence. It has been suggested (Gale and Christie, 1987) that extensive use of networking and enhanced communications could mean that the system itself *becomes* the organization.

## RESEARCH ISSUES RELATED TO OFFICE TECHNOLOGY

1. Various claims have been made concerning the benefits provided by computer technology. These claims are discussed in more detail in Chapter 6. In Chapter 5 (Study 1) user perceptions of the advantages and disadvantages of using technology in the office are considered. In Chapter 6 (Study 2) user perceptions of their use of technology in particular circumstances are investigated.

2. Do user perceptions of the 'Ideal Office' coincide with the perceptions of the computer industry and with trends in the development of office technology? This issue is considered in Chapter 7 (Study 3).

## CONCLUSION

Although there has been a change in emphasis in models of office work from those which concentrated on a single user operating a word processor to models of computer-supported cooperative work which consider the impact of technology on groupworking some of the theories of office work reviewed in this chapter seem to imply that the office is inextricably linked with technology and perhaps equates to computer-based technology. Unlike technology which changes rapidly, facets of office work such as collecting money from customers, evolve slowly over time and use technology "as a means to an end rather than as an end in itself" (Stewart, 1984). It therefore seems more sensible to have a clear understanding of high level issues relating to office technology rather than low level issues although it is recognised that there may be a need to understand specific details of the computer interface when considering a specific design issue such as the effects of a particular type of keyboard on the user's ability to press the keys easily, and so on.

This chapter has described key theories of office work. In Chapter 3 the emphasis is on approaches to understanding the use of office technology in the context of key theories of human-computer interaction.

# CHAPTER 3 - APPROACHES TO UNDERSTANDING HUMAN-COMPUTER INTERACTION

## SUMMARY

Although interfaces have become more usable since computers were first introduced, there is still room for improvement and a whole area of research - human-computer interaction - has emerged. Various approaches to the study of human-computer interaction are considered with emphasis on how they can be applied to the office. The approaches considered include: the Quantitative approach, the Psychophysiological approach, the Cognitive approach, the Social Psychological approach, the Ergonomic approach and the Integrated approach. "No single complete model of the user-system interface exists" (Williges, 1987). A rigid adherence to one approach or specific model is counter-productive to understanding the complexity of the user interface.

## INTRODUCTION

In Chapter 2 the proliferation of computer-based technology was noted. As more and more people from a variety of backgrounds began to use computers it became clear that improvements to the interface were needed. This has resulted in much research related to computer use. This research, which can involve input from a variety of disciplines, is broadly categorised as human-computer interaction. The growth in interest in human-computer interaction (HCI) is noted by Booth (1989): "Throughout academia, industry and government there is an increasing awareness of the importance of human-computer interaction." 'Human-computer interaction' is sometimes called 'user-system interaction'. However, the term 'human-computer interaction' is used in this thesis since it tends to be more widely-used than 'user-system interaction' and because while complex technology may sometimes be involved, in other cases the technology may be too simple to merit the title 'system'.

This chapter considers various approaches to the study of human-computer interaction with emphasis on how these approaches can be applied to understanding the use of computer-based technology in the office. Office applications are given priority due to the widespread use of computers in the office (see Chapter 2). However, certain principles will be common to computer use whatever the particular application. More detailed descriptions of the main approaches and issues considered in human-computer interaction can be found in "the growing number of articles and books" (Booth, 1989) including Baecker and Buxton (1987), Barker (1989), Booth (1989), Thimbleby (1990), Johnson (1992) and Shneiderman (1992).

Williges (1987) distinguishes two broad categories of models of the user - conceptual and quantitative models. **Conceptual models** deal mainly with how the user represents cognitive processes such as information processing, perception, attention, memory, decision-making and response selection. **Quantitative models** are mainly concerned with the numerical representation of user performance, ergonomic models which use anthropometric and biomechanical data, computer simulation models and statistical models.

Another way of considering the classification of approaches to the study of human-computer interaction proposed by the author is to divide the approaches into three main categories - those which give priority to the investigation of computer characteristics (quantitative approach), those which give priority to human characteristics (cognitive approach, social psychological approach) and those which attempt to give equal priority to both the human and the computer (ergonomic approach, integrated approach).

There are many dimensions to the performance of a user-computer system which may be considered by the different approaches to understanding human-computer interaction. Some of these dimensions include (Card et al., 1980):

1. **Time** - How long does it take a user to accomplish a given set of tasks using the system?
2. **Errors** - How many errors does a user make and how serious are they?
3. **Learning** - How long does it take a novice user to learn how to use the system to do a given set of tasks?
4. **Functionality** - What range of tasks can a user do in practice with the system?
5. **Recall** - How easy is it for a user to recall how to use the system on a task that the user has not done for some time?
6. **Concentration** - How many things does a user have to keep in mind while using the system?
7. **Fatigue** - How tired do users get when they use the system for extended periods?
8. **Acceptability** - How do users subjectively evaluate the system?

Issues such as system response time and system security need to be considered in addition to the design of hardware and software (Fischer, 1984; Shneiderman, 1992).

Hammond et al., (1987) suggested that the following issues need to be considered when assessing the usability of office systems: Does the system provide the necessary functions? Is the system easy to learn? Is the system easy to remember? Bjørn-Andersen and Rasmussen, 1980 (cited by Hammond et al., 1987) mentioned the need

to consider how computerized tasks can be organized so that they can fit successfully into existing work and social contexts.

However, it may be incorrect to assume that users require systems to be easy to learn, easy to use, and provide specific functions. Ease of use and usefulness may be incompatible as a system which is easy-to-learn may not necessarily provide the versatility of function required by users. A system which is initially hard-to-learn but eventually mastered may be better understood by the user.

The author has been very critical in selecting material for the present chapter. This has resulted in the exclusion of papers which have a low score according to the author's criteria of dependability. Thus the issues debated and the sources used benefit from a high degree of academic rigour having a modal dependability rating of 5 (see Chapter 4). Other sections of the thesis will, by their nature, be obliged to sample different sources which may produce more variable reliability.

## QUANTITATIVE APPROACH

In the quantitative approach to understanding human-computer interaction formal representations of interfaces are considered to provide the tools necessary to explore the psychological aspects of the 'cognitive complexity' of a device, and to provide the quantitative metrics necessary for applying these theoretical ideas to the design of actual products (Kieras and Polson, 1985). Such techniques include the use of Backus-Naur Form (BNF) which consists of grammatical rewrite rules and transition network diagrams.

The information processing characteristics of a user of a computer system may be described in terms of models. An early, influential, model in HCI research was the Model Human Processor (Card, 1984). This Processor contains a Perceptual Processor, a Cognitive Processor and a Motor Processor. These Processors can be described in a qualitative way and also using quantitative parameters such as cycle time.

The Keystroke Level-Model considers the processing limits of the user in relation to interface components such as a keyboard and pointing devices (Card, 1984). As the name suggests, the Keystroke-Level Model analyses the interface at the level of quantitative measures of keystrokes and enables predictions to be made about the time it takes an expert user to perform a given task on a given computer system (Card and Moran, 1980).

Command Language Grammar is a symbol-based notation developed by Moran (1981) at Xerox Parc. Moran describes Command Language Grammar from a linguistic view, a psychological view, and a design view. The emphasis is on commands input to and output from the system. One limitation of this approach, which may be common to other HCI models, is that it "only concerns itself with the design of the user interface and not with a complete application" (Johnson, 1992).

Thimbleby (1990) discusses the merits of using a formal approach to understanding human-computer interaction and proposes that since mathematics is a "normal and essential part of design" in engineering disciplines it "has a useful place in user interface design too". Dix and Harrison (1986) propose that formal methods provide a precise way to ensure that a computer system satisfies requirements such as **generative user engineering principles** and enable an objective evaluation of improvements in usability to be made.

Quantitative models have not been widely-used as design tools for building user-system interfaces (Williges, 1987). One reason for this may be unresolved issues relating to quantitative models of user-system interaction such as their restriction to only a few computer-based activities, the need to investigate the facility with which they can be extended to other applications, and the need to employ an integrated strategy for data collection.

Formal analyses of work tasks may be inadequate for defining job routines and communications channels in sufficient detail to be translated into software (Fischer, 1984). The quantitative approach may be useful for understanding low level aspects of office work such as the keystrokes involved in word processing but it ignores higher level issues such as health and safety, motivation, and organizational issues.

## PSYCHOPHYSIOLOGICAL APPROACH

The psychophysiological approach concentrates on physical aspects of human-computer interaction considering such issues as fatigue and physical effort. Health and safety issues such as the prevention of repetitive strain injury (RSI), radiation, and visual problems are also relevant.

Psychophysiological measures include electroencephalograms (EEG), oculomotor responses, heart rate and hormone production (Gale and Christie, 1987). Anthropometric and biomechanic measurements of relevant parts of the user's body are

also regarded as important, for example in the design of input devices such as the keyboard (Oborne, 1987).

Gale (1973 - cited by Christie, 1985) suggested that psychophysiology considers the integration of three domains - overt behaviour, subjective experience, and physiology. The emphasis is on ensuring that the user-system interface is designed "appropriately for the humans concerned" (Gale, 1985). The results of psychophysiological research may be of interest to a wide variety of people including manufacturers, trade unions, standards bodies, government and user organizations (Gale and Christie, 1987).

In common with some studies following other approaches, the validity and generalizability of some psychophysiological studies may be questioned since very few studies have been carried out in field contexts, the tasks used may be dissimilar to real-life tasks, and there may be little control over salient variables, particularly where real-life situations are studied (Gale and Christie, 1987).

## COGNITIVE APPROACH

The cognitive approach, which includes cognitive ergonomics and cognitive psychology, views the user as a processor of information. The approach provides a common framework in which models of memory, problem-solving, perception and behaviour can be integrated with one another (Card et al., 1983). Wickens (1987) describes principles of human information processing which he states are "generally based upon decades of well controlled empirical research" and claims that "adherence to the guidelines presented will lead to an improved system design". Christie (1987) noted that the information processing characteristics of the user need to be matched with those of the system when allocating functions between the user and the system. Users vary in many ways such as their knowledge of various tasks, knowledge of other systems, motor skills such as typing speed, technical ability in using programs, and experience with the system being considered (Card et al., 1980). Fischer (1984) considers that although the physiological and perceptual characteristics of users are fairly well understood, a method for measuring subjective factors involved in human-computer interaction is needed.

A fundamental aspect of the cognitive approach is recognition that "users do not respond passively to a system, they are normally actively involved in the interaction: they have goals and expectations, they make inferences and predictions. Users interact with their model of the system (Manktelow and Jones, 1987). According to Manktelow

and Jones inappropriate user models may be responsible for many errors since such models cause inappropriate inferences and predictions to be made.

In the influential GOMS model (Card and Moran, 1980; Card et al., 1983) the user is considered to be goal-driven. Tasks such as text-editing can be represented in terms of these goals. The user's task representation is composed of their understanding of Goals, Operators, Methods and Selection Rules.

Norman (1986, 1988) suggested that when people use technology problems may occur because of discrepancies between physical and psychological variables. Norman refers to the **Gulf of Execution** which goes from the user's goals to the physical system and the **Gulf of Evaluation** which goes from the physical system to the goals. Good design should aim to minimize these gulfs. For example, the user can alter his/her goals to match those of the system and the designer can construct the input and output characteristics of the system to provide a better match to the psychological needs of the user.

Gardiner (1986) stated that differences in 'cognitive style' between users - that is, differences in working methods and decision-making - should not be overlooked when designing computer systems. Moreover, further research is needed into mental models to provide insights into problems which may occur when implementing metaphor-based interfaces (Gardiner, 1987).

Two important types of model relevant to the study of human-computer interaction are the user's model of the system and the designer's model of the system. The designer's model may also be referred to as the user model or model of the user. Hollnagel and Woods (1983) mention the idea of a 'cognitive system' in which the computer has an image or 'model' of the user. Norman (1988) described three types of model: the design model (the designer's conceptual model), the user's model (the mental model developed through interaction with the system), and the system image (this results from the physical structure that has been built and includes documentation, instructions, and labels). Communication between the designer and user takes place through the system image. The emphasis in this thesis is on gaining knowledge of the user's model through investigation of user perceptions of technology and the office, in particular user perceptions of functionality and acceptability.

A major advantage of the cognitive approach is its emphasis on the viewpoint of the user and the user's model of the system. Problems ranging from minor to catastrophic

may occur if designers ignore the necessity to understand user capabilities, expectations, and requirements when designing systems. This is discussed further in Chapter 4.

A potential limitation of the cognitive approach is that it may be difficult to 'measure' a user's thoughts and perceptions. One method for inferring information processing activities is to use techniques such as protocol analysis to obtain verbal reports (Newell and Simon, 1972; Williges, 1987). However, if the user is required to verbalize activities this may interfere with the task being performed. In addition, verbal reports can produce large amounts of data which can be difficult and time-consuming to analyse. It may not always be possible for people to verbalize detailed cognitive processing activities (Williges, 1987).

## SOCIAL PSYCHOLOGICAL APPROACH

The social psychological approach emphasises social and organizational issues when considering human-computer interaction. These issues include job design, job satisfaction, motivation, training, and user attitudes towards office systems. The effect of office technology on role definition and status for individuals within an organization is another important issue.

Hughes (cited by Coops and Hobson - 1992) comments that "control systems with reactive databases can only be effective when systems designers have access to guidance on the social aspects of work". This conclusion refers to a study of the work of air traffic controllers by a research team at Lancaster University but the emphasis on social aspects of work seems relevant to any type of work, including office work. Some of the social aspects of work, for example, the impact of computers on communication, are considered further in Chapter 6.

### Organizational approach

In addition to considering the individual, the social psychological approach considers the effect of technology on groups of people. User behaviour does not take place within a vacuum but within an organizational context and "within the context of the user's life as a human being". That is, the user cannot be treated as just a type of computer because people have physical, physiological and emotional needs (Christie and Kaiser, 1985). When analysing office work attempts should be made to identify requirements suitable for the organization as a whole and not merely its technical aspects (Schäfer et al., 1988). "Office technology in the future may not be able to

support the effectiveness of organizations" unless consideration is given to organizational issues (Bjørn-Andersen, 1986).

Fischer (1984) mentions the need to consider whether a computer system enables information to be shared amongst members of a group in addition to supporting individual work. The effect of electronic communication on social skills and the ability of people to communicate face-to-face is particularly relevant now that there is a growing interest in computer-supported cooperative work and increasing use of multimedia systems and networks.

A comment made by His Royal Highness, Prince Philip, Duke of Edinburgh at the inauguration of London Guildhall University in 1993 seems to highlight the essence of the organizational approach: "What matters much more in my experience is the spirit of the organization ... It wasn't just the ships and the aeroplanes and the equipment that won the Battle of the Atlantic ... it was the spirit of the people in the ships and in the aircraft and in the headquarters, that's what did it." (London Guildhall University newsletter, 1993).

The concept of "organizational interfaces" is mentioned by Malone (1985). Whereas the user interface usually refers to a single user, an organizational interface is the interface between computers and groups of users. The increase in interest in computer-supported cooperative work is likely to necessitate improved understanding of such interfaces. Malone describes four perspectives for understanding organizations - the information processing or cognitive perspective, the motivational perspective, the economic perspective, and the political perspective - and advocates that computer systems should be designed in such a way that they "fit naturally into human organizations". When designing organizational interfaces disciplines such as organizational behaviour and management, group dynamics, and economics need to be considered (Marshall et al., 1987).

An important issue which may be considered by the organizational approach is the resistance to new working practices which may be encountered when computer-based technology is introduced. Unions may fear job losses while managers may be concerned about the cost of installation, maintenance and training. There may be a general resistance to change (Damodaran et al., 1980; Bjørn-Andersen, 1983; Wainwright and Francis, 1984; Blackler and Brown, 1987). However, this resistance may not be as applicable now as it was before the use of computer systems became so widespread (Kemp, 1987).

It is important to consider both the functional and psychological aspects of human-computer interaction so that the capabilities of office technology can be matched with organizational and personal goals (Fischer, 1984). When investigating office work social psychological issues should be considered in addition to cognitive issues such as the goal-directed nature of user behaviour (Gardiner, 1986; Christie, 1987). The social psychological and cognitive approach can be seen as **complementary** rather than contradictory. Although it may be difficult to integrate different domains of knowledge, psychological research and technological development should ideally occur in parallel (Gardiner, 1986).

The social psychological approach acknowledges the complexity of human behaviour and the wider issues relating to office work but a possible limitation is that it considers high-level issues and may not be relevant to lower level issues related to specific technology.

## ERGONOMIC APPROACH

Ergonomics, also known as human factors, is usually defined as the scientific study of the relationship between humans and their work environment (Murrell, 1965; Chapanis, 1965 - cited by Thomas, 1984). The ergonomic approach emphasises studying the **whole** human-machine-workplace-environment situation (Shackel, 1986) which should reduce the chance of a serious design fault being overlooked. The ergonomic approach involves "taking account of people in the way we design and organize things - 'Designing for People' " (Wilson, 1990). An overview of the basic principles of ergonomics may be found in texts such as *Ergonomics at Work* (Oborne, 1987).

Galer (1988) noted that "the incorporation of human factors into IT product design is an essential prerequisite to the effective use and acceptance of future generations of office systems". Poorly designed user interfaces are considered to be responsible for the finding that less than 40% of the potential range of functions is used on many systems (Fischer, 1984). In 1993 it was reported that "advanced features already available on faxes, phones and photocopiers are rarely used because people do not know how to operate them" (*PC Week*, 1993).

Issues which may be considered in the ergonomic approach include physiological characteristics of people, display design, control design, workspace design, seating, and safety (Cakir et al., 1980; Oborne, 1987). For example, the impact of visual display terminals (VDTs) on health (Stewart, 1985). Psychological issues are also considered

in the ergonomic approach. Cognitive ergonomics is considered particularly important in relation to the study of human-computer interaction.

The ergonomic approach can be applied to various aspects of the office such as **office environment** (lighting, heating, noise levels); **workstation design** (design of desks, chairs and other office furniture); **organizational issues** (job design, rest pauses); **information technology/human-computer interaction/user-system interaction** (the design and implementation of computer systems); **health and safety** (ensuring that office environments and products do not harm the office worker). EC Directives (e.g. EC Directive 90/270 Minimum safety and health requirements for office work with display screen equipment) have been set to standardize certain aspects of the office environment such as the level of glare in the office (Silk, 1991). Standards for VDT work have also been set by the International Organization for Standardization (Reiterer and Oppermann, 1993) (e.g. ISO 9241, Part 1 - Ergonomic requirements for office work with visual display terminals).

Office systems need to be able to adapt to meet different requirements. For example, there should be provision for changes in abilities as the user moves from being a novice to an experienced user. The ergonomic approach recognises that individuals and organizations evolve over time (Fischer, 1984).

It has been suggested (Stewart, 1984) that there are similarities between the components of advanced office systems (electronic filing and video-conferencing systems, etc) and those of traditional computing (displays, keyboards, printers, black boxes and wiring). This may mean that there are similar problems when users interact with the office environment.

When determining user needs it is important to consider issues such as office activities and the potential user population (Czaja, 1987). Czaja cites Panko (1984) who suggested that office needs should be examined at three levels: organizational, departmental, and individual.

The durability of the ergonomic approach, in the sense that it is not dependent on specific technology, is suggested by a comment from Stewart (1985) that "traditional ergonomics never dies: it just finds new examples of short-sighted design".

The ergonomic approach considers a wide variety of issues which are relevant to human-computer interaction and attempts to give priority to the needs of users.

However, this strength may sometimes be a weakness since the diversity of the ergonomic approach makes it difficult for all aspects of human-computer interaction to be considered in depth unless there is a large research team with a variety of skills and the necessary resources. In addition, ergonomists often lament being called in to assess a system once it has been designed when it may be too late for ergonomic recommendations to be implemented.

## INTEGRATED APPROACH

Since the office is multi-faceted it may be productive to regard offices from an interdisciplinary or multi-perspective approach rather than from a single perspective (Kammersgaard, 1988). The ergonomic approach may be regarded as an example of an integrated or interdisciplinary approach.

Kammersgaard (1988) describes four different perspectives - the dialogue partner perspective, the tool perspective, the systems perspective and the media perspective, and proposes that a distinction may be made between approaches which concentrate on the use of computers by individuals and those which consider collective use. The dialogue partner perspective and tool perspective focus on individual use and the systems perspective and media perspective on collective use.

A virtual protocol model can be used to describe human-computer interaction. Nielsen (1986) describes a seven-layer hierarchy consisting of goal, task, semantic, syntax, lexical, alphabetic and physical layers. The **goal layer** "is distinct from all the other layers in the model in that it deals with the real world concepts that the computer system is all about. All lower levels deal with the representations of these concepts inside the given computer system" (Nielsen, 1986). The goal layer is considered to describe the complexity of office work more adequately than the lower levels.

The strengths and limitations of the integrated approach are similar to those of the ergonomic approach. That is, the integrated approach recognises the multi-faceted nature of office work and considers a wide variety of issues which are relevant to human-computer interaction but the diversity of the approach makes it difficult for all aspects of human-computer interaction to be considered in depth.

## CONCLUSION

An attempt to integrate key features of the theoretical approaches reviewed above is provided in Figure 1. The figure shows the approaches in ascending order from the low level quantitative approach to the high level integrated approach together with

examples of the type of methods used by each approach, possible applications, and influential authors. The arrows indicate a move to a higher level of analysis.

**FIGURE 1 - AN ATTEMPT TO INTEGRATE KEY THEORETICAL APPROACHES TO THE STUDY OF HUMAN-COMPUTER INTERACTION**

**QUANTITATIVE APPROACH** (Lowest level)
formal representations of the interface: e.g keystrokes involved in word processing
(Card and Moran, 1980; Card, 1984; Dix and Harrison, 1986; Thimbleby, 1990)

↓

**PSYCHOPHYSIOLOGICAL APPROACH/COGNITIVE APPROACH**
***Psychophysiological approach*:** electroencephalograms, heart rate, anthropometric and biomechanical measurements: e.g. fatigue, physical effort
(Gale and Christie, 1987; Oborne, 1987)
***Cognitive approach*:** protocol analysis: e.g. memory, problem-solving, perception, mental models, goals
(Card et al., 1983; Hollnagel and Woods, 1983; Norman, 1986, 1988; Wickens, 1987)

↓

**SOCIAL PSYCHOLOGICAL APPROACH**
questionnaires, interviews: e.g. job satisfaction, user attitudes, job design, impact of technology on individuals and on the organization
(Fischer, 1984; Malone, 1985; Bjørn-Andersen, 1986; Schäfer et al., 1988)

↓

**ERGONOMIC APPROACH/INTEGRATED APPROACH** (Highest level)
any of the techniques for the approaches described above depending on the level of investigation: e.g. physiological characteristics, display design, workspace design, safety, complexity of office work
***Ergonomic approach*:** (Stewart, 1985; Shackel, 1986; Oborne, 1987; Wilson, 1990)
***Integrated approach*:** (Nielsen, 1986; Kammersgaard, 1988)

Booth (1989) emphasises the multi-disciplinary nature of the study of human-computer interaction in the following definition: "HCI is a multi-disciplinary venture involving not only ergonomics and software engineering, but also cognitive psychology, cognitive science, social psychology, mathematics, organizational psychology, artificial intelligence, computational linguisitics and sociology". In addition to the subjects mentioned by Booth, Johnson (1992) includes computer science, philosophy, anthropology, graphic art, and the creative and performing arts. While there may be some overlap in the issues considered by different disciplines and approaches, the scope and limitations of a particular approach need to be recognised so that the advocates of that approach do not seem to be suggesting that their approach is the only one suitable for understanding human-computer interaction. The approach which is the most appropriate to use when investigating user-system interaction will vary according to the purpose for which the approach was chosen.

Chapters 2 to 4 consider existing knowledge relevant to *'User perceptions of technology and the office'*. Chapter 2 considered 'the office', the current chapter considered 'technology' and Chapter 4 discusses 'user perceptions' (the rationale for investigating user perceptions, user-centred research methods, and the methods chosen for the empirical studies reported in Chapters 5 to 9).

# CHAPTER 4 - THE ROLE OF USER PERCEPTIONS IN INVESTIGATIONS OF HUMAN-COMPUTER INTERACTION

## SUMMARY

User perceptions seem to be given insufficient emphasis by the designers of technology. However, user perceptions should be considered as user views may affect their reactions to, and acceptance of, technology. This chapter discusses the need for user-centred research when designing technology for use in the office and introduces the empirical research described in detail in Chapters 5 to 9.

## INTRODUCTION

When introducing office technology "typically one crucial component has been mismanaged: *people*" (Blackler and Oborne, 1987). Blackler and Oborne suggest that the needs and reactions of the people who will be affected by new technology need to be considered to increase the chance that technology will be used effectively.

It has been suggested that users continue to experience difficulty in the use of office systems and that not all the facilities available are used or understood. "It is becoming increasingly clear that the comfort of a good fit between man and machine is largely absent from the technology of the information age" (Sedgwick, 1993). "If you set out to make something difficult to use, you could probably do no better than to copy the designers of modern computer systems" (Norman, 1988). Norman lists problems which may occur including misleading command names or actions and uninformative error messages. Despite the recommendation by Shneiderman (1987, 1992) that hostile, unhelpful messages such as "catastrophic error" and "What?" should be avoided, messages such as "bad command" and "offending command" are still found.

One explanation for the discrepancy between what is available and what is used could be an inadequate understanding of user perceptions of the nature of office work and the role of computers in the office. Is it intended that computer systems will simulate the entire office or that their prime function will be as a tool to support but not supplant office activities? Do people really want a fully electronic office? (Smith, 1990b)

In the report of ESPRIT project 285 (OSSAD - Office Support Systems Analysis and Design), it was stated that "there may be a huge gap between technical potential and the realization of this potential in the organization. Typical weaknesses ...are... designs of soft- and hardware solutions that do not assist specific needs of the office worker"

(Baron and Beslmüller, 1989). The OSSAD project is discussed in more detail in Chapter 5.

The ease with which people can use computer systems in the office and the usefulness of such systems is likely to depend to a large extent on the match between the activities in which the users wish to engage, their constructs regarding 'the office', and their expectations regarding the nature of the computer system which they are using. The author has suggested elsewhere (Smith, 1994) that in order to ensure optimal use of computer systems in the office it is necessary to establish 1) the nature of office work 2) the nature of technology 3) user requirements for office systems. A close match between these three areas may ensure more effective use of computers in the office.

The empirical research for this thesis is based on the assumption that the 'office' exists and that there are common features to offices wherever those offices might be found. Emphasis is placed on the **functions** rather than the **design** of computer-based office technology because this is where the main gap in current knowledge seems to exist (Herbach, 1983; Shneiderman, 1992). Certain functions will be found whether the office is part of a multinational company with large numbers of employees or based in the corner of a room such as a kitchen and run by a single individual.

## USER-CENTRED DESIGN

Although the emphasis in this thesis is on the application of technology to the office certain principles are common to the design process and to human-computer interaction whatever the specific application.

When considering the design of technology a distinction may be made between the user-centred approach and the computer-centred approach. In the **user-centred approach** the introduction of computer systems is considered by starting on the 'outside' and moving inwards (Fischer, 1984). This means that human psychological and behavioural needs are considered first, followed by the work tasks carried out and finally specific technical details. Fischer regards the user-centred approach as a superior successor to the **computer-centred approach** where the first consideration is what the hardware and software can do with the final system being built around these computing capabilities. Technology-centred research methods may be insufficient as they may only provide a small part of the whole picture (Kammersgaard, 1988).

Sedgwick (1993) proposes that a key principle of user-centred design is "not to assume that more technology is always better". To paraphrase *Animal Farm* (Orwell, 1945) a

balance is needed between the attitude towards technology which is similar to the initial 'no technology good, technology bad' philosophy and the later chanting of 'no technology good, technology *better!*' (Smith, 1994).

Knowledge of the computer system, task environment, and end-user are vital components in the design of computer systems as well as consideration of anthropometric and biomechanical data relating to the user (Williges, 1987). Thomas (1984) suggests that designers need to consider who will use a system, what they will use that system for, and the context in which that system will be used.

Stewart (1984) advocates employing a **systems approach** to the office with emphasis on the system life-cycle. Three key office system concepts are described by Stewart: purposiveness, interaction and life-cycle. **Purposiveness** refers to the business purpose of the office. Technology is used as a means to an end rather than as an end in itself. **Interaction** refers to the interactions which take place between people, equipment, procedures and environments. All these factors need to be considered simultaneously as emphasis on only one aspect is likely to lead to problems. **Life-cycle** involves moving from the analysis of requirements, through planning and design, to implementation and finally operation. The cycle continues when the experiences of the operation phase feed into the analysis of the next generation of the system. Williges (1987) suggests that the life-cycle includes system analysis, specification, design, development and maintenance.

"The functional perspective considers whether or not the design is serviceable for its intended purpose" (Johnson, 1992). However, according to Johnson, designers have difficulty with the functional approach "largely for reasons of pride, because in stating what the design can be used for, there is at least an implicit statement of what it cannot be used for" even though "no design, whether it is software or otherwise, can be used for any- and everything".

The HUFIT (Human Factors in Information Technology) project took a user-centred design approach and devised design tools, methods and techniques for use in the development of European office systems (ESPRIT Synopses, 1990a). Galer (1988) stated that the project provided a framework for a comprehensive and unified human factors contribution to the design of information technology products from their conception, through the development process, to their installation and use.

Shackel (1984) cites Martin and Parker (1971) who commented that "no matter how hard he tries, a designer cannot really believe that people will be unable to use his system". The comment made by Christie and Kaiser (1985) that "with an increasingly wide range of non-specialist users, a user-oriented approach to the design of the user-system interface has become even more important than in the past" is still considered to be applicable today.

Advocates of the user-centred approach to design may come across the 'everybody knows' problem (Laughery, 1993) and the 'common-sense' theory. These problems relate to the attitude towards design which regards user involvement as unnecessary since certain information is common knowledge. Chapanis (1959 - cited by Laughery, 1993) commented that design decisions should not be based on common sense: "A science of human engineering built on common sense is like a house built on quicksand". Laughery concludes that "common-sense ideas not only change, they are often just wrong".

Lingaard (1992) suggests that "the focus of design and development of computer systems is changing" resulting in increased concern with the appropriateness of the systems developers produce to the tasks and users they are intended to support.

A major strength of the user-centred approach to designing interfaces is that it is not technology-dependent. The basic concepts relating to user capabilities and requirements remain constant whatever tools or environments are involved. Drastic changes can be made to the technology available but basic user requirements and characteristics will remain the same which means that the basic concepts behind their design can be transferred to future systems. For example, the **concepts** of windowing are independent of the physical parameters of particular windows on particular machines and will still be applicable even if existing computer systems are superceded.

Davis (1989) cautions against users actually developing a system without consulting a systems analyst. However, this thesis is not recommending that users should actually design a system but rather that an increased understanding of user requirements and models may be gained from investigating user perceptions. There are many areas where users know what they want but do not necessarily expect to implement their ideas directly. For example, when building a house the client (user) may specify what they want the house to look like but would not normally expect to be handed a trowel and a bag of cement.

## WHY SHOULD WE STUDY THE USER INTERFACE?

Various factors need to be considered when assessing or designing a product such as a computer. These factors include efficiency, durability, reliability, convenience, and safety. Aesthetic factors such as the packaging and appearance of the product as well as the cost and maintenance of that product should also be considered as the appearance of a product may affect users' perceptions of the product's usability (Smith, 1986). A product or environment should be comfortable to use or work in, it should not harm the health of the user or result in injury and it should be suitable for use for the purpose for which it was designed.

The point at which people come into contact with technology and environments may be described as the user interface. It is important to be aware of the physical and psychological characteristics of users in order to maximise the usability and usefulness of technology. Hammond et al. (1987) commented that "human factors recommendations have had less impact on design than many in the discipline would have hoped for". However, the consequences of ignoring the user may be physical, psychological, financial, and environmental.

### Physical consequences

Physical problems which may occur as a result of ignoring user characteristics include inability to use the product, health problems, injuries, and possibly death.

*Inability to use the product* - Users may be unable to use a product at all or encounter great difficulty when using the product. A classic example of poor design is the lathe which appears to have been designed for a user who is 4.5 feet tall, 2 feet across the shoulders with an arm span of 8 feet (*Applied Ergonomics*, 1969). An inexperienced computer user may be unable even to locate the 'ON' switch for the computer. Cheque books and scissors are among the products which left-handed people may find difficult to use.

*Health problems* - Various health problems may result from ignoring user characteristics. Deafness may be caused by noisy machinery, vibration white finger may result from using a pneumatic drill, and repetitive strain injury may occur where work involves constant repetitive small movements. Keyboard use, data entry, and folding cardboard boxes have all been associated with repetitive strain injury.

*Injuries* - A fall on an over-polished floor may cause fractures. Inadequate, or non-existent machine guarding on machines may cause amputations. Back injuries are a common consequence of incorrect lifting procedures.

The technology used by people may have considerable destructive power and in extreme cases poor design and working practices may cause death (Thomas, 1984). "Sometimes the human error is turned from a minor mistake into tragedy by poor design" (Lowe, 1990). Unsafe fastenings on train doors have caused deaths when passengers fell out of the train. Inadequate methods for checking that the bow doors were shut resulted in the disaster involving the car ferry *Herald of Free Enterprise* in 1987. The nuclear plant disaster at Chernobyl in 1986 which resulted in many deaths was attributed to poor interface design and human error (Reason, 1987).

**Psychological consequences**

The psychological consequences of poor design may include frustration, irritation, discontent, and anger. A major disaster resulting from a serious flaw in the user interface may sometimes cause Post Traumatic Stress Disorder or 'shell shock' in victims of the disaster. Less extreme negative emotions may be felt when files are lost and discs damaged during computer use or when the photocopier jams and so on. There may be poor motivation and even absenteeism where a product such as a software package is difficult to use. Negative emotions caused by poorly-designed technology may mean that a product is not used to its full capacity which could affect productivity. Training times may also be longer. A well-designed product may induce positive emotions in the user and increase motivation to use that product.

The user may develop an inappropriate model of a product. The need to consider the user's model was considered in a discussion of the cognitive approach in Chapter 3. Young (1983 - cited by Johnson, 1992) suggested that important differences exist between the designer's model of the system, the user's model of the computer system, and the researcher's model of the user. Johnson concludes from Young's view that there are two categories of model - models of users and models of computer systems modelled by designers, researchers, computer systems and users. "User interface designs fail not just because of technical errors but because of failures of communication between user and designer and because of different perspectives of the role of systems" (Thimbleby, 1990).

**Financial consequences**

User evaluations may be considered to be prohibitively protracted or expensive or unlikely to provide useful information. However, "experience has shown that often the apparently minor item, overlooked for a time, has proved to become a significant and costly problem later" (Shackel, 1986). The potential financial consequences of poorly-designed equipment and workplaces include poor productivity (Stewart, 1985), absenteeism, lost contracts, and compensation demands for injuries, accidents and ill-health. Market forces are also important. A product which is perceived to be easy, safe, and convenient to use is likely to sell better than one which is considered to be unsafe and inconvenient to use.

Many products, including computers, are alike in practical or functional terms which means that sales are often determined solely by psychological differences. "A product's personality is more than its mere physical nature" (Gregory, 1982). This statement indicates that the "psychological" as well as the physical aspects of a product should be considered when designing or assessing that product and applies to office technology as well as consumer products such as kettles and video recorders.

Four main groups of people have an interest in computer system design - the manufacturer, designer, buyer, and user (Shackel, 1986). Each group has its own interests and a tendency to view the system according to its own values and criteria - the prime concern of the manufacturer may be manufacture, that of the buyer price and so on. The user is primarily concerned with acceptability which Shackel defines as a combination of ease of operation, convenience, comfort, appearance and familiarity. This provides justification for user involvement in empirical research in interface design as other groups are not likely to be so aware of user concerns. "Having input from marketing personnel is certainly not equivalent to having unbiased input from real end-users" (Thomas, 1984). One reason for this is that it may be difficult for the people involved in promoting and selling a product to look for defects when their usual role is to overlook or explain away any problems with that product. Designers should remember that there are many types of user and that the needs of individual users change over time as they become more experienced (Fischer, 1984).

The need for user involvement is recognised by companies such as IBM, DEC, and Bellcore who have "usability laboratories in which people try out software under close observation" (Durham, 1993). However, users may be involved only at the later stages of product design "to hunt down the last few problems in nearly-finished software". Durham recommends that "at the start of a project human factors specialists need to go

out into the workplace, to interview and observe the people who will use the software" and notes that "usability translates directly into cash savings, because people can work faster and with fewer errors". Improved usability may also produce savings in the training and technical support bills.

Even though individuals working in an organization may have little control over the products and systems bought for that organization they are now able to purchase computers for use in the home which means that marketing factors should not be ignored. The financial incentive for improving usability for home, office, and entertainment applications where use is "frequently discretionary and competition is fierce" is important (Shneiderman, 1992).

**Environmental consequences**

Disasters caused by poor interface design may cause severe environmental damage as well as physical and psychological suffering. Oil tanker disasters have resulted in pollution of beaches and the sea. The Chernobyl disaster in 1986, "contaminated 400 square miles of land around the Ukrainian plant, and significantly increased the risk of cancer deaths over a wide area of Scandinavia and Western Europe" (Reason, 1987).

Although designers may be reluctant to employ user evidence - "human factors recommendations have had less impact on design than many in the discipline would hope for" (Hammond et al., 1987) - the possible physical, psychological, financial, and environmental consequences of ignoring human factors illustrate why it is essential to understand the user interface.

## WHY SHOULD WE STUDY USER PERCEPTIONS?

User perceptions of a product or system form an important aspect of the user interface. In this thesis **perceptions** are considered by the author to be similar to 'constructs', 'concepts' or 'models' rather than 'attitudes'. Kelly (1955) used the term 'constructs' to refer to the "transparent patterns or templets *[sic]*" which people create and then attempt to fit over the realities of which the world is composed. An 'attitude' has been defined as a construct that is used to refer to certain mental processes of a person (Pennington, 1986) and as primarily *evaluative* (Eiser and van der Pligt, 1988). Pennington notes that the structural approach to defining attitudes attempts to relate them to other concepts such as values, beliefs, intentions and behaviour. The author's research focuses on views of what an office **constitutes** rather than whether the subjects regard the office as a good or a bad thing. One exception to this interpretation is Study 4 (Chapter 8) where users are required to evaluate two products.

It can be argued that, in addition to the physical, psychological, financial and environmental reasons discussed earlier in this chapter, there are moral, social and political reasons to justify the search for an understanding of user perceptions of technology. Perceptions and attititudes towards a particular phenomenon may affect both individuals and society as a whole, particularly when those perceptions and attitudes affect behaviour and policies.

Various groups have perceptions of technology including the **individual** [e.g user, designer, journalist, politician, the man or woman on the Clapham omnibus], **groups** [e.g. users, designers, journalists, the government, the electorate, the "Greek chorus" (Moscovici, 1984) in the *Ferret and Three Whippets*], **society** [e.g. individual countries, European Union]. Perceptions are likely to be two-way. That is the government has perceptions of the electorate, the electorate has perceptions of the government, users have perceptions of designers, and vice versa.

People have perceptions of various topics including politics, religion, sport, and technology. Figure 1 illustrates the possible impact of perceptions of different phenomena on behaviour.

**FIGURE 1 - POSSIBLE IMPACT OF PERCEPTIONS ON BEHAVIOUR**

| TOPIC | POSSIBLE IMPACT ON BEHAVIOUR | |
|---|---|---|
| | **'Negative' perceptions** | **'Positive' perceptions** |
| **Politics** | Repression | Democracy and Libertarianism |
| **Religion** | Sectarian violence/intolerance | Peaceful coexistence |
| **Sport** | Excessive competitiveness<br>Hooliganism/violence | 'Healthy' competition |
| **Technology** | Poor usability<br>Poor access<br>Inadequate training<br>Low acceptance<br>Many accidents<br>Used to harm society and individuals | Good usability<br>Good access<br>Adequate training<br>High acceptance<br>Few accidents<br>Used for benefit of society and individuals |

The perceptions of individuals or groups may affect behaviour resulting in the use or abuse of technology (see Figure 2). An understanding of user perceptions of technology may explain why the same technology is used or abused. There may be individual, cultural and social perceptions of acceptable uses of technology. Circumstances may also affect the way in

which technology is used. User perceptions of possible uses of technology are explored throughout the thesis - for example, user perceptions of 'good' and 'bad' uses of office technology are studied in Chapter 5 and user perceptions of their use of technology in various circumstances in Chapter 6.

**FIGURE 2 - USES AND ABUSES OF TECHNOLOGY**

| | 'Use' | 'Abuse' |
|---|---|---|
| **Nuclear power** | radiotherapy;electricity | nuclear bombs |
| **Lasers** | surgery | weapons |
| **Electricity (and Gas)** | cooking;heating;light | torture; judicial execution |
| **Office technology:** | | |
| **Faxes** | communication of 'good' news/important information; summoning help | communicating 'bad' news /humiliating information |
| **Mobile phones** | same as faxes | a nuisance to others in public places |
| **the Internet** | facilitating global communication and access to information | distributing pornography; theft of information/unauthorised access to information; spamming/junk mail |
| **Video surveillance** | reducing crime | freedom of movement; 'Big Brother' |
| **Databases** | facilitating information access | theft of information; unauthorised access to information; 'Big Brother' |
| **Pencils** | writing implement | an implement of torture (one of the examples given by a human rights organization of alleged misuse of 'innocuous' objects) |

Perceptions may affect policies as well as behaviour. For example, the perception that "commuters are dreadful people" may lead to cuts in subsidies, increased fares, poor safety standards and overcrowding while the perception that "commuters are valuable members of society who contribute to the wealth of the country" may result in investment in public transport to ensure that it is inexpensive, efficient, reliable and safe. With respect to technology, perceptions of user needs, views and requirements may affect policies on training, technology availability, acceptable social and 'political' uses of technology, for example, data protection, video surveillance, and so on. In February 1995 a meeting of the heads of the G7 countries considered issues relating to computer use such as training and security. An understanding of perceptions may be

ineffective if the message is misunderstood by the recipient and 'policy-makers' so that inappropriate action or no action is taken.

It is necessary to investigate user perceptions of the nature of office work and the advantages and limitations of using computer-based technology in the office in order to increase understanding of user models of office technology. Hansen (1971 - cited by Card et al. 1983) suggested that designers should "know the user!". Norman et al. (1986) and Manktelow and Jones (1987) are among the authors who have advocated gaining an understanding of the user's model of the system (see Chapter 3 'Cognitive approach'). Blackler and Oborne (1987) argued that there is "a growing need to understand what people require from IT, how they can use it, and what effects it can have on them". It can be argued that "whether users benefit from a system depends as much on the users' attitudes as it does on the concrete design of the system" (Thimbleby, 1990).

Although users and designers are not assumed to always have different priorities it is important to determine the nature of their perceptions about office work and technology and the importance they attach to those perceptions. Differences in the priorities of users and designers may have a detrimental effect on the usability and acceptability of a system. For example, the user and designer may agree on the basic concept of providing an electronic storage system but while the designer may concentrate on producing a 'realistic' filing cabinet icon and assume that this is self explanatory, the user may be satisfied with just the words SAVE FILE so long as the words provide a clear instruction as to how to save a file. At a very basic level while both the user and designer may agree on the benefits of technology, the novice user may be primarily concerned with functions which are taken as self-evident by the designer such as locating the switch which turns the machine ON (or equally important OFF, particularly in an emergency!) rather than with 'Phil, the intelligent agent' (Schofield, 1990) or 'x megabytes RAM' (Smith, 1994).

**Moral/political reasons for considering user perceptions**

It has been claimed (Wells, 1908) that "the desire to suppress opinions adverse to our own is almost instinctive in human nature". However, the author believes that although there may be evidence for this view, this should not prevent investigation of alternative views: "I disapprove of what you say, but I will defend to the death your right to say it" (Voltaire, attri. in Tallentyre, 1907 ). User perceptions should be investigated for both moral and practical reasons.

Do "actions speak louder than words" or is the following view correct: "words have wings: they mount up to the heavenly heights and they endure for eternity" (Yanchiker (1940, cited by Gryn, 1995)? Throughout history, certain groups in society have been denied the opportunity to express their views because of repression, intolerance and persecution. The principles of democracy seem to provide a moral obligation to allow people to express their views or to have someone to speak on their behalf. It may sometimes be too late as expressed in the following poem attributed to the Lutheran Pastor Martin Niemöller who was arrested in 1937 for anti-Nazi activities:

> First they came for the Jews
> and I did not speak out -
> because I was not a Jew.
>
> Then they came for the communists
> and I did not speak out -
> because I was not a communist.
>
> Then they came for the trade unionists
> and I did not speak out -
> because I was not a trade unionist.
>
> Then they came for me
> and there was no one left
> to speak out for me.
>
> (*The Guardian*, 1995a)

A user-centred approach is taken in the empirical research (Study 1-Study 5) in this thesis since people are considered as the essential element in human-computer interaction even though the term 'human-computer interaction' seems to imply an equal relationship between the user and the system and that the 'needs' of both the user and the system should be given the same amount of attention.

"When designing a new system ask: What does the system do for the user? What does the user do for the computer? Why is there inequality? What ideas could make the design more equal? ... It appears that placing equal opportunity interaction as an ideal can usefully guide user interface design."

"As well as a user using a computer, a computer ought to be able to use a user!"

"Designers ought to consider the complexity of 'programming' the human user as part of user interface design."

These quotes from Thimbleby (1990) illustrate the idea that there is, or should be, equality between the user and the computer. The last two quotes may be in jest but, if

taken seriously, raise a chilling spectre of the potential for computer-mediated fascism to become reality rather than just a fictional nightmare, or, less dramatically, a parent-child relationship with the designer/programmer as the 'wise' parent controlling the user or 'stupid' child. The technology-centred approach almost seems to be adhering to the view expressed by Pierce (1908 - cited in Orne 1962) that "it seems too often as if the subject were now regarded as a stupid automaton".

A hypothetical example of the pitfalls of ignoring the views of 'non-experts', which is perhaps unfair to the experts but illustrates the point, would be a situation in which two programmers, two psychologists, and a child were trying to establish why a computer was not working. While the programmers were trying to debug the program and the psychologists were discussing the frustration felt by the users when the system is 'down' the child notices that the computer has not been plugged in at the wall!

One reason for considering user perceptions is to counteract the apparent 'designer knows best' philosophy expressed in the following quote from Thimbleby (1990): "The people who should be benefiting from computers are the users and the people best able to help them benefit are designers." Thimbleby argues that "designers need a personal commitment to their users ... Thus there is a need for iterative design, involving the user, of bringing democratic processes back into design." The designer should not 'forbid' the user to do anything unless there is a good reason for doing so such as technological limitations or potential harm to others.

The user-centred approach may be described as 'democratic'. That is, everyone, regardless of age, background, and experience has perceptions of the world and a right to express those views however outrageous. Coleman, a group manager at VisiCorp, producers of the software VisiOn, proposed that: "Not everybody is qualified to design a product, but everybody in the world is qualified to say whether they like or don't like some aspect of using the product" (Lemmons, 1983).

It has been suggested (Card et al.,1983) that the computer is a communication tool which differs from other tools as people operate **with** computers rather than being operators **of** computers. However, while computers can be very powerful it should be remembered that any power which computer systems have originates from people via the software which operates the system. People should retain ultimate control over the interaction.

The author suggests that the real issue is not so much 'human-computer interaction' but 'user-designer' interaction through the computer. That is, a communication problem may exist between two groups of people who sometimes agree/understand each other and other times disagree/fail to understand each other. Rather than the implicit power struggle implied by reference to a 'technology-centred' approach with designers 'in charge' or a 'user-centred' approach with users 'in charge' it might be better to refer to a 'people-centred' approach with designers and users recognising that they are both interested in maximising the potential of technology.

User perceptions of the nature of office work and the role of technology in the office can be compared with current knowledge to determine the accuracy of user perceptions when compared with 'reality' (Smith, 1994). Although what people say and what actually happens may differ, it is felt that subjective data have a value independent of their use for implementation because user perceptions provide some insight into the user's thought processes and therefore any underlying user's model. "People's thoughts also really exist, though the correspondence between what people really think exists and what really does exist is a continually changing one" (Kelly, 1955).

Predictions of the extent of agreement which can be expected between the perceptions of different people vary. Carroll (1967) predicts a high level of agreement: "Because of the continuity of the physical, biological, and social environment in which human beings live, their concepts will show a high degree of similarity". Kelly (1955) states that "no-one has yet proved himself wise enough to propound a universal system of constructs".

## HOW SHOULD WE STUDY USER PERCEPTIONS?

This section provides a brief overview of user-centred methods of investigation and major issues in experimental design. It is not considered appropriate to discuss the merits and limitations of these methods and issues in detail in this chapter but they are discussed where appropriate in Chapters 5 to 9. The appropriateness of the research method chosen depends on the problem addressed and the claims made for that research. For example, while a philosophical analysis of the merits of driving would not be appropriate to answer the problem of how to produce more durable tyres, it might be appropriate if considering why people wish to get from 'A' to 'B' and whether alternative methods of transport exist, and so on.

Various methods exist for investigating issues relevant to the user-centred approach including checklists, questionnaires, field and laboratory studies, user trials, technical

tests, task/job analysis, observation, and assessment against a standard. Additional methods include protocol analysis, video analysis, interviews, and focus groups.

Surveys and protocol analyses can be used to identify the users. Observations and interviews can be conducted to identify the nature of user tasks. Experiments and prototyping can be used to assess which design option satisfies both user needs and user task requirements. Specifications can be used to check the resultant designs (Johnson, 1992).

Various issues need to be considered when planning empirical research whatever the issues being investigated. These issues include subject characteristics such as age, sex (Hudgens and Billingsley, 1978), intellectual ability, personality, occupation, motivation, expectations, level and type of computer experience (where relevant) and other characteristics of the experimental situation such as time of day, workload, and the social psychology of experiments, including potential 'experimenter effect' (Orne, 1962; Pennington, 1986). It is also necessary to consider how the data will be analysed and which statistical tests, if any, are appropriate.

Ecological validity - that is the generalizability of the results from an experiment to the 'real' world - is an important consideration (Pennington, 1986; Brunswick 1947 - cited in Orne, 1962). An approach described by Gale and Christie (1987) is the CAFE of EVE (Controlled Adaptive Flexible Experimental Office of the Future in an Ecologically Valid Environment) which aims to create a research environment in which the stringency of the laboratory is combined with the ecological validity of the field environments by the use of participant observation and extending the work role of employees to include that of the reflective user.

"*What is this life if, full of care, we have no time to stand and stare?*" (Davies, 1870-1940) - In empirical research it is often necessary to strike a balance between feasibility and ideal requirements. The choice of method may be constrained not only by the requirements of acceptable 'scientific' practice such as ethics, validity and reliability but also by practical considerations such as the cost of the research, availability of subjects, and need to satisfy a 'sponsor'. Market forces may diminish the scope for 'philosophical' rather than 'practical' research by placing emphasis on the solution of practical problems rather than on research for its own sake.

An important issue which needs to be considered when analysing experimental data is the choice of statistical tests. Two main categories of test exist - **parametric** and **non-**

**parametric**. Parametric tests are considered to be more 'powerful' and 'robust' than non-parametric tests. Parametric tests assume that the data come from an interval or ratio scale, are based on exact numerical scores and require a normal distribution of scores with homogeneity of variance (Greene and D'Oliveira, 1982; Johnson, 1992). Non-parametric tests are based on ranks rather than on the actual numerical values of the scores themselves and can be used when the data can only be measured at the ordinal level (ranked in order of magnitude) or nominal level (allocated to categories). Given the varied nature of the data generated within the author's research, both parametric and non-parametric tests were used where appropriate.

## INTRODUCTION TO THE EMPIRICAL RESEARCH (STUDIES 1-5)

### Approach chosen

In Chapter 3 various approaches to the study of human-computer interaction were discussed. Among the fields relevant to user-centred investigations of office technology are: user perceptions, user attitudes, consumer ergonomics, consumer psychology, market research, and advertising. In this thesis the emphasis is on user perceptions although there is some overlap with other areas.

An 'eclectic' approach was chosen by the author for the empirical research in the thesis as this was considered more appropriate to the area investigated than an approach which adhered rigidly to the research instruments and literature associated with a single discipline. Since the boundaries between different disciplines and sub-disciplines may be blurred it could be misleading to regard the research as based only on a single discipline or sub-discipline. The issues considered in the thesis may be of interest to readers with a background in disciplines such as psychology (cognitive, social, occupational, and marketing), ergonomics, computer science, sociology, and politics.

A computer-based review of existing literature in the fields of human-computer interaction and psychology revealed an apparent lack of research into user perceptions of technology and the office. Although thousands of references were scanned by the CD-ROM search only 3 relevant references were identified (see Table 1). A repeat CD-ROM search fifteen months later produced similar results.

Although research into user attitudes towards technology does exist (for example Brosnan and Davidson, 1994) this research seems to focus on specific issues such as computer phobia rather than on user perceptions of, and attitudes towards, office work and office technology in general. The situation does not seem to have changed significantly since Shackel (1984) wrote "there have been surprisingly few attitudinal

studies about computers" and Oborne (1985) noted that little empirical work has been undertaken to investigate secretarial attitudes towards word processing systems. Whereas existing research tends to concentrate on specific users in specific office environments the author considers the office and technology in a wider context.

**TABLE 1 - EXTENT OF RESEARCH INTO USER PERCEPTIONS OF TECHNOLOGY AND THE OFFICE**

| | CD-ROM DATABASE | | | |
|---|---|---|---|---|
| | **Computer Select (October 1994)** | **Hilites (Spring 1993)** | **PsycLit (January 1987-June 1994)** | |
| | | | **Journals** | **Books** |
| the nature of office work | 0 | 0 | 0 | 0 |
| optimal use of computer systems in the office | 0 | 0 | 0 | 0 |
| user attitudes towards the office | 0 | 0 | 0 | 0 |
| user perceptions of the office | 0 | 0 | 0 | 0 |
| the role of technology in the office | 0 | 0 | 0 | 0 |
| the ideal office | 0 [1] | 0 | 0 | 0 |
| user attitudes towards technology | 0 | 0 | 0 | 0 |
| the future of the office | 1 [0] | 0 | 1 | 2 [1] |
| **Number of references available** | 72496 [76930] | ?? [25000] | ??* | ?? |

NOTES

1. [] = data from earlier CD-ROM search (Computer Select February 1993, Hilites Winter 1991, PsycLit January 1987-March 1993) Where no figure in [] is provided the results from the two searches were identical.

2. * the total number of references is unknown but figures for journal articles for specific topics are:

| | |
|---|---|
| attitudes | 25768 [21280] |
| technology | 4712 [3911] |
| work | 21969 [18133] |
| interaction | ?? [13698] |
| office | 1865 [1540] |

3. **Computer Select** covers 40 computer industry journals and 110 'other publications' published over one year.
**Hilites** covers journals and books in computer science, ergonomics, and psychology.
**PsycLit** covers over 1300 journals in 27 languages from approximately 50 countries and English language books in psychology, sociology, linguistics, medicine, law, physiology, business, psychiatry, and anthropology.

4. Variations of key phrases and single words were searched as well as the exact phrase listed above. For example, 'attitudes towards technology', 'perceptions of technology', 'what is office work'.

**Aims**

The overall aims of the empirical research were to increase understanding of user perceptions of office work and the role of technology in the office, to investigate the relationship between information derived from the author's studies and existing knowledge, and to determine the extent to which trends in the development of computer-based office systems reflect user perceptions.

**Dependability of sources of information included in the thesis**

The users from the user-centred point of view may be considered either in a narrow context as the people who are physically using computer technology or in a wider context as anyone who is affected by, and has views about, technology. In this thesis the emphasis is not only on end-users but also on users in general. For this reason, novels, newspapers, advertisements, cartoons, and conversations were considered as well as journals and books written by human-computer interaction experts.

Various types of evidence for a particular theory may exist including reports of empirical research in academic journals, newspaper reports, interviews, literature reviews, eyewitness accounts, and personal opinions. The assumption that 'experts' are the only reliable source of information is not necessarily correct. Although common sense, hearsay and fiction may be considered to have only limited scientific validity insight into a particular research issue may come from unlikely sources. The writer E. M. Forster (1947) seemed to anticipate the development of electronic forms of communication and multimedia and its possible drawbacks:

"....the round plate that she held in her hands began to glow. .... Presently she could see the image of her son who lived on the other side of the earth, and he could see her. [...]
'I want you to come and see me.'
Vashti watched his face in the blue plate.
'But I can see you!' she exclaimed. 'What more do you want?'
'I want to see you not through the Machine,' said Kuno. 'I want to speak to you not through the wearisome Machine.'
'Oh, hush!' said his mother, vaguely shocked. 'You mustn't say anything against the Machine.' [...]
'You talk as if a god had made the Machine,' cried the other.'[...] Men made it, do not forget that. Great men, but men. The machine is much, but it is not everything. I see something like you in this plate, but I do not see you. I hear something like you through this telephone, but I do not hear you.' "

This extract from a work of fiction is interesting because it neatly illustrates a perspective on the impact of technology even though the author was writing well before the technology 'explosion' of the late twentieth century. Other novelists writing

before the recent surge of interest in human-computer interaction have also had interesting ideas about the potential impact of technology. For example, the phrase 'BIG BROTHER IS WATCHING YOU' (Orwell, 1949) has been quoted so often as to pass into everyday speech. However, now that 'big brother' is indeed watching you through the surveillance cameras in the car park, at the railway station, in the supermarket, in the post office ..., Orwell's novel may not seem so far-fetched. The use of video links in office-based multimedia systems has implications for monitoring workers with or without their consent.

The dependability of a source may vary. Variations in quality may occur both within and between different types of evidence. Experiments may be replicable, reliable and valid or unreliable with unsubstantiated conclusions. Reports in the national press may also vary in reliability. Although a report in a prestigious journal would appear to have a high level of scientific dependability it has been alleged that data fabrication sometimes occurs even in apparently reputable journals.

The reliability of various sources of evidence may be decided by internal or external monitoring. Both newspapers and academic journals attempt to ensure the dependability of their reports through self-regulation and peer review. Newspapers monitor their own activities through the Press Complaints Commission while academic journals have a refereeing process. However, self-regulation may not be an infallible guarantee of the accuracy of information.

The reliability of the refereeing process for journals has been questioned. The same paper may be regarded by one referee as "rubbish" and by another as "the most important paper ever published in this journal" (Bowbrick, 1995). Bowbrick reports that studies of papers submitted to biomedical and social science journals have shown a level of agreement among referees that is only slightly higher than random. Rothkopf (1994) reports a study by Blank which found that the correlation between the numerical ratings provided by two referees was only 0.24.

External monitoring of both types of publication may take place by the readers. Newspapers have to contend with the possibility of legal action if erroneous or controversial material is published. There may even be political ramifications as in the 'cod fax' affair in November 1994 where the editor of *The Guardian* was censured by the House of Commons. The author is unaware of instances of learned journals being sued for publishing misleading information.

**FIGURE 3 - CRITERIA USED BY THE AUTHOR TO ASSESS THE DEPENDABILITY OF REFERENCES INCLUDED IN THE THESIS**

| | | RATING |
|---|---|---|
| **TYPE OF AUTHOR** | | |
| Academic | | 5 |
| IT professional | | 4 |
| Other professional | | 4 |
| Computer journalist | | 3 |
| Other journalist | | 3 |
| Fiction writer (Novelist, Poet) | | 2 |
| Unknown | | 1 |
| **YEAR OF PUBLICATION** | | |
| 1995-1991 | | 5 |
| 1990-1981 | | 4 |
| 1980-1971 | | 3 |
| 1970-1956 | | 2 |
| 1955 and earlier | | 1 |
| **TYPE OF PUBLICATION** | | |
| Academic book, journal, or report (published) | | 5 |
| Academic computer-based conference (unpublished) | | 4 |
| Academic lecture (unpublished) | | 4 |
| Computer magazine/journal | | 4 |
| Professional magazine/journal/newsletter | | 4 |
| 'Non-professional' magazine/journal | | 3 |
| Newspaper | | 3 |
| Television/radio programme | | 3 |
| 'Non-academic' book (e.g. novel; personal recollection) | | 2 |
| 'Non-academic' lecture/speech | | 2 |
| Film (fiction) | | 2 |
| Unknown | | 1 |
| **TYPE OF EVIDENCE** | | |
| Experimental (e.g interview, survey, case study, field study, laboratory study) | | 5 |
| Theoretical | - model | 4 |
| | - technical | 3 |
| | - literature review | 3 |
| 'Non-academic' report (newspaper, television,etc) | | 3 |
| Personal opinion/personal recollection | | 2 |
| Fiction (novel, film, cartoon, poem) | | 1 |

**NOTES**

1. Individual criteria
   - 5 = high dependability
   - 1 = low dependability
2. Final dependability rating
   - 17-20 = 5
   - 13-16 = 4
   - 9-12 = 3
   - 5-8 = 2
   - 1-4 = 1

In the thesis both academic journals and books and newspaper reports were included. Academic journals and books were considered to provide dependable information on models and experimental studies while newspapers provided up-to-date topical information concerning current developments in technology and current perceptions of technology. While journals tend to be read only by a relatively small number of specialist readers, newspapers reach a much wider population (see Table 1, Chapter 9) and may therefore exert a greater influence on shaping and reflecting the perceptions of users in society as a whole.

The author devised a 5-point rating scheme enabling a judgement to be made of the dependability of each reference included in the thesis. Four criteria were used - the type of author, year of publication, type of publication and type of evidence (see Figure 3). A rating of 5 indicates that the reference was considered to be highly dependable by the author on that criterion and a rating of 1 that the reference was not considered very dependable. The scores for each of the four criteria were added together to produce a total score (maximum = 20). This score was then assigned a final rating on a scale from 1 to 5. A final rating of 5 indicates that the reference was considered to be highly dependable by the author on all the criteria and a rating of 1 that the reference was not considered very dependable. The modal dependability rating for the references included in the present chapter is 5. A more detailed analysis of the references included in the thesis is provided in each chapter and in Chapter 10. Although the scheme used was based on the author's subjective judgement it enable a consistent assessment of the references to be made.

**Research techniques used by the author**

Two main research techniques were used in the present research: questionnaires and content analysis. In addition, one study involved analysis of videos. Laboratory-based experiments were not considered appropriate as the emphasis was on investigation of user attitudes and perceptions rather than on testing specific technology. The questionnaires used in Studies 1 to 5 and the coding system used in Study 5 were devised by the author specifically for this thesis since no suitable 'ready-made' questionnaires were thought to exist. The questionnaires evolved - that is, they were driven by the information provided by respondents. The initial research involved open questions while later questions were more directive.

The main reason for using questionnaires was to obtain information from a larger sample of users than could be covered using individual interviews. Although a large number of people can be reached using questionnaires, there may be a low response

rate and the information supplied relies on the respondent's memory. However, low response was not a major problem in the studies in this thesis, possibly due to issuing the questionnaires to subjects who were thought to be willing to respond. Since the information required was concerned with user perceptions rather than with personal experience it was not felt to be memory dependent.

Cross-validation of questionnaire information on user perceptions of the nature of office work and the role of technology in the office was obtained from the literature review to establish the extent of the correspondence between what users **say** when completing questionnaires and what **actually** happens when using technology. The link between perceptions and actual behaviour is considered in more detail in Chapters 5 to 9. Additional confirmation for the author's findings was provided by surveying the literature, and 'casual observation'. In the words of the 'professional rugby fan' and raconteur Max Boyce: "I know, ... 'cos I was there". 'Casual observation' involved observation of instances of user behaviour while waiting in bus queues, travelling by train, walking around London, and so on. The term 'casual' is used since the observations were opportunistic rather than planned.

The empirical research consists of five main studies. Studies 1 and 2 investigate user perceptions of existing office technology, Studies 3 and 4 investigate user perceptions of trends in the development of technology, and Study 5 compares user perceptions with the portrayal of computer industry perceptions by computer journalists. An outline of the aims of each study is given below and a detailed description is provided in Chapters 5 to 9.

**Subjects**

The increasing use of office technology such as word processors, communications technology, and databases means that people in a variety of occupations can be regarded as 'office workers' It was therefore not considered appropriate to restrict the subjects to a sample of specific office workers in a specific company since organizational, technological and social changes mean that data from a sample of workers in a specific office may be applicable only to that office. In addition, firms may have been unwilling to allow access to a large office population as such studies tend to be conducted internally or undertaken by consultants.

Many of the subjects who participated in Studies 1 to 4 had both theoretical and practical knowledge of office technology since they consisted mainly of:

a) undergraduate students on computing courses who intended to work as designers

b) IT professionals (postgraduate students on a part-time master's degree course in user-interface design who were already working in the computer industry as analysts and designers).

Many of the subjects who participated in Study 1 worked in a variety of occupations including clerical work and administration. Virtually all the subjects had some experience of using computers.

**Study 1: User perceptions of the nature of office work (Chapter 5)**
In Study 1 a **Free Response Questionnaire** was used to obtain information on user perceptions of office work and the role of technology in the office in order to determine whether there are shared perceptions of office work and the role of technology in the office.

**Study 2: The effect of situation characteristics on user perceptions of their use of technology (Chapter 6)**
Subjects were issued with a **Situations Questionnaire** consisting of hypothetical situations based on the information obtained from Study 1.

**Study 3: User perceptions of the ideal office (Chapter 7)**
Study 3 involved an analysis of the individual sections of the **Free Response Questionnaire** issued in Study 1 and a review of current developments in office technology.

**Study 4: An evaluation of current developments in computer-based office systems (Chapter 8)**
A comparison of two prototype computer systems was made by showing subjects a video made by each company to demonstrate that company's view of how future computer systems should look. Subjects were asked to evaluate each system using a questionnaire (the **Evaluation Questionnaire**) based on the hypothetical situations investigated in Study 2.

**Study 5: Content analysis of computer journalists' portrayal of the computer industry (Chapter 9)**
A content analysis of two leading publications was carried out for the period January 1991 to June 1993 to determine whether computer industry priorities and perceptions of technology and the office and current trends in the development of computer-based office systems as portrayed by computer journalists reflect the user perceptions

identified in Studies 1 to 3. Both communalities and differences in perceptions were of interest.

## CONCLUSION

In this chapter the rationale for investigating user perceptions of technology and the office was considered and an outline of the author's empirical research provided. Office technology which is designed taking into account user perceptions may be more widely accepted by the users of that system than an interface designed with no consideration of user perceptions. Empirical investigations of user perceptions of technology and the office to determine whether users share similar perceptions relating to office work and office technology are described in Chapters 5-9.

# CHAPTER 5 - AN INVESTIGATION OF USER PERCEPTIONS OF THE NATURE OF OFFICE WORK (STUDY 1)


## SUMMARY

User perceptions of the nature of office work and the role of computers in the office were investigated by issuing a free-response questionnaire to 75 subjects. The questionnaire was divided into three main parts - The Office, Using Computers in the Office (Advantages and Disadvantages), and The Ideal Office. It was hypothesised that the subjects would share similar conceptions of the nature of office work and perceive that while it is advantageous to allocate certain features of the office to the computer, computer systems have a detrimental effect on certain other features - particularly those relating to informal social communication. The responses of the subjects could be described by eight factors - information-handling, human contact, paper-handling, financial security, communication, technology, work, and health preservation. These factors are considered to form the main constituents of office work as perceived by the subjects who participated in this study. Overall agreement was found between the subject groups on the factors which constitute office work.


## INTRODUCTION

In recent years the use of computer systems in the office has expanded rapidly and is likely to increase even further in the future. It is therefore important to understand the nature of office work and the role of technology in the office so that technology can be applied to office work more appropriately and so that the usability and acceptability of office technology can be enhanced.

Current office computing systems provide many of the features considered to characterize 'the office'. The author has claimed elsewhere (Smith 1990a, 1990b, 1991) that computer systems, particularly those offering multiple windowing facilities, provide an effective means of completing office activities. Recent developments, such as interest in the use of multimedia for teamwork/groupwork, mean that aspects of 'the office' other than basic office tasks such as the provision of wordprocessing facilities are being allocated to the computer. The impact of a computer which could simulate people, as in the 'intelligent agents' metaphor, on organizational and social aspects of the office is likely to be much greater than a computer which is intended merely as a tool to carry out mundane office tasks.

"Perhaps users could actually step into the programs themselves, software providing a 'virtual reality' " (Schofield 1990). The interest in virtual reality indicates that the

computer is regarded as much more than just a tool. It seems quite clear that certain aspects of the work environment are totally unsuitable for allocation to virtual reality. For example, a 'virtual tea-break' is unlikely to be widely acceptable.

The references in this chapter were derived mainly from academic 'textbooks', journals and newspaper articles. The modal dependability rating of the references is 5 indicating a high level of dependability.

## THE NATURE OF OFFICE WORK

Various views of the nature of office work and of the role of technology in the office were described in Chapter 2. These views include the functional/activity view, communication view, desktop metaphor, information-handling view, and decision-making view. Various studies of time allocation and the activities which occur in offices have been performed although their results were sometimes imprecise and based on only a small sample of organizations (Christie and Kaiser, 1985).

The OSSAD (Office Support Systems Analysis and Design) study which took place in five field sites (three banks, a paper machine company and an education centre for a trades union federation) in Finland, France, Germany, and Italy used a formal office language to obtain a formal description of office work which could help users and manufacturers develop and validate a computer-based Office Support System (Baron and Beslmüller, 1989; ESPRIT, 1990c). In the report of the OSSAD study (Conrath and Dumas, 1989) it was suggested that an office is "an identifiable set of people organized to process data and information in the pursuit of interdependent goals".

The relationship between different views of office work and the role of technology in the office and the results of the present study is discussed below (see 'Discussion').

### Studies of user perceptions of the nature of work and the role of technology in the office

As mentioned in Chapter 4, while attitude research has been performed into general issues related to human-computer interaction such as computerphobia (Brosnan and Davidson, 1994), there seems to be a lack of research into user perceptions of the nature of office work. Studies which have been made include those by Rockart and Flannery (1989), Gallup Organization and Tandem Computers (1992), Gutek and Winter (1990), Kemp (1987), Spinas (1987), and Cooper (1992).

Two individual views of the nature of office work were expressed in letters to two different publications:

"We get through work with great speed and efficiency now with fast printer, fax machines, etc., but the fun and the characters have all gone" (Mrs M.S., 1993).

"...This is where the "traditional office" is actually to be found: in the humdrum, often tedious, environments in which most of us are still expected to work every day" ('Name and address supplied', *The Guardian*, 1993).

Rockart and Flannery (1989) interviewed 200 end-users and 50 members of information systems staff with responsibility for supporting end-user computing in seven major organizations, including three Fortune 50 manufacturing companies, ('Fortune' is a managerial journal) to determine their views concerning end-user computing and found that the respondents viewed end-user computing as a means for facilitating decision-making and improving productivity.

Gallup and Tandem (1992) conducted a telephone survey to determine the attitude of 100 Fortune 500 senior executives concerning the role of information technology within large organizations and found that 92 per cent of executives said that their customers benefitted from the companies' use of information technology.

Gutek and Winter (1990) surveyed the effects of office computerization and perceived control over the computer on job satisfaction. The subjects were 89 computer-using work groups in 49 different organizations in Southern California. Each member of the work group completed a questionnaire and the supervisor or manager of each work group was interviewed. Gutek and Winter concluded that user perceptions of control over the computer have little direct effect on job satisfaction and that "computer systems mirror the existing environment rather than altering it".

Kemp (1987) surveyed studies of attitudes to information technology in general. These surveys considered the perspective of the general public, management, trade unions and unemployed people. A MORI survey of 1824 adults interviewed in 134 constituencies in 1985 found that 42 per cent thought that information technology would affect their jobs. Kemp concludes that the majority of people who participated in the surveys he reviewed held mainly positive attitudes towards information technology in general. However, more negative reactions were found when specific applications of technology were considered. Unlike Gutek and Winter (1990) Kemp suggests that "negative perceptions of new technology may result in people being unable or unwilling to perform at their best and in the technology being used suboptimally".

Spinas (1987) studied the experiences and requirements of computer users engaged in office work. Interviews and questionnaires supplemented by an observation of user behaviour were used to determine the opinions of clerical employees in four companies towards the computer system they were using. Spinas concluded that varied job content and user control over the system were important.

A national survey of over 1000 office workers by the ICR Survey Research Group found that office equipment "has never been more user-friendly" Cooper (1992). No difference in attitudes was found between the 18-to-34 age group and the 35-to-44 age group.

Although the studies surveyed above sampled large numbers of office workers in a variety of organizations the studies tended to concentrate on investigating specific issues and personal experiences. This differs from the present study where the author considers user perceptions of the nature of office work and role of technology in the office in general (see author's interpretation of 'perceptions' in Chapter 4). Kemp (1987) studied attitudes to information technology in general but used a more directive questionnaire than that used by the author in the present study.

## THE PRESENT STUDY

The need for consideration of user perceptions was discussed in Chapter 4. The impact of user perceptions on the success of technology is highlighted in the following comment made by a market analyst: "Forms software by itself isn't going very far because of the user perceptions of electronic forms" (Schroeder, 1992). Wield (in Boeller et al., 1992) reporting on lessons learned about the design of a plotter when erroneous assumptions were made by designers about the design of a lever, notes that "no one person, especially the designer, can determine user reaction" and concludes that "the design might be improved further now that we have gained a clearer understanding of DesignJet user perceptions".

The aims of the present study were to investigate user perceptions of the activities which occur in a typical office, the advantages and disadvantages of using computer systems in the office, and the features which the subjects would allocate to a computer in their ideal office. The study aimed to investigate whether the subjects shared a common understanding of office work and the role of technology in the office. The perceptions of the subjects were compared with information in the literature to determine the extent to which the perceptions of the subjects could be related to existing knowledge of the nature of office work and the role of office technology.

It was thought that user perceptions of the nature of office work would reflect the author's view that there are several basic elements which comprise office work. It is possible that any similarities found could be due solely to the common sampling period. However, comparisons with descriptions of work in the literature provide a basis for determining whether user perceptions reflect constant elements which exist regardless of the sampling period.

It was felt to be important to obtain information from users of computer systems to see how far the perceptions of users coincide with those of the computer industry. The problems encountered by users of computer systems indicate that designer assumptions concerning user expectations and requirements are not infallible: "...although computer technology has made great advances over the past 30 years, the designer's knowledge and understanding of the user has not significantly changed". The result of this is that "many systems have been developed that are considered to be functionally excellent, but perform badly in the real world" (Booth, 1989).

## METHOD

### SUBJECTS

75 subjects completed the Free Response Questionnaire.

**Age** - 69 per cent of the subjects were aged 18-34 and 27 per cent 35-49. The age groups 17 and under, 50-64, and 65 and over each contained 1 per cent of subjects.

**Sex** - 57 per cent of subjects were male and 43 per cent female.

**Occupation** - 52 per cent of the subjects were full-time students ('Students') and 48 per cent worked full-time in a variety of occupations ('Professionals'). The majority of the 'Students' were attending computer-based courses. The 'Professionals' included clerical and administrative workers (19 per cent of the total number of subjects), other professions including teachers of English as a Foreign Language, a company director, library assistant, and an air hostess (21 per cent), and IT professionals who worked in the computer industry in addition to attending a part-time master's course in user interface design (8 per cent).

**Experience** - 95 per cent of the subjects had experience of using computers while 5 per cent had never used a computer.

**Type of computer experience** - 39 per cent of the subjects had experience of using computers as software designers and 54 per cent used computers for other purposes. The remaining 7 per cent did not use computers at all. (Of the 54 per cent using computers for other purposes 37 per cent were end-users and 12 per cent programmers.)

**Frequency of use** - 73 per cent of the subjects used computers every day, 16 per cent used computers once a week, 4 per cent once a month, and 7 per cent never used computers.

**Bias**

The amount of bias existing in research is related to the sampling boundary. Are the research findings applicable only to the sample of subjects studied or to people with totally different characteristics? Many of the subjects in the current study had experience of office work and most (95 per cent) had experience of using office technology. The results from the current study can be regarded as definitely applicable to the subjects who participated since there was a 100 per cent sample of the subjects available. The results can also be generalised to users with similar characteristics. That is, people who have studied computer systems and people with a basic knowledge of office work and office technology. Whether the results can be generalised to all users or whether similar results would be found if the study was repeated with subjects from a totally different background needs to be ascertained by further investigation and by considering existing knowledge. One test of the generalizability of the results is the extent to which other results of the research reported in the thesis converge with the results from the sample reported in the present study.

## PROCEDURE

The technique used for this study was a self-administered, paper-based questionnaire - the **Free Response Questionnaire** - devised by the author (see Appendix A). Free responses rather than fixed responses were requested in the main part of the Free Response Questionnaire even though this makes data analysis more complex as a principal objective of this study was to see what sort of responses subjects would provide with a minimum of prompting and so that the extent of spontaneous similarity between the perceptions of different respondents could be determined.

The problem of low response rates (Moser and Kalton, 1975) was counteracted by targetting the questionnaires on subjects known to be likely to be willing to respond.

The overall response rate was 83 per cent. The questionnaire was mailed to about 50 per cent of subjects and issued personally to the remaining 50 per cent of subjects.

In order to counteract possible order effects (Damos, 1986), the order of presentation of the pages of the questionnaire was randomised and subjects were asked to ensure that they completed the pages of the questionnaire in the order that they had been presented.

The questionnaire was divided into two main parts: the Background Information Questionnaire and the Free Response Questionnaire. The aim of the Background Information Questionnaire was to obtain information on subject characteristics such as computer experience and occupation as it was felt that characteristics such as occupation and computer experience could affect the responses provided to the Free Response Questionnaire.

The aim of the Free Response Questionnaire was to elicit information about subjects' perceptions concerning the activities which occur in a typical office (The Office), the advantages and disadvantages of using computers in the office (Using Computers in the Office), the features which subjects would assign to computers in their ideal office, and their forecast for when those features were likely to be implemented at reasonable cost (The Ideal Office). The implementation forecasts were analysed separately and form part of Study 3 ('The Ideal Office' - see Chapter 7). Although some subjects might regard the 'ideal' office as one without computers it was felt necessary to impose this constraint in order to provide a basis for comparison between subjects and because one of the aims of the study was to discover what people would like office computer systems to provide.

In addition to listing items, subjects were also required to assign a rank to each item on their list according to how important they felt that item to be in order to determine whether the subjects shared similar perceptions and, if so, whether they regarded them as being of similar importance. The subjects gave a numerical rank with 1 indicating that the subject regarded that item as the most important on their list, 2 that the item was the next most important, and so on. However, variations in the number of items listed by subjects could make between subject comparisons difficult since the difference between a rank of 1 and 2 for subject A is not necessarily the same as the difference for subject B unless the two lists of items are identical.

Subjects were asked to imagine a 'typical' office even though it is recognised that there are a wide variety of offices such as offices in a bank, offices in schools, offices in hospitals, and so on since the aim of the study was to elicit the activities which individual subjects **thought** characterised all offices. The study was concerned with investigating whether evidence could be found for the existence of shared perceptions concerning the nature of office work rather than with recollections of personal experience by the subjects.

## RESULTS

Various multivariate methods exist for interpreting a large amount of data in terms of a few groups or concepts including multidimensional scaling, discriminant analysis, cluster analysis and factor analysis. The two main alternatives considered for the interpretation of the subjects' responses were cluster analysis and factor analysis. Factor analysis was chosen in preference to cluster analysis since "the poorness of the superstructure of calculations that can be built on clusters relative to factors, supports...preference for the factor over the correlation cluster model" (Cattell, 1978). Aldenderfer and Blashfield (1984) stated that "factor analysis is based on an extensive body of statistical reasoning" but "most cluster analysis methods are relatively simple" and "different clustering methods can and do generate different solutions to the same data set".

In the current study factor analysis was used to supplement the author's intuitive analysis with a more independent form of analysis to increase confidence about the way in which the data were interpreted. The factor analysis was used as a means of interpreting the subjects' responses in terms of a few areas or dimensions to guide later research in the thesis. The factors produced from the analysis are not intended to be regarded as similar to the psychometric factors derived from personality research. Since the analysis was exploratory rather than confirmatory (West, 1991; Kline 1994) it was not considered necessary to identify an exact number of factors and a finite number of elements in each factor. The author's analysis considers one way of classifying user perceptions of technology and the office but this is not necessarily the only way in which the data could be classified. In the context of the thesis other terms could be substituted for the term 'factor' including 'areas', 'topics', 'dimensions', and 'heuristics'.

Since factor analysis can produce more than one way of interpreting data and therefore more than one 'correct' answer it may be said to reflect the real world in which phenomena exist more often in 'shades of grey' than in 'black and white'. However, the mechanics of the analysis may be regarded as 100 per cent reliable. That is, identical

data were produced when the oblimin rotation was repeated using a different version of SPSS.

The analysis of the results was carried out in four stages:
STAGE 1. Free Response Questionnaire (1528 responses)
STAGE 2. Classification Checklist (328 labels)
STAGE 3. Labels Checklist (50 labels)
STAGE 4. Factor Analysis (8 factors)

## STAGE 1. FREE RESPONSE QUESTIONNAIRE

1528 free responses were collected from the Free Response Questionnaire and analysed to determine whether there were any similarities in the responses made by the subjects. The results of the initial analysis indicated that people share similar ideas concerning the nature of 'the office' but vary in their opinions concerning the importance of a concept and in the language they use to express that concept. For example, 'filing' was listed by 51 per cent of subjects but the rank it received varied from 1 to 12 with a mode of 5.

## STAGE 2. CLASSIFICATION CHECKLIST

The 1528 'free responses' were classified by the author into 328 groups according to semantic similarity to produce a **Classification Checklist**. For example, the responses 'save time', 'big saving of time', 'saves time' and 'time-saving' were included in one group and 'automatic coffee machine', infallible coffee machine', 'really good coffee-maker - voice-controlled!', 'tea machine that gives decent tea' and 'supersonic coffee-making machine (responding to verbal requests)' in another. Each of the groups contained one item felt by the author to be totally unrelated semantically to the remaining items in the group to allow a check to be made on the reliability of the assessment of the remaining items in the group (see Appendix A for an extract from the Classification Checklist).

The Classification Checklist was divided into four parts corresponding to the sections used in the Free Response Questionnaire - The Office, Using computers in the office (Advantages), Using Computers in the office (Disadvantages), and The Ideal Office. However, the sections were not labelled when issued to the judges to avoid influencing their judgement. Each judge completed the four parts of the checklist in a different order to avoid bias caused by order of presentation.

The Classification Checklist was assessed by four judges. The judges were three lecturers and a research assistant in a department specialising in teaching computer-based subjects who could all be considered as 'computer experts'. Three of the judges were male and one female.

The judges were asked to choose one item from each group of responses which they felt to be the best label (that is, the most semantically similar) for all the items in the group and to give the remaining items a rating of 1 to 5 according to how similar the judge felt the item to be to the chosen label (5 = identical/high similarity 1 = no similarity). 328 labels were derived from the 328 groups of responses.

All the judges consistently gave a rating of 1 to the response considered by the author to be semantically dissimilar in each group which suggests that the technique used was reliable and that the judges were all giving responses based on judgements of semantic similarity.

**STAGE 3. LABELS CHECKLIST**

The 50 strongest labels derived from the Classification Checklist were used to produce a **Labels Checklist** to allow a comparison of the semantic similarity of the labels to take place. (Appendix A contains an extract from the Labels Checklist.)

The strength of the labels was decided by the amount of agreement between the judges on the semantic similarity of the items in a group and choice of a label and the number of Free Response Questionnaire responses represented by each label. For example, a label selected by all four of the judges was considered to be very strong and a label chosen by only two of the judges to be relatively weak. A label representing less than 8 Free Response Questionnaire responses was considered as weak regardless of the amount of agreement between the judges on semantic similarity.

Four judges were required to compare each label with every other label. The judges included a student and a management analyst who used computers regularly in their current occupation and a teacher and student who had very little computer experience and did not use computers in their current occupation. Two of the judges were male and two female.

The labels were presented in pairs. Each judge gave each pair of labels a rating from -10 to +10 according to how similar they felt the two labels to be. A rating of +10 indicated a very high degree of similarity, a rating of 0 indicated no similarity and a

rating of -10 indicated a high degree of dissimilarity. A comparison of label 'A' with Label 'B' was assumed to be the same as a comparison of label 'B' with Label 'A'. Each judge made 1250 comparisons. The average rating of the judges for each pair of labels was calculated and recorded in a 50x50 'semantic similarity ratings matrix'.

## STAGE 4. FACTOR ANALYSIS

The 'semantic similarity matrix' based on the judgements of semantic similarity of the labels in the Labels Checklist was analysed using an oblique factor analysis (Oblimin rotation) to see whether the 50 labels could be described in terms of a smaller number of factors.

In this chapter the four sections of the Free Response Questionnaire (Office, Advantages, Disadvantages, Ideal Office) were analysed as a whole to provide an overall picture of the subjects' perceptions of office work and the role of office technology in the office. In Chapter 7 ('User perceptions of the Ideal Office') factor analysis of the responses for each section of the questionnaire was performed to enable a comparison to be made between perceptions of the office as it is perceived to be at present with perceptions of how the office could be in the future.

The main stages in factor analysis used in the present study were production of a correlation matrix from the semantic similarity ratings obtained from the Labels Checklist, initial factor extraction using Principal Components Analysis (using the Kaiser-Guttman test for the number of factors), oblique rotation of the factors obtained from the Principal Components Analysis (the oblique solution used was Oblimin), and interpretation of the factors obtained from the oblique rotation. The factor analysis was completed using SPSS-X (Release 4.0) on a VAXcluster. An oblique solution was chosen in this study as it allows either correlated or uncorrelated factors to emerge and it was felt that there was some overlap between the psychological dimensions assumed to be represented by the factors. That is, it was assumed that all the factors which would be derived from the factor analysis would be related to 'office work' to some extent. An orthogonal rotation would have forced a solution in which all the factors were uncorrelated. Katz and Hyman (1993) analysed attitudes from a survey of concern over telecommunication privacy using both oblimin (oblique) and varimax (orthogonal) rotations and found that similar results were obtained from the two types of rotation.

Table 1 shows the variance accounted for by the 8 factors obtained from the initial factor extraction (Principal Components Analysis). The 8 factors identified accounted

for 80.4% of the total variance. Each of the factors was analysed for subcomponents but none were found. Although Factor 1 (Information-Handling) accounted for 41% of the variance the exact amount of variance was not considered to be crucial since the factors were regarded as indicative of important areas to guide future research rather than as 'psychometric' factors. However, since information-handling was considered to be a major dimension of office work and using technology in the office it was investigated further by the author in later chapters. In Chapter 6 (*'The effect of situation characteristics on user perceptions of their use of technology'*) and Chapter 8 (*'An evaluation of current developments in computer-based office systems'*) three aspects of information management are studied - information gathering, information storage/retrieval, and information protection.

**TABLE 1 - VARIANCE ACCOUNTED FOR BY EACH FACTOR**

| VARIABLE | COMMUNALITY | FACTOR | EIGENVALUE | PCT OF VAR | CUM PCT |
|---|---|---|---|---|---|
| X1 | .88277 | 1 | 20.50733 | 41.0 | 41.0 |
| X2 | .83996 | 2 | 7.25798 | 14.5 | 55.5 |
| X3 | .78294 | 3 | 3.91099 | 7.8 | 63.4 |
| X4 | .81447 | 4 | 2.34472 | 4.7 | 68.0 |
| X5 | .73307 | 5 | 1.95871 | 3.9 | 72.0 |
| X6 | .85144 | 6 | 1.64894 | 3.3 | 75.3 |
| X7 | .78821 | 7 | 1.41668 | 2.8 | 78.1 |
| X8 | .86645 | 8 | 1.16664 | 2.3 | 80.4 |

PCT OF VAR = percentage of variance explained
CUM PCT = cumulative percentage of variance explained

The oblique rotation of the factors obtained from the initial factor extraction using Oblimin converged in 62 iterations. Table 2 shows the significant loadings (± 0.3 and higher, Child, 1970) derived from the Oblimin rotation.

## TABLE 2 - SIGNIFICANT LOADINGS FOR THE FACTORS

| LABELS | FACTORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 |
| improved storage of data | .67 | - | - | - | - | - | - | - |
| file management | .63 | - | .45 | - | - | - | - | - |
| file maintenance | .60 | - | .48 | - | - | - | - | - |
| easy data retrieval | .57 | - | - | - | - | .31 | - | - |
| quicker to do things | .55 | - | - | - | - | .43 | - | - |
| filing | .50 | -.34 | .60 | - | - | - | - | - |
| data entry | .46 | - | - | - | - | .39 | - | - |
| ready information at hand | .46 | - | - | - | - | .38 | - | - |
| increased efficiency | .46 | - | - | - | - | .36 | - | - |
| reduction of paperwork | .31 | - | -.69 | - | - | - | - | -.36 |
| computer goes down | -.52 | - | - | - | - | -.39 | - | - |
| expense | -.47 | - | - | .52 | - | - | -.35 | - |
| reduced job satisfaction | -.39 | -.64 | - | - | - | - | - | - |
| power failure | -.30 | - | - | - | - | -.59 | - | - |
| lunch | - | .81 | - | - | - | - | - | - |
| seeing clients | - | .71 | - | - | - | - | - | - |
| tea/coffee-making | - | .69 | - | - | - | - | - | .41 |
| meetings | - | .67 | - | - | - | - | - | - |
| diary management | - | .49 | - | - | .35 | - | - | - |
| decision-making | - | .47 | - | .34 | .32 | - | - | - |
| communication | - | .46 | - | - | .32 | - | - | - |
| improved communication | - | .38 | - | - | .37 | .41 | - | - |
| information gathering | - | .32 | .48 | - | .41 | - | - | - |
| lack of human contact | - | -.61 | - | - | - | - | .33 | - |
| security | - | -.37 | - | .53 | .44 | - | - | - |
| dealing with post | - | - | .81 | - | - | - | - | - |
| mail | - | - | .77 | - | - | - | - | - |
| correspondence | - | - | .76 | - | - | - | - | -.32 |
| photocopying | - | - | .69 | - | - | .33 | - | - |
| dealing with correspondence | - | - | .66 | - | - | - | - | - |
| information storing | - | - | .50 | - | .31 | - | - | - |
| document preparation | - | - | .32 | - | - | .45 | - | - |
| payroll | - | - | - | .88 | - | - | - | - |
| accounting | - | - | - | .87 | - | - | - | - |
| security of data | - | - | - | .63 | - | - | - | - |
| maintaining accounts | - | - | - | .58 | - | .30 | - | - |
| telephone management | - | - | - | - | .80 | - | - | - |
| using different types of communication | - | - | - | - | .74 | - | - | - |
| telephone communication | - | - | - | - | .72 | - | - | - |
| voice processing | - | - | - | - | .44 | .53 | - | - |
| printers | - | - | - | - | - | .95 | - | - |
| computerised typewriters <u>without</u> typist | - | - | - | - | - | .88 | - | - |
| wordprocessing | - | - | - | - | - | .76 | - | - |
| communications from computer i.e. videoconferencing (to include telephone, fax, etc.) | - | - | - | - | - | .71 | - | - |
| typing/wordprocessing | - | - | - | - | - | .68 | - | - |
| electronic mail | - | - | - | - | - | .60 | - | - |
| loss of jobs | - | - | - | - | - | - | .97 | - |
| staff training | - | - | - | - | - | - | -.51 | - |
| work | - | - | - | - | - | - | -.39 | - |
| health hazards | - | - | - | - | - | - | - | .86 |

Each factor shared some variance with the other factors. That is, the factors identified do not exist in isolation but share some constituents with at least one other factor. Table 3 shows the factor correlation matrix with significant correlations (± 0.3 and higher) highlighted in bold. The existence of significant correlations provides evidence that it was correct to assume that there is some overlap between the psychological dimensions thought to be represented by the factors.

**TABLE 3 - FACTOR CORRELATION MATRIX**

| | FACTOR | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **F1** | **F2** | **F3** | **F4** | **F5** | **F6** | **F7** | **F8** |
| **FACTOR 1** | 1 | | | | | | | |
| **FACTOR 2** | .07 | 1 | | | | | | |
| **FACTOR 3** | .27 | .07 | 1 | | | | | |
| **FACTOR 4** | .19 | .13 | **.35** | 1 | | | | |
| **FACTOR 5** | .18 | **.31** | .21 | .22 | 1 | | | |
| **FACTOR 6** | **.44** | .05 | .23 | .24 | .18 | 1 | | |
| **FACTOR 7** | -.05 | -.21 | -.22 | -.21 | -.24 | .02 | 1 | |
| **FACTOR 8** | -.23 | .05 | -.07 | -.03 | -.14 | **-.30** | -.05 | 1 |

The specific **label** given to a particular factor is likely to vary depending on who is interpreting the factors although the **constituents** of the factor will not vary. The labels used for the factors are based on the constituents identified and should be regarded as a collective name for referring to the factor as a whole. In the discussion of the factors below, the label given to the factor is in capital letters followed by a list of the significant constituents of that factor in lower case. 'Opposite' refers to the constituents forming the opposite 'pole' of the factor.

Evidence for considering office work and office technology in terms of the factors or dimensions identified from the factor analysis was found in existing knowledge. Indicative examples from the literature are given below with the author's interpretation of the factors. Additional evidence for viewing the office in terms of the dimensions identified can be found from a variety of sources including advertisements, the media, and observation. Advertisements for 'office' jobs often stress the need to know specific wordprocessing packages indicating that employers share the subjects' perception of the incompatibility of hardware and software packages. Television programmes such as the comedies *The Fall and Rise of Reginald Perrin* and *Nice Day at the Office* and newspaper cartoons such as *Bristow* provide a fictional depiction of office life (discussed further in Chapter 9). 'Casual' observation of workers in London provides some evidence that information management and human contact are important in 'real' life. Office workers may be observed walking around the City carrying large piles of paper indicating that paperwork forms part of office life while the large number of

sandwich shops and long queues of office workers in those shops at midday indicate that lunch is an important aspect of office life.

**FACTOR 1 - INFORMATION-HANDLING: improved storage of data, file management, file maintenance, easy data retrieval, quicker to do things, filing, data entry, ready information at hand, increased efficiency, reduction of paperwork opposite computer goes down, expense, reduced job satisfaction, power failure**

The constituents of Factor 1 appear to be related to efficient information handling and reliability while the opposite constituents are unreliability, inefficiency, and expense.

A survey of 100 senior executives by the Gallup Organization and Tandem Computers Inc. found that "instant and accurate access to information" was given as the most important reason for purchasing information technology (Gallup and Tandem, 1992).

Gutek and Winter (1990) in a survey of the effects of office computerization on job satisfaction concluded that user perceptions of control over the computer and "computers per se" have little direct effect on job satisfaction. It is not clear whether Gutek and Winter are referring to overall job satisfaction. A worker could be dissatisfied with the technology but satisfied with their job in general due to other compensating factors such as the nature of their work.

**FACTOR 2 - HUMAN CONTACT: lunch, seeing clients, tea/coffee-making, meetings, diary management, decision-making, communication, improved communication, information gathering opposite reduced job satisfaction, lack of human contact, security, filing**

Initial consideration of Factor 2 indicates that the constituents fall into two distinct groups - lunch and tea/coffee-making in one group and the remaining constituents such as seeing clients, meetings, diary management and communication in the other. However, if lunch and tea/coffee-making are regarded as social activities rather than as nutritional/physiological activities the constituents of Factor 2 may be regarded as a single group concerned with contact with people while the opposite constituents include lack of human contact and reduced job satisfaction. The subjects may perceive that job satisfaction can be gained from social contact and lost if there is no human contact.

Although the emphasis in some advertisements for computers appears to be on price and technical details such as a "486DX2 50 MHz processor", "4Mb RAM, upgradeable to 32 Mb", and "#9 GXE VL-Bus graphics accelerator with 3 MB Video RAM" (Dell Dimension advertisement, November, 1993), Sedgwick (1993) suggested that "people

generally care less about knowing the time to the nanosecond than about seeing how long they've got until lunch". In the current study 'lunch' and 'tea/coffee making' appeared as constituents of the factor 'Human Contact' which supports the view that lunch is perceived to be an important aspect of the office.

**FACTOR 3 - PAPER-HANDLING: dealing with post, mail, correspondence, photocopying, dealing with correspondence, filing, information storing, information gathering, file maintenance, file management, document preparation opposite reduction of paperwork**

Factor 3 appears to be very strongly related to paper-handling and information organization with emphasis on mail/correspondence (dealing with post, mail, correspondence, and dealing with correspondence) and filing (filing, information storing, file maintenance, and file management). The interpretation of Factor 3 as emphasising the paper-handling rather than the communication aspects of correspondence is supported by the fact that the only significant opposite constituent is reduction of paperwork.

Paper still seems to play an important role in the office (Fisher, 1990; Coffey, 1993a; Taylor, 1993a) despite predictions that increased use of office technology would result in a paperless office. Taylor stated that "about 95 per cent of information used in the office is still stored on paper, rather than electronically".

**FACTOR 4 - FINANCIAL SECURITY: payroll, accounting, security of data, maintaining accounts, security, expense, decision-making opposite - no significant opposite constituents**

The constituents of Factor 4 fall into 2 main groups - one related to money (payroll, accounting, maintaining accounts and expense) and the other to security (security of data and security). Decision-making appears to be unrelated to either group. However, it does have some relationship as expenditure of money requires a certain amount of decision-making. The link between money and security may be regarded as financial security - that is, people feel secure when they have money. No opposite constituents were identified.

Computer security is often mentioned in newspapers, on television, and so on. Kiernan (1994) stated that "lax security is threatening the credibility of the Internet, the global computer network". Haynes (1994) reported that the theft of secret passwords had sparked a security alert among users across Britain and stated that stolen passwords could be a gateway to confidential information and government data stored on computer. Cole (1994) reported that "computer crime as a whole is big business with

estimates on the worldwide figure put at billions of pounds. It also comes in a variety of forms, from hardware and data theft, to the illegal entry of databases ('hacking') and the disruption of computer systems with viruses".

The potential expense of using technology is mentioned in a report by *The Times*: "Councils could save a total of £50 million a year if they made better use of technology, the Audit Commission says today. Over complex systems, too many operating staff and costly disc storage are putting up the expense of computer use" (*The Times*, 1994).

**FACTOR 5 - COMMUNICATION: telephone management, using different types of communication, telephone communication, security, voice processing, information gathering, improved communication, diary management, decision-making, communication, information storing opposite - no significant opposite constituents**

Various forms of communication are identified in Factor 5 (telephone management, using different types of communication, telephone communication, voice processing, improved communication, and communication). The other constituents (information gathering, diary management, decision-making, and information storing) do not seem to be directly related to communication. However, it may be that a certain amount of communication is needed when making decisions and gathering information and that diary management is an integral part of organizing opportunities for communication. No opposite constituents were identified.

The existence of a **communication view** of office work (see Chapter 2) and the growth in use of telecommunications (see Chapter 7) may be seen as an indication of the importance of communication.

**FACTOR 6 - TECHNOLOGY: printers, computerised typewriters without typist, wordprocessing, communications from computer i.e. videoconferencing (to include telephone, fax, etc.), typing/wordprocessing, electronic mail, voice processing, document preparation, quicker to do things, improved communication, data entry, ready information at hand, increased efficiency, photocopying, easy data retrieval, maintaining accounts opposite power failure, computer goes down**

Several constituents of Factor 6 (printers, computerised typewriters without typist, wordprocessing, communications from computer i.e. videoconferencing (to include telephone, fax, etc.), typing/wordprocessing, electronic mail, and voice processing) mention some form of technology with the emphasis on computer technology. The

remaining constituents seem to fall into two groups - one containing activities which could be completed using technology (document preparation, data entry, photocopying, and maintaining accounts) and the other the benefits of using technology (quicker to do things, improved communication, ready information at hand, increased efficiency, and easy data retrieval). There were only two opposite constituents: 'power failure' and 'computer goes down'. This indicates that the ability to complete work using technology, particularly computer-based technology, is considered to be strongly related to, and dependent upon, the reliability of that technology and a reliable power supply.

The increasing use of computer-based technology, and developments in telecommunications and other areas (see Chapter 7) indicate the importance of technology. Lloyd (1994) mentioned the "drastic change" in the business environment being brought about by information technology.

The anxiety expressed by subjects in the present study about dependence on an unreliable power supply and insecure systems may have some validity. Problems may occur even on an apparently secure system. Thimbleby (1990) reports the loss of 64 Mb out of a 100 Mb disc when his computer crashed and "the recovery program designed to rescue users from such disasters could not cope".

**FACTOR 7 - WORK: loss of jobs, lack of human contact opposite staff training, work, expense**

The constituents of Factor 7 are loss of jobs and lack of human contact. This suggests that work is regarded in terms of contact with others and that human contact forms a major part of work. This is supported by the appearance of 'work' as one of the opposite constituents.

Patel (1993) notes that when "the subtle and complex interactions between employees and new technology, and the way people are organised at work" are ignored the consequences can be serious. Patel cites as an example the collapse within 36 hours of the £1.5 million initiative by the London Ambulance Service for dealing with emergency calls. One of the causes of problems was poor training. The importance of training was also mentioned in a report on the use of information technology by councils. In this report the Audit Commission called for better staff training (*The Times*, 1994). The subjects who participated in the current study mentioned training as an important aspect of office work which indicates that the subjects' perception of the importance of training reflects the perceptions of a wider population.

**FACTOR 8 - HEALTH PRESERVATION: health hazards, tea/coffee-making opposite reduction of paperwork, correspondence**

The constituents of Factor 8 (health hazards and tea/coffee-making) appear to be unrelated to each other and not intuitively related to the constituents of the 'opposite' dimension (reduction of paperwork and correspondence). The inclusion of 'tea/coffee-making' with 'health hazards' implies that it is regarded as a health risk. This contradicts the perception of 'tea/coffee making' as beneficial found in Factor 2. However, 'tea/coffee-making' may have a different meaning in Factor 8 than in Factor 2. In Factor 2 the social aspects of tea/coffee-making were relevant whereas in Factor 8 the physiological aspects seem to be more important. Excessive caffeine intake and spilling hot coffee may both be regarded as detrimental to health. The existence of correspondence as the opposite constituent could be interpreted as 'concern with work' while the other constituents (health hazards and tea/coffee-making) involve 'concern with health'.

"Eyestrain, irritability, lethargy and difficulty in concentrating have been commonly found in studies of VDU operators" (Thompson, 1989). Stafford (1992) reports that a survey of office workers found that 47 per cent cited eyestrain associated with VDT use as the biggest office health problem and notes that "optometrists agree that eyestrain is indeed a problem, and that it causes problems different than those other eye patients suffer".

Thompson (1989) notes that "a few" cases of repetitive strain injury (RSI) have been reported among secretaries. There is conflicting evidence on the extent of RSI - one view is that the incidence is "much lower than commonly believed" (Ubois, 1992a), the other is that the incidence of reported cases of appears to be growing. Ubois (1992b) reports a 1000 per cent increase in six years in some industries. The controversy continues - in 1993 a High Court judge ruled that repetitive strain injury does not exist (Johnson, 1993) while in 1994 it was reported that 2000 lawsuits had been filed in the U.S.A. accusing manufacturers of selling equipment that they knew could lead to repetitive strain injury (Freedland, 1994a).

**Overall analysis of the factors identified**

The eight factors identified by the factor analysis in this study may be considered in terms of how they relate to the 'work' - 'non-work' dimension. At the 'work' end of the dimension are information-handling, human contact, paper-handling, financial security, communication, technology, work, and health preservation. At the opposite 'non-work'

end are inefficient, unreliable information-handling, lack of human contact, lack of paper-handling, no money, no communication, unreliable technology, unemployment, and health risks.

Human Contact, Communication, and Work may be said to be related to the psychological 'needs' of people and Health Preservation to physiological 'needs'. This division bears some similarity to Maslow's description of a hierarchy of needs (Maslow, 1943 - cited in Murrell, 1976) and Thimbleby's discussion of Theory X and Theory Y of human nature (McGregor, 1960 - cited by Thimbleby, 1990) and to the comment made by Greif (1991) that "the central goal of work design in German action theory is to promote long-term well-being and human growth or personality development (i.e. the development of interests, skills, and general abilities)".

The factors identified described the information provided by the majority of Free Response Questionnaire respondents. Although a comparison of the perceived importance of the responses made by the Free Response Questionnaire respondents was not made since there were differences in the number of items listed by different subjects which could have distorted the analysis, the high degree of consistency in the type of responses obtained overall suggests that the responses given were not affected by the circumstances in which the questionnaire was completed and reflected shared perceptions held by the subjects concerning the basic features of office work and the role of technology in the office.

## DISCUSSION

The information obtained from the present study indicated that the participants shared similar perceptions of the nature of office work and the role of technology in the office which could be described by eight factors or dimensions. These dimensions were information-handling, human contact, paper-handling, financial security, communication, technology, work, and health preservation..

The use of subjective data has been questioned by various authors: "the lack of correspondence between what people say about their behavior or attitudes and what can be measured is not unusual and has been remarked upon before in a number of papers and studies (Bernard et al., 1984; Ettema, 1985; Holleran, 1991)" (Holleran, 1992). However, the widespread use of opinion polls and large amount of money spent on market research indicate that user opinions are considered to be valuable. The subjects as a whole had extensive experience of computers increasing the chances that

their opinions and perceptions of computers are based on actual knowledge and experience rather than just speculation.

It has been suggested elsewhere (Smith, 1986) that ideally a combination of subjective and objective techniques should be used when assessing a product as the use of a single technique may produce misleading results. However, it is felt that subjective data have a value independent of their use for implementation because user perceptions provide some insight into the user's thought processes and therefore any underlying user's model (see Chapter 3 and Chapter 4).

In the present study users share similar perceptions even though those perceptions may not necessarily reflect actual behaviour or objective criteria. It is important to consider a) **why** people might have 'misperceptions' about the office and the role of technology b) the effect of any misperceptions on the user's interaction with technology and on system design. For example, in the present study many subjects expressed anxiety about dependence on an unreliable power supply and about insecure systems. A user who **thinks** that a system is unreliable and insecure is likely to be reluctant to store vital information in that system or to spend time creating paper backups 'just in case the system goes down' even though the system can be shown to be very reliable using objective criteria. Designers and retailers need to be aware of such user anxiety so that they can reassure users that a system is reliable.

Although the subjects in the current study think that computer systems adversely affect social relationships, the benefits of using computers for communication were stressed. An explanation for this apparent contradiction may be that there is a distinction between informal and formal social relationships and also between local and distant communication ('local' and 'distant' are used here to refer to the physical distance between the people who are trying to communicate). It seems that subjects regard computers as detrimental to informal social relationships and local communication but beneficial to distant and formal communication. The issue of user perceptions of their use of technology in specific circumstances is considered further in Chapter 6.

It is not clear whether the results of the current study would be replicated if repeated with the same or similar subjects. However, since the study was meant to highlight areas for further investigation, replicability is not thought to be a major issue since the research described in subsequent chapters was guided by, but not dependent on, the results of the current study. That is, the studies described later in the thesis could have been carried out independently whether or not the current study had taken place.

**Comparison of the current study with views of the nature of office work**

A summary of different views of office work is given in this section. More details can be found in Chapter 2. The **functional/activity view** states that office work may be described as a set of activities or tasks (Hirschheim, 1985; Hines, 1985 - cited by Christie, 1987). The **communication view** stresses the role of communication and information-handling in office work (Christie and Kaiser, 1985). Conrath et al. (1981, cited by Christie, 1987) suggested that office work consisted of communication and processing. Doswell (1990) describes three types of communication - face-to-face, telephone, and written communication. Thimbleby (1990) summarises the benefits of using computers as "communication and control". The **desktop metaphor/paper-handling view** stresses paper-handling. Stewart (1985) suggests that since Victorian times the formal office as we know it today has been organized around paper as "the vehicle for information" with the role of office workers being to create, collect, store, assimilate, communicate, and process the information. In the **information-handling view** the information-handling aspects of office work are emphasised (Oborne, 1985; Wainwright and Francis, 1984; Herbach, 1983; Armour, 1986; Coulouris, 1979; Stewart, 1984; Thompson, 1989; and Schäfer et al., 1988). The **decision-making view** describes office work as a goal-directed problem-solving activity (Barber, 1983 - cited by Christie, 1987). The **multiple-task view** describes office work in terms of a variety of tasks being completed simultaneously.

There seems to be a broad similarity between the dimensions derived from the present study and the views of office work described in the literature. The **functional/activity view** seems to be reflected in the factor Work, the **communication view** in Human Contact, Communication, and Technology, the **desktop metaphor/paper-handling view** in Information-Handling, Paper-Handling, and Technology, the **information-handling view** in Information-handling, the **decision-making view** in Human Contact, Financial Security, and Communication, and the **multiple-task view** in all the factors derived from the present study. Although none of the views of office work considered above seems specifically reflected in the factor Health Preservation, occupational health is considered important in some approaches to the study of work such as the ergonomic approach.

Conrath et al. (1981 - cited by Christie, 1987) described a scheme for classifying office tasks based on oral and written descriptions of about a thousand tasks obtained from a survey of more than 150 white collar workers. This scheme included categories such as planning, deciding, human relating, participating in interactive meetings informing,

advising, selling, handling paperwork, completing forms, typing, accounting, arranging meetings and appointments, handling telephone calls, and distributing mail.

Christie (1985) reports that managerial work was identified by factor analysis as consisting of 15 main functions including promoting safety, judgement and decision-making, developing group cooperation and teamwork and manufacturing process administration. When all office workers were considered two main types of activity were identified - communication (including formal and informal meetings) and information-handling.

Newman (1987) described the following categories of office activities: contract negotiation (selling and promoting products, purchasing materials, recruiting staff, negotiating with unions), contract implementation (paying bills, raising invoices, paying staff), work organization/management (planning, assigning tasks, 'other functions directly associated with management'), support (typing, mail collection and delivery, secretarial support) and information supply (researching, collecting and processing data, writing, consulting).

Many of the constituents of the factors identified in the present study are similar to those derived from the empirical studies reported by Christie, Conrath and Newman. Although each author reported different numbers of categories for office work this difference is not considered to be significant. All the authors refer to a limited number of categories which supports the idea expressed in this thesis that office work consists of a number of basic dimensions. The constant nature of certain aspects of office work seems to be illustrated by the description of offices produced by the Office Management Association in 1958 (cited by Hirschheim, 1985) as consisting of 'general services' such as copying, correspondence, and telephone use and 'information services'. This description from 36 years ago still seems applicable to user perceptions of today's office.

One of the aims of the Functional Analysis of Office Requirements project (FAOR) carried out as part of the ESPRIT programme was to develop a generic model of the office using a soft systems methodology developed by Checkland (ESPRIT, 1990b). The FAOR Approach included the use of a formal method - the Petri net and a User Needs Analysis Questionnaire. Schäfer et al. (1988) concluded from their investigation of office work that different interpretations may be made of "what an office actually constitutes" and "what purpose it serves". Czaja (1987) suggested that "understanding what people do in offices is not an easy task, since office work is so diverse and ill

defined". However, the results of the current study indicate that users have a relatively limited idea as to what activities occur in an office and that office work can be described in terms of a few dimensions.

The information obtained from the present study supports the comment made by Doswell (1990) that different views of the office are "complementary aspects of the same entity which happen to emphasise different aspects as appropriate" and the author's view expressed in Chapter 2 that "while each view of office work seems appropriate for some aspects of office work, no one view seems applicable to all aspects of the office".

The results of the current study suggest that the subjects shared perceptions of office work and the role of technology in the office. Eight dimensions were identified: human contact, communication, information-handling, paper-handling, technology, work, financial security, and health preservation. These dimensions may be regarded as the subjects' view of 'the office as it is at present'. In Chapter 6 (Study 2) the effect of situation characteristics on user perceptions of their use of technology is investigated using a questionnaire based on the responses obtained in the present study.

# CHAPTER 6 - THE EFFECT OF SITUATION CHARACTERISTICS ON USER PERCEPTIONS OF THEIR USE OF TECHNOLOGY (STUDY 2)


## SUMMARY

This study investigated the perceived use of technology in 'typical' office situations. It was hypothesised that user perceptions of their use of technology in office situations would depend on their perceptions of 1) the characteristics of a particular situation and 2) the options available for a particular situation. Two groups of subjects (undergraduate students and IT professionals) were presented with a verbal description of 58 office situations derived from the results of *'An investigation of user perceptions of office work'* (Chapter 5). The situations were divided into four categories: 'document preparation', 'information management', 'decision-making' and 'communication'. The options available were divided into those considered to be technology-based and those considered to be non-technology-based.

The results obtained indicate that subjects perceived that they would choose different options for situations belonging to a similar category based on the information available about the specific characteristics of a particular situation. For situations in the categories 'document preparation', 'information management', and 'communication' subjects chose a technology option significantly more often than a non-technology option, while the reverse held for 'decision-making' situations. There were minor differences in the results for some categories of situation but overall there was no significant difference in the views of undergraduates and IT professionals.


## INTRODUCTION

Literature relating to the factors which may influence the use of technology, in particular the use of technology in the office, is reviewed below. Four types of office situation - document preparation, information management, decision-making, and communication - are considered in detail since a review of the literature and the information obtained from *'An investigation of user perceptions of the nature of office work'* (see Chapter 5) indicated that these categories of situation represent important areas in which office technology is likely to be used.

The references in this chapter have a modal dependability of 5 and are derived from academic journals, 'textbooks' and newspapers. The books and journals provide theoretical information and the results of empirical investigations while the newspaper references provide an up-to-date picture of issues currently perceived to be important by a wider section of society.

## FACTORS INFLUENCING THE USE OF TECHNOLOGY

Computer designers may assume that the computer will be perceived by users as the preferred, perhaps the only, option for the majority of situations likely to be encountered in the office. However, even though other methods may be slower and less efficient, it is not essential to have access to a computer. For example, documents can be created and messages sent in various ways which do not require computer use. Caldwell et al. (1995) note that "due to the limitations of technology and different situation requirements, there is no one best communication medium that can satisfy all user needs in all situations".

User attitudes towards technology are likely to affect their use of technology. Various factors may be responsible for shaping user attitudes including the power of advertising, previous experience with similar technology, availability of technology, availability of training, company policy, and so on. Use of technology may also influence attitudes. For example, a 'good' experience with a photocopier (it copies what you want with no errors) may induce a favourable attitude towards that copier while a 'bad' experience (it 'eats' a vital document just before an important meeting) may induce an unfavourable attitude.

Hiltz (1984) concluded from a study of the use of a computerised conferencing system by research scientists over a two year period that there is a "complex interdependence of technological potentials and social structural variables in determining the success of technological innovations". Spacapan and Oskamp (1990) stated that "a key variable in determining acceptance of new technology seems to be whether users have control over the decision of when and where to use it". This view seems to be vindicated by a questionnaire-based survey of the discretionary use of computers by 355 members of a university in the USA which led Paré and Elam (1995) to conclude that "personal level factors such as perceived usefulness, internal beliefs, computer anxiety, and habits, were the dominant predictors of PC usage". Paré and Elam note that social and environmental factors should also be considered.

Computer purchase and use may be dictated by 'fashion' as well as by functional considerations. Mutch (1991) suggests that there has been a change in the public perception of computers from "You'll never get me using one of those" to "We're ever so modern, there's our new computer". One example is mobile phones. There has been a massive increase in the use of mobile phones over the last ten years. At present there are 2.2 million users in Britain and County NatWest estimates that there will be 12 million users by the turn of the century (Jones, 1994). Jones suggests that "the toy is no

longer a plaything of the business elite" and states that "only 10 per cent of mobile users work in the professional or business sector. 36 per cent work in domestic and commercial maintenance; a further 37 per cent are contractors, delivery drivers, couriers and the like". Jones notes the increase in use of mobile phones outside places of work in pubs, parks, shopping centres and golf courses.

The use of technology just because it exists is mentioned by Moore (1993): "Once you are in possession of one of these magic machines a whole new world opens up to you. A world of escalating urgency where the most mundane information becomes somehow more significant because it arrives via a bleeping machine, a world where the medium has more cachet than the message". However, in a variation on the theme of 'not blaming the messenger', it should be acknowledged that, on the whole, technology does not create but merely transmits messages. While technology may be used for trivial purposes such as faxing an order for a pizza, it can be used for communication in far more serious situations. The author understands that faxes were used by people trapped in Kuwait to send messages to Britain during the Gulf war in 1991 and have been used in Bosnia. However, Paddy Ashdown, the leader of the Liberal Democrat party, commented that he found email provided more convenient access than facsimile when contacting Bosnia (*The Guardian*, 1994a).

A study of the introduction of groupware technology into an office within a large organization revealed that the way in which the technology was implemented and used was significantly influenced by organizational elements including the users' mental models and by structural properties such as reward systems and workplace norms (Orlikowski, 1993). For example, Orlikowski notes that the existing competitive individualistic culture in the organization was not changed to one in which cooperation and sharing knowledge with peers was the norm by the introduction of technology which facilitated communication.

**The use of technology in office situations**

One way in which office situations may be considered is in terms of Type A and Type B activities (Christie, 1985). Type A activities require direct communication between people by such methods as face-to-face meetings, telephone, and teleconferencing. Type B activities require people to interact directly with information rather than directly with other people. This may involve paper or information in electronic form. In 1985 Christie noted rapid developments in technology such as word processors, electronic mail, electronic storage and retrieval aimed at Type B activities but less interest in technology such as audio conferencing and audio-video conferencing aimed

at Type A activities. The current position (1995) seems to be that there is interest in technology to support both Type B activities (e.g. CD-ROM) and Type A activities (e.g. multimedia, videophone).

In the current study office situations are divided into four categories - document preparation, information management, decision-making, and communication - based on a literature review and the results of an earlier empirical study conducted by the author (see Chapter 5). These categories are discussed in more detail below.

**Document Preparation**

Some of the potential advantages of electronic document production were listed by Richardson (1988): "unlimited revision of documents without re-keying; spell-checking; rapid record sorting on multiple attributes; file merging; direct entry of text and graphics via optical scanning and desktop access to very large databases stored on CD-ROMs." Much research has been completed related to issues such as reading documents on screen (Richardson, 1988; Oborne and Holton, 1988; Shneiderman, 1992).

Not everyone is convinced of the merits of word processing. *The Times Higher Education Supplement* (1993) reports that the reply they received from Lord Beloff to their request for a book review "on a 3.5" floppy disc and save *[sic]* in Ascii" was "I do not possess a word processor and have no idea what a floppy disc would be. Sorry, but at the age of 80 I am not going to learn new tricks. You should by now have had a second copy by post".

Among the drawbacks of electronic document production are claims that "authors have stopped thinking before they write because they know it is 'so easy to change it afterwards' " and that word processing is used to produce "high-quality internal memos ... when the message is little more than a confirmation or brief file note. The business worth may be insignificant" (Stewart, 1985).

Despite claims that computer use would lead to 'the paperless office' Wise (1992) suggested that "computers generate as much paper as they replace". Wellner (cited by Wise), working on a prototype 'DigitalDesk' at the Xerox research centre in Cambridge, suggested that since "people prefer paper to screens" computer power should be used to enhance rather than replace the qualities of paper.

**Information Management**

Various methods of computer-based information storage exist such as database query, hypertext/hypermedia, multimedia, and CD-ROM (Shneiderman, 1992). The advantages of using technology for filing are listed by Czaja (1987): "faster access to information, reductions in misfiling, storage efficiency, and increases in amount of usable floor space."

One issue which needs to be considered when using electronic storage is organizing information for easy retrieval (Czaja, 1987; Shneiderman, 1992). Wilson (1990) reporting his personal experiences and that of colleagues of filing over more than 8 years suggests that speed of retrieval is a crucial factor in filing. Wilson cites other studies such as Bärtschi (1985) which reached a similar conclusion. Another issue is the need to backup information in case it is accidentally deleted.

**Decision-Making**

It has been suggested that decisions may be divided into two main categories - a few long-term significant decisions which are made at the top of the organization and many short-term, time-critical routine decisions which occur at the bottom of the organizational hierarchy (Doswell, 1990). Martocchio et al. (1993) state that decisions are "typically not made by one individual or one department". However the author feels that a board meeting may be necessary for deciding on mass redundancies but not for deciding whether to make a cup of coffee. Nevertheless, such apparently trivial decisions may be regarded as an essential element in an organization.

"Decision support systems do not automate decision-making but are used to support nonroutine problem-solving tasks, to examine a wide range of alternatives, and to observe the effects of manipulating certain variables on outcomes ('what if')" Czaja (1987). Applications mentioned by Czaja include planning (e.g. financial planning), model building, model analysis, risk analysis, simulation, and forecasting. In order to be effective, decision support systems should be designed to support specific user groups in specific decisions. Whatever the data provided by the system there may be group consultation and discussion before a *final* decision is reached.

One major decision which employees in modern offices may increasingly have to make is choosing where to work. The factors which may influence the choice of where to work is considered in detail below.

***Choosing where to work: the role of teleworking*** - Developments in telecommunications have increased opportunities for people to work at home/away from the office. The use of teleworking was considered a novel phenomenon as recently as 1976: "Even more extreme is the conception that office work may well be done at home" (Short et al., 1976). In 1990 a prediction by the CBI, supported by the Henley Centre for Forecasting and the MIT's Sloane School of Management, was that the number of people telecommuting (working at home) in the U.K. would increase from over 650,000 people in 1990 to four million by 1995 (*Mind Your Own Business*, 1990). In 1993 the Henley Centre for Forecasting reported that there are now 1.2 million teleworkers in Britain (Myerson, 1993). The saving to industry of teleworking on this scale is estimated at £10 million a year (*Daily Mail*, 1993).

A British Telecom advertisement (November, 1993) mentioned a survey which reported a 45 per cent increase in productivity when teleworkers at 250 major UK companies started working at home. Among the reasons given for the improvements in productivity were fewer days lost through illness, fewer interruptions from colleagues, improved concentration, and freedom from commuting.

An issue raised by Hiltz (1984) which may gain in importance if teleworking becomes more prevalent is the potential impact on the worker's family. Hiltz found a mixture of reactions from family members to the use of a computerised conferencing system at home ranging from "great curiosity and enthusiasm" to "hostility and resentment".

The PATRA (Psychological Aspects of Teleworking in Rural Areas) project which forms part of the European Commission's Third Framework Programme used questionnaire and interview surveys of teleworkers, office-based workers and managers across Europe to study the social and psychological experiences of teleworking (Dooley et al., 1994). Dooley et al. concluded that while teleworking offers "considerable benefits to both employers and employees, [...] its effectiveness is reduced if the organizational, social and ergonomic features of this new kind of working relationship are not considered carefully".

As teleworking becomes more prevalent, practical as well as psychological issues may need to be considered: Who is responsible for paying for overheads such as the electricity to operate computers, heat, and lighting? Who is responsible for health and safety, if for example, an employee has an accident at home while carrying out their employer's business?

## Communication

"Trying to get a cup of coffee from a spatial reality, a decision table or a database should be reminder enough that there is more to an office than formal procedures and decision-making activities: there are also people" (Doswell, 1990). Newman and Newman (1991) note the low uptake of computer-mediated textcommunication when compared with other developments such as fax machines and suggest that one reason for this may be lack of attention to human factors and the social world which exists outside the computer conferencing environment.

Interactions between people rely on a set of conventions shared by members of the community which enable people to use similar methods to structure their reality and interactions (Reichman, 1986). For example, successful participation in a situation such as a committee meeting requires knowledge of the rules and social skills governing that situation (Arygyle et al., 1981). The nature and importance of social skills at work were described by Argyle (1972) and discussed by Short et al. (1976) and Hiltz and Turoff (1993).

Both verbal and non-verbal signals are important in governing social interaction - verbal signals are used mainly for conveying and receiving information and non-verbal skills to support verbal signals and manage the immediate social situation. When technology is used, for example when speaking to an answering machine, some non-verbal cues and "feedback and correction strategies" may be lost or distorted (Utley, 1993).

McClellan (1994) notes that the absence of non-verbal cues (e.g. facial expression) can result in misunderstanding when using on-line communication. This has resulted in the development of 'netiquette' - on-line codes of behaviour. For example, ':-)' to show good intentions, ';-)' to indicate irony. Apparently these symbols should be viewed sideways to make sense (the symbols then appear like a face). However, since it is not usual to read sideways and the symbols do not seem to have intuitive meaning when read conventionally, the code presumably has to be learned or explained by 'experts'. In addition impeccable typing seems to be required - imagine the potential social gaffe of typing a ':' instead of a ';' !

There has been a rapid increase in the use of voice mail in Britain with companies, local authorities and cinemas using electronic voice systems to "sift and divert callers and give out information" (Purgavie, 1994). In America voice mail is regarded by some corporations as indispensible. One insurance company credits it with increasing

employee productivity by more than 20 per cent. However, callers can feel stranded and alienated in "voice mail jail" although it is claimed that in America voice mail is "beginning to lose its anti-social reputation and is already changing the nation's language and manners".

"Corporate e-mail is on a roll, growing by 83 per cent among the *Fortune 2000* firms between 1991 and 1993" (Thackray, 1994). The Electronic Messaging Association predicts that by 1995, 20 million US workers will be sending and receiving electronic messages. This increase in use of electronic mail can result in problems such as large numbers of messages to be read. Thackray reports that one editorial director gets between 40 and 50 email messages a day.

Following reports of defamatory and abusive messages being transmitted via electronic mail, a representative of the Australian Academic and Research Network suggested that the use of electronic mail and computer bulletin boards provides an example of technology advances occurring before acceptable social behaviour patterns have been established (Maslen, 1993). In 1994 an academic was awarded Aus$ 40,000 (£19,000) after a court found that defamatory remarks had been made about him on the Internet system (Maslen, 1994).

It is suggested by Moore (1993) that one consequence of modern communications technology such as mobile phones and faxes is that the boundaries between public and private, work and leisure are no longer respected: "If you fall down and break your leg, some idiot with a camcorder will be recording your pain [...] If someone sends you a humiliating rejection by fax, you can guarantee that everyone else will have read it before you". The boundaries between work and leisure may become blurred. For example, if one has a fax machine at home work-related communications may be received at all times.

Informal meetings often occur as people move around from one place to another while at work. However, physical distance need not necessarily have an adverse effect on communication. Shneiderman (1992) suggests that "the distance to colleagues is no longer measured in miles but in intellectual compatibility and responsiveness; a close friend is someone who corresponds from 3000 miles away within 3 minutes with the necessary reference to finish a paper at 3 a.m.".

"Much communication is, and needs to remain, of a group-to-group nature" (Christie, 1987). There is currently much interest in groupware and computer-supported

cooperative work (for example Greenberg, 1991; Shneiderman, 1992; Baecker, 1993). An understanding of social isolation, integration and feedback among group members is seen as fundamental to understanding the influence of communications media on organizational and social behaviour (Taha and Caldwell, 1993). Newman et al. (1990) considered the advantages of using technology for information and distribution and communication among researchers and practitioners in the field of human-computer interaction and concluded that electronic communication can be beneficial, particularly for isolated workers and researchers with limited opportunities to attend conferences. Hiltz and Turoff (1993) suggested that although computerised conferencing may be impersonal it can also be the cheapest and most convenient form of communication for "geographically dispersed groups of people who must regularly exchange information and opinions".

A distinction may be made between formal and informal communication in an organization (Short et al, 1976; Christie and Kaiser, 1985; Schäfer et al., 1988; Doswell, 1990; Kraut et al., 1990). Technological developments should facilitate the development and maintenance of optimal formal and informal communication structures" (Christie and Kaiser, 1985; Doswell, 1990; Kraut et al., 1990). One effect of using telecommunications rather than face to face for formal meetings may be the loss of opportunities for informal contact - "the chats at the beginning and end of the meeting, the break for lunch and drinks in the bar, are all lost" (Short et al., 1976).

The impact of situation requirements and media characteristics on the use of communications media was studied by Caldwell et al. (1995). 15 employees of a state government information and telecommunications office in the USA completed a survey in which they were required to decide on the level of appropriateness of various communications media in hypothetical situations using an 11-point Likert-type scale. Eight situations varying on high or low levels of three factors (message urgency, amount of message content, and distance between communicators) and 12 communications media were studied. Caldwell et al. concluded that judgements of media appropriateness were affected by situations, the appropriateness of media usage depends on the match between situation requirements, and that "situation effects are more salient in some 'situation dependent' media". Caldwell et al. surveyed 1072 voice mail users to confirm the reliability and validity of their results. Although their study was broadly similar to the current study, Caldwell et al. studied fewer situations and situations categories than the author. In addition, the author's subjects were required to choose one option from a list rather than rating all the options. However, the Caldwell

et al. study indicates that other researchers are recognising the key issues highlighted in this thesis and adopting a similar approach.

## RATIONALE FOR THE CURRENT STUDY

### Relationship between attitudes and behaviour

Empirical studies (for example, LaPiere, 1934 and various other studies reviewed by Wicker, 1973) have shown little relationship between behaviour and attitudes. Fishbein and Ajzen (1975), Kemp (1987), Eiser and van der Pligt (1988), and Pennington (1986) also discussed the relationship between attitudes and behaviour. Investigations of consumer behaviour have found that an individual's attitudes towards a product do not give a good indication of the likelihood that the individual will purchase or use that product (Arygle et al., 1981; Furnham and Argyle 1981). Warr (1978) concluded from consideration of twenty types of occupational attitude and five types of work behaviour that actions and attitudes are linked only in certain circumstances. Social, environmental, and personal factors may influence behaviour as well as attitudes.

Despite the apparently limited value of attitudes for predicting behaviour (Warren and Jahoda,1973), as already discussed in Chapters 4 and 5, attitude studies are useful for gaining some insight into how people view the world. In Chapter 4 a distinction was made between **attitudes** and **perceptions**. It was suggested that attitudes may be regarded primarily as evaluations and perceptions as concepts or models. Kemp (1987) proposed that "attitudes are best thought of as hypothetical variables" which reflect the values and beliefs of people. It has been suggested of communications technology that "users' attitudes towards media may vary even when objective measures of their performance do not" (Champness, 1972 - cited by Christie, 1975). Hiltz (1984) stated that attitudes and motivation were the strongest predictors of acceptance of a computerised conferencing system rather than objective characteristics of users such as previous computer experience or typing ability".

The role of studying social situations when investigating psychological processes at work and the determinants of behaviour is discussed by Argyle et al. (1981). Furnham and Argyle (1981) suggest that "the analysis of social situations is not a simple task. However, it is both important and necessary to a full understanding of social behaviour in context". Suchman (1987) states that "planned, purposeful actions are inevitably *situated actions*", that is, "actions taken in the context of particular concrete circumstances". Each situation may have different goals, rules, and concepts (Argyle et al., 1981).

**The current study**

The review of the literature above indicates that technology has both advantages and limitations for use in particular situations and that its use may be influenced by the perceptions of the user concerning the attributes of the technological options available and the nature of the situation. In the study described in this chapter user perceptions of their use of technology in particular situations are considered.

## AIMS OF THE PRESENT STUDY

The aims of the present study were:

1. To investigate user perceptions of their use of technology in specific situations when given a choice of technology-based and non-technology-based options for a particular situation.

2. To determine whether there is a tendency for subjects to perceive that they will choose technology for most of the situations in one situation category (e.g. communication) but not for those in another (e.g. information management).

## METHOD

### SUBJECTS

Two groups of subjects participated in the study - undergraduate students and IT professionals. All the undergraduate subjects were completing the third year of a computer-based course concerned with the design of end-user office products. The IT professionals were employed in a variety of occupations related to computing such as systems engineering, programming, software engineering, systems analysis, and designing office systems. All the IT professionals were completing a master's degree in user interface design on a part-time basis. See Table 1 for details of the subjects who participated in the present study.

**TABLE 1: BACKGROUND INFORMATION**

| | DOC PREP | | INFO MAN | | DECISION | | COMM | |
|---|---|---|---|---|---|---|---|---|
| | U | IT | U | IT | U | IT | U | IT |
| TOTAL NUMBER OF SUBJECTS | 20 | 19 | 20 | 9 | 13 | 8 | 21 | 19 |
| AGE | | | | | | | | |
| 18-34 | 20 | 16 | 20 | 6 | 13 | 5 | 21 | 15 |
| 35-49 | 0 | 3 | 0 | 3 | 0 | 3 | 0 | 4 |
| SEX | | | | | | | | |
| male | 11 | 13 | 13 | 8 | 8 | 8 | 13 | 13 |
| female | 9 | 6 | 7 | 1 | 5 | 0 | 8 | 6 |
| OCCUPATION | | | | | | | | |
| student | 20 | 0 | 20 | 0 | 13 | 0 | 21 | 0 |
| IT professional | 0 | 19 | 0 | 9 | 0 | 8 | 0 | 19 |

**NOTES**
1. U = undergraduate subjects, IT = IT professionals
2. DOC PREP = DOCUMENT PREPARATION, INFO MAN = INFORMATION MANAGEMENT, DECISION = DECISION-MAKING, COMM = COMMUNICATION

## PROCEDURE

The method used in the current study was based on verbal descriptions of hypothetical office situations. Booth (1989) suggested that task scenarios - "descriptive stories about the intended use of the product" - may be useful when assessing the use of products. Christie and Holloway (1975) investigated decisions concerning hypothetical discussions in a study of the factors affecting the use of telecommunications by managers. Magnusson (1981) studied social situations using verbal descriptions of those situations. Carroll et al. (1987) worked through detailed hypothetical scenarios of office tasks such as a casual computer user setting up a meeting when designing and testing a prototype office information system called TaskMapper. Dickinson and Goodman (1989) used written scenarios as part of a study of teleconferencing equipment.

One limitation of using hypothetical scenarios rather than actual situations is that they "rest upon accounts of circumstances that are either imagined or recollected" (Suchman, 1987). Alternative methods could have been used such as observation of actual situations or simulated situations. However, observation could cause ethical problems where people are undertaking sensitive or confidential work. The use of actual technology in simulated situations requires representative technology to be available. In addition, it was not considered ethical to simulate certain situations used in the current study such as being in a smoke-filled building or stuck in a train. The use of hypothetical rather than actual situations enabled a larger number of situations and technology options to be considered.

Each subject completed a questionnaire created by the author consisting of a background information section (for example, the age of the subjects) and a set of scenarios relating to document preparation, information management, decision-making, or communication (see Appendix A). The situation categories chosen were considered to reflect the factors identified in an earlier study (see Chapter 5). Although there are fewer situation categories than factors, all the factors are considered to be represented within the situations studied. For example, the situation category Communication is considered to involve Human Contact.

The situations within each category were broadly divided into pairs of identical situations varying only in one detail. For example, the amount of time available (long, short), the recipient of a document (colleague, Head of Department), the amount of money available (generous budget, limited budget), and so on. The aim of this was to determine the extent to which specific circumstances influenced user perceptions of whether they would use technology or non-technology in particular situations.

The options chosen for each situation category were those thought to be representative of the current options available in a 'typical' office for use in various office situations. Subjects were expected to assume equal availability of each of the options available and equal familiarity with how to use each option even though in a real situation subjects are likely to use the option or combination of options with which they are most familiar or whatever happens to be available at the time.

The choice of options for situations in the 'decision-making: choosing where to work' category differs slightly from the remaining situations as they relate to where subjects perceived that they would wish to work rather than to 'technology/non-technology'. The aim of this was to see whether additional evidence would be obtained for the perception that human contact, financial security, and health preservation are fundamental dimensions of office work.

The potential effects of bias when subjects completed the questionnaires were minimised by not informing subjects of the category to which the situations belonged and by randomising the order of presentation of the situations and the order of presentation of the options available for each situation within each questionnaire.

Variations in the availability of subjects meant that not all subjects completed a questionnaire for all the situation categories. When analysing the questionnaires the four categories of situation were considered separately even though some subjects completed a questionnaire for more than one situation category.

**Classification of options into technology/non-technology**

Four judges were asked to sort 35 cards containing the options for the situations in the present study into two piles according to whether they thought that the option written on the card was 'technology' (computer-based) or 'non-technology' (non-computer-based /'paper -based') in order to allow an estimate to be made of the validity/reliability of the 'technology'/'non-technology' coding used in the analysis of the questionnaires

issued in the current study. The cards were presented to the judges in random order. (See Appendix A for details of the classification of the options.)

Two of the judges were male and two female. All the judges except one had extensive computing experience - one was a researcher in user-interface design, two were lecturers in computing and user-interface design, and the fourth judge was a retired accounts clerk.

There was a high level of agreement between the judges for 31 of the 35 options (all 4 judges were in agreement for 24 options and 3 judges were in agreement for 7 options). For the remaining 4 options 2 judges thought that the option was related to technology and 2 that it was related to non-technology. The author's judgement was used to decide on the final classification for 3 of these options based on similarity to other classifications made by the judges. For example, all the judges agreed that 'telephone' should be classified as technology so 'phone suppliers, dealers' was classified as technology since the telephone was the medium used to make contact. A 'technology/non-technology' distinction was considered inappropriate for the remaining option. The high level of agreement between the judges for the majority of options suggests that they had a clear perception of the distinction between 'technology' and 'non-technology'.

## RESULTS

The questionnaires were analysed considering: 1) the specific options selected by the subjects, 2) the choice of technology or non-technology, 3) the choice of technology or non-technology in specific situations for each of the main situation categories (Document Preparation, Information Management, Decision-making, and Communication). The specific characteristics of the situations were considered within rather than between categories because although there were some similarities in the specific characteristics between as well as within categories (e.g. 'time available' was a characteristic of some situations for all categories) it was felt that there were confounding factors as the situations in different categories were not identical. The statistical tests used in the analysis were the Friedman Two-way Analysis of Variance by Ranks (A: Specific option chosen for each situation), the Wilcoxon Matched-Pairs Signed Ranks test (B: 'Technology' or 'Non-technology'), and the Binomial Test (C: Specific Characteristics of Situations) (Siegel, 1956; Greene and D'Oliveira, 1982). A significance level of .05 was selected prior to the analysis. All tests were two-tailed. In the tables below statistically significant probabilities are highlighted in bold. 'NS' indicates that the results were not significant. While each aspect of the study is

reported separately, Table 12 (see 'Discussion') presents a summary of the results so that an overall pattern can be seen.

Table 2 lists the number of subjects choosing 'technology' or 'non-technology' for each situation category for all the situations in the current study. For the situation categories Document Preparation and Information Management a significant preference for choosing technology rather than non-technology was found for both subject groups. For Communication a significant preference for technology was shown by the IT professionals but not by the undergraduates. For Decision-making both subject groups showed a significant preference for choosing non-technology rather than technology. These results are discussed in more detail below.

**TABLE 2 - 'TECHNOLOGY' vs. 'NON-TECHNOLOGY': ALL SITUATIONS**

| SITUATION CATEGORY | | T | N | z-Score | Probabilities | Direction |
|---|---|---|---|---|---|---|
| **Document Preparation** | U | 148 | 52 | -6.72 | **.00006** | **T** |
| | IT | 144 | 46 | -7.04 | **.00006** | **T** |
| **Information Management** | U | 236 | 103 | -7.17 | **.00006** | **T** |
| | IT | 103 | 35 | -5.70 | **.00006** | **T** |
| **Decision-making** | U | 23 | 120 | -8.03 | **.00006** | **N** |
| | IT | 22 | 62 | -4.26 | **.00006** | **N** |
| **Communication** | U | 184 | 154 | -1.58 | **NS** | **-** |
| | IT | 174 | 116 | -3.35 | **.001** | **T** |

**NOTES**

1. U = undergraduates, IT = IT professionals, T = technology N = non-technology, - = not statistically significant
2. Choosing where to work: home or office - 'technology'/'non-technology' distinction not applicable: Undergraduates: home 17, office 35; IT professionals: home 17, office 11
3. The figures in the 'T' and 'N' columns refer to the frequency of choice of technology or non-technology by the subjects for situations in that category.

## DOCUMENT PREPARATION (Situations 1-10)

**Options: 'technology':** typewriter, word processor, desktop publishing
**'non-technology':** handwriting

**TABLE 3 - DOCUMENT PREPARATION**

| | Probabilities | Direction |
|---|---|---|
| **[A] SPECIFIC OPTION CHOSEN FOR EACH SITUATION [1-10]** | U .001 ($\chi_r^2$ = 38.31) | Wo |
| | IT .001 ($\chi_r^2$ = 38.25) | Wo |
| **[B] 'TECHNOLOGY' OR 'NON-TECHNOLOGY' [1-10]** | U .01 (W = 0) | T |
| | IT .01 (W = 0) | T |
| **[C] SPECIFIC CHARACTERISTICS OF SITUATIONS** | | |
| **Recipient** | | |
| (head of department) [5] | U .002 | T |
| | IT .002 | T |
| (colleague) [6] | U NS | - |
| | IT .002 | T |
| ('close' friend) [7] | U NS | - |
| | IT NS | - |
| (business contact) [8] | U .002 | T |
| | IT .002 | T |
| **Time available** | | |
| Report for department | | |
| (short) [1] | U .002 | T |
| | IT .002 | T |
| (long) [2] | U .002 | T |
| | IT .002 | T |
| Report for new customers | | |
| (short) [3] | U .002 | T |
| | IT .002 | T |
| (long) [4] | U .002 | T |
| | IT .002 | T |
| **Type of document** | | |
| (minutes) [9] | U NS | - |
| | IT NS | - |
| (notes) [10] | U NS | - |
| | IT NS | - |

**NOTES**
U = undergraduate subjects, IT = IT professionals, NS = not significant, [x] = situation number
W = symbol used for Wilcoxon statistic by Greene and D'Oliveira (1982), Siegel (1956) uses T
Wo = word processing, T = technology, N = non-technology, - = no statistically significant preference

The subjects perceived word processing to be the most suitable option for the majority of document preparation situations with handwriting being preferred for writing a personal letter to a close friend, taking the minutes at a Board meeting, and recording ideas for a conference paper. The lack of popularity of typewriting may indicate that

the typewriter is considered to have been superceded by the word processor. [A] [1-10]

Both groups of subjects expressed a strong preference for selecting the technology options rather than the non-technology option for the majority of situations in the 'document preparation' category. [B] [1-10]

The characteristics of the 'document preparation' situations which significantly affected the choice of technology or non-technology were the 'recipient' and 'time available'. Technology was chosen by both subject groups whether the 'recipient' of a memorandum was a colleague or the Head of department, whether the 'time available' for preparing a report for an internal meeting of the department was short (end of today) or long (end of next week), and whether the 'time available' for preparing a report for circulation to new customers was short (end of today) or long (end of next week). [C] [5,6] [1,2] [3,4] Non-technology was selected whether the 'type of document' was minutes or notes. [C] [9,10] When the recipient of a letter was a (close) friend a non-technology option was selected whereas when the recipient was a business contact a technology option was selected. [C] [7,8]

Boylan (1992) found that 70 per cent of the writers she interviewed (including James Ballard, Margaret Drabble, Fay Weldon, Colin Thurbron and Ben Okri) still write full manuscripts by hand and claims that resistance to word processors is not restricted to older writers but is also found in younger writers. Josephine Hart (cited by Boylan) who writes her novels by hand suggested that while "you can dominate the pen, machines seem to me to have a mind of their own". Walsh (1993) consulted writers, *Paris Review's* series on *Writers at Work*, and *Novels and Novelists* by Martin Seymour-Smith and concluded that there is a "phantasmagoric world of superstitions, rituals and paraphernalia that should have the marketing departments of Apple, IBM and Olivetti tearing their hair out". Walsh reports that Umberto Eco uses "a fountain pen on slower creative days" and a "word processor" when he wants to get things down immediately". Although the observations reported by Boylan and Walsh relate to novelists, the choices made by the subjects who participated in the present study seem to confirm the view that handwriting is perceived to be good for recording ideas and word processing for improving the final presentation. For example, handwriting was chosen for recording ideas for a conference paper and word processing/desktop publishing for preparing a report for circulation to new customers. In addition, aspects such as level of keyboard skills may influence the choices made by a particular individual.

## INFORMATION MANAGEMENT (Situations 11-27)

The Information Management results are considered under the headings Information Gathering, Information Storing/Retrieval, and Information Protection (see Tables 4-6).

## INFORMATION GATHERING (Situations 11-14)

**Options: 'technology':** database (on computer); 'phone suppliers, dealers

**'non-technology':** consult someone else at work (e.g. colleague, librarian); look through filing cabinet (in your office); hunt through papers in your office (on desk, floor, etc.); consult books, journals, newspapers; attend a conference (e.g. a scientific conference, business presentation etc.)

**TABLE 4 - INFORMATION GATHERING**

| | Probabilities | Direction |
|---|---|---|
| **[A] SPECIFIC OPTION CHOSEN FOR EACH SITUATION** [11-14] | U .001 ($\chi_L^2 = 24.02$)<br>IT .05 ($\chi_r^2 = 13.42$) | Da<br>Da /P |
| **[B] 'TECHNOLOGY' OR 'NON-TECHNOLOGY'** [11-14] | U NS<br>IT .05 (W = 3) | -<br>T |
| **[C] SPECIFIC CHARACTERISTICS OF SITUATIONS** | | |
| **Time available** | | |
| (short) [11] | U NS<br>IT NS | -<br>- |
| (long) [12] | U NS<br>IT .004 | -<br>T |
| **Availability of information** | | |
| (freely available) [13] | U NS<br>IT NS | -<br>- |
| (hard to obtain) [14] | U NS<br>IT NS | -<br>- |

NOTES - see Table 3
Da = database (on computer), P = 'phone suppliers, dealers

Both groups of subjects expressed a strong preference for selecting the technology options rather than the non-technology options for most of the situations in the 'information gathering' category. [A,B] [11-14]

Technology was selected by both subject groups whether the 'time available' for determining the cost of new equipment was short (today) or long (end of next week). [C] [11,12] When trying to find out the annual profits of a rival company 'availability of information' affected the choice of option - technology was selected when information was freely available and non-technology when the information was hard to obtain. [C] [13,14]

**INFORMATION STORING/RETRIEVAL (Situations 15-22)**
**Options: 'technology':** database (on computer)
**'non-technology':** rely on your own memory, filing cabinet; pile of papers (on desk, floor, etc.)

**TABLE 5 - INFORMATION STORING/RETRIEVAL**

| | Probabilities | Direction |
|---|---|---|
| **[A] SPECIFIC OPTION CHOSEN FOR EACH SITUATION [15-22]** | U **.001** ($\chi_r^2 = 47.09$) | **Da** |
| | IT **.01** ($\chi_r^2 = 16.05$) | **Da** |
| **[B] 'TECHNOLOGY' OR 'NON-TECHNOLOGY' [15-22]** | U **.01** (W = 0) | **T** |
| | IT **.05** (W = 4) | **T** |
| **[C] SPECIFIC CHARACTERISTICS OF SITUATIONS** | | |
| **Frequency of access required** | | |
| (daily) [20] | U **.002** | **T** |
| | IT NS | - |
| (not for months) [21] | U NS | - |
| | IT NS | - |
| (many requests) [22] | U **.002** | **T** |
| | IT **.008** | **T** |
| **Amount of information** | | |
| (large) [16] | U **.002** | **T** |
| | IT NS | - |
| (small) [17] | U NS | - |
| | IT NS | - |
| **Space available** | | |
| (limited) [15] | U **.002** | **T** |
| | IT NS | - |
| (plenty) [16] | U **.002** | **T** |
| | IT NS | - |
| **Training available** | | |
| (no) [18] | U NS | - |
| | IT NS | - |
| (yes) [19] | U **.002** | **T** |
| | IT **.008** | **T** |

**NOTES** - see Table 3
**Da** = database (on computer)

'Database (on computer)' was selected by the majority of subjects for most of the information storing/retrieval situations. 'Rely on your own memory' and 'pile of papers (on desk, floor, etc.)' were not selected as the most popular option for any of the situations in this category. This could be because subjects regarded the storage capacity of human memory to be inadequate for the amount of information specified in most of the hypothetical situations. Cook and Sellitz (1973) mention the potential impact of factors such as 'social desirability' - that is, giving answers which the

respondent thinks are socially acceptable rather than necessarily a 'true/honest' reflection of actual behaviour, on self-report measures. It is possible that in the current study subjects may have regarded admitting to using the floor for storing information as inefficient and giving an impression of being disorganised. [A] [15-22]

Both groups expressed a strong preference for selecting the technology option rather than the non-technology options for most of the situations in the 'information storing/retrieval' category. [B] [15-22]

The results obtained for the IT professionals were the same as those for the undergraduate subjects for 'frequency of access required', 'space available', and 'training available'. [C] [20,21,22] [15,16] [18,19] Technology was preferred to non-technology whatever the 'frequency of access required' (very often: many requests, frequent: daily or infrequent: not for months) and whatever the 'space available' in the office (limited space or large spacious office). When 'training available' was considered technology was chosen when there was a generous training budget and non-technology when there was no training budget.

There was a difference between the subject groups in the choice of technology or non-technology when the 'amount of information' was considered. Technology was chosen by the IT professionals whether the amount of information was large or small whereas the undergraduate subjects chose technology when the amount of information was large and non-technology when the amount of information was small. It is not clear why this difference was found except that the IT professionals may have been more familiar with using technology to store information whatever the quantity of information as they were employed in computer-based occupations. [C] [16,17]

**INFORMATION PROTECTION (Situations 23-27)**
**Options: 'technology':** database (on computer)
**'non-technology':** rely on your own memory, filing cabinet; pile of papers (on desk, floor, etc.)

**TABLE 6 - INFORMATION PROTECTION**

| | | Probabilities | Direction |
|---|---|---|---|
| **[A] SPECIFIC OPTION CHOSEN FOR EACH SITUATION** [23-27] | U | **.001** ($\chi_r^2 = 36.29$) | **Da** |
| | IT | **.01** ($\chi_r^2 = 14.51$) | **Da** |
| **[B] 'TECHNOLOGY' OR 'NON-TECHNOLOGY'** [23-27] | U | **.05** (W = 49) | **T** |
| | IT | **NS** | - |
| **[C] SPECIFIC CHARACTERISTICS OF SITUATIONS** | | | |
| **Availability of information** | | | |
| (freely available) [26] | U | NS | - |
| | IT | NS | - |
| (hard to obtain) [27] | U | NS | - |
| | IT | NS | - |
| **Reliability of power supply** | | | |
| (unreliable) [23] | U | **.002** | **N** |
| | IT | NS | - |
| (reliable) [24] | U | NS | - |
| | IT | NS | - |
| **Office security (who has access to office?)** | | | |
| (staff and clients) [25] | U | NS | - |
| | IT | NS | - |
| (staff only) [26] | U | NS | - |
| | IT | NS | - |

**NOTES** - see Table 3
Da = database (on computer)

'Database (on computer)' was selected by the majority of subjects for most of the information protection situations indicating that the subjects had a strong perceived preference for using a computer-based database for storing confidential information. 'Rely on your own memory' and 'pile of papers (on desk, floor, etc.)' were not selected as the most popular option for any of the situations in this category which implies that subjects did not perceive these methods as feasible for storing confidential information. [A] [23-27]

Both groups expressed a strong preference for selecting the technology option rather than the non-technology options for the majority of situations in the 'information protection' category. [B] [23-27]

The only characteristic of the 'information protection' situations which produced a difference in the choice of technology or non-technology was 'reliability of power supply'. When the power supply was considered to be very reliable the majority of subjects chose technology whereas when the power supply was unreliable most subjects chose non-technology. This implies that the subjects perceived use of a computer to depend on the presence of a reliable power supply and coincides with the claim made by Czaja (1987) that many users are reluctant to use existing electronic filing systems "because they have fears of permanently losing information if the system fails". In Chapter 5 it was noted that data may be lost even from an apparently 'fail-safe' system. [C] [23,24]

Technology was chosen rather than non-technology whatever the 'availability of information' (freely available: all staff, or hard to obtain: certain members of staff only), and whatever the level of 'office security (who has access to office? - staff and clients or staff only)'. [C] [26,27] [25,26]

## DECISION-MAKING (Situations 28-35, 52-58)

The Decision-making results are considered under the headings General Decision-making and Choosing where to work (see Tables 7-10).

## GENERAL DECISION-MAKING (Situations 28-35)

**Options: 'technology':** consult computer (decision support system, intelligent system)
**'non-technology':** rely on your own judgement and experience, consult someone else (colleague, expert, etc), consult information sources (files, books, reports)

**TABLE 7 - GENERAL DECISION-MAKING**

| | | Probabilities | Direction |
|---|---|---|---|
| **[A] SPECIFIC OPTION CHOSEN FOR EACH SITUATION** [28-35] | | U .01 ($\chi_r^2 = 12.62$) | R |
| | | IT NS | - |
| **[B] 'TECHNOLOGY' OR 'NON-TECHNOLOGY'** [28-35] | | U .01 (W = 0) | N |
| | | IT .01 (W = 0) | N |
| **[C] SPECIFIC CHARACTERISTICS OF SITUATIONS** | | | |
| **Time available** | (short) [32] | U .006 | N |
| | | IT .016 | N |
| | (long) [33] | U NS | - |
| | | IT NS | - |
| **Finance available** | (limited) [34] | U .006 | N |
| | | IT .016 | N |
| | (unlimited) [35] | U .006 | N |
| | | IT .016 | N |
| **Type of decision** | (major: redundancies) [28] | U .002 | N |
| | | IT NS | - |
| | (major: building evacuation) [30] | U .002 | N |
| | | IT .008 | N |
| | (important) [31] | U .002 | N |
| | | IT .008 | N |
| | (minor) [29] | U .006 | N |
| | | IT .008 | N |

**NOTES** - see Table 3
R = rely on your own judgement and experience

The results obtained indicate that the subjects had a strong perceived preference for using methods such as relying on their own judgement or experience or consulting someone else rather than using computer-based systems for decision-making. 'Consult computer (decision support system, intelligent system)' was not selected as the most

popular option for any of the situations in the 'general decision-making' category which implies that subjects did not perceive this method to be feasible for making the final decision whatever the nature of the decision to be made. The apparent reluctance of the subjects to rely on computers for decision-making seems to be surprising given the current trend towards increasing the use of decision support systems in aircraft, medicine, and so on. In reality subjects might use a combination of methods when making a decision. However, the emphasis in the situations in the current study was on the method subjects thought that they would rely on to make the *final* decision. [A] [28-35]

The non-technology options were selected by the majority of subjects for all the situations. The technology option was not selected as the most popular option for any of the situations by the undergraduates and for only one situation by the IT professionals. [B] [28-35]

The majority of subjects chose non-technology rather than technology for all the situations whether the 'finance available' was limited or unlimited, and whether the 'type of decision' was major (redundancies: 10% of work force, building evacuation: thick smoke in basement), important (building evacuation (water slowly seeping into basement), or minor (colour scheme for office carpets). [C] [34,35] [28,29,30,31]

When the 'time available' for planning a major new project was short (end of today) the IT professionals selected non-technology whereas when the time available was long (a month) technology was selected. The undergraduate subjects selected non-technology regardless of the time available. It is not clear why this difference occurred although the experience gained with computer-based project planning as part of their work may have made the IT professionals more willing to use this option as part of the decision-making process. [C] [32,33]

Martocchio et al. (1993) used a 'policy capturing' methodology to study the factors affecting decision-making in the contexts of computer training and software selection. This involved presenting subjects with written scenarios and asking them to make a decision such as deciding which information package to use when given information about ease of use and number of features available. Martocchio et al. suggest that policy capturing is more 'objective' than asking decision-makers to rank or rate the importance of factors to their decisions and allows the researcher to infer the importance of these factors from the decisions themselves. However, a certain amount of inference may still be necessary. For example, in the current study the reasons for

the choices made by the subjects *appeared* to vary according to variations in the information provided but the author was still inferring reasons for the decisions rather than making a precise measurement.

## CHOOSING WHERE TO WORK (Situations 52-58)

### Home or office (Situations 52-55)

**Options:** home, office ('technology'/'non-technology' distinction not applicable)

**TABLE 8 - CHOOSING WHERE TO WORK: HOME OR OFFICE**

| | Probabilities (see Note 2) | Direction |
|---|---|---|
| **[A] SPECIFIC OPTION CHOSEN FOR EACH SITUATION** [52-55] | | |
| **[B] 'TECHNOLOGY' OR 'NON-TECHNOLOGY'** [52-55] | U NS<br>IT NS | -<br>- |
| **[C] SPECIFIC CHARACTERISTICS OF SITUATIONS** | | |
| **Amount of social contact at office** | | |
| Long commuting time | | |
| (high) [52] | U NS<br>IT NS | -<br>- |
| (low) [53] | U NS<br>IT NS | -<br>- |
| Short commuting time | | |
| (high) [54] | U NS<br>IT NS | -<br>- |
| (low) [55] | U NS<br>IT NS | -<br>- |

**NOTES**

1. See Table 3
2. The results for 'technology/non-technology' are the same as for 'specific option chosen for each situation' as they are based on the same data.

The results obtained, although not significant, indicated that while the undergraduates perceived that they would prefer to work in the office rather than at home for most of the situations in the 'choosing where to work: home or office' category the IT professionals perceived that they would rather work at home.[A,B] [52-55]

When the amount of commuting time was long (two hours a day) most of the IT professionals stated that they would choose to work at home whether the number of people they might see when in the office was high or low. This differs from the undergraduate subjects who stated that when the commuting time was two hours and the number of people they might see was high they would choose to work in the office.

However, when the commuting time was two hours and the number of people they might see was low they would choose to work at home. The reason for the difference between the two groups is not clear but it suggests that the IT professionals perceived the amount of commuting time to be a significant factor when deciding where to work with a long commuting time being a deterrent to working in the office. It is also possible that the IT professionals were more likely to be able to afford to have their own computers at home since most were in full-time employment. Some undergraduates were likely to live in shared accommodation such as lodgings or a hall of residence and may have perceived it to be easier to work in the 'office' than at 'home'. [C] [52,53]

This perception of the subjects in the current study seems to coincide with the view that one of the benefits of telecommuting is "more time to do other things instead of sitting in a traffic jam" (Foremski, 1989). However, according to Huws et al. (1990) "survey after survey" has found that freedom from commuting is only one of the reasons given for choosing teleworking. Factors ranked more highly include the need to combine working with family demands, the need for flexibility, and the desire for autonomy. Presumably the respondents in the surveys considered by Huws et al. were not regular commuters on the 'Misery line' or else freedom from commuting might have been ranked more highly! "Britain's worst railway line was living up to its reputation last night after police were called to hold back thousands of angry commuters trying to get home" (*Evening Standard*, 1991). The people who struggled to get to work during the 1994 rail strikes probably also perceived telecommuting in a favourable light.

While there is some agreement that "the benefits to employers considerably outweigh the losses", there is less agreement on the impact of teleworking on the workers themselves. However, "social isolation is generally considered to be the greatest disadvantage of home-based telework" and research, including a questionnaire-based survey in 1987 of telework in 14 companies in Germany and the UK by empirica *[sic]*, has confirmed this view (Huws et al., 1990). Formeski notes that "many people report the negative side of telecommuting as a need for greater discipline to work at home" and "being away from the office can also create problems of isolation".

The problem of social isolation may be overcome by ensuring that part of the week is spent in the office and by greater use of telecommunications. Puplett (cited in *Mind Your Own Business*, 1990) recommended that: "we spend at least one day a week in the office in order to keep in touch with colleagues and maintain the team spirit that is an essential ingredient in every successful company". In the PATRA project, which

studied teleworking, Dooley et al. (1994) found that telecommunications, especially e-mail, modems and telephones, compensated for a reduced level of interaction with work colleagues.

In the current study when told that the amount of commuting time was short (walking distance) both groups of subjects stated that they would choose to work in the office regardless of the number of people they were likely to see there. This indicates that length of commuting time may influence decisions of whether to work at home more than opportunities for face-to-face social contact with colleagues. [C] [54,55]

**Current office or new office (Situation 56)**
**Options: 'technology':** new office
**'non-technology':** current office

**TABLE 9 - CHOOSING WHERE TO WORK: CURRENT OFFICE OR NEW OFFICE**

| | Probabilities | Direction |
|---|---|---|
| **[A] SPECIFIC OPTION CHOSEN FOR EACH SITUATION** [56] | (see Note 2) | |
| **[B] 'TECHNOLOGY' OR 'NON-TECHNOLOGY'** [56] | U NS<br>IT NS | -<br>- |
| **[C] SPECIFIC CHARACTERISTICS OF SITUATIONS**<br>**Proximity of office to staff common room** [56] | (see Note 2) | |

**NOTES**
1. See Table 3
2. The results for 'specific option chosen for each situation' and 'specific characteristics of situations' are the same as for 'technology/non-technology'.

The 'technology' option was selected by the majority of subjects in both groups rather than the 'non-technology' option. [A,B] [56]

When given the choice of whether to work in a new office which had a link to the computer network but was in a separate building 20 minutes walk from the staff common room or to stay in an office which had no link to the computer network but was located near the staff common room, the majority of subjects in both groups chose the new office. This indicates that access to a network was considered to be more important than access to the staff common room. However, it is not clear whether this is because 'work' and facilities for access to electronic communication are perceived to be more important than 'leisure' and the possibility for face-to-face communication. [C] [56]

**Company A or Company B (Situations 57-58)**
**Options: 'high' technology availability:** Company A (computer for each member of staff)
Situation 57: + short lunch/coffee break
Situation 58: + poor staff health record
**'low' technology availability:** Company B (staff share computers)
Situation 57 + flexible length lunch/coffee break
Situation 58 + comprehensive staff health care

**TABLE 10 - CHOOSING WHERE TO WORK: COMPANY A or COMPANY B**

| | Probabilities (see Note 2) | Direction |
|---|---|---|
| **[A] SPECIFIC OPTION CHOSEN FOR EACH SITUATION** [57-58] | | |
| **[B] 'TECHNOLOGY' OR 'NON-TECHNOLOGY'** [57-58] | U NS<br>IT NS | -<br>- |
| **[C] SPECIFIC CHARACTERISTICS OF SITUATIONS** | | |
| **Attitude towards lunch/coffee breaks** (strict: Company A, lenient: Company B) [57] | U NS<br>IT NS | -<br>- |
| **Provision of staff health care** (poor: Company A, good: Company B) [58] | U NS<br>IT NS | -<br>- |

**NOTES**
1. See Table 3
2. The results for 'specific option chosen for each situation' and 'specific characteristics of situations' are the same as for 'technology/non-technology'.

While the undergraduates chose 'low' technology availability for both situations in the 'Choosing where to work: Company A or Company B' category the IT professionals tended to choose 'high' technology availability for both situations. However, the results were not significant. [A,B] [57,58]

When given a choice of working for Company A which provided a computer for each member of staff but allowed only a short lunch and coffee break or Company B which had fewer computers but was very flexible about the length of lunch and coffee breaks, most of the IT professionals stated that they would choose to work for Company A whereas most of the undergraduate subjects stated that they would choose to work for Company B. This implies that the IT professionals perceived 'high' technology availability to be more important than lunch and coffee breaks when choosing where to work while the undergraduate subjects perceived lunch and coffee breaks to be more important than 'high' technology availability. It is not clear why this difference was found but since most of the IT professionals were already working in computer-based employment they may have perceived 'high' technology availability to be more important than the undergraduate subjects as a result of their work experience.

Technology may have been regarded by the IT professionals as an essential feature while coffee breaks were regarded as being of lower priority. [C] [57]

When given a choice of working for Company A which provided a computer for each member of staff but had a poor staff health care record or Company B which had fewer computers but comprehensive staff health care, the IT professionals were evenly split between Company A and Company B whereas most of the undergraduate subjects stated that they would choose to work for Company B. This implies that the IT professionals were undecided as to whether 'high' technology availability is more important than a comprehensive staff health care programme when choosing where to work while the undergraduate subjects perceived a comprehensive staff health care programme to be more important than 'high' technology availability. [C] [58]

## COMMUNICATION (Situations 36-51)

**Options: 'technology':** multimedia; pager; electronic mail/e-mail; telephone; telex; facsimile/fax

**'non-technology':** write/send memorandum, letter, report; courier; have an informal face-to-face meeting (wait for chance encounter in corridor, coffee/lunch break, etc.); arrange a formal face-to-face meeting (make an appointment, business lunch, etc.)

The IT professionals selected the same options as the undergraduate subjects for most of the situations in the 'communication' category. The options selected most frequently by both groups were telephone and formal face-to-face meeting while telex and courier were selected least often. [A] [36-51]

Czaja (1987) stated that "the introduction of technology may modify the social environment and create changes in working relationships and communication/ interaction patterns ... people may come to rely on electronic mail and teleconferencing rather than face-to-face meetings". However, the perception of the subjects in the current study was that they would use both technology and non-technology options for communication. [B] [36-51]

## TABLE 11 - COMMUNICATION

| | Probabilities | Direction |
|---|---|---|
| **[A] SPECIFIC OPTION CHOSEN FOR EACH SITUATION [36-51]** | U .001 ($\chi_r^2$ = 72.77) | F/Te |
| | IT .001 ($\chi_r^2$ = 51) | Te/F |
| **[B] 'TECHNOLOGY' OR 'NON-TECHNOLOGY' [36-51]** | U NS | - |
| | IT NS | - |
| **[C] SPECIFIC CHARACTERISTICS OF SITUATIONS** | | |
| **Recipient** | | |
| (business acquaintance) [42] | U .002 | N |
| | IT NS | - |
| (colleague) [43] | U .002 | N |
| | IT NS | - |
| **Time available** | | |
| Colleagues | | |
| (short) [38] | U .008 | T |
| | IT .004 | T |
| (long) [39] | U NS | - |
| | IT NS | - |
| Head of department | | |
| (short) [46] | U .002 | T |
| | IT NS | - |
| (long) [47] | U NS | - |
| | IT NS | - |
| **Finance available** | | |
| (limited) [50] | U NS | - |
| | IT .022 | T |
| (unlimited) [51] | U NS | - |
| | IT NS | - |
| **Location of recipient** | | |
| (near) [36] | U NS | - |
| | IT NS | - |
| (far) [37] | U NS | - |
| | IT .004 | T |
| **Location of sender** | | |
| (train) [44] | U .002 | T |
| | IT .002 | T |
| (car) [45] | U .002 | T |
| | IT .002 | T |
| **Availability of recipient** | | |
| Head of department | | |
| (good) [40] | U NS | - |
| | IT NS | - |
| (poor) [41] | U NS | - |
| | IT NS | - |
| Colleague | | |
| (good) [48] | U .002 | N |
| | IT NS | - |
| (poor) [49] | U NS | - |
| | IT NS | - |

**NOTES**
1. See Table 3
2. F = formal face-to-face meeting, Te = telephone

Non-technology was selected by both groups of subjects rather than technology whether the 'recipient' of confidential information was a colleague or a business acquaintance. [C] [42,43]

Technology was selected rather than non-technology whether the 'time available' for telling several colleagues the time of the next staff meeting was short (two hours) or long (a week). [C] [38,39]

When the 'time available' for sending information from a long, complicated document to the Head of department in the U.S.A. for a meeting being held in the U.S.A. was short (two hours) most subjects chose technology whereas when the time available was long (two weeks) most subjects chose non-technology. [C] [46,47]

When deciding which method to use for discussing a project with partners from an overseas company most subjects chose technology when the 'finance available' was limited (limited budget for travelling expenses) while when the finance was 'unlimited' (generous budget for travelling expenses) most subjects chose non-technology. This variation in option according to the finance available differs from the finding of a study by Christie and Holloway (1975) in which 54 of the 63 subjects who preferred to travel to a meeting rather than to telecommunicate stated that they would prefer to travel no matter how inexpensive the telecommunication system available. Technological improvements made since the 1970s may be one reason why the subjects in the current study seemed willing to use technology. [C] [50,51]

Christie and Holloway (1975) found that, when deciding which option to use for a hypothetical discussion, significantly more managers chose to telecommunicate when the discussion was given a non-person-oriented rather than a person-oriented description, when acquaintances rather than strangers were involved, and when the travel time associated with holding the discussion face to face was long.

When the 'location of recipient' for telling a colleague the time of the next staff meeting was near (next office) the choice of the IT professionals was split evenly between technology and non-technology whereas technology was chosen when the location of the recipient was far (3 floors above). The undergraduate subjects selected non-technology when the location of the recipient was near and technology when the location of the recipient was far. [C] [36,37]

The majority of subjects in both groups selected technology whether the 'location of sender' of a message concerning an indefinite delay in reaching work was in a train or in a car. [C] [44,45]

Non-technology was selected by the IT professionals when the 'availability of recipient' for sending apologies for being unable to attend an important Board meeting to the Head of Department was good (easy to contact as 'open door' policy) and technology when the availability was poor (very busy, can only be contacted through a formidable secretary). The undergraduate subjects selected non-technology whether the availability was good or poor. [C] [40,41]

When deciding which method to use for discussing a project with a colleague most subjects chose technology when the 'availability of recipient' was poor (rarely available due to very busy schedule) whereas when the recipient was often available due to a fairly relaxed schedule most subjects chose non-technology. [C] [48,49]

## DISCUSSION

A summary of the statistically significant specific situation characteristics is provided in Table 12. The pattern of responses obtained for the undergraduates and IT professionals was broadly similar. This indicates that the responses obtained in the current study reflect shared perceptions of preferences for using technology or non-technology in the office and that the choice of option in a particular situation depends on the characteristics of that situation. While it is possible that subjects consistently chose a particular response for a particular situation merely because of chance factors such as ticking a response at random, the results obtained from the statistical tests suggest that it is unlikely that the strong preferences found for particular options for certain situations (e.g. for two of the situations in the 'decision-making' category **all** the subjects chose a non-technology option) were simply the result of chance.

**TABLE 12 - SUMMARY OF STATISTICALLY SIGNIFICANT SITUATION CHARACTERISTICS**

| | TECHNOLOGY | | NON-TECHNOLOGY | |
|---|---|---|---|---|
| | U | IT | U | IT |
| **DOCUMENT PREPARATION** | | | | |
| **Recipient** | | | | |
| head of department | ✓ | ✓ | - | - |
| business contact | ✓ | ✓ | - | - |
| colleague | - | ✓ | - | - |
| **Time available** (long,short) | | | | |
| report for department | ✓ | ✓ | - | - |
| report for new customers | ✓ | ✓ | - | - |
| **INFORMATION MANAGEMENT: INFORMATION GATHERING** | | | | |
| **Time available** | | | | |
| long | - | ✓ | - | - |
| **INFORMATION MANAGEMENT: INFORMATION STORING/RETRIEVAL** | | | | |
| **Frequency of access required** | | | | |
| daily | ✓ | - | - | - |
| many requests | ✓ | ✓ | - | - |
| **Amount of information** | | | | |
| large | ✓ | - | - | - |
| **Space available** | | | | |
| limited | ✓ | - | - | - |
| plenty | ✓ | - | - | - |
| **Training available** | | | | |
| no | - | - | ✓ | ✓ |
| **INFORMATION MANAGEMENT: INFORMATION PROTECTION** | | | | |
| **Reliability of power supply** | | | | |
| unreliable | - | - | ✓ | - |
| **DECISION-MAKING: GENERAL DECISION-MAKING** | | | | |
| **Time available** | | | | |
| short | - | - | ✓ | ✓ |
| **Finance available** | | | | |
| limited | - | - | ✓ | ✓ |
| unlimited | - | - | ✓ | ✓ |
| **Type of decision** | | | | |
| major | - | - | ✓ | ✓ |
| important | - | - | ✓ | ✓ |
| minor | - | - | ✓ | ✓ |
| **COMMUNICATION** | | | | |
| **Time available** (short) | | | | |
| head of department | ✓ | - | - | - |
| colleagues | - | ✓ | - | - |
| **Finance available** | | | | |
| limited | - | ✓ | - | - |
| **Location of recipient** | | | | |
| far | - | ✓ | - | - |
| **Location of sender** | | | | |
| train | ✓ | ✓ | - | - |
| car | ✓ | ✓ | - | - |
| **Time available** (short) | | | | |
| colleagues | - | - | ✓ | - |
| **Availability of recipient** (good) | | | | |
| colleague | - | - | ✓ | - |

**NOTES:** U = undergraduates, IT = IT professionals', ✓ = statistically significant result, - = not applicable

Both groups of subjects expressed a strong preference for selecting technology options rather than non-technology options for the majority of situation categories. For 'document preparation' and 'information management' subjects expressed a clear preference for technology rather than non-technology, for 'communication' there was a split preference between technology and non-technology and for 'decision-making' a distinct preference for non-technology rather than technology. One explanation for this could be that fundamental differences exist in the type of situations in each category. It may be that 'document preparation' and 'information management' are perceived to be 'mechanical' situations for which technology is adequate whereas 'decision-making' and 'communication' are regarded as 'cognitive' and 'social' situations respectively where reliance on machinery is unsuitable.

Short et al. (1976) suggested that "social presence is an important key to understanding telecommunications". The capacity to transmit information about facial expression, direction of looking, posture, dress and non-verbal vocal cues are considered by Short et al. to contribute to the social presence of a telecommunications medium. This capacity may depend as much on subjective impressions as on the objective characteristics of the medium.

Face-to-face interaction may be regarded as the "richest form of human communication" as other forms of communication are characterized by resource limitations or additional constraints (Suchman, 1987). It has been suggested that the social presence provided by a teleconferencing system may interact with the person-orientation of a discussion to affect the acceptability of the system (Christie, 1975). "If person-orientation is low, the system need not create a high degree of social presence to be acceptable. But if person-orientation is high, the system will be acceptable only if it affords a high degree of social presence."

Face-to-face meetings have been found to have the highest perceived social presence and letters the lowest perceived social presence with video and telephone use between these two extremes (Short et al., 1976). Gale (1989) found that the feeling of 'social presence' increased as the bandwidth of the communication increased with the highest score being obtained under a 'shared whiteboard plus audio and video' condition and the lowest under a 'shared whiteboard only' condition. In an investigation of the effect on synchronous communication of adding a Shared Workspace to audio by Whittaker et al. (1993) it was found that the visual channel in the form of a Workspace produced

benefits for the completion of demanding text-based tasks and complex graphical tasks but did not bring communication benefits.

A field study by Markus et al. (1992) showed that when given a choice between electronic mail, voice mail, and fax for communication respondents tended to use multiple media rather than relying on a single method of communication. However, there was a tendency to prefer one medium for asynchronous communication and the other media for occasional specialized purposes.

Some adaptation may occur when there are long-term two-way audio and video connections between offices (Dourish and Bellotti, 1994). It is reported by Dourish and Bellotti that members of the work group may come to relate to the connected offices as if they were a single, shared office.

In the current study the perceived choice of technology or non-technology for communication could have been influenced by the perceived social presence of the options available. This could be investigated at a later date. Future research directions are discussed further in Chapter 10.

A distinction may be made between the **preferred** option and the **feasible** option when deciding on the use of technology. One example is an incident which occurred during the 1994 football World Cup in the U.S.A. Following a bureaucratic misunderstanding in an earlier match, the Ireland manager Jack Charlton was banned from the touchline. The option of choice for both the manager and team members was face to face communication - as one team member expressed it: "The players like to see 'Big Jack' on the touchline". However, an alternative form of communication had to be found. The option chosen was a mobile phone which Mr Charlton used from a television commentary box after reporting that this produced better quality transmission of messages than a two-way radio (Republic of Ireland vs. Norway, ITV, 28 June 1994).

If the results of the current study provide an accurate portrayal of user perceptions, then in some cases there seems to be a close match between user and computer industry perceptions of technology and in other cases a fundamental mismatch. An example of a mismatch appears to be decision support systems while an example of a good match is the mobile telephone. There was a marked reluctance to rely on technology for making decisions although it is possible that technology would be used as **part** of the decision-making process. However, the manufacturers of mobile

telephones seem to have anticipated the needs of rail commuters or car drivers who are 'trapped' on a train or stuck in a traffic jam just before an important meeting.

An indication of the representativeness of the situations included in the questionnaire used in the present study and of the accuracy of user perceptions that the telephone would be a feasible option to use for communication when stuck in a traffic jam was provided by a broadcast of '*Any Questions*' (BBC Radio Four, 19 March 1993). Two of the panellists participated via a mobile telephone as they were both stuck in a traffic jam in different locations and were unable to reach the programme venue. However, the programme was shorter than usual as the technical quality of some of the mobile telephone contributions was considered to be unacceptable when compared with the usual standard of recording obtained.

An example of confirmation of the prediction that mobile phones could be used when facing an indefinite delay on a train was provided on a London commuter train in November 1994. The train was stuck between stations for 1½ hours with no announcements as to the cause of the delay. One passenger used his mobile phone to request someone else to phone the station for information as to the cause of the delay. By eavesdropping on the conversation the rest of the carriage was able to learn that signal problems were to blame. A guard was later heard walking along the track beside the train saying that he had been providing information which no one had heard due to a faulty intercom system on the train. This incident is an example of the 'casual' observation technique described by the author in Chapter 4.

Another example of the usefulness of mobile phones for communicating information concerning delays occurred a few days prior to the previous incident when a passenger stuck at a bus stop for 50 minutes on her way to work following the non-arrival of the bus was able to contact her place of employment using a mobile phone.

In addition to demonstrating the use of technology in everyday situations the above incidents illustrate the unreliability of technology and a possible reason why homeworking may be popular. In the case of the train a multi-million pound computer-based signalling system had recently been installed following a two-month closure of the station. Freedom from the aggravation of commuting may result in teleworking being perceived as preferable to travelling to an office.

There may be cultural differences in tolerance of faulty technology. In December 1989 a lengthy memo was issued to rail passengers in Toronto explaining why there had

been a delay a few days previously. In December 1994 an Australian paper thought it newsworthy that a train in Sydney had been delayed for 30 minutes following a hurricane. In London, where transport delays seem to be a regular occurrence, the author has seen announcements that trains are running to schedule as if this were perceived to be notable occurrence.

The current study has indicated that the choice of technology or non-technology in particular office situations is influenced by the characteristics of the situation as well as the technological options available. Chapters 5 and 6 have considered 'the office as it is perceived to be at present'. Chapters 7 and 8 consider 'the office as it may be in the near future'. Chapter 7 (Study 3) also considers user requirements for the 'Ideal Office' and user predictions for when those requirements are likely to be implemented.

# CHAPTER 7 - USER PERCEPTIONS OF THE IDEAL OFFICE (STUDY 3)


## SUMMARY

This study involved considering user perceptions of the 'Ideal Office' and an analysis of the literature relating to current developments in technology. User perceptions of the 'Ideal Office' were considered by comparing responses to the Ideal Office section of the Free Response Questionnaire (see Chapter 5 '*An investigation of user perceptions of technology and the office*') with responses to the other sections of the Free Response Questionnaire (The Office, Advantages of using computers in the office, Disadvantages of using computers in the office) to see to what extent the subjects' perceptions of 'the office as it could be in the future' matched their perceptions of 'the office as it is at present'. Information was elicited about the features which subjects would assign to computers in their ideal office and their forecast for when those features were likely to be implemented at reasonable cost. In addition to listing features they would like to see in their 'Ideal Office', subjects were also required to evaluate them by assigning a rank to each item on their list according to how important they felt that item to be to allow an evaluation to be made of the relative importance of the items to each subject. The information obtained from the current study suggests that the subjects share broadly similar views of the nature of the 'Ideal Office' and the relative importance of the features which should be included. Analysis of the estimates of when the 'Ideal Office' will be implemented indicates that subjects perceive that most features will be available in the near future (within a year) or soon (within 5 years). User perceptions of the 'Ideal Office' are considered in the light of current developments in office technology to see how far the perceptions of users and the computer industry coincide.


## INTRODUCTION

Earlier chapters have emphasised the role of technology in completing office work. In this chapter user perceptions of the 'Ideal Office' are considered in the context of current developments in office technology and predictions for future technological developments. That is, 'what users think they would like' is compared with 'what they are likely to get'. General issues such as the impact of developments in office technology on society as a whole are also considered since the growth in availability and use of certain technology such as mobile phones and personal computers at home and elsewhere means that 'office technology' is no longer restricted to the office and that areas such as home and leisure activities may be affected by developments in 'office technology'.

The term "ubiquitous computing" has been used by Weiser, manager of the Computer Science Laboratory at the Xerox Palo Alto Research Center to describe the explosion in computer availability (Weiser, 1993). Weiser suggests that this forms the Third Wave in computing. The First Wave was many people per computer, the Second Wave was one person per computer, and the Third Wave is many computers per person (*HOTT*, 1994). That is, many computers are available through the physical environment although they are effectively invisible to the user. In addition to considering technical details, Wieser notes that "a key part" of the evaluation of ubiquitous computing is "using the analyses of psychologists, anthropologists, application writers, artists, marketers, and customers".

Trends in the development of technology are thought to provide an indication of the computer industry's view of the 'ideal' office. In theory, the computer industry only develops products which will 'sell'. In practice, not all products are a resounding success. This may be due to technical problems or perhaps to incorrect assumptions about user perceptions and requirements.

In this chapter references come from a variety of sources including academic journals, newspapers, and novels. Since the emphasis was on current technological developments and the perceived impact of technology on society many references were derived from newspapers as these were considered more likely to provide up-to-date information than journals. The modal dependability rating for the references in this chapter is 4.

## CURRENT DEVELOPMENTS IN TECHNOLOGY

This section provides information on current developments in technology to provide a basis for considering the results obtained from the present study. As the main emphasis in this chapter is on attitudes towards developments in technology rather than on the technology itself the technical details of current developments are not discussed in detail.

Doswell (1990) proposes that the future of office technology may be seen "as a continuation of the recent technological past" and predicts that in the future "hardware will continue to become cheaper, faster, and more accessible", "software will become more powerful, more intelligent, and more accessible" and that changes in the way people work "might have a significant impact upon the organization and functioning of our society".

In *The Third Wave* Toffler (1981) stated that "no-one 'knows' the future ... social forecasts, moreover, are never value-free". "Predictions about where technology will take us are highly risky" (Coffey, 1993a). For example, the paperless office predicted in the Seventies has not materialised (Fisher, 1990; Taylor, 1993a; and Coffey, 1993a). Taylor stated that "about 95 per cent of information used in the office is still stored on paper, rather than electronically". Spinrad, a director of corporate technology for Xerox, suggests that while the advantages of electronic filing have been recognised "a piece of paper is a marvelous *[sic]* cheap display" and "paper is going to exist for a good long while" (Fisher, 1990).

In 1989 Negroponte predicted three technical developments for the 1990s - speech input/output, animation, and "a society of intelligent agents". There have been developments in all these areas, for example, multimedia, virtual reality, and Agent Based Computing. In 1995 in *Being Digital* Negroponte continues to predict a future in which computerised "agents" are prevalent. In his review of *Being Digital* Naughton (1995) suggests that while Negroponte "is an experienced observer of the computing industry who understands markets and consumers, and knows the difference between ingenuity and marketability", moral issues and the potential adverse social consequences of the technological developments predicted are insufficiently explored.

In 1990 it was noted that "a hot topic at the Ottawa Business and Government Computer Show will be connectivity, how computers can talk to each other" (Rachlis, 1990). A report in *The Observer* (1993) on "the office technology of tomorrow" stresses the importance of open systems to "halt companies' dependence on one hardware supplier" and to "vastly increase the scope of the modern computer". Teleconnect suggests that "nothing is more important than our customers" and that open systems will benefit the customer more than "glitzy products that enhance personal productivity" (*Teleconnect*, 1992).

Interest in integration of office technology is growing. "Microsoft is setting out to define a standard for the integration of office devices with PC networks" (*PC Week*, 1993). Office devices include telephones, printers, fax machines, photocopiers and other equipment "around which modern office life revolves". Integration will allow office equipment to be managed and controlled from a PC. In the "office of the future" it is important to consider integration not only in terms of equipment but also in terms of the skills and potential of people (Thompson, 1989). In March 1994 a colloquium dedicated to the integration of telecommunications and information technology was held by the Institution of Electrical Engineers (IEE, 1994). The colloquium stressed

technical aspects of developments in telecommunications such as optimal bandwidths. Other issues discussed included the decreasing cost of videophones and the social impact of long-term "office share" connections (see Chapter 6).

Doswell (1990) mentions "increasing miniaturisation". Coffey (1993a) suggests that "the most noticeable change will be that everything will be smaller". Taylor (1993b) comments that silicon integration and other technological developments have enabled "real processing power" to be packed into "ever smaller and less costly packages". Coffey notes that laptop and notebook PCs are increasing in popularity. Taylor (1993b) suggests that "the 'clamshell' notebook computer has become the *de facto* standard for portable computing and the fastest growing segment of the world computing market".

"Technology has changed the way people work in the office beyond recognition in the past 10 years" and "the next 10 years are likely to see more of the same" (Coffey, 1993a). While radical developments in technology may change the methods used to complete work, the author has suggested throughout this thesis that the fundamental features of office work do not change over time. For example, communication may be completed using smoke signals, morse code, telephone, facsimile, and so on.

**Input devices**

"The workstation of the future [...] will be equipped for voice input and output" (Booth, 1989). Bill Crow, one of the developers of Hewlett-Packard's New Wave predicts that "a fundamental principle of HCI design will be input by natural language processing and voice recognition" (Baynes, 1992). In 1994 IBM launched its Personal Dictation System. This computer can be 'trained' to respond exclusively to one person's voice. It types at 120 words a minute, inserts grammar and corrects punctuation (Champkin, 1994).

The Newton Message-Pad is an 'intelligent' hand-held computer that understands handwriting (Wilson, 1993). There is no keyboard - the user writes on a glass screen with a special plastic pen. The 'intelligence' derives from the computer's ability to teach itself details about its owner such as how the owner writes, who the owner phones most often and so on and to 'guess' what the owner wants it to do. However, it has been argued that the current computer industry perception of handwriting recognition systems is that they "are playmates not workmates" (Smith, 1993).

**Telecommunications**

Three major areas for future developments in office technology were mentioned in a report by the European Strategic Programme for Research and Development in Information Technology - workstations; communications and networks; integrated applications (ESPRIT Synopses, 1989). In 1991 an ESPRIT report predicted increasing demands for open and distributed systems; increasing use of graphical interfaces, multimedia presentation and multimodal user-system interaction; and rapid developments in mobile and portable computing.

In a report on office technology in the *Financial Times* in 1993 issues discussed included networks, communications, and videoconferencing (Wiltshire, 1993). In 1994 there was a 6-page report on developments in telecommunications in the USA (*Financial Times*, 1994) and an 11-page special report on mobile communications in the *Evening Standard* (Godfrey, 1994). "The next few years will see great advances in telecommunications [...] Some of this technology is already available; soon there will be more and it will be cheaper to use" (Flower, 1994).

ESPRIT reports in 1989 and 1991 predicted an increasing demand for suitable bandwidths and flexible use of bandwidths to support workstation interconnection and services such as high-speed fax, remote database access, videoconferencing and videotelephony (ESPRIT 1989, 1991). Corbitt (1993) mentioned videophones and videoconferencing. It has been suggested by the Swedish company Ericsson that the cordless PABX will "revolutionise office communications during the 1990s" (Taylor, 1993a).

There is currently great interest in a network called the Internet. This is a world-wide network of computer networks linked together. Originally set up to enable universities and research establishments to exchange e-mail and computer files, the Internet now permits the distribution of letters, electronic magazines and books (Schofield, 1994b). As many as 35 million people world-wide are thought to be on "The Net" and this figure is growing at the rate of a million new users per month (Freedland, 1994b). Freedland mentions the potential social impact of this expansion such as abuse by terrorists, drug-dealers and political extremists. Another problem may be the exclusion of certain groups: "What happens to the elderly, the technophobic, the under-educated and the poor for whom modems and gateways are as alien as a close encounter?" (Freedland, 1994b).

Petto who studied the interactions of three large discussion groups over a period of four years suggests that Internet use may lead either to "greater democracy and participation in intellectual discussions" or to "greater fragmentation of society" (Davidson, 1995). If Petto is correct this provides some evidence for the idea that it is user perceptions and social values which govern the way in which technology is used. Therefore it is important to understand user perceptions and the values of society as a whole.

Informal conventions governing Internet use seem to have developed called 'netiquette'. Terms such as 'spamming' and 'flaming' are used to describe user reactions to those who transgress the 'rules'. Flaming occurs when a user who unwittingly sends a message to the 'wrong' conference receives abusive messages or 'mail bombs' - "a huge useless program that takes up large amounts of the user's disc space" (Arthur, 1994). A similar fate may await those considered guilty of 'spamming' - sending the electronic equivalent of 'junk mail'. It seems that the same level of intolerance shown in the judgmental error messages displayed by some operating systems has been transferred to network use by the Internet vigilantes. There may be informal rules governing socially acceptable behaviour when using certain forms of technology similar to the social skills described by Argyle (1972).

**Personal Digital Assistants (PDAs)**

Handheld machines called 'personal digital assistants' that combine some of the functions of PCs with those of telephones are being developed. One example is the Newton Message-Pad (see 'Input devices' above). Computers the size of a pocket diary may eventually be connected to global networks so that users can verbally summon up and manipulate information (Coffey, 1993a). However, according to Bill Gates the head of Microsoft, "voice recognition systems and personal digital assistants are a long way off being reliable and affordable" (McClellan, 1993).

**Multimedia**

The impact of multimedia seems to have been recognised in the Multimedia PC Standard (Fletcher, 1992). Fletcher suggests that "having access to a desktop computer that can play animation, show high resolution images, playback digitised audio and offer the capacity and cost-effectiveness of application distribution using CD-ROM opens up a whole new vista of applications capable of integrating more than straight business functions like wordprocessing, databases and accounting". Such applications include training, presentations, and electronic books making it easier "to envisage PCs having a whole lot more to say in the future".

**CD-ROM**

CD-ROM (Compact Disc Read Only Memory) allows vast quantities of information to be stored in a much smaller space than other computer storage devices such as floppy discs (Diamond, 1993). "There have been developments in electronic and optical data storage" (Taylor, 1993a) and "CD-ROM systems have begun to appear in the office". The number of online databases increased from 400 in 1979 to 5000 in 1991 and "the growth of digital information sources will continue inexorably" (Baynes, 1992).

It has been suggested that computers will increasingly be used in the home. Links to the 'information superhighway' (Schofield, 1994a) - "a national network of fibre optic cable" - will enable people to do their shopping or banking without leaving their front rooms (McClellan, 1993).

**Groupware**

The increase in interest in groupware - technology designed to enable people to work in groups or teams rather than as individuals - is discussed by Coffey (1993b). Research into the use of groupware for computer-supported cooperative work is described in Greenberg (1991) and Baecker (1993).

**Virtual reality**

"Anything could be true. The so-called laws of Nature were nonsense [...] what knowledge have we of anything, save through our own minds?" (Orwell, 1949).

"Reality is a crutch" (graffiti slogan, Toffler, 1970).

"Virtual reality emerged from developments in flight simulation technology and involves the creation of an artificial environment which looks and feels as if it actually exists" (Swain, 1993). Shneiderman (1992) reviews some of the design issues related to the implementation of virtual reality systems such as the characteristics of the visual display, eyephone and dataglove design.

Ross (cited by Taylor, 1993a) predicts the idea of a 'virtual office' "more akin to a hotel, where individuals have flexible space where and when they need it, sharing facilities". The issue of sharing office facilities, sometimes called 'hotelling' or 'hot desking' is discussed by Myerson (1993). An American office manufacturer cited by Myerson predicts that "the workspace of the future is more than a desk but less than an office" and will resemble a telephone box. Myerson notes that while "all this makes the company accountant very happy [...] hot desking poses deep-rooted psychological problems for a system which has relied as much on the symbolic status value of

geographical territory to reward loyalty and initiative as the real value of the pay cheque at the end of the month".

When co-workers or collaborators are not located in the same physical space, a **media space** can be used to link them together (Baecker, 1993). "Media spaces integrate audio, video and computer networking technology in order to provide a rich communicative environment for collaboration" (Dourish, 1993). Research into 'media spaces' is already under way at Rank Xerox EuroPARC (Dourish, 1993; Dourish et al., 1994; Dourish and Bellotti, 1994).

Howard Rheingold, author of *The Virtual Community* suggested that "people overwhelmingly are not that interested in communicating with information. People are interested in communicating with each other" (*The Electronic Frontier*, 1993). It is claimed that "though they may start off in cyberspace, virtual communities often develop a real existence" (McClellan, 1994) and that users of computer networks may develop real feelings for fellow users. Presumably McClellan is suggesting that electronic interaction may result in the development of relationships similar to those developed by face-to-face communication.

While developments in technology, particularly telecommunications, may facilitate opportunities for teleworking, Huws et al. (1990) conclude from their study of telework that "there will continue to be many functions which need to be carried out face-to-face by human beings who live near each other or can easily travel to a shared workplace".

It has been suggested that eventually "virtual reality will surpass real life" (Williams, cited by Grossman, 1994). This raises the issue of **why** there is thought to be a need to improve 'real life' and whether it is a good idea to attempt 'improvements'. It could be likened to the effect of hallucinogenic drugs - such drugs can induce both good and bad experiences and a similar effect might be found with some virtual reality applications. If taken to extremes virtual reality could adversely affect the sanity of susceptible individuals. With some 'confused' elderly people 'reality orientation' is considered an important part of their therapy. This means ensuring that any calendars they see show the correct date, clocks indicate the correct time, and so on. 'Jet lag' is a well-known phenomenon amongst long-distance travellers crossing time zones. People suffering from delusions may see and hear things which do not actually exist which may result in harm either to themselves or to others. While virtual reality may have beneficial

applications such as training and leisure, there seems to be both a physiological and psychological need to remain aware of 'reality'.

**Differences between humans and machines**

The increasing interest in virtual reality applications and artificial intelligence highlights a need to understand the differences between humans and machines. In the 1970s there was interest in bionics ("the replacement of parts of the body with electronic or mechanical devices" - *Chambers English Dictionary*, 1988). This was demonstrated in the television programme *The Bionic Man* and use of the word 'bionic' in the sense of superhuman when Southampton football fans chanted in 1976 that Mick Channon was 'bionic man'. Bionics could be seen as a breakdown of the barriers between humans and computers and as an extreme example of human-computer interaction! Thimbleby (1990) notes that some people control their bodily functions by electronics.

While it may be possible to reduce the contents of the world's libraries to a few compact discs people are unlikely to be able to cope with thousands of references at one time. Baynes (1992) comments that "humans may be able to make sense of information in a manner which is far beyond the capability of the most advanced computer architecture but we do it very slowly. RISC chips we are not." And would we want to be? Thimbleby (1990) discusses how people can be distinguished from computers in relation to information processing and concludes that "we still don't know the answer" although "specifically human traits" such as fatigue, inattention, and motivation are acknowledged. "One of the problems with technology is the difference between machines and people" (Don Norman, *The Electronic Frontier*, 1993). Norman suggests that while "a machine needs things that are precise, accurate [...] a person cares about other things - about joy, about love, truth, beauty, fun. Can you imagine a machine that cares about fun?"

Baynes (1992) states that the idea of a homunculus (a 'little man') forms the basis for Agent Based Computing. In Agent Based Computing the aim is to change computers from being passive tools to proactive entities which possess some knowledge of the needs of the user and act on his or her behalf. It is claimed that 'Agents' are active rather than passive, exhibit some level of 'intelligence', and learn from experience. Bill Crow, one of the developers of Hewlett-Packard's New Wave predicts that "by the year 2000 I see agents as being perceived as autonomous entities that assist the user and will be perceived as having their own personality" (Baynes, 1992). The idea of a computer with a 'personality' could create problems - people often have problems interacting with each other never mind a temperamental computer!

Agents were also mentioned in the television programme *The Electronic Frontier* (1993). The narrator commented that if the use of agents succeeded "there'll be no more need for real travel agents, or for real main streets, for real newsagents, or even for real cinema ushers" and a software developer mentioned "software pets that are just made out of code and pixels, but you can actually love them like a real pet".

Kane (1993) reports that a spokesman from a computer manufacturer who used robots to produce the computers and then returned to humans stated that: "We looked at the robots, compared the cost of reprogramming them with the performance of the average human worker and went back to humans. Much cheaper and more efficient."

## RATIONALE FOR THE CURRENT STUDY

In the above review of current developments in technology the emphasis in the references was on what is likely to happen with no obvious consideration of the extent to which these developments are considered desirable by the people likely to be affected, particularly those who may actually use the technology. While the future of office technology was often considered, little reference to the 'Ideal Office' was found in the literature. An isolated example located was Lohr (1992) who mentioned that manufacturers in the United States are considering the design of the 'ideal' office chair.

The 'Scandinavian' approach (Bjørn-Andersen, 1985) to the 'Ideal Office' sees technology as a means to improve the quality of the user's working life and suggests general principles for an 'ideal system' including support for cognitive characteristics associated with emotions and creativity and increasing opportunities for social contact (Booth, 1989).

Toffler (1970) mentioned *probable* futures, *possible* futures, and *preferable* futures. Using Toffler's classification, current developments in office technology may be regarded as the probable future, user perceptions of the 'Ideal Office' may be regarded as the preferable future from the viewpoint of the users, and technology designed by the computer industry taking note of user perceptions could be regarded as the possible future of office technology.

In an earlier study (see Chapter 5) user perceptions of office work and the role of technology in the office were considered by analysing responses to a Free Response Questionnaire. Eight dimensions were identified: information-handling, human contact, paper-handling, financial security, communication, technology, work, and health preservation. In Chapter 5 the office was considered as a whole - the good, the bad,

and the neutral. In the current study the responses made to the four sections of the Free Response Questionnaire were considered in more detail to enable a comparison to be made between user perceptions of 'the office as it is at present' (The Office, Advantages of using computers in the office, Disadvantages of using computers in the office) with user perceptions of 'the office as it could be' (The Ideal Office). In addition, user estimates of when the 'Ideal Office' would be implemented at reasonable cost were studied.

**Aims**

1. To investigate user perceptions of the role of technology in the 'Ideal' office.

2. To compare user perceptions of 'the office as it is at present' with perceptions of 'the office as it could be'.

3. To investigate user predictions for when the 'Ideal' office is likely to be implemented.

4. To compare current developments in office technology with user perceptions of the 'Ideal Office' to see the extent to which user perceptions of the 'Ideal Office' are being matched by current developments in office technology.

## METHOD

### SUBJECTS

The subjects who participated in the current study were the same subjects who participated in the '*User perceptions of technology and the office*' study (see Chapter 5). 75 subjects completed the Office, Advantages of using computers in the office, and Disadvantages of using computers in the office sections of the Free Response Questionnaire (see Chapter 5 for details).

71 subjects completed the 'Ideal Office' section of the Free Response Questionnaire. 54 per cent of the subjects were full-time students ('Students') and 46 per cent worked full-time in a variety of occupations ('Professionals'). The 'Professionals' included clerical and administrative workers (20 per cent of the total number of subjects), other occupations including teachers of English as a Foreign Language, a computer consultant, company director, library assistant, and an air hostess (20 per cent) and IT professionals who worked in the computer industry in addition to completing a part-time course in user interface design (6 per cent). A high proportion of subjects (89%) had experience of using computer systems as end-users, software designers,

programmers, and so on while only 11% of subjects had never used a computer system.

The Delphi technique, a procedure for obtaining predictions about the future from pooled judgements made by 'experts', could have been used to obtain 'accurate' forecasts about the future. However, the level of technical expertise of the subjects was not considered to be crucial to the current study since the emphasis was on the subjects' perceptions rather than on feasible expectations. If 'accurate' forecasts had been required, a certain level of technical knowledge would have been necessary. For example, one could draw up plans for one's 'ideal' house without any knowledge of building. However, if one actually wanted to get that house built, it would be useful to consult an architect and a builder.

## PROCEDURE

The 'Ideal Office' questionnaire was a two-part self-administered, paper-based questionnaire devised by the author (see 'Free Response Questionnaire Extract' below) and issued as part of the Free Response Questionnaire in the '*User perceptions of technology and the office*' study (see Chapter 5).

### FREE RESPONSE QUESTIONNAIRE EXTRACT

### THE IDEAL OFFICE

Imagine that you have been given the opportunity to assign any features of the office you like to a computer to create your ideal office. Describe the features that you would include assuming that there are no constraints on the technology or money available, and so on. Rank these features according to how important it would be to you for them to be included. For example, if you have described 10 features, write "1" against the feature you consider to be the most important, "2" against the feature you consider to be the second most important, "3" against the feature you consider to be the third most important, and so on until you reach "10". You may describe as many or as few features as you like but please ensure that you rank all the features that you list.

Assume that you are still creating your ideal office but are now limited by financial and technological constraints. When do you think that the features you would like in your ideal office could be implemented at reasonable cost? Write a number against each feature you have listed using the following list:

1 = never likely to be implemented
2 = likely to be implemented 25 years from now
3 = likely to be implemented 10 years from now
4 = likely to be implemented 5 years from now
5 = likely to be implemented 1 year from now

| FEATURES | IMPORTANCE RANKING | IMPLEMENTATION FORECAST |
|---|---|---|
| _____ | _____ | _____ |

Subjects were asked to imagine that they had been given the opportunity to assign any features of the office they liked to a computer in order to create their ideal office. They were then asked to describe the features they would include assuming that there were no constraints on the technology or money available, and so on. In the first part of the task subjects were required to rank the features they had listed according to how important they felt them to be. In the second part of the task subjects were required to assume that they were still creating their ideal office but were now limited by financial and technological constraints. Subjects were asked to estimate when they thought that the features they had listed could be implemented at reasonable cost on a scale from 1 to 5 with 1 = never likely to be implemented and 5 = likely to be implemented one year from now.

It could be argued that a rating for 'already available' should have been included as an additional option. However, this omission is not regarded as very important. It is assumed that subjects who regarded an item as already existing chose 5 ('likely to be implemented 1 year from now') as the nearest option to 'already available'.

In the first part of the 'Ideal Office' questionnaire subjects were given the opportunity to list any features they wished assuming that there were no constraints on the technology or money available in order to allow subjects to be 'creative' in the features they listed. In the second part where subjects were asked to estimate when the items they had listed could be implemented the limitation of financial and technological constraints was imposed. This was to ensure that there was some shared basis to subject estimates to allow comparisons between subjects to be made and also to determine the extent to which subjects perceived their perceptions of the 'Ideal Office' to be feasible.

Subjects were allowed to describe as many or as few features as they wished so long as they ensured that they ranked everything they had listed. It is appreciated that for some subjects the ideal office might not include computers but it was felt necessary to impose this constraint, even though people were imagining their 'ideal' office, in order to provide some basis for comparison between subjects and because one of the main aims of the study was to discover what people would like office computer systems to provide.

## RESULTS

### Factors comprising the 'Ideal Office'

In the '*User perceptions of technology and the office*' study described in Chapter 5 an oblique factor analysis (Oblimin rotation) of all the sections of the Free response Questionnaire produced the following eight factors: information-handling, human contact, paper-handling, financial security, communication, technology, work, and health preservation.

In the current study each section of the Free Response Questionnaire was analysed separately using oblique factor analysis (Oblimin rotation). The significant factor loadings (0.3 or higher) for the factor analyses of the individual sections of the Free Response Questionnaire are listed in Table 1. The labels given to the dimensions identified were based on a comparison of the factor constituents with those of the factors derived from the '*User perceptions of technology and the office*' study. The label given to the dimensions in the current study reflects a close match with the constituents of the dimensions in Chapter 5.

**TABLE 1 - SIGNIFICANT LOADINGS FOR THE FACTORS**

**THE OFFICE AS IT IS AT PRESENT**

| LABELS | FACTORS | | | |
|---|---|---|---|---|
| | F1.O | F2.O | F3.O | F4.O |
| **THE OFFICE** | | | | |
| dealing with post | .95 | - | - | - |
| filing | .94 | - | - | - |
| mail | .91 | - | - | - |
| dealing with correspondence | .68 | - | - | - |
| photocopying | .64 | - | - | -.31 |
| information storing | .59 | - | - | -.36 |
| information gathering | .47 | .46 | - | - |
| lunch | - | .90 | - | - |
| meetings | - | .88 | - | - |
| seeing clients | - | .86 | - | - |
| tea/coffee-making | - | .78 | - | - |
| decision-making | - | .73 | - | - |
| telephone communication | - | .64 | -.51 | - |
| using different types of communication | - | .62 | -.46 | - |
| diary management | - | .60 | -.32 | -.37 |
| communication | - | .54 | - | -.50 |
| payroll | - | - | .69 | -.34 |
| wordprocessing | - | - | - | -.96 |
| typing/wordprocessing | - | - | - | -.86 |
| data entry | - | - | - | -.80 |
| maintaining accounts | - | - | - | -.77 |
| document preparation | - | - | .34 | -.67 |
| work | - | .34 | - | -.51 |

**ADVANTAGES OF USING COMPUTERS IN THE OFFICE**

| | F1.A | F2.A | F3.A |
|---|---|---|---|
| ready information at hand | .98 | - | - |
| file maintenance | .92 | - | - |
| increased efficiency | .86 | - | - |
| easy data retrieval | .85 | - | - |
| improved communication | .82 | - | - |
| improved storage of data | .81 | - | - |
| quicker to do things | .81 | - | .33 |
| wordprocessing | .78 | - | - |
| document preparation | .77 | - | - |
| electronic mail | .51 | - | .48 |
| payroll | - | .96 | - |
| accounting | - | .78 | - |
| security | .33 | .43 | - |
| reduction of paperwork | - | - | .91 |

**DISADVANTAGES OF USING COMPUTERS IN THE OFFICE**

| | F1.D | F2.D | F3.D | F4.D |
|---|---|---|---|---|
| photocopying | .85 | - | - | - |
| security of data | .80 | - | - | - |
| document preparation | .73 | - | -.32 | - |
| security | .63 | - | - | -.45 |
| lack of human contact | - | -.89 | - | - |
| staff training | - | .81 | - | - |
| decision-making | - | .75 | - | - |
| loss of jobs | - | -.46 | - | .34 |
| computer goes down | -.33 | - | .72 | - |
| power failure | -.43 | - | .67 | - |
| reduced job satisfaction | - | -.56 | .67 | - |
| expense | - | .44 | .59 | |
| health hazards | - | - | - | .89 |

**THE OFFICE AS IT COULD BE**

**THE IDEAL OFFICE**

| | F1.I | F2.I | F3.I | F4.I |
|---|---|---|---|---|
| computerised typewriters <u>without</u> typist | .95 | - | - | - |
| printers | .85 | - | - | - |
| electronic mail | .77 | - | - | - |
| communications from computer i.e. videoconferencing (to include telephone, fax, etc.) | .76 | - | - | - |
| voice processing | .75 | .33 | - | - |
| wordprocessing | .68 | - | - | -.32 |
| telephone management | - | .95 | - | - |
| diary management | - | .79 | - | - |
| communication | - | .58 | - | -.35 |
| payroll | - | - | .93 | - |
| accounting | - | - | .84 | - |
| security | - | - | .53 | - |
| photocopying | - | - | - | -.85 |
| correspondence | - | - | - | -.82 |
| file management | - | - | - | -.75 |
| document preparation | .36 | - | - | -.47 |

NOTES
THE OFFICE
F1.O= PAPER-HANDLING, F2.O = HUMAN CONTACT, F3.O = COMMUNICATION,
F4.O = TECHNOLOGY
ADVANTAGES OF USING COMPUTERS IN THE OFFICE
F1.A = TECHNOLOGY, F2.A = FINANCIAL SECURITY, F3.A = INFORMATION-HANDLING
DISADVANTAGES OF USING COMPUTERS IN THE OFFICE
F1.D = TECHNOLOGY, F2.D = WORK, F3.D = INFORMATION-HANDLING
F4.D = HEALTH PRESERVATION
THE IDEAL OFFICE
F1.I = TECHNOLOGY, F2.I = COMMUNICATION, F3.I = FINANCIAL SECURITY
F4.I = PAPER-HANDLING

The correlation between the factors identified from the individual sections of the Free Response Questionnaire is shown in Table 2. Significant correlations (0.3 and higher) are highlighted in bold. The existence of significant correlations indicates that there is some psychological overlap between the factors.

**TABLE 2- FACTOR CORRELATION MATRIX**

| | THE OFFICE AS IT IS AT PRESENT | | | |
|---|---|---|---|---|
| | FACTOR 1 | FACTOR 2 | FACTOR 3 | FACTOR 4 |
| **THE OFFICE** | | | | |
| FACTOR 1 | 1 | | | |
| FACTOR 2 | .21 | 1 | | |
| FACTOR 3 | -.11 | -.03 | 1 | |
| FACTOR 4 | **-.59** | -.27 | .06 | 1 |
| **ADVANTAGES OF USING COMPUTERS IN THE OFFICE** | | | | |
| FACTOR 1 | 1 | | | |
| FACTOR 2 | **.38** | 1 | | |
| FACTOR 3 | .19 | -.13 | 1 | |
| **DISADVANTAGES OF USING COMPUTERS IN THE OFFICE** | | | | |
| FACTOR 1 | 1 | | | |
| FACTOR 2 | .19 | 1 | | |
| FACTOR 3 | -.13 | .05 | 1 | |
| FACTOR 4 | -.19 | -.14 | -.003 | 1 |
| | **THE OFFICE AS IT COULD BE** | | | |
| **THE IDEAL OFFICE** | | | | |
| FACTOR 1 | 1 | | | |
| FACTOR 2 | .18 | 1 | | |
| FACTOR 3 | .29 | .21 | 1 | |
| FACTOR 4 | **-.42** | -.28 | **-.36** | 1 |

The dimensions identified for 'the office as it is at present' were: paper-handling, human contact, communication and technology (The Office), technology, financial security, and information-handling (Advantages of using computers in the office), technology, work, information-handling, and health preservation (Disadvantages of using computers in the office). The dimensions identified for 'the office as it could be' were technology, communication, financial security, and paper-handling. These dimensions constitute the perceptions of the 'Ideal Office' held by the subjects in the current study.

A comparison of the factor constituents for each factor demonstrated that three of the four Ideal Office factors (paper-handling, communication, technology) had similar constituents to the factors identified for The Office and the fourth factor (financial security) constituents similar to one of the factors identified as an Advantage of using computers in the office. This suggests that subjects perceive their 'Ideal Office' to be an enhanced version of the office as it is at present rather than as something radically different. The responses made by the subjects indicate that, on the whole, the computer was perceived as a tool to assist in the completion of office work and not as a replacement - that is, subjects did not envisage a totally 'robotized' office.

Current developments in technology reviewed earlier in this chapter can be considered in terms of information-handling (CD-ROM, multimedia), paper-handling (handwriting input, Newton Message-Pad), human contact/communication (telecommunications, Personal Digital Assistants, networks, groupware) and, of course, technology (all current developments). This indicates that the subjects in the current study and the computer industry share similar global perceptions of the 'Ideal Office'. However, there may be differences in perceptions of the desirable extent and pace of future developments. This issue is discussed further below (see 'Discussion').

The relationship between the factors identified for the office as a whole (Chapter 5) and specific aspects of the office (the current study) is shown in Table 3. Some factors appeared in more than one section of the Free Response Questionnaire. For example, technology appeared in all the analyses. This may be an artefact of the experimental design since the role of office technology was stressed in the wording of the questionnaire. However, it may be that subjects perceive good, bad, and neutral aspects to a particular dimension. Technology may be perceived favourably when it assists the user to complete work and unfavourably when it breaks down, and so on.

**TABLE 3 - RELATIONSHIP BETWEEN FACTORS IDENTIFIED FOR THE OFFICE AS A WHOLE AND SPECIFIC ASPECTS OF THE OFFICE**

| | OFFICE | ADVANTAGES | DISADVANTAGES | IDEAL OFFICE |
|---|---|---|---|---|
| **FACTOR 1** | - | ✓ | ✓ | - |
| **FACTOR 2** | ✓ | - | - | - |
| **FACTOR 3** | ✓ | - | - | ✓ |
| **FACTOR 4** | - | ✓ | - | ✓ |
| **FACTOR 5** | ✓ | - | - | ✓ |
| **FACTOR 6** | ✓ | ✓ | ✓ | ✓ |
| **FACTOR 7** | - | - | ✓ | - |
| **FACTOR 8** | - | - | ✓ | - |

NOTES
F1 = INFORMATION-HANDLING, F2 = HUMAN CONTACT, F3 = PAPER-HANDLING
F4 = FINANCIAL SECURITY, F5 = COMMUNICATION, F6 = TECHNOLOGY, F7 = WORK
F8 = HEALTH PRESERVATION

**Importance ranks assigned to the 'Ideal Office' responses** - Some variation in the importance ranks given by the subjects to their 'Ideal Office' responses was found. However, a detailed comparison of importance ranks was not made as the subjects listed varying numbers of items and this could have distorted the analysis. The ranks given were regarded merely as indicators of perceived importance rather than precise measurements.

**Implementation estimates for the 'Ideal Office' factors**

The modal implementation estimates obtained for the 'Ideal Office' factors can be found in Table 4. The most usual modal implementation estimate was 5 ('likely to be implemented one year from now'). The subjects seemed to perceive that their 'Ideal Office' would be implemented in the near future rather than in the distant future. The implications of the implementation estimates are discussed in greater detail in below (see 'Discussion').

**TABLE 4 - IMPLEMENTATION ESTIMATES FOR EACH IDEAL OFFICE FACTOR (ALL SUBJECTS)**

| FACTOR | MODE | RANGE |
|---|---|---|
| TECHNOLOGY [N=47] | 5 | 2-5 |
| COMMUNICATION [N=39] | 5 | 1-5 |
| FINANCIAL SECURITY [N=14] | 5 | 2-5 |
| PAPER-HANDLING [N=32] | 5 | 1-5 |

NOTES
N = number of subjects
1 = never likely to be implemented
2 = likely to be implemented 25 years from now
3 = likely to be implemented 10 years from now
4 = likely to be implemented 5 years from now
5 = likely to be implemented 1 year from now

## DISCUSSION

The results obtained in the current study suggest that the subjects share similar perceptions of the role of technology in the 'Ideal Office'. Four dimensions were identified: technology, communication, financial security, and paper-handling.

When asked for implementation estimates, most subjects predicted that the 'Ideal Office' was 'likely to be implemented one year from now' with the next most frequent estimate being '5 years from now'. This indicates that subjects perceive that the 'Ideal

Office' will exist in the near future rather than being a long term aspiration. The subjects may lack visionary powers to predict what will happen in the more distant future. An alternative view is that they do not want a 'revolutionary' new office but simply an improved version of the present. People may find it easier to predict and cope with gradual change rather than dramatic change. One reason for this may be that it is easier for people to accept, learn, and assimilate something which is basically familiar than something which is unfamiliar. This issue is discussed further below (see 'The pace of technological change').

Comparison of current developments in office technology with user perceptions of the 'Ideal Office' indicates that the closest match is in the areas paper-handling and communication. Computer industry perceptions of the 'Ideal Office' are considered further below. There is also an overview of some general issues related to current technological developments since 'office technology' is no longer restricted to the office - it may be found in the home and elsewhere and may be used in contexts other than office work.

**The pace of technological change**

In 1952 Russell suggested that "changes occur with a rapidity which is psychologically difficult" and that "science, while it has enormously accelerated outward change, has not yet found any way of hastening psychological change" (Russell, 1952). Since the pace of change in computer technology seems to have accelerated rapidly since 1952, Russell's view seems even more appropriate today. Toffler sees technology as a "major force behind the accelerative thrust" of change. In *Future Shock* Toffler stated that "the acceleration of change in our time [...] has "personal and psychological as well as sociological consequences" (Toffler, 1970). In an interview in 1994 Toffler stated that 'future shock' was analagous to 'culture shock' - "with future shock you stay in one place but your culture changes so rapidly that it has the same disorienting effect as going to another culture" (*New Scientist*, 1994a).

People may be overwhelmed by change and society may be "doomed to a massive adaptational breakdown" unless we learn to control the rate of change. Individuals and society as a whole may both be subject to 'future shock'. One way to avoid mass 'future shock' is "the conscious regulation of technological advance" although Toffler acknowledges that the politics of technology control may result in conflict to ensure that the views of the pro- and anti-technology extremists do not prevail.

Toffler (1981) predicted a Third Wave "revolution in the office" and suggested that "even a partial shift towards the electronic office will be enough to trigger an eruption of social, psychological and economic consequences". Since 1981 there have already been widespread developments in technology, for example in telecommunications. Whereas the computer industry seems to be planning radical changes in technology the subjects who participated in the current study seem to perceive a future where technology changes gradually. Coffey (1993a) proposes three barriers to the implementation of technological developments in the near future - cost, ease of use by 'non-computer scientists' and social aspects since 'humans are social animals'. Other factors which may affect implementation and acceptance of 'radical' changes may be development at too rapid a pace and information overload (Toffler, 1970).

The subjects who participated in the current study seem to see the 'Ideal Office' as similar to the existing office with a few improvements and enhancements. This could imply that people wish to retain autonomy over the more interesting aspects of office work. It could also indicate that users are already getting basically what they would like in terms of office technology and are looking for enhancements of existing systems rather than major innovations. However, current developments in computer systems in areas such as Agent Based Computing and virtual reality indicate a possible mismatch between user and computer industry perceptions of the 'Ideal Office'. The success of Microsoft Windows "now the fastest-selling retail program in the history of retail software" is attributed, in part, to its provision of "evolution rather than revolution" (Schofield, 1992).

**Computer industry perceptions of the 'Ideal Office': *The Electronic Frontier***

"The past was alterable. The past never had been altered" (*Nineteen Eighty Four* - Orwell, 1949).

*The Electronic Frontier* (1993) was a television programme concerned with current developments in computer technology. Included in the programme were views from Microsoft "the world's largest software company" such as the following comments from Bill Gates the chairman of Microsoft: "I think information is very fundamental" and "certainly computers will be in any meaningful sense as smart as people at some point".

"There's a person in my head I'm trying to please when I write this software, who is usually a teenage boy - just because I guess I was a teenage boy when I first discovered computers, and I know how much they can love them" (*The Electronic Frontier*,

1993). This comment made by a software developer may illustrate why differences in perceptions between users of office software and software developers occur - while teenage boys may be avid users of computer games, and perhaps use their computers for study and hobbies, they are not 'professional' office workers.

The potential power of increased infiltration of computer technology should not be underestimated. A columnist for *Infoworld* claimed that Microsoft's "ambition is to put a personal computer in every home and every business" and that "Microsoft is an attempt to control the world. Microsoft will probably succeed" (*The Electronic Frontier*, 1993). The much-publicised launch of Windows 95 in August 1995 suggests that Microsoft continues to have a great influence on computing.

An important issue is the ability of 'reality' to be altered by 'digitising imagery'. For example, "The next scene is one of President Clinton's inauguration. What we tried to do here is to make him look nervous, and we've manipulated George Bush a bit to make him look less happy [...] You could really wipe out history, or change it however you want" (Greenberg, *The Electronic Frontier*, 1993).

The reviews by television critics of the developments described in *The Electronic Frontier* were not exactly rapturous:
"This film ... offered a glimpse into the future that, despite its many enticements I found hugely depressing" (Norman, 1993).

"My computer being as unambitious as its master, I think it will be content to remain a glorified typewriter. Indeed I shall insist on it" (Paterson, 1993).

" 'Hi! My name is Wanda, and I will be your guide' read the speech bubble of a prissy cartoon saleswoman for an electronic travel service. [...] Clear off the whole easy lot of you: Wanda; the on-screen dancing candles; Oliver the metaphoric information retriever; the ACME News Agency in the graphic drawn main street" (Horwell, 1993).

"Fascinating as it was, one could not help but be alarmed by some of the brilliant but morally infantile engineering. Have we created another branch of science whose discoveries go way beyond our ability to use them properly?" (Thomas, 1993).

If the views of television critics reflect the perceptions of the general public, there appears to be a mismatch between the view of the future held by the computer industry and that held by the potential users of that technology.

**Perceptions of 'scientist'/'technologists'**

A clue to the apparent reluctance of users to share the computer industry view of the future may be linked to the frequent descriptions of scientists and technologists as "computer anoraks, people with no social life and nothing better to do" (McClellan, 1994), "mad boffins" (Irwin, 1994) "supernerd" (Schofield, 1994a), nerds, and geeks (see quotes listed below). People may generalise these unflattering attributions to the technology itself making them suspicious of 'radical' changes in technology.

"Nerds wear thick glasses, peer at monitor screens, pore over technical manuals, have lank hair falling in their eyes, colour-code pens in their shirt pockets and relax by backing their victims into corners to talk about the latest developments in microchips" (Miles, 1994).

"I remember these saddies from university, young men whose social life was playing Space Invaders, all hunched up in the student bar with a half of bitter shandy for company" (Norman, 1993).

"A soft squeaking geek - indistinguishable from the toy bunny with which he shared his space" (Horwell, 1993).

"This is not just a bunch of computer nerds" (Rheingold, *The Electronic .Frontier*, 1993).

The world's leading software executive has been described as looking and sounding like "an ageing Dennis the Menace" (Moody, 1992) and "though he's trying his best to come on vaguely human [...] he still looks, as everyone says, like the archetypical nerd" (McClellan, 1993).

Even people within the computer industry sometimes refer to each other in derogatory terms - "when you see someone leaning almost nose to the screen you call them a pixel-necked geek" (Microsoft employee, *The Electronic Frontier*, 1993).

"Computers are cold, impersonal, technological devices and women find it hard to get enthused about them" (Wilson, 1994). However, in the studies reported in the current thesis, no significant differences between male and female subjects in attitudes towards computers were found. Interestingly, all but two of the above derogatory comments about 'scientists' were made by male writers.

"It is the nerds, often working alone, who specialize in bringing applied computer technology to the consumer market. The nerds in other words are the ones shaping the computers available to the average person, and they are shaping them in their own

image - the image of people for whom the personal side of life has often been harsh, and to whom computers are a way out. Yet non-nerds, regular folks who consider themselves well-adjusted comprise the bulk of the computer-buying market" (Easterbrook, 1988).

A cynical view of developments in office technology and equipment (Thimbleby, 1990) is that they occur partly for the financial benefit of the companies supplying such technology and equipment regardless of whether such developments are beneficial to the customers and to society in general. It certainly seems to be a lucrative area - Lohr (1992) mentions the $7.6 billion-a-year office furniture industry; *PC Week* (1993) notes that the market for office PCs is estimated to be $15 billion in the US alone and that sales of fax machines, printers, photocopiers and phones exceeds $20 billion; Harrison (1993) mentions that the company manufacturing the first consumer virtual reality system was valued at £72 million when floated on the stock market and earned a personal fortune of £7.2 million for the head of the company. The Swedish company Ericsson predicts that the global market for cordless PABX extensions will be worth $5 billion by 1998 (Taylor, 1993a).

However, user demands may be responsible for increased demand for technological developments and availability of products rather than 'aggressive' marketing. An ESPRIT report attributes the need for, and development of, faster, more advanced networks to increasing user pressure on 'conventional networks' as well as advances in high-speed transmission media such as optical fibre (ESPRIT Synopses, 1989). "Technology that survives is as much dependent on the behavior of users as on the inventions of the engineers" (Meadow, 1985 - cited by Doswell, 1990).

Despite the predictions of increasing use of office technology, Sharpe (1993) forecasts that "users face a future of increasing prices and slower technological change" due to prohibitively expensive manufacturing plants for memory chips and processor chips. This contradicts an earlier forecast that by 1998 "transistors will cost one five-millionths of a cent each - rendering computing power essentially free" (Winchester, 1992).

**The impact of current technological developments on society**

Since 'office' technology is increasingly used at home as well as in the office and current technological developments seem to be moving way beyond 'glorified typewriters' and 'adding machines', it is important to consider the impact of technology on society in general.

Throughout history (even prior to the oft-cited Luddites) new developments have probably been greeted with reactions ranging from the **sceptical** - "You don't really want to do it like that", "It'll never work" to the **indifferent** - "So what" - to the **enthusiastic** "Best thing since sliced bread", "Wow!". Crichton, the author of books including *The Andromeda Strain*, suggests that "I do believe that plenty of people oversell the benefits of anything new. Distopian sci fi has a long, honourable tradition and stands as a critical, fearful view of new technology. In a contemporary industrial society like ours, this is a useful counterpoint to the mindless enthusiasm which is trumpeted by PR companies around the world to pump up the stock" (cited in Orr, 1993).

Cooley (1987 - cited by Booth, 1989) stated that "decisions we make in respect of technological developments in the next five or ten years will have a profound effect on the way our society develops; the manner in which human beings relate to machines and to each other; and the relationship between human beings, their built environment and nature itself". Examples of such developments perhaps include artificial intelligence, global communications networks and virtual reality.

"Communications have been hitherto the chief factor limiting the size of empires. In antiquity the Persians and Romans depended on roads, but since nothing travelled faster than a horse, empires became unmanageable when the distance from the capital to the frontier was very great. This difficulty was diminished by railways and the telegraph [...] There would now be no technical difficulty about a single worldwide empire" (Russell, 1952). Russell made these comments more than 40 years ago but current developments in technology, particularly in telecommunications, for example, the Internet, suggest that his prediction has even more potential to come true now than it did in 1952.

Will current technological developments result in the nightmare scenario of the future depicted by Orwell (1949) where there is a [technological] "boot stamping on a human face - for ever" or will they be used to ensure that "the world is now a better place for a common man than ever it was before, the spectacle wider and richer and deeper, and more charged with hope and promise" (Wells, 1908)? The answer is likely to be somewhere in between. The uses to which the technology is put will affect its impact rather than the technology itself: "technology is absolutely neutral and the same microprocessors would be used for good or evil. The determination of that comes through the individual, what the collective group of individuals align themselves with" (interview with one of the founders of a high-technology communications company in

the United States, cited in Reinecke, 1988) - unless of course one believes in Doctor Who and the daleks or vindictive computer 'Agents'!

Shneiderman (1992) notes that increased use of computers "might lead to a variety of oppressions - personal, organizational, political, or social" and suggests that to avoid this computer professionals should consider the influence of computer technology and "guide it to produce the maximum benefits with minimum harm". This sentiment is echoed by Weiser (1993) who states that "only society can cause the right system to be used" and advocates "technological enablement combined with an informed populace that cannot be tricked in the name of technology".

This chapter compared user perceptions of how they would like office technology to develop ('the office as it could be') with perceptions of 'the office as it is at present' and current developments in technology ('the office as it is likely to be'). In Chapter 8 the author's investigation of 'the office as it is likely to be' is extended by considering the effectiveness of employing user perceptions to evaluate current developments in office technology.

# CHAPTER 8 - AN EVALUATION OF CURRENT DEVELOPMENTS IN COMPUTER-BASED OFFICE SYSTEMS (STUDY 4)


## SUMMARY

In previous chapters emphasis was placed on investigating user perceptions of office work and the role of technology in the office in general. The aim of the current study was to determine the effectiveness of employing user perceptions to evaluate specific computer systems. The study involved a comparison of two computer systems (System A and System B) designed by leading companies. The comparison was made by showing subjects a video made by each company to demonstrate that company's view of computer systems they were developing. It was found that subjects felt that it was more important to be able to use a computer system for some situations than for other situations and that there was a slight preference for all subject groups for System A. That is subjects thought that System A could be used successfully in more situations than System B. Thus a different sample and use of a different methodology yielded results which were broadly similar to those found in *'The effect of situation characteristics on user perceptions of their use of technology'* (Study 2 - Chapter 6).


## INTRODUCTION

The need to evaluate technology and various methods of assessment are discussed below with emphasis on the methods considered most relevant to the author's approach. The references in this chapter provide an overview of essential issues which need to be considered when evaluating technology and have a modal dependability rating of 5. A discussion of types of evaluation is provided below .

## EVALUATION OF TECHNOLOGY

"As a result of the importance of the usability approach in system development and the EC's Directive concerning the minimum safety and health requirements for VDT workers ... there is an accepted need for the practical evaluation of user interfaces" (Reiterer and Oppermann, 1993). Issues such as usability, learnability, efficiency, and acceptability may be considered when evaluating technology (Johnson, 1992). Other aspects which could be considered are "high user satisfaction" (Shneiderman, 1992) and perceived fun (Igbaria et al., 1994). However, in a questionnaire survey of seventy-seven North American companies to determine the effects of perceived usefulness and perceived fun on the acceptance of microcomputer technology, Igbaria et al. found that perceived usefulness was "more influential than perceived fun in determining whether to accept or reject microcomputer technology". In the current study emphasis is placed on perceived usability and efficiency in particular situations.

The efficiency and ease-of-use of technology needs to be assessed to avoid problems occurring when the technology is used. Evaluation can occur at various stages of the design process (Hammond et al., 1985; Johnson, 1992). "Much good design evolves" (Norman, 1988). "Design should be regarded as dynamic rather than static" (Shneiderman, 1992), "a continuing process of evolution" (Mumford, 1983) and "an ongoing process" (Czaja, 1987). However, market forces may discourage evolutionary design: "if different companies manufacture the same type of item each must do it differently to allow its product to be distinguished from others" (Norman, 1988). This may result in detrimental changes being made to a well-designed product.

A distinction may be made between formative and summative evaluation (Williges et al., 1987; Booth, 1989). Formative evaluation involves obtaining user feedback to aid the designer in making decisions for design revisions during an iterative design process. Summative evaluation is used to test the final design.

There are various methods available for evaluating interfaces (Reiterer and Oppermann, 1993) including informal methods such as reliance on the designer's intuition and experience and more structured methods such as "system walkthroughs", assessment by "human factors researchers", analysis of human performance (Hammond et al., 1985), time taken to perform a task, errors (Booth, 1989), paired comparisons (Mitchell, 1992), interviews, verbal data including "thinking aloud" while using technology (Moll, 1987), checklists and guidelines. The use of guidelines, checklists and metrics is reviewed by Smith (1990c) and Shneiderman (1992).

Johnson (1992) states that evaluation methods may vary in sophistication and applicability. The least sophisticated approaches require little preparation and are the least time-consuming but may have little diagnostic value. More sophisticated methods may be time-consuming and tend to require specialised knowledge but they are likely to provide the most information on design problems. Hammond et al. (1985) conclude that while evaluation methods should be "speedy, valid, and reliable", compromises and tradeoffs are usually necessary whichever method is used. Holleran (1991) discusses the potential limitations of usability tests including the choice of subjects, experimenter bias, validity, and reliability. Holleran argues that validity and generalizability may be enhanced by using several evaluation methods and states that "usability testers should not rely *exclusively* on data from verbal reports but carefully judge their consistency with more objective data". Objective data could include time to complete tasks, errors made, and sequences of actions such as commands and mouse clicks. Reiterer and

Oppermann (1993) note that each evaluation method has advantages and disadvantages and that no one method is sufficient if used in isolation.

Evaluation may be made by individuals or groups and occur in the laboratory or field (Williges et al., 1987). Laboratory evaluation permits more control over extraneous variables but field evaluation allows testing in realistic situations. Lingaard (1992) discusses the choice of subjects when evaluating technology and states that in usability laboratories designers are often included in the evaluation. Lingaard suggests that even though the data obtained may be similar to that obtained from undergraduate students or actual users, the data obtained from designers may be more acceptable to their colleagues. It is possible that undergraduate students are 'actual users' of the technology being considered. For example, the majority of students who participated in the research described in this thesis had experience of using computers on a regular basis and could therefore be regarded as actual users.

In 1994 a whole issue of the journal *Behaviour & Information Technology* was devoted to **usability laboratories** (Nielsen, 1994). This issue contained 22 papers from around the world from companies producing products such as consumer electronics, telecommunications software, PC software, and PC operating systems indicating that usability laboratories are widely used. Usability laboratories are laboratories found within a company and dedicated to 'in-house' usability testing. Many of the laboratories described in *Behaviour & Information Technology* had video cameras and a one-way mirror enabling video records to be made of an evaluation session (Nielsen, 1994). Various numbers of rooms may be available such as a room for the test subject(s), a control room for the experimenter(s)/usability specialists, and a room where additional staff can observer the test without interfering with either the subject or experimenter. Such staff may include executives or, more usually, members of the development team. Shneiderman (1992) commented that usability laboratories may be an effective form of evaluation as "real users perform real tasks under the eye of experienced observers". However, the presence of observers may influence the situation by providing an added distraction for the users even if the observers are hidden behind a one-way mirror.

Hammond et al. (1985) used system walkthroughs by three pairs of human factors researchers and analysis of the performance of five novice users to evaluate a commercially available document processor. Hammond et al. concluded that different classes of information are provided by the two forms of evaluation - user testing provides low-level information on procedural and conceptual difficulties but little or no

overview is provided so that interpretation is needed to identify the sources of problems and to determine the effectiveness of changes. Expert walkthroughs provide a more integrated view and hypotheses concerning the sources of difficulties but expert opinions may be prone to various types of omission and bias.

A comprehensive review of evaluation methods may be found in *Evaluation of human work: A practical ergonomics methodology* (Wilson and Corlett, 1990). Booth (1989) summarized various evaluation options: "The measures we can use to evaluate a system include: time, errors, verbal protocols, visual protocols, patterns of system use, user attitude measures, and cognitive complexity measures. Methods of evaluation include: concepts tests, using naive, friendly, or hostile users, simulating users, structured walkthroughs, expert reviews, simulation trials, iterative informal laboratory experiments, formal laboratory experiments, audits, field trials, follow-up studies, and field studies." The choice of options will depend on the purpose of the evaluation, resources available (e.g. facilities, money, number of researchers), access to users/subjects and so on.

One feature common to many of the evaluation methods described above is that they require the presence of a physical product. As the prototypes to be evaluated in the current study were available to the author only as video representations, methods such as user trials and observation of actual use which require access to an actual product were considered unsuitable. Evaluation techniques relevant to the current study such as using video for evaluation, evaluation questionnaires, and weighted evaluation are discussed below. Attitude measures were considered to be a suitable method of evaluation in the current study since the author was interested in considering user perceptions.

## USING VIDEO FOR EVALUATION

The value of video for evaluation has been recognised by authors including Mumford (1983) and Cooper (1994). Mumford suggested that video can be "valuable as a means for communicating information about technical and organizational options" to designers and other groups including managers and trade unions.

The problem of demonstrating a new product to potential customers is mentioned by Cooper (1994): "There's a new black box. The guys in R&D have been working on it for years. It's great. It looks good. And it automates a task which previously took a team of people a week. But it's too big to put in a suitcase. And it's too expensive to send out samples to your sales team."

Cooper proposes that video could provide a solution to this problem since video enables the potential customer to actually see the technology operating and "seeing is believing". Cooper suggests that "there is a wide perception that something filmed with a video camera is a true reflection of reality". Another advantage is that "video is an excellent medium for expressing feelings. While the printed photograph can indicate quality and excellence of design, it cannot offer background music, moving video-graphics, or the relaxed voice of an authoritative speaker, expertly explaining your product."

While Cooper highlights the benefits to the seller of a product, his comment that "video is in control: it is the video not the viewer that determines everything that is seen and heard" could be regarded as a limitation when potential buyers and users are evaluating that product. While they may be able to use the rewind and fast forward buttons to choose which sections to watch, users have no control over the content of the video. The video is likely to highlight only the good aspects of the product. Some design problems may only emerge during actual use of the product. The items included in a questionnaire may encourage respondents to evaluate both good aspects of a product and concealed negative aspects. For example, the Evaluation Questionnaire designed by the author for use in the current study enabled respondents to give both high and low usability evaluations.

## EVALUATION QUESTIONNAIRES

There are various approaches to understanding how people choose between alternatives including the marketing view, the consumerist view, and the psychologist's view (Tuck, 1976). The marketing view involves market research. The consumerist view involves consumer pressure in the form of specialist consumer magazines such as *Which?* produced by the Consumers' Association, and irate letters to newspapers and television programmes. The psychologist's view considers various theories such as group theory, conformity theory, learning theory, and the study of attitudes. The trade-off analysis theory (Tuck, 1976) suggests that people make choices by 'trading-off' one valued attribute of a product or choice analysis against another.

One way of assessing the perceived acceptability and usability of technology is to measure attitudes. Attitudes can increase understanding of a variety of areas such as stereotyping, prejudice, voting intentions, consumer behaviour and interpersonal attraction (Pennington, 1986). The use of questionnaires to assess users' attitudes may be useful for assessing the acceptability of a new design but not for identifying reasons why there are problems in usability (Johnson, 1992). Computer companies launching

new products are likely to be very interested in the acceptability and potential sales of a new product and may wish to evaluate the attitudes of potential customers by using questionnaires.

Questionnaires can be used to measure attitudes. "Written user surveys are an inexpensive and generally acceptable approach with both management and users" (Shneiderman, 1992). However, while questionnaires may be inexpensive to issue and easy to implement, and highlight unstructured problems, Reiterer and Oppermann (1993) suggest that questionnaires may ask leading questions, produce large amounts of data, and be held in low regard by those questioned. If precise rather than general questions are used this will increase the chance of obtaining useful results (Shneiderman, 1992). In addition, questionnaires can include open questions such as 'Do you have any comments on this section?' to enable respondents to prove extra information. Different types of rating scales can be used to measure attitudes. However, Tuck (1976) noted that "there is abundant evidence for the equivalence of different measures of attitude towards the same object".

Kirakowski and Dillon (1987) reviewed "as many papers as we could find" to produce a Computer-User Satisfaction Inventory consisting of statements related to 'affect' (the user's feelings towards aspects of the system) and 'competence' (the perceptions of the user concerning their ability to use the system) with which subjects were required to agree or disagree on a five point scale with reference to the computer system they used most often. Kirakowski and Dillon conclude that attitude questionnaires can be used to assess user satisfaction with different computer systems but may not discriminate between similar commercially available systems unless there are clear differences between the systems since each system is likely to have strengths and weaknesses.

Reiterer and Oppermann (1993) discuss the use of written questionnaires as an evaluation method citing the Questionnaire for User Interface Satisfaction (Norman and Shneiderman, 1989); the Evaluation Checklist (Ravden and Johnson, 1989) and the Software Usability Measurement Inventory (MUSiC, 1992).

Shneiderman (1992) reports that the Questionnaire for User Interface Satisfaction (QUIS) developed by Shneiderman and Norman has been found to be useful for demonstrating the benefits of improvements to a videodisk-retrieval program, comparing two Pascal programming environments, assessing word processors, and setting requirements for redesign of an online public-access library catalogue. One

attribute of the QUIS is flexibility. It may be used in short or long form, in parts, or with domain-specific items added by the researchers issuing the questionnaires.

The Software Usability Measurement Inventory (SUMI) is intended to measure user satisfaction "and hence assesses user perceived software quality" (Bevan and Macleod, 1994). SUMI, developed as part of the ESPRIT MUSiC project, "is an internationally standardized 50-item questionnaire" which contains questions such as "using this software is frustrating" and "learning how to use new functions is difficult". Bevan and Macleod state that "SUMI results have been shown to be reliable, and to discriminate between different kinds of software products in a valid manner". SUMI is relevant for obtaining information on "the users' perception of the usability of a software product already in use" and the users' perception of the usability of a prototype product.

## WEIGHTED EVALUATION

The expectancy-value model of attitude formation suggests that a person's attitude towards an object is related to the strength of that person's beliefs linking the object to various attributes multiplied by the person's evaluations of the attributes of the object. Attitudes are predictable from the sum of the resulting products ($A = \Sigma b_i e_i$) (Fishbein and Ajzen, 1975). According to Fishbein, behavioural intentions depend on a person's attitude to the behaviour in question and the person's subjective norms about the behaviour in question (Tuck, 1976; Pennington, 1986). 'Attitude' refers to whether the behaviour is considered good or bad by the person and 'norm' to whether other people think that the behaviour is good or bad. The combined ratings provide a better indication of the overall evaluation than the individual ratings (Tuck, 1976). Tuck notes Sheth's argument that Fishbein does not consider the importance of a particular attitude but concludes that "the utility and validity" of Fishbein's expectancy-value theory has been shown in a variety of studies including political behaviour, choice of mode of transport, and choice of job.

Davis (1993) describes a technology acceptance model based on Fishbein and Ajzen's theory. Davis suggests that attitude towards using a system is based on perceived usefulness and perceived ease of use. In a questionnaire-based study of 112 end-users of an electronic mail system and a text editor, Davis found that perceived usefulness was 50 per cent more influential than ease of use in determining usage. Davis notes that "no amount of ease of use can compensate for a system that doesn't do a useful task".

A guide for evaluating 'basic' image filing systems - that is systems which can scan paper documents - produced by the National Computing Centre (NCC) described a six-

step evaluation procedure: establish requirements, draw up a checklist, establish what products are available, select a shortlist of suppliers, assess the products, and evaluate the products. The checklist should specify which criteria are considered essential, which are desirable and which are irrelevant or unnecessary (Pritchard, 1985).

When assessing the products, the NCC advocates the use of a score sheet so that items can be given a score from 0 to 10 depending on how well the product satisfies a given criterion. In the Evaluation phase a weighted ranking method of evaluation may be used. This involves assigning a weighting factor to each criterion to reflect its relative importance. The NCC suggests allocating each criterion to a hierarchical level and then assigning weights to each criterion.

Mitchell (1992) suggests that paired comparisons are useful for weighting criteria and evaluating hardware and software concepts as this is a "simple, uncomplicated, and portable method for choosing from among alternatives". However, "the disadvantages are the constraints on the number of criteria and design alternatives which can be employed".

Coffee (1992) describes a "PC Week Labs' Shoot-Out of courseware authoring tools" in which 11 judges were required to evaluate 51 items for six competing products. The judges were also required to give priorities to each item. This method led to one of the products being "declared the winner based on every possible measure". The measures used included calculation of an overall score based on a weighted composite of individual items using weightings derived from category-weighting factors and individual item weights assigned by the judges.

In the current study a weighted evaluation method (the **Evaluation Questionnaire**) was used to evaluate subjects' perceptions of videos describing two systems (System A and System B).

## RATIONALE FOR THE CURRENT STUDY

The need to develop evaluation criteria and usability metrics when designing an interface is mentioned by Williges et al. (1987). The use of attitude questionnaires to measure user satisfaction and dissatisfaction and to provide a benchmark for evaluating and comparing the effects of different commercial computer systems on users was advocated by Kirakowski and Dillon (1987) and Williges et al. (1987). Williges et al. also suggest that rating scales should be used in conjunction with actual performance

measures during evaluation and state that "magnitude evaluation" may be useful for subjective evaluation.

There is a need to investigate perceived usefulness, perceived ease of use, attitude toward using, and actual usage behaviour since "user acceptance is often the pivotal factor determining the success or failure of an information system project" (Davis, 1993). Since key decisions about the design of a system are often made at an early stage it is important to have early acceptance testing before too many development costs have been incurred (Davis,1993). Since the current study considered the perceived usefulness of products at the prototype stage and the author was particularly interested in user perceptions, investigation of actual use was not considered to be essential.

In the current study subjects used a questionnaire (the **Evaluation Questionnaire**) derived by the author from the results of the studies described in Chapters 5 to 7 to evaluate videos produced by two leading companies to describe the systems they were developing. Subjects were asked to evaluate the suitability of the systems for use in specific situations using rating scales.

The systems evaluated are referred to below as System A and System B. A description of the theoretical basis for the two systems can be found in Furner et al. (1990) and Gale (1989). The project on which one of the systems is based was concerned with "building a multipoint teleconferencing demonstrator as part of the work necessary to produce international technical standards for this technology" (Furner et al., 1990). This system consists of a multiservice audio-visual terminal (AVT) for access to videotelephony and a range of meeting aids. The AVT is based around a personal computer offering a graphical windowing interface which is "typical of those used in modern offices".

The video for the other system includes reference to a project concerned with determining the value added to a system by incorporating audio and video (Gale 1989). The performance, feelings, and perceptions of workgroups using an experimental video communication system for cooperative tasks were measured and it was found that there were no significant differences in the quality of output, or the time taken to complete the tasks, under three conditions: data sharing, data sharing plus audio, data sharing plus audio and video. It was concluded that high bandwidth communication is particularly effective for social, informal communication.

The author wished to consider further the information obtained in *'The effect of situation characteristics on user perceptions of their use of technology'* (Study 2 - Chapter 6) and also to evaluate the perceptions of subjects known to have both theoretical and practical knowledge of computer systems concerning the suitability for use in specific situations of two prototype systems designed by leading companies which were available to the author in video format. After consideration of alternative methods of evaluation it was decided that the use of an Evaluation Questionnaire would provide an appropriate method.

**Aims of the current study**

1. To assess user perceptions of the usability of specific systems in specific situations.

2. To see whether the method developed would discriminate between different computer systems. That is, would the method produce different usability evaluations for different systems?

## METHOD

### SUBJECTS

**TABLE 1 - DETAILS OF SUBJECTS**

| | UNDERGRADUATES | | IT PROFESSIONALS | |
|---|---|---|---|---|
| | **Group 1 [N=14]** | **Group 2 [N=28]** | **Group1 [N=6]** | **Group 2 [N=11]** |
| **Age** | | | | |
| 18-34 | 14 | 25 | 6 | 8 |
| 35-49 | 0 | 3 | 0 | 3 |
| **Sex** | | | | |
| Male | 4 | 15 | 6 | 8 |
| Female | 10 | 12 | 0 | 3 |
| no reply | 0 | 1 | 0 | 0 |
| **Experience** | | | | |
| System A - limited | 4 | 7 | 0 | 2 |
| - none | 8 | 13 | 6 | 9 |
| - no reply | 2 | 8 | 0 | 0 |
| System B - limited | 5 | 7 | 0 | 6 |
| - none | 7 | 13 | 6 | 5 |
| - no reply | 2 | 8 | 0 | 0 |

There were four groups of subjects. Two groups consisted of undergraduate students on computer-related courses and two groups of IT professionals (see Table 1). All the undergraduates were expected to have some knowledge of computers as they were studying computer-related subjects. The IT professionals were completing a part-time master's course in user interface design in addition to working full-time in computer-

based occupations such as computer management, database administration, programming, and systems engineering. They could therefore be expected to have practical as well as theoretical knowledge of computer technology.

## VIDEOS

The videos used in the current study were made by the companies whose prototype products they described. Both videos were in VHS format. The video for System A lasted 8 minutes and for System B 11 minutes. Both videos had a male presenter. System B had additional commentary by a male researcher who worked with the company and was responsible for the project described in the video. Both videos described multimedia systems with audio and video channels. Both systems were based around a personal computer. In addition, System A had facilities for links to a telephone and facsimile. File management facilities were mentioned in the System A video but not the System B video. Both videos were felt to be comparable in terms of the quality of production, material included, length, and so on. Clear demonstrations of the facilities available were provided through close-ups of the PC screen and a verbal description. Table 2 shows the estimated amount of time spent on various topics for each video. A detailed description of the content of the videos for System A and System B can be found in Appendix A.

**TABLE 2 - ALLOCATION OF TIME TO SPECIFIC TOPICS**

| | SYSTEM A | | SYSTEM B | |
|---|---|---|---|---|
| DOCUMENT PREPARATION | 0 | (0%) | 0 | (0%) |
| INFORMATION MANAGEMENT | 60 | (12%) | 75 | (11%) |
| DECISION-MAKING | 0 | (0%) | 120 | (18%) |
| COMMUNICATION | 320 | (63%) | 285 | (43%) |
| QUOTES | 20 | (4%) | 60 | (9%) |
| OTHER | 110 | (22%) | 120 | (18%) |
| TOTAL | 510 | | 660 | |

**NOTES**

1. Time is expressed in seconds
2. % = percentage of video allocated to this topic
3. Times were estimated by the author from a detailed description of the videos obtained from watching the videos on several occasions and timing each item using a watch with a second hand and the rewind facility on the video recorder (see Appendix A).

Both videos showed a similar pattern of time allocation. For example, the largest amount of time was allocated to Communication and the least to Document Preparation. The apparent lack of emphasis on Document Preparation (both videos) and Decision-making (System A) during the video presentations implies that the

companies perceived these features to be of lesser importance when 'selling' their products than Information Management and Communication. This could indicate a mismatch between user and computer industry perceptions as the subjects in an earlier study in this thesis (see Chapter 5) perceived Document Preparation and Decision-making to be as important as Information Management and Communication. Quite a large proportion of time was allocated to the category Other. This category included 'incidental' items such as introductory and concluding music. The Quotes category included comments made by the video presenters.

**PROCEDURE**

Subjects were asked to evaluate each video using a questionnaire (the **Evaluation Questionnaire**) created by the author. The Evaluation Questionnaire consisted of two parts - **Part 1: Usefulness Criteria** and **Part 2: Perceived Usefulness Evaluation** (see Appendix A). (These titles were not printed on the questionnaires issued to subjects.) Each part contained a description of hypothetical situations similar to those used in *'The effect of situation characteristics on user perceptions of their use of technology'* (Chapter 6). Statements from the actual videos were also included to provide an indication of whether the company perceptions of, and claims made about, the systems were shared by the subjects evaluating the system.

Both parts of the Evaluation Questionnaire contained 35 statements or questions. Part 2: Perceived Usefulness Evaluation contained an additional question asking for an overall evaluation of the system: 'Overall, how well does this system meet the requirements of a computer-based office system?'. The aim of this question was to allow a comparison to be made between the overall evaluation of the system and the evaluation for specific situations. The overall order of the questions was randomised to minimise order effects.

Subjects were unlikely to have had extensive experience of the actual systems shown in the video as the videos were describing systems which were not yet commercially available. However, since the videos were shown on various courses by other lecturers, the Evaluation Questionnaire contained a question to determine whether the subjects had seen the videos prior to participating in the current study since prior exposure to the videos could have influenced the evaluations given to the systems. However, it was found that most of the subjects had not seen either of the videos on a previous occasion.

**Part 1: Usefulness Criteria** contained statements which could be made about a 'typical' computer-based office system. For example: 'The system can be used to provide the Head of Department, who is attending a conference in the U.S.A., with information from a long, complicated document for a meeting being held in the U.S.A. two weeks from today.' For each statement subjects were required to decide on the extent to which it was important for the statement to be true using a 5-point scale where 1 was 'unimportant' and 5 'very important'.

In **Part 2: Perceived Usefulness Evaluation** subjects were asked questions relating to how well the system they were evaluating could be used for each of the situations described in Part 1: Usefulness Criteria as above. Subjects were asked to provide an evaluation for each situation using a 5-point scale where 1 was 'not at all well' and 5 'extremely well'.

The videos were viewed by the author and several colleagues prior to showing them to the subjects. It was felt that the videos gave an adequate, concise description of the features of each system and of the companies' perspective on the important aspects of their system. Although there was thought to be sufficient information to enable the completion of all the questions in Part 2: Perceived Usefulness Evaluation, subjects were allowed to choose the option 'unable to decide' when they were unable to make a decision. The choice of the option 'unable to decide' could also indicate areas which were not emphasised in the videos.

There was a tendency for the majority of 'unable to decide' responses to be made by a small proportion of subjects in each group. That is, a few subjects replied 'unable to decide' to several questions rather than a majority of subjects being unable to decide for one or two specific situations. This indicates that the subjects who gave a large number of 'unable to decide' responses were feeling generally indecisive rather than indicating that the videos contained insufficient information. It also suggests that it was correct to assume that there was sufficient information to enable the completion of all the questions in the Evaluation Questionnaire.

The procedure used was as follows: Subjects completed Part 1: Usefulness Criteria. Subjects watched the video for System A (or System B). Subjects completed Part 2: Perceived Usefulness Evaluation for System A (or System B). Subjects watched the video for System B (or System A). Subjects completed Part 2: Perceived Usefulness Evaluation for System B (or System A). The average time taken to complete the whole evaluation process was 60 minutes. Each subject assessed both videos to allow the

author to make a comparison between each subject's evaluation of the two systems. The order of presentation and evaluation of the videos was randomised within groups to minimise order effects. The videos were shown using a VHS video recorder and a large television monitor. Two rooms and two video recorders were used for both undergraduate groups to enable the subjects to watch the videos simultaneously.

## RESULTS

The results were considered in terms of a comparison of the medial importance criteria set by the subjects (Part 1: Usefulness Criteria) and how well the criteria were considered to be met by each of the systems evaluated (Part 2: Perceived Usefulness Evaluation). A significance level of 0.05 for a two-tailed test was set as the critical value for significance prior to the analysis for all the tests described below.

### Usefulness criteria set by the subjects

The medial importance criterion (Part 1: Usefulness Criteria) set by each subject group for each of the situation categories is shown in Table 3. Similar importance ratings were given by each subject group to each of the situation categories. The most frequent importance rating was 4 indicating that the majority of subjects in all subject groups thought that it was important to be able to use a computer for most of the given situations. A Friedman Test (Greene and D'Oliveira, 1982) indicated that the importance ratings for Decision-making were significantly lower than the ratings for the other situation categories ($\chi_r^2$ = -21.53, **p <.002**). This suggests that the majority of subjects felt that it was not very important to be able to use a computer for the decision-making situations. This coincides with the finding in one of the author's earlier studies (*'The effect of situation characteristics on user perceptions of their use of technology'*, Chapter 6) that subjects would be unwilling to rely on a computer to make the final decision in certain situations.

**TABLE 3 - IMPORTANCE CRITERIA SET BY THE SUBJECTS**

| | SITUATION CATEGORY | | | | |
|---|---|---|---|---|---|
| | **DOC** | **INFO** | **DECI** | **COM** | **QUO** |
| **SUBJECT GROUPS** | | | | | |
| Undergraduates - Group 1 | 3 | 4 | 3 | 4 | 4.25 |
| - Group 2 | 3 | 3.5 | 2.5 | 4 | 4 |
| IT professionals - Group 1 | 3.5 | 3.75 | 1.5 | 3.5 | 4 |
| - Group 2 | 3 | 4 | 2 | 4 | 4 |

**NOTES**
DOC = Document Preparation, INFO = Information Management, DECI = Decision-making
COM = Communication, QUO = Quotes

**How well did the systems meet the usefulness criteria set by the subjects?**

The medial rating for each subject for each of the situation categories in Part 2: Perceived Usefulness Evaluation was converted to a percentage of the maximum rating that the system could have received for perceived usefulness. (For example, the maximum rating which could be obtained was 5. A medial rating of 3 would convert to a perceived evaluation of 60%). The same procedure was used for System A and System B (see Table 4).

**TABLE 4 - EXTENT TO WHICH SYSTEMS WERE JUDGED TO MEET THE USEFULNESS CRITERIA**

| | VIDEO | |
|---|---|---|
| **SITUATION CATEGORY** | **SYSTEM A** | **SYSTEM B** |
| **DOCUMENT PREPARATION** | | |
| Undergraduates - Group 1 | 90% | 80% |
| - Group 2 | 80% | 80% |
| IT professionals - Group 1 | 60% | 60% |
| - Group 2 | 60% | 60% |
| **INFORMATION MANAGEMENT** | | |
| Undergraduates - Group 1 | 75% | 80% |
| - Group 2 | 80% | 65% |
| IT professionals - Group 1 | 60% | 60% |
| - Group 2 | 60% | 50% |
| **DECISION-MAKING** | | |
| Undergraduates - Group 1 | 70% | 70% |
| - Group 2 | 80% | 80% |
| IT professionals - Group 1 | 80% | 80% |
| - Group 2 | 60% | 60% |
| **COMMUNICATION** | | |
| Undergraduates - Group 1 | 100% | 85% |
| - Group 2 | 90% | 90% |
| IT professionals | 100% | 100% |
| - Group 2 | 80% | 70% |
| **QUOTES** | | |
| Undergraduates - Group 1 | 80% | 100% |
| - Group 2 | 95% | 85% |
| IT professionals - Group 1 | 85% | 70% |
| - Group 2 | 80% | 80% |

All subject groups stated that overall both systems met the requirements of a computer-based office system 'very well'. The Spearman Rank Correlation Coefficients were: System A (undergraduates and IT professionals) 0.68 (NS); System B (undergraduates and IT professionals) 0.8 (NS); Undergraduates (System A vs. System B) 0.55 (NS); IT professionals (System A vs. System B) 0.94 ($p < .01$). There was high between subject groups agreement for all the comparisons apart from the comparison of System A with System B for the IT professionals. For this comparison

one group of IT professionals showed a tendency to give a higher usefulness evaluation to System A than to System B.

One possible explanation for the low evaluation given to System B by the IT professionals to situations in the **Information Management** category was that Information Management was not described in detail in the System B video whereas it was mentioned in the System A video. However, this does not explain why the undergraduates gave a higher evaluation to both systems for Information Management as they were basing their judgements on the same information.

High evaluation ratings were given by both the undergraduates and IT professionals to situations in the **Communication** category. Since communication was given the greatest emphasis in both the System A and System B videos (see Table 2) this indicates that the companies and subjects who participated in the current study shared similar perceptions concerning communication.

Situations in the **Quotes** category also received high evaluation ratings from both the undergraduates and IT professionals indicating that the subjects who participated in the current study either shared similar perceptions to those of the companies or that the companies had succeeded in convincing the subjects that the statements made in the videos about the systems were correct.

The tendency of the IT professionals to give a lower evaluation whatever the situation category may be due to their greater experience of computer systems gained through their employment or to their interest in user interface design. A 'critical' attitude to computer systems or a desire to improve interface design may have led the IT professionals to take the interface design course.

***Overall usefulness evaluation***

A comparison of the overall usefulness evaluation was made (Part 2: Perceived Usefulness Evaluation *'Overall, how well does this system meet the requirements of a computer-based office system?'*) The medial overall usefulness evaluation was 4 (80%) for both systems for the IT professionals and one undergraduate group. The other group of undergraduates gave a medial overall evaluation of 4.5 (90%) to System A and 4 (80%) to System B.

The extent of **within subject groups** agreement on the evaluation of System A and System B was tested using the Wilcoxon Matched-Pairs Signed Ranks Test (Siegel,

1956, Greene and D'Oliveira, 1982) (see Table 5). No significant differences were found for any of the subject groups which indicates that System A and System B were judged to be equally useful for situations in a specific category.

**TABLE 5 - EXTENT OF WITHIN SUBJECT GROUPS AGREEMENT (SYSTEM A vs SYSTEM B)**

| | UNDERGRADUATES | | IT PROFESSIONALS | |
|---|---|---|---|---|
| | Group 1 | Group 2 | Group 1 | Group 2 |
| DOCUMENT PREPARATION [N=7] | NS | ? | NS | NS |
| INFORMATION MANAGEMENT [N=10] | NS | ? | NS | NS |
| DECISION-MAKING [N=3] | NS | ? | NS | ? |
| COMMUNICATION [N=8] | NS | NS | NS | NS |
| QUOTES [N=7] | NS | ? | NS | NS |

**NOTES**
N = number of situations in category
? = number of matched pairs too small for the tables available

The extent of **between subject groups** agreement on the evaluation of System A and System B was tested using the Mann-Whitney U Test and Kruskal-Wallis One-way Analysis of Variance by Ranks as appropriate. The results are shown in Table 6. The only statistically significant between-subject groups difference was found for System B for situations in the **Document Preparation** category ($p < .02$). The undergraduates showed a tendency to evaluate both systems as meeting the Document Preparation usefulness criterion for more situations than the IT professionals.

**TABLE 6 - EXTENT OF BETWEEN SUBJECT GROUPS AGREEMENT**

| | ALL SUBJECTS | U1/U2 | IT1/IT2 |
|---|---|---|---|
| **DOCUMENT PREPARATION [N=7]** | | | |
| System A | NS | NS | NS |
| System B | $p < .02$ | NS | NS |
| | (H=11.89, df=3) | NS | NS |
| **INFORMATION MANAGEMENT [N=10]** | | | |
| System A | NS | NS | NS |
| System B | NS | NS | NS |
| **DECISION-MAKING [N=3]** | | | |
| System A | NS | NS | NS |
| System B | NS | NS | NS |
| **COMMUNICATION [N=8]** | | | |
| System A | NS | NS | NS |
| System B | NS | NS | NS |
| **QUOTES [N=7]** | | | |
| System A | NS | NS | NS |
| System B | NS | NS | NS |

**NOTES**
U1 = undergraduates, Group 1, U2 = undergraduates, Group 2
IT1 = IT professionals, Group 1, IT2 = IT professionals, Group 2
N = number of situations in category

A high level of agreement was found within and between subject groups for both the usefulness criteria (How important is it to be able to use a computer for situations in a specific category?) and in the evaluation of the two systems. Since the systems had similar features - for example, both were multimedia systems - it is not surprising that similar evaluation ratings were found when the overall features of the systems were considered.

## DISCUSSION

Although there were some differences between the undergraduates and IT professionals in the usefulness requirements and perceived usefulness evaluations given to some situations, there was agreement between all the groups that overall System A and System B met the suitability for use criterion very well. All the subject groups agreed that it was not important for a computer system to be suitable for use in all the situations included in the **Evaluation Questionnaire**. The high level of agreement on the suitability for use of both systems could indicate that the Evaluation Questionnaire was unable to discriminate between systems. However, the author feels that since the systems were designed by leading companies and had similar features, the similar evaluations obtained indicate that the systems were perceived by the subjects to be of a similarly high standard.

The suitability for use criterion was considered very important for situations in the Information Management and Communication categories, important for situations in the Document Preparation category, and not very important for situations in the Decision-making category. The subjects felt that neither System A nor System B met the Information Management usefulness criteria very well.

The statements in the Quotes category were given both a high importance rating and a high evaluation rating by all the subject groups. This, together with the high overall evaluation rating given to both System A and System B, implies that the subjects and the companies shared similar perceptions regarding the essential requirements for a computer-based office system (such as "The system can be used with 'no special training' " and "The system allows people to compensate for the lack of face-to-face communication"). However, the low importance and evaluation ratings given to some situations and situation categories implies that in some areas a mismatch existed between the subjects' and the companies' perceptions of what makes a useful system. This mismatch could cause problems in encouraging users to accept the systems.

The results obtained in the current study suggest that the Evaluation Questionnaire can be used to evaluate user perceptions of the suitability of computer systems for use in different situation categories. However, one drawback of the Evaluation Questionnaire is that it provides information on user **perceptions** of whether a system or product is suitable for use in particular situations but does not provide a practical test of whether the system can **actually** be used in that situation. McQuarrie and Langmeyer (1987) compared the buying plans and prior behaviour of 142 computer owners and concluded that market researchers should question consumers about both their cognitions and their past actions. Davis (1993) notes the use of assessments of video mockups of applications by some designers, including a leading computer manufacturer, but suggests that such research should be supplemented by research into actual user acceptance in the workplace. However, the author feels that assessment of video mockups can be a useful method to use for initial evaluation of prototypes.

The usefulness criterion set by one subject group may not necessarily be shared by other subject groups. One group may consider it important for a computer system to satisfy a particular criterion while another group considers it less important. However, if users share general perceptions of the importance of particular usefulness criteria, similar importance ratings would be expected for all subject groups.

In the current study it is not clear whether the perceptions expressed by the subjects in the current study are 'accurate' assessments of System A and System B. Two points should be considered. The first is Kelly's assertion (Kelly, 1955) that there is no universal system of constructs suggesting that unanimous agreement among the subjects on all evaluations could not be expected. The second that the ratings give an indication of the relative importance of particular usefulness criteria rather than a precise measurement. However, the evaluations given should be regarded as an accurate indication of the subjects' perceptions of the systems at the time the evaluations were taking place. It should also be recognised that those perceptions could affect the subjects' actual use and acceptance of the systems.

The use of videos and evaluation questionnaires, as in the present study, enables a large number of people to evaluate a system simultaneously and relatively quickly. Although the results obtained using this method could be supplemented or verified by alternative methods such as actually using the system in certain situations or by simulating situations where required, it is not always feasible to carry out practical tests for reasons such as time, money, availability of researchers and subjects, and so on. For example, it would not have been easy to arrange for the 59 subjects who participated in

the current study to actually be stuck in a train just before making a presentation to an important client (Situation 23) or for construction work to interrupt the power supply to the building where they were working (Situation 11). These situations do actually occur, particularly in cities such as London, but not necessarily on demand!

The author sees possibilities for the use of questionnaires similar to the Evaluation Questionnaire both by potential buyers/users and by the computer industry. Once the requirements for a system have been established - these may be general user requirements in the case of the computer industry or specific requirements in the case of an individual user or buyer - an evaluation of a particular system or comparison between systems can be made using a method similar to that described in the current study. For example, the Evaluation Questionnaire used in the current study could be used by companies to conduct comparative evaluation of sales videos. Although the method is used in the current study in the context of office technology, a similar method could be used to evaluate user perceptions of other products.

Evaluation of general requirements by a computer company may be a lengthy process depending on the number of subjects and criteria considered but evaluation of individual requirements by a single user could be very quick as only one criterion which is perceived as important by that user may be considered, such as the cost or availability of a particular product. However, use of a questionnaire similar to the one used in the current study could provide a relatively quick, cheap, and portable method to evaluate user perceptions of a product in 'final' or prototype form.

This chapter has described how user perceptions may be used in the evaluation of prototype computer systems. In Chapter 9 media coverage of office technology is considered using content analysis of two leading publications to see whether user perceptions of technology derived from the results of the author's earlier studies (see Chapters 5-7) match trends in the reporting of developments in office technology by computer journalists.

# CHAPTER 9 - CONTENT ANALYSIS OF COMPUTER JOURNALISTS' PORTRAYAL OF THE COMPUTER INDUSTRY (STUDY 5)


## SUMMARY

A content analysis of two publications - *The Guardian* and *PC Week* - for the period January 1991-June 1993 was carried out to determine the extent of agreement between user perceptions of technology and the office as reflected in the eight factors described earlier in this thesis (see Chapters 5-8) and the perceptions of the computer industry as portrayed by computer journalists. It was thought that the content of computer publications such as *The Guardian* and *PC Week* would provide information on computer industry perceptions since the media would be expected to report items regarded as important by the industry. The media content would also be expected to reflect computer journalists' portrayal of computer industry perceptions of user perceptions.

It was found that both the publications analysed mentioned most of the factors identified earlier in this thesis but varied in the amount of coverage given to those factors. The factor which consistently received the most coverage was Technology and the factor which received the least coverage was Health Preservation. A similar pattern of coverage was found for both publications. Repeated sampling over a period of 30 months did not seem to affect whether or not a factor was mentioned. The outcome of the content analysis provides additional evidence for the hypothesis that the factors identified from the responses of the subjects who participated in the author's earlier studies (Studies 1-4) reflect perceptions considered important by a broader range of people than just the subjects who participated in the author's studies.


## INTRODUCTION

This chapter considers media portrayal of technology and the office with emphasis on newspapers although other types of media such as radio and television are also considered. The modal dependability rating for the references is 4.

The perceptions people hold are, to some extent, determined by the "information reaching us from our environment" (Toffler, 1981). Before the advent of mass media information tended to be received from people in the immediate environment such as teachers, priests, and the family. Toffler suggests that "the Second Wave multiplied the number of channels from which the individual drew his or her picture of reality". In addition to people, imagery could be received from television, radio, newspapers and magazines. In the Third Wave, Toffler argues, technological developments such as fast,

inexpensive printing presses and satellite television may result in an acceleration in the speed of information flow and a demassification of the media. However, despite Toffler's prediction 'Second Wave' media such as national newspapers, in Britain at least (see Table 1), still reach large audiences.

## MEDIA PORTRAYAL OF TECHNOLOGY

Coverage of the computer industry may be found in various types of media including newspapers, magazines, books, radio, television, films, and advertisements. Media representations of technology may be fictional, for example science fiction books, television drama, and films, or non-fictional, for example, newspaper coverage of technological developments and television documentaries. Fictional depictions of technology may be regarded as providing a form of allegory or metaphor of shared perceptions and 'rules' in society while non-fictional media representations give a picture of actual events, developments and perceptions. In the current study emphasis is given to non-fictional coverage, in particular newspapers, since this was considered to be particularly relevant to the author's investigation of user perceptions of technology and the office.

Newspaper articles may be regarded as a form of **social representation** (Moscovici, 1984). Social representations may be regarded as ideas or perceptions held by society as a whole. Moscovici suggests that the amateur politicians, doctors, and so on found in any public meeting place may be regarded as providing a "permanent commentary on major national, scientific or urban events and features". Newspapers may fulfil a similar role - they may reflect current ideas, shape them, or both.

**Documentaries** Examples of documentaries include *The Electronic Frontier* (1993) broadcast on BBC 1 (see Chapter 7), *The Net* (1994) broadcast on BBC 2, and *In Business* (1994) broadcast on Radio 4.

**Drama** Dennis Potter, in an interview with Melvyn Bragg, mentioned that he included virtual reality and cryogenics in the plays *Karaoke* and *Cold Lazarus* since "virtual reality will so invade the entertainment business and your own sense of reality ... It is very much a thing of the future, going to influence a lot of the ways we think about ourselves" (extract from *Without Walls* broadcast on Channel 4, *The Guardian*, 1994).

**Pop music** Interest in technology has been reflected in popular music. For example, *Telstar*, *2001*, *Starman*, *In the year 2525*, *Video killed the radio star*, *Atomic*, and *Hanging on the telephone*. There are also songs relating to work. For example, *Part of*

*the union*, *Working on the chain gang*, *Whistle while you work*, *Everything stops for tea*, *9 to 5*, and *Just another day*.

**Poetry** Computer technology has moved at least one person to write a poem as the following extract from *'Mouse'* written following the loss of a computer mouse shows:

> Alas for me my mouse is lost
> It's up and run away
> 'Twas here when I went home last night
> But can't be found today
> I thought that it was happy
> So quietly it sat
> It's tail in my computer
> And it's body on the mat [...]
>
> (*Ergonomics Australia*, 1994)

The 'joys' of commuting, and perhaps a perception of one advantage of teleworking, have also been expressed in poetry:

> As I travel these tracks I cannot forgive
> How I lose by degrees the incentive to live
> [...]
> From germ-free services smelling of pine
> Now it's travel no-class on the misery line
>
> (extract from *Network South East*, John Cooper Clarke, 1994)

**Advertisements** Advertisements can depict the computer industry's perceptions of their products and the image they are trying to project to their customers. Advertisements seen recently on London taxis indicate an attempt at humour:

> "From here to the information highway" (seen 22 November 1994)
> "The PC is dead! Long live the PC&C Globalyst!" (seen 6 December 1994)
> "Today a snail in the slow lane. Tomorrow a road warrior on the information super highway (seen 14 February 1995)
> "Tell your boss where to go" (seen 9 June 1995)

It is noticeable that some of the advertisements above are based on popular images or familiar phrases from contexts other than computing (for example, "The PC is dead!..." is similar to "The king is dead!..."). This suggests that the advertisers are trying to relate new products to existing models and images held by users rather than attempting to create new images.

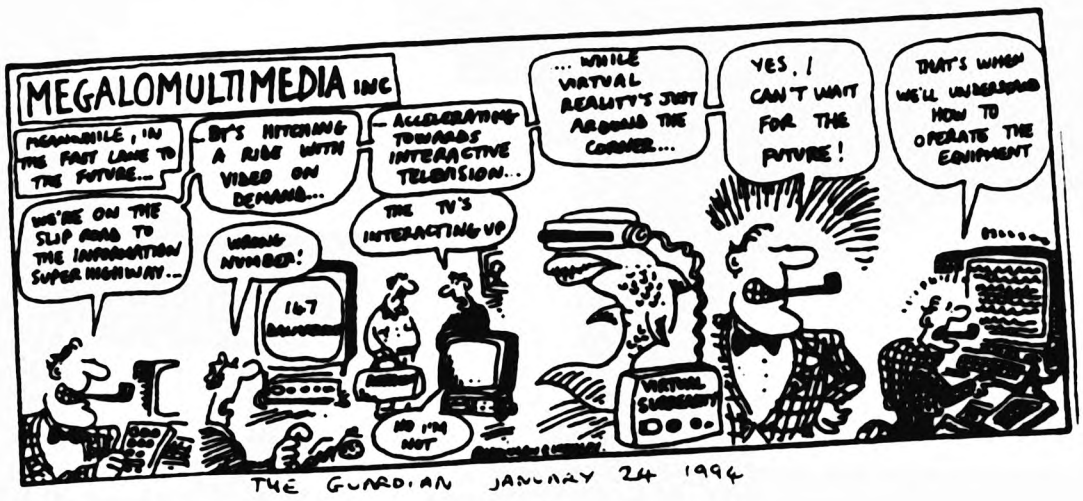
**Humour and technology** Humorous references to technology can be found in cartoons, jokes, and comedy programmes.

*Cartoons* - Figure 1 gives examples of a few cartoons derived from *The Guardian* (Megalomultimedia Inc., Newman and Woolley, 1994; Superhighway police; *The Guardian*, 1994b) and *New Scientist* (Polar bear, Charlesworth, 1994). The *Bristow* cartoons by Frank Dickens depict office life from the perspective of a buying clerk. Regular *Bristow* themes include the relationship between management and subordinates, canteen food, and commuting. Recent *Bristow* cartoons published in the *Evening Standard* have considered issues related to office technology such as electronic surveillance in the office, word processing and mobile phones. The possible misuse of technology, in the shape of a malevolent penguin and a pair of 'technotrousers' was humorously represented in Nick Park's Oscar-winning animated film *The Wrong Trousers* (1993).

*Comedy programmes* - Situation comedies such as *The Fall and Rise of Reginald Perrin* (1970s), *Terry and June* (1980s), and *Nice Day at the Office* (1990s) portray fictional perceptions of office life and office technology. Themes included in these comedies include social hierarchies in offices (all three comedies), commuting (*The Fall and Rise of Reginald Perrin*), office technology (*Nice Day at the Office*) and perceptions of how to succeed at work ("I didn't get where I am today by ... " C.J. in *The Fall and Rise of Reginald Perrin*). The character of Reginald Perrin in *The Fall and Rise of Reginald Perrin* also illustrates that public actions and words may differ from private perceptions For example when he speaks to his mother-in-law and imagines a wart-hog or adopts a subservient demeanour to his boss while privately thinking of something derogatory.

Cartoons and satire may provide valuable insights into shared perceptions. A cartoon may illustrate emotions such as disgust, contempt, fear and ridicule. The 'audience' and the cartoonist need to share a common understanding of the topic of the cartoon if its intended message is to be successfully interpreted.

## FIGURE 1 - HUMOUR AND TECHNOLOGY




THE GUARDIAN JANUARY 24 1994

NEW SCIENTIST 23 APRIL 1994

THE GUARDIAN 25 MAY 1994

## NEWSPAPERS

Individual articles in major newspapers such as *The Observer, Daily Mail, Financial Times*, *Evening Standard*, and *The Times Higher*, have been included elsewhere in this thesis wherever they were thought by the author be relevant. A detailed content analysis of these papers was not carried out as they do not carry regular columns comparable to those in *The Guardian* and *PC Week* and also because it was not feasible to consider all newspapers in great detail in the current study. Table 1 shows the circulation figures for the publications included in the current study and figures for some of the other newspapers included elsewhere in this thesis. These figures illustrate the large number of people who read newspapers and may potentially be influenced by the ideas expressed in those papers.

**TABLE 1 - NEWSPAPER CIRCULATION 1990-1995**

| | 1994/1995 Dec-May | 1993/94 Nov-Apr | 1992/93 Nov-Apr | 1991 Jan-Jun | 1990 Jul-Dec |
|---|---|---|---|---|---|
| **Daily** | | | | | |
| *Daily Mail* | 1,780,155 | 1,770,125 | 1,768,163 | 1,719,819 | - |
| *The Guardian* | 400,813 | 400,373 | 418,331 | 413,423 | - |
| *The Independent* | 289,057 | 290,354 | 353,146 | - | - |
| *Financial Times* | 294,766 | 296,011 | 290,940 | - | - |
| **Sunday** | | | | | |
| *Sunday Express* | 1,411,445 | 1,593,329 | 1,717,621 | 1,662,846 | - |
| *The Observer* | 467,017 | 500,373 | 518,608 | 579,045 | - |
| **Regional Daily** | | | | | |
| *Evening Standard* | - | - | - | 518,789 | - |
| **Weekly** | | | | | |
| *PC Week* | 50,000 | - | - | - | 47,894 |
| **Other** | | | | | |
| *New Scientist* | 113,441 | | | | |

**NOTES**

1. - = no figure available
2. Daily, Sunday, and Regional Daily papers - 1994/95 figures obtained from *The Guardian* (1995b); 1993/94, 1992/93 *The Guardian* (1994c); 1991, 1990 *The Advertisers Annual 91-92* (1991)
3. Weekly - 1994 figure obtained from telephone call to VNU editorial department, May 27 1994; 1990 figure obtained from *The Advertisers Annual 91-92* (1991)
4. Other - figure obtained from *New Scientist* (1995)

Table 2 shows information on newspaper references included elsewhere in this thesis. Relevant newspaper articles were found for all chapters which indicates that newspapers perceive that their readers are interested in various issues related to technology. The largest number of articles was found for Chapter 7 which considered current developments in technology.

## TABLE 2 - NEWSPAPER REFERENCES INCLUDED IN THESIS

| CHAPTER | NEWSPAPER | YEAR | NUMBER OF ARTICLES | TOTAL |
|---|---|---|---|---|
| **Chapter 1: Introduction** | | | | **1** |
| | *The Times Higher* | 1994 | 1 | |
| **Chapter 2: The Office** | | | | **5** |
| | *The Guardian* | 1991,1993 | 1, 2 | |
| | *The Observer* | 1994 | 1 | |
| | *The Times Higher* | 1995 | 1 | |
| **Chapter 3: Approaches to understanding human-computer interaction** | | | | **2** |
| | *Daily Mail* | 1991 | 1 | |
| | *The Guardian* | 1992 | 1 | |
| **Chapter 4: The role of user perceptions in investigations of human-computer interaction** | | | | **6** |
| | *The Weekend Australian* | 1990 | 1 | |
| | *The Guardian* | 1990,1993,1995 | 1, 1, 2 | |
| | *The Times Higher* | 1995 | 1 | |
| **Chapter 5: An investigation of user perceptions of the nature of office work** | | | | **11** |
| | *PC Week* | 1992 | 1 | |
| | *The Guardian* | 1990,1991 | 1, 1 | |
| | | 1993,1994 | 2, 1 | |
| | *The Times Higher* | 1993 | 1 | |
| | *Sunday Express* | 1994 | 1 | |
| | *The Observer* | 1994 | 2 | |
| | *The Times* | 1994 | 1 | |
| **Chapter 6: The effect of situation characteristics on user perceptions of their use of technology** | | | | **15** |
| | *The Guardian* | 1991,1992,1994 | 1, 2, 1 | |
| | *Daily Mail* | 1993 | 1 | |
| | *The Independent* | 1993 | 1 | |
| | *The Times Higher* | 1993,1994 | 3, 1 | |
| | *The Observer* | 1993,1994 | 1, 2 | |
| | *Evening Standard* | 1991,1994 | 1,1 | |
| **Chapter 7: User perceptions of the ideal office** | | | | **40** |
| | *PC Week* | 1992,1993 | 2, 1 | |
| | *The Guardian* | 1992,1993 | 2, 7 | |
| | | 1994 | 2 | |
| | *Daily Mail* | 1993,1994 | 4, 1 | |
| | *Financial Times* | 1993,1994 | 3, 1 | |
| | *The Times Higher* | 1994 | 2 | |
| | *The Observer* | 1993,1994,1995 | 5, 1, 1 | |
| | *Sunday Express* | 1993,1994 | 1, 1 | |
| | *Evening Standard* | 1992,1993 | 1, 1 | |
| | | 1994 | 1 | |
| | *The Ottawa Citizen* | 1990 | 2 | |
| | *The New York Times* | 1992 | 1 | |
| **Chapter 8: An evaluation of current developments in computer-based office systems** | | | | **1** |
| | *PC Week* | 1992 | 1 | |
| **Chapter 9: Content analysis of computer journalists' portrayal of the computer industry**[1] | | | | **5** |
| | *The Guardian* | 1990,1994,1995 | 1, 3, 1 | |
| **Chapter 10: User perceptions of technology and the office: Discussion and conclusions** | | | | **2** |
| | *Evening Standard* | 1994 | 1 | |
| | *The Guardian* | 1994 | 1 | |
| **ALL CHAPTERS** | | | | **88** |

**NOTES**

The content analysis described in Chapter 9 is based on newspaper articles.

## CONTENT ANALYSIS

In Scandinavia in the eighteenth century words were counted in hymns and sermons by Swedish authorities and dissidents to prove and disprove heresy (Dovring, 1973 - cited by Rosengren, 1981). More recently, Weber (1990) argued that "even though much basic research remains to be done, the accumulated results of the last 20 years suggest that, for many kinds of problems, existing techniques of content analysis lead to valid and theoretically interesting results". Weber also comments that developments in computer technology such as devices for making text machine readable, and a general reduction in computer costs have renewed interest in content analysis. "In the 1990s these tools will be applied increasingly to a wide range of social science questions." An example of the application of content analysis is provided by Wyllie and Sprigge (1990) who reported that content analysis of a database of material published over an eighteen-month period demonstrated a change in emphasis in design philosophy from the "life-cycle" model to a "more flexible evolutionary approach".

Holsti (1969) commented that while content analysis has been shown to be a valuable research method in many areas of inquiry, it can lead to studies "which appear to have been motivated by the ease with which they could be carried out" and cites Cartwright (1953) who stated that: "In reviewing the work in this field, one is struck by the number of studies which have apparently been motivated by little more than a sheer fascination with counting." However, 'counting' may be an appropriate technique to use where it is based on a theory-driven taxonomy.

Berger (1991) suggested that the advantages of content analysis are that it is usually relatively easy to get material, unobtrusive (and thus does not influence people), inexpensive, yields data that can be quantified, and can deal with current events or past events, or both. However, certain limitations of content analysis are mentioned by Berger - it is hard to be sure that the sample studied is representative, it can be hard to obtain a working definition of the topic being studied, it may be hard to find a measurable unit, it may not be possible to prove that the inferences made on the basis of content analysis are correct. The author feels some of these limitations may also apply to other research techniques.

The reliability of the coding used in content analysis needs to be assessed. McQuail (1977) comments that "unreliability of coding which arises from the intrinsic ambiguity of content cannot be fully assessed". A detailed discussion of reliability and validity can be found in Krippendorff (1980).

## RATIONALE FOR THE CURRENT STUDY

The aim of the current study was to compare user perceptions derived from the author's earlier studies (see Chapters 5-8) with computer industry perceptions as reflected in the media. Emphasis was placed on the eight factors derived from the '*User Perceptions of the Nature of Office Work*' study (see Chapter 5). These factors - Information-Handling, Human Contact, Paper-Handling, Financial Security, Communication, Technology, Work and Health Preservation were thought to comprise user perceptions of the key features of the office. The intention of the current study was to see whether or not these factors were mentioned in the media, and if so, the frequency of occurrence and allocation of space to each factor.

It was expected that there would be no significant changes over a particular time period in the major issues covered in the media if it is correct to assume that the fundamental issues relevant to office work and the role of technology in the office remain constant. However, the specific details considered in the media **will** change over time as existing technology is modified. For example, there may be less emphasis on computer-supported cooperative work at the beginning of the time period considered and greater emphasis at the end of the time period.

Content analysis was considered a relevant technique to employ because:

1. The media may influence and/or reflect user perceptions.
2. Newspapers are considered to provide more up-to-date coverage of computer industry developments and perceptions than academic journals. Academic journals may contain 'dated' information where there is a long delay between submission and publication of material. However, if computer-based journals become more prevalent this point may no longer be applicable.
3. Content analysis can be performed by one person although issues such as reliability of coding and measurement error need to be considered.
4. The same technique can be applied to a variety of topics.
5. Comparisons over time can be made.
6. Content analysis is an established research technique.

The current study compared computer industry perceptions as portrayed in the media and user perceptions derived from earlier empirical work in this thesis. To what extent are there similarities and differences in the perceptions of the computer industry and users? What are the implications of these similarities and differences for understanding user-system interaction?

It was expected that there would be a significant difference between user and media perceptions in the specific topics mentioned. Whereas the users who participated in the empirical research described earlier in this thesis (see Chapter 5 - *'User Perceptions of the Nature of Office Work'*) tended to concentrate on general issues and did not mention specific companies or 'leading figures' in the computer industry, the media portrayal of the computer industry would be expected to place much greater emphasis on naming specific companies, and so on.

It was also expected that if all the factors were considered to be of equal interest to users/readers each factor would be mentioned an equal number of times and allocated a similar amount of space in the publications analysed.

## METHOD

### PUBLICATIONS

The computer pages of *The Guardian* January 1991-June 1993 and the front and back pages and Office Update page of *PC Week* January 1991-June 1993. *The Guardian* and *PC Week* were considered as they are both respected publications which report on the computer industry. *The Guardian* has been running a regular computer section for 10 years (Schofield, 1993). Both *The Guardian* computer pages and *PC Week* are published weekly providing a large source of material to consider. Table 3 shows the number of authors contributing articles for the period analysed.

**TABLE 3 - AUTHORS**

| PUBLICATION | AUTHORS | | |
|---|---|---|---|
| | Number of authors | Number of weeks author appeared | Total number of weeks in study |
| ***The Guardian*** | **66** | | **60** |
| | 1 | 45 | |
| | 1 | 14 | |
| | 1 | 13 | |
| | 1 | 11 | |
| | 1 | 7 | |
| | 3 | 5 | |
| | 5 | 3 | |
| | 15 | 2 | |
| | 38 | 1 | |
| ***PC Week*** | | | |
| Front and back page | Unknown - all articles anonymous | | **57** |
| Office Update page | **1** | 37 | **37** |

**PROCEDURE**

A sample of two major publications - *The Guardian* and *PC Week* - was analysed by the author in terms of the frequency of occurrence of the eight factors (Information-Handling, Human Contact, Paper-Handling, Financial Security, Communication, Technology, Work, and Health Preservation) derived from the *'User Perceptions of the Nature of Office Work'* study (Chapter 5). An additional category was None to allow coding of items which did not seem to be about any of the eight factors. This category could have been labelled 'Miscellaneous' but 'None' was thought to emphasise that this category did not include items related to any of the eight factors. A detailed description of the procedure used to code the data can be found in Appendix A. No distinction was made between the 'opposite' poles of the factors since the prime concern was to establish whether or not a particular factor was mentioned rather than to consider in detail the way in which that factor was mentioned. Coding was not restricted to articles which specifically mentioned the office. Each unit (that is, a headline or paragraph) was considered as a self-contained unit so that it could be classified without referring to the rest of the article.

Two weeks from each month between January 1991 and June 1993 were collected and analysed. The choice of weeks was randomised when all the weeks for that month were available. However, in some cases the chosen week was missing so another week in that month was selected. The publications were collected mainly from libraries in London. The collection of material was, to some extent, limited by the cost of photocopying. Whereas one library charged 10 pence per page, a specialist newspaper library charged £1-05 per page which would have made the collection of material from this source prohibitively expensive.

Coding within and between publications was carried out in random order to minimise order effects. The number of articles per page varied. For example, some of the earlier pages of *The Guardian* were broadsheet and contained more than three articles whereas later pages were tabloid and tended to contain only one or two articles. The Office Update page of *PC Week* regularly contained only one article. Subjects were required to code a maximum of three articles per page as this number represented the bulk of the content of most of the pages.

The headline, first three paragraphs, and concluding paragraph were analysed for each of the selected articles. It was felt that this sample provided an adequate indication of the content of the whole article and did not result in the exclusion of more interesting material elsewhere in the article even though the number of paragraphs in each article

varied. A test of the representativeness of the sampling frame was made by comparing the results obtained from coding the whole article with the results obtained using the headline, first three paragraphs and concluding paragraph using a sample of 10 articles for each publication (see Table 4). The mean Spearman Rank Correlation Coefficient obtained was 0.86 for *The Guardian*, 0.88 for *PC Week* (front and back page), and 0.87 for *PC Week* (Office Update page) showing a high level of agreement between the coding obtained from coding the whole article and that obtained from coding part of each article and indicating that the author's sampling method was representative of the content of the whole article.

**TABLE 4 - COMPARISON OF CODING OF WHOLE ARTICLE WITH CODING OF SAMPLE OF ARTICLE (SPEARMAN RANK CORRELATION COEFFICIENT)**

*The Guardian* 1, 0.85, 0.88, 0.75, 0.91, 0.93, 0.85, 0.91, 0.90 ($p < .05$, two-tailed)
0.61 ($p < .10$, two-tailed)

*PC Week* (front and back page) 0.73, 0.91, 1, 0.85, 0.91, 0.98, 1, 0.78, 0.88, 0.75
($p < .05$, two-tailed)

*PC Week* (Office Update page) 0.88, 0.88, 0.98, 0.91, 0.76, 0.73, 0.88, 1, 0.99
($p < .05$, two-tailed)
0.65 ($p < .10$, two-tailed)

Each headline or paragraph was coded as a separate unit. The main interest was in whether or not a factor was mentioned within a particular unit rather than in the number of times the factor was mentioned since frequent mention within a particular unit does not necessarily indicate greater perceived importance, it could just indicate a repetitive writing style.

Manual coding was performed due to the lack of availability of equipment such as an optical scanner and because the use of computerised techniques such as automatic word counts was not considered essential. While a major advantage of computer-based coding is its reliability, the computer may be unable to distinguish the nuances of coding as effectively as a human coder. For example, while a computer might be able to accurately count occurrences of the word 'chip', would it be able to distinguish whether the 'chip' was a microchip or an accompaniment to fish? In addition, human coding may be more suited to assessing the context of items than computer coding.

**Reliability of coding**

One aim of the coding system used in the current study was to ensure high *reproducibility* (Krippendorff, 1980). That is, to increase the possibility that similar

results would be obtained by different coders. Reproducibility may also be referred to as intercoder reliability (Weber, 1990). The aim was also to maximise the *stability* (Krippendorff, 1980) or intracoder reliability of the coding - that is, the chance of similar results being obtained by the same coder on a different occasion.

The reliability of the coding system used in the current study was investigated. *Stability* (intracoder reliability) was tested by the author recoding a sample of the articles (20%) six months after the initial coding. The Spearman Rank Correlation Coefficient for stability was found to be 0.90 for *The Guardian*, 0.96 for *PC Week* (front and back page) and 0.95 for *PC Week* (Office Update page). Overall stability for both publications was 0.94 ($p < .01$, two-tailed test).

*Reproducibility* (intercoder reliability) was tested by getting three judges to recode a sample (20%) of the articles using a similar procedure to that used by the author (see Appendix A). Two of the judges were male lecturers teaching computer-related subjects, the third judge was a female retired accounts clerk. One of the male judges was unable to code all the sample due to other commitments so the third judge coded the weeks which this judge did not code. Table 5 show the results obtained from a comparison of the coding of each judge with the author's coding.

**TABLE 5 - REPRODUCIBILITY (INTERCODER RELIABILITY) OF CODING (SPEARMAN RANK CORRELATION COEFFICIENT)**

| | **Judge 1** | **Judge 2** | **Judge 3** |
|---|---|---|---|
| ***The Guardian*** | 0.69 ($p<.05$) | 0.93 ($p<.01$) | 0.96 ($p<.01$) |
| ***PC Week*** | | | |
| Front and back page | 0.94 ($p<.01$) | 0.92 ($p<.01$) | 0.92 ($p<.01$) |
| Office Update page | 0.98 ($p<.01$) | 0.84 ($p<.01$) | 0.92 ($p<.01$) |

These results indicate that the coding used in the current study is very reliable in terms of both stability (intracoder reliability) and reproducibility (intercoder reliability).

**Validity of coding**

An assessment of the *semantic validity* (Krippendorff, 1980) of the responses from which the eight factors were derived was carried out in the Classification Questionnaire section of the *'User Perceptions of the Nature of Office Work'* study (Chapter 5). In the *User Perceptions* study 77% of labels derived from items in the Classification Questionnaire were chosen by at least 3 of the 4 judges who participated demonstrating a high level of perceived semantic validity.

## RESULTS

The number of times each factor was mentioned for a particular week was recorded and converted to a percentage of the total number of items coded for that week to enable comparisons between weeks to be made since each week contained a different number of items depending on the number of articles and content of those articles for that week. Table 6 shows the percentage occurrence and Figure 2 illustrates the yearly occurrence of each factor.

The percentages for the Office Update page of *PC Week* may be slightly distorted in comparison with those for *The Guardian* and the front and back pages of *PC Week* since the Office Update page consistently contained fewer items. The Office Update percentages are likely to seem artificially high when compared with *The Guardian* and the other pages of *PC Week*. However, this distortion is not considered so important when the Office Update pages are compared with each other since a similar amount of distortion is likely to have occurred for each page.

**TABLE 6 - PERCENTAGE OCCURRENCE OF FACTORS**

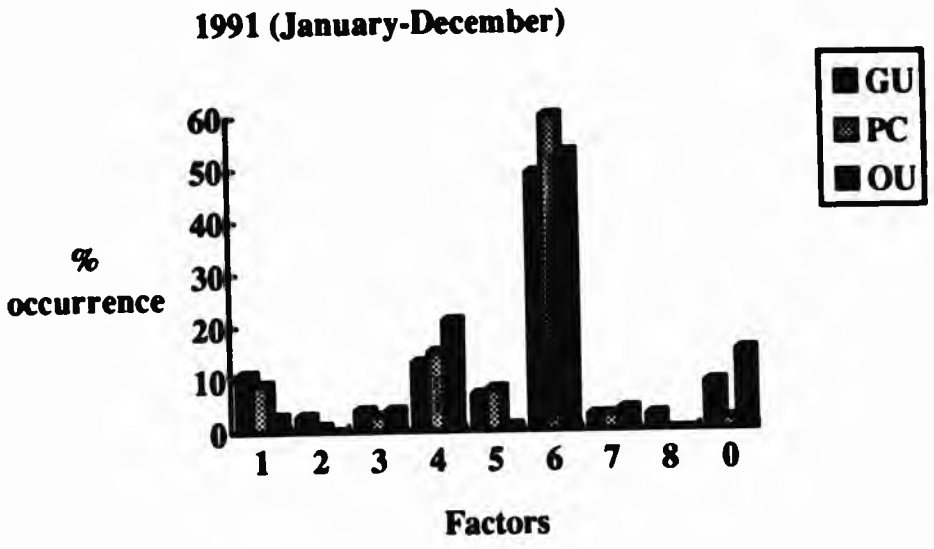
| | FACTORS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 0 |
| | INFO | HUM | PAPER | FINAN | COMM | TECH | WORK | HEAL | NONE |
| **1991** | | | | | | | | | |
| **MEAN % (JANUARY-DECEMBER)** | | | | | | | | | |
| **GU** | 11% | 3% | 4% | 13% | 7% | 49% | 3% | 3% | 9% |
| **PC** | 9% | 1% | 3% | 15% | 8% | 60% | 3% | 0% | 2% |
| **OU** | 3% | 0% | 4% | 21% | 1% | 53% | 4% | 0% | 15% |
| **1992** | | | | | | | | | |
| **MEAN % (JANUARY-DECEMBER)** | | | | | | | | | |
| **GU** | 6% | 3% | 6% | 11% | 8% | 54% | 3% | 1% | 11% |
| **PC** | 7% | 1% | 2% | 20% | 8% | 56% | 5% | 0% | 2% |
| **OU**[1] | 6% | 1% | 1% | 19% | 2% | 52% | 5% | 0% | 15% |
| **1993** | | | | | | | | | |
| **MEAN % (JANUARY-JUNE)** | | | | | | | | | |
| **GU** | 7% | 2% | 9% | 11% | 10% | 52% | 1% | 0% | 10% |
| **PC** | 9% | 2% | 2% | 10% | 15% | 59% | 3% | 0% | 3% |
| **OU**[2] | 0% | 0% | 0% | 13% | 0% | 67%, | 0%, | 0% | 20% |
| **OVERALL MEAN** | | | | | | | | | |
| **GU** | 8% | 3% | 6% | 12% | 8% | 52% | 2% | 1% | 10% |
| **PC** | 8% | 1% | 2% | 15% | 10% | 58% | 4% | 0% | 2% |
| **OU** | 3% | 0% | 2% | 18% | 1% | 57% | 3% | 0% | 17% |

**NOTES**

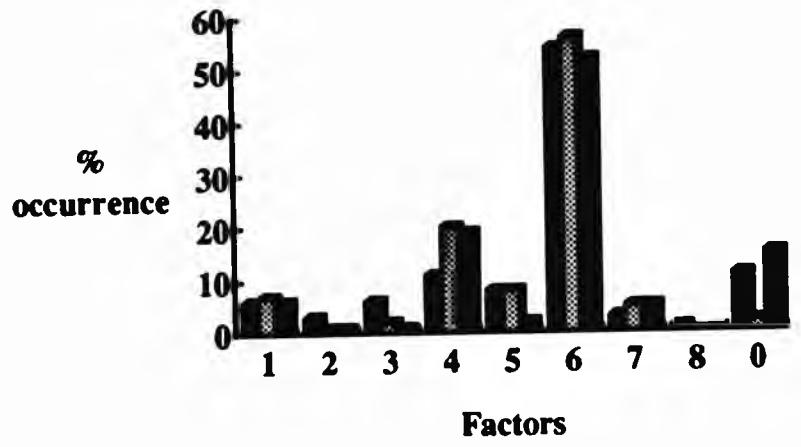
1. INFO = Information-handling, HUM = Human Contact, PAPER = Paper-handling, FINAN = Financial Security, COMM = Communication, TECH = Technology, WORK = Work, HEAL = Health Preservation, NONE = None
2. OU 1 = based on January-September only. October-December not available
3. OU 2 = based on January-March only. April-June 1993 not available
4. percentages have been rounded up

## FIGURE 2 - MEAN PERCENTAGE OCCURRENCE 1991-1993

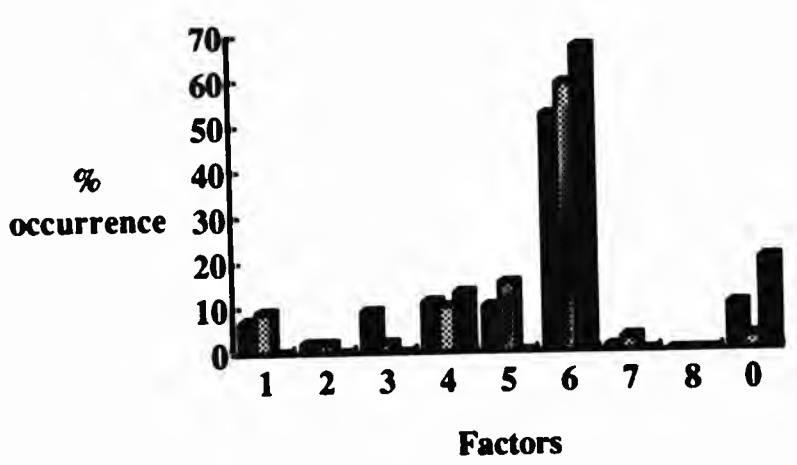
**1991 (January-December)**




**1992 (January-December)**




**1993 (January-June)**




**NOTES**

1. GU = *The Guardian*, PC = *PC Week* (Front and Back page), OU = *PC Week* (Office Update page)
2. Factors: 1= Information-handling, 2 = Human Contact, 3 = Paper-handling, 4 = Financial Security 5 = Communication, 6 = Technology, 7 = Work, 8 = Health Preservation, 0 = None

The outcome of the analysis of media portrayal of computer industry perceptions supports the idea that the perceptions of technology and the office held by both users and the computer industry can be categorised according to eight dimensions: Information-Handling, Human Contact, Paper-Handling, Financial Security, Communication, Technology, Work, and Health Preservation. However, there are marked differences in the prominence given to those dimensions (see Table 7). For example, whereas the subjects who participated in the *'User Perceptions of the Nature of Office Work'* study (Chapter 5) regarded all the dimensions as of broadly similar importance, analysis of media coverage suggests that the computer industry regards technical details and financial issues as paramount with less emphasis on face-to-face human contact and health issues. This could be an artefact of the portrayal of computer industry perceptions by the publications considered in this study but if it reflects actual computer industry priorities this indicates areas which may need additional attention if user and computer industry perceptions are to coincide so that the acceptability and usability of computers can be enhanced.

**TABLE 7 - COMPARISON OF CURRENT STUDY WITH STUDY OF USER PERCEPTIONS OF THE NATURE OF OFFICE WORK**

| | FACTORS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 0 |
| | INFO | HUM | PAPER | FINAN | COMM | TECH | WORK | HEAL | NONE |
| Users | 16% | 16% | 15% | 7% | 15% | 23% | 5% | 4% | 0% |
| Content | 8% | 2% | 4% | 14% | 9% | 55% | 3% | 1% | 6% |

**NOTES**
1. Users = *User perceptions of the nature of office work* (Chapter 5), Content = Content analysis
INFO = Information-handling, HUM = Human Contact, PAPER = Paper-handling,
FINAN = Financial Security, COMM = Communication, TECH = Technology, WORK = Work,
HEAL = Health Preservation, NONE = None
2. Users - number of responses represented by each factor expressed as a percentage of the total number of responses.
3. Content - based on overall mean percentage of *The Guardian* and *PC Week* (Front and back page). *PC Week* (Office Update page) excluded as based on only one article per week.
4. percentages have been rounded up

## DISCUSSION

It was found that both the publications analysed mentioned most of the factors identified earlier in this thesis but varied in the amount of coverage given to those factors. The factor which consistently received the most coverage was Technology and the factor which received the least coverage was Health Preservation. A similar pattern of coverage was found for both publications. The sampling period did not seem to affect whether or not a factor was mentioned. (This applies both within and between publications.) This indicates that the factors identified from user responses are stable

and reflect core issues rather than being transitory reflections of particular circumstances.

While all the factors - Information-Handling, Human Contact, Paper-Handling, Financial Security, Communication, Technology, Work, and Health Preservation mentioned by the users in earlier studies in this thesis were mentioned sometimes, the main emphasis in the sample of computer industry perceptions as portrayed in *The Guardian* and *PC Week* from January 1991-June 1993 seemed to be on general issues related to Technology such as technical specifications, and general hardware and software developments. Issues concerned with Financial Security such as cost, sales, prices, and so on also received a large amount of coverage. Health Preservation consistently received the least coverage. The 'None' category included miscellaneous items which were not felt to fit into any of the other categories.

It is not clear from the content analysis whether the minimal coverage given to certain factors reflects a significant difference in perceptions between the computer industry and users or merely that certain factors are considered to be more interesting to the readers of particular publications. For example, developments in virtual reality and 'information superhighways' may be perceived by journalists to be more interesting to the reader than the development of a new word processor. This may be more applicable to *The Guardian* which is aimed at the general public than to *PC Week* which is a specialist publication likely to be read mainly by people with a specific interest in the computer industry. Since May 1994 the computer section of *The Guardian* has been superceded by a weekly pull-out supplement *Online* dedicated to information technology and science. This indicates that *The Guardian* perceives technological developments to be of increasing interest to their readers.

Recently other publications have also run occasional supplements. For example, *New Scientist* (1994b), *Evening Standard*, (Godfrey, 1994), and *Financial Times* (1994) have published supplements concerned with developments in telecommunications. In addition technology-related items can be found throughout newspapers from the front page to the letters column. Office technology has even been seen on the sports pages in an advertisement for mobile phones featuring England rugby players. This supports the view that newspapers in general perceive interest in technology to be growing for the generalist reader as well as the specialist reader. It also supports the view that there is a need to be aware of the coverage of technology in the media as it may reflect or influence user perceptions of technology. The link between the media and technology

was highlighted in August 1995 when an issue of *The Times* was paid for by an advertisement to publicise the launch of Windows 95 by Microsoft.

Currently much space in newspapers is devoted to issues relating to teleworking, the use of the Internet and mobile phones. Issues covered include access to computing facilities, the effect on privacy, access to information, and social 'rules' governing the use of networks and mobile phones.

The user responses from which the factors Information-Handling, Human Contact, Paper-Handling, Financial Security, Communication, Technology, Work, and Health Preservation were derived were collected mainly between February and April 1991. In order to enable an exact comparison to be made between user perceptions and media depiction of computer industry perceptions, the user perceptions should have been studied over a similar period to that used for the content analysis of computer industry perceptions. This would have enabled the effect of time on user perceptions to be considered. However, it was not feasible to do this for operational reasons such as the lack of availability of the subjects for a longitudinal study. In addition, if the author is correct to suggest that while specific aspects of user perceptions may change over time, basic perceptions do not change, the lack of a comparable time-scale may not be particularly important.

Certain issues may be mentioned frequently in the news then fade either for good or temporarily. For example, while the general topic 'sport' is mentioned on a regular basis in newspapers, the content of the sports pages varies. Around the time of an international football match the behaviour of England's football supporters 'hit the headlines' frequently while during the 1993 Ashes series space was devoted to lamenting England's lack of spin bowlers! Similarly, there may be regular items concerned with the weather in general with specific headlines alternating between "Phew, Wot a scorcher!" and "Brr, Britain freezes" with an infrequent appearance of "'Hurricane, What hurricane?' say the weather forecasters".

Media coverage of the computer industry perceptions is considered to follow a similar pattern - continuing coverage of certain issues with occasional new developments or revival of 'old' items. Basic issues such as an interest in technical specifications and price seem to remain constant while specific issues such as the actual products and companies named vary. For example, yesterday the issue may have been that Company A produced a cheaper, faster computer than Company B, today the issue may be that

Company C produced a cheaper, faster computer than Company B, and tomorrow that Company D will be producing a cheaper, faster computer than Company C, and so on.

Some of the regularity over time may be due to the same authors writing the articles being analysed or to a common editorial policy rather than to fixed perceptions. However, while the Office Update page of *PC Week* was written by a single author, *The Guardian* articles were written by many authors (66) which suggests that the constancy found was due to shared perceptions rather than a common author (see Table 3).

The outcome of the content analysis of media portrayal of computer industry perceptions supports the idea that the basic perceptions of technology and the office held by both users and the computer industry are similar. However, there are marked differences in the prominence given to those dimensions.

Chapter 10 contains an overall discussion of all the studies completed by the author and the implications of these studies for future research.

# CHAPTER 10 - USER PERCEPTIONS OF TECHNOLOGY AND THE OFFICE: DISCUSSION AND CONCLUSIONS

## SUMMARY

User perceptions of technology and the office are considered in the light of the findings of the thesis. The applicability of the author's research to emerging research issues is discussed. The thesis illustrates that investigations of user perceptions of the office using the methods employed by the author can highlight similarities and differences between user and computer industry perceptions of technology and increase understanding of user models of technology and office work.

## INTRODUCTION

In earlier chapters studies of user perceptions of technology and the office were described and their relationship to existing knowledge considered. When research for this thesis began the emphasis in research into human computer interaction seemed to be on the individual working with a single computer in a 'traditional' office. Issues considered included menu design, screen layout, the development of VDU standards, and so on. Interest now seems to be on networked computers, and group-working. Issues considered include teleworking, virtual reality, and the social effects of increased use of technology. Since office technology is no longer found only in offices ("ubiquitous computing" - Weiser, 1993) user perceptions of the role of such technology need to be considered in a wider context than just the office. The thesis has evolved to reflect developments in technology and emerging issues related to user perceptions of technology and the office.

Technological advances in some areas may still leave unresolved problems in other areas as illustrated by the comment, reputed to have been made just after the 1969 moon landing, that : "if they can do *that*, why can't we have a decent bus service in Bristol?" (Norman, 1994). Although modern computers may be more 'user-friendly' now, there is still a place for investigating specific usability issues as well as higher level issues (see Chapter 3).

### The future of office work and office technology

*"Onwards, ever onwards" or "Plus ça change, plus c'est la même chose" ("The more things change, the more they are the same") (Karr, 1849)?*

While some features of society seem to remain constant, other features seem to disappear completely and others recur after an absence. A few examples of features which recur are listed below (Table 1).

**TABLE 1 - EXAMPLES OF RECURRENT FEATURES OF SOCIETY**

| Feature | Previous appearance | Most recent appearance. |
|---|---|---|
| cholera | London, 1840s | Rwanda, 1994 |
| Sarajevo | 1914 | 1995 |
| mass unemployment | 1930s | 1990s |
| rise in Fascism | 1930s | 1990s |
| platform shoes | 1930s, 1970s | 1990s |

While the examples in Table 1 range from the trivial to the serious, they illustrate that society does not always move forward. The following quote may appear to be relevant to the present but it actually refers to 1897: "A visitor to the Exhibition now being held, and one who remembers the two previous ones, must notice the wonderful advance of Science during the few intervening years...there is a most varied collection of applications of electrical work in the building" (*The Australian Technical Journal of Science, Art and Technology*, 1897).

The idea that some features change, some remain the same, and some disappear is considered relevant to the study of office work and computer-based technology. A basic proposition of this thesis is that while the fundamental nature of office work is constant and can be explained in terms of a few dimensions, specific types of technology may be transient. Table 2 illustrates the idea that while there are constant dimensions comprising office work the technology used to complete that work has a transient nature. While compiling this table it was interesting to note that along with the more obvious developments such as the invention of the telephone and computer, other inventions have also had a dramatic impact on mundane aspects of office work. Where would offices be without staples, paper clips and biros?

Table 2 concentrates on major developments from the eighteenth century to the present. As far as the twenty-first century is concerned, since this starts in only five years' time, the early part of the century would be expected to show developments similar to those occurring now, while predictions for the latter part of the century may be best left to Nostradamus and the tea-leaf readers. However, although it may be difficult to predict technological developments one can safely predict that humans will not have been superceded by computers and that the following quote from *Animal Farm*, substituting 'computer' for 'pig', is unlikely to apply: "The creatures outside looked from pig to man, and from man to pig, and from pig to man again; but already it was impossible to say which was which" (Orwell, 1945). People will still be communicating with each other, worrying about their health, handling information and

so on. One example of a continuing concern seems to be the rules governing social interaction - from the 'etiquette of conversation' in 1900 (*The Farmer and Grazier*, 1900) to rules governing socially acceptable behaviour on computer networks - 'netiquette' in 1995. The main changes are likely to be in the technology available to assist with whatever people wish to undertake. In the distant future this may, or may not, include computer-based technology.

**TABLE 2 - THE RELATIONSHIP OF OFFICE WORK TO TECHNOLOGICAL DEVELOPMENTS**

| OFFICE WORK | TIME | TECHNOLOGY |
|---|---|---|
| **Information-handling** | 18th century | paper files |
| | 19th century | " " |
| | 20th century | filofax, databases, multimedia |
| | 21st century | ? |
| **Human Contact** | 18th century | face-to-face (coffee shops, etc) |
| | 19th century | " " " |
| | 20th century | " " " |
| | 21st century | ? |
| **Paper-handling** | 18th century | fountain pen |
| | 19th century | typewriter, paper clip |
| | 20th century | biro, typewriter, wordprocessor, staples, desktop publishing |
| | 21st century | ? |
| **Financial Security** | 18th century | paper-based accounts |
| | 19th century | " " " |
| | 20th century | direct transfer via computer |
| | 21st century | ? |
| **Communication** | 18th century | face-to-face (coffee shops, etc) |
| | 19th century | Penny post, telegrams, telephone |
| | 20th century | 'post-it' notes, electronic mail, telecommunications, facsimile, networks |
| | 21st century | ? |
| **Technology** | 18th century | quill pen |
| | 19th century | telephone, manual typewriter, fountain pen |
| | 20th century | biro, computers, mobile telephone |
| | 21st century | ? |
| **Work** | 18th century | emphasis on individuals and teamwork |
| | 19th century | " " " " " |
| | 20th century | " " " " " |
| | 21st century | ? |
| **Health Preservation** | 18th century | immunisation |
| | 19th century | public heath (e.g. sewers) |
| | 20th century | occupational health, VDU standards |
| | 21st century | ? |

**"A nice little earner"?**

Computers seem to provide, to borrow a phrase from Arthur Daly in the television programme *Minder*, "a nice little earner" not just for those involved in the computer industry (the manufacturers, retail outlets, computer training suppliers, computer maintenance personnel) but also for the researchers involved in studying human-

computer interaction (books, lectures, conferences, television appearances), the journalists reporting on developments in computer-based technology, and so on. Multiplied worldwide this produces a huge number of people who have a vested interest in ensuring the continued prevalence of computer-based technology. However, while the computer industry may wish to eradicate or minimize problems in using computer technology, researchers would be required to look elsewhere if the necessity to consider human-computer interaction became obsolete. At present it seems that no one involved with computers need panic as new issues relating to both technical aspects and usability aspects are likely to emerge even as other issues are resolved.

**Rationale for thesis**

One aim of the thesis was to illustrate that an increased understanding of user requirements and models may be gained from investigating user perceptions. Subjective data have a value independent of their use for implementation because user perceptions provide some insight into the user's thought processes and therefore any underlying user's model. User perceptions may affect their use of technology and should be considered when assessing the acceptability, usefulness, and impact of office technology.

***Why study the user interface?***

An awareness of the physical and psychological characteristics of users is important in order to maximise the usability and usefulness of technology. If user characteristics are ignored there may be physical, psychological, financial, and environmental consequences (see Chapter 4). The **physical consequences** of ignoring user characteristics include inability to use the product, health problems, injuries, and possibly death. The potential **psychological consequences** of poor design include frustration, irritation, discontent, anger, poor motivation, and absenteeism. An inappropriate model of the interface may be developed by the user. A well-designed interface may induce positive emotions in the user and increase motivation. The **financial consequences** which may result from an inadequate understanding of the user include lost contracts, and compensation demands for injuries, accidents and ill-health. Favourable user perceptions of product may lead to increased sales. The **environmental consequences** which may result from poor interface design include severe environmental damage and large-scale physical and psychological suffering.

***Why study user perceptions?***

In addition to the physical, psychological, financial, and environmental problems which may occur if user perceptions and characteristics are ignored there are moral, social,

and political reasons for considering user perceptions towards a particular phenomenon since perceptions may affect both individuals and society as a whole (see Chapter 4). With respect to office technology perceptions of user needs, views and requirements may affect policies on issues such as training, technology availability, and acceptable social and 'political' uses of technology (for example, data protection and video surveillance).

It could be argued that the need to understand user perceptions of technology has become even more relevant since the author's research began. Developments in telecommunications, international networks, virtual reality, and increased use of computers in the home as well as the office mean that more and more people are using computer-based technology. An understanding of the physical and psychological impact of computers on individuals and on society in general seems to be increasingly necessary as we approach the twenty-first century.

## KEY FINDINGS AND CONCLUSIONS

Since there appeared to be little existing research into user perceptions of the nature of office work and the role of technology in the office the overall aims of the author's research were to increase understanding of user perceptions of office work and the role of office technology, to determine the extent to which trends in the development of computer-based office systems reflect user perceptions, and to investigate the relationship between information derived from the author's studies and existing knowledge. **Existing knowledge** was considered in Chapters 2 to 4 (office work, human-computer interaction, the role of user perceptions). **User perceptions** were considered in Chapters 5 to 8 (Study 1: office work/role of office technology; Study 2: the use of technology in 'typical' office situations; Study 3: the 'ideal office'; Study 4: evaluation of current developments. **Portrayal of the computer industry by computer journalists** and perceptions of office technology in the media were considered in Chapter 9 (Study 5: content analysis).

### Existing knowledge

*The nature of office work*

A review of the main theories of the nature of office work and of the role of technology in the office indicated that none of the theories met all the criteria considered essential by the author for understanding office work and the role of technology in the office.

*Approaches to understanding human-computer interaction*

Consideration of various approaches to the study of human-computer interaction with emphasis on how these approaches can be applied to the use of technology in the office suggests that each approach uses different techniques and addresses different issues. The approach which is the most appropriate to use when investigating human-computer interaction will vary according to the purpose for which the approach has been chosen.

*The role of user perceptions in investigations of human-computer interaction*

A review of the literature indicated that it is necessary to understand the physical and psychological characteristics of users and user perceptions of the role of computers in the office for a variety of reasons ranging from moral and political reasons to physical, psychological, environmental and financial reasons.

**User perceptions**

*'The office as it is at present'*

*A: User perceptions of the nature of office work and the role of computers in the office*

Eight factors were described by factor analysis of a free-response questionnaire devised by the author: information-handling, human contact, paper-handling, financial security, communication, technology, work, and health preservation.

There was a high degree of consistency in the type of responses obtained. This suggests that the subjects shared similar conceptions of the nature of office work and perceived that while it is advantageous to allocate certain features of the office to the computer, computer systems have a detrimental effect on certain other features. For example, subjects appeared to regard computers as detrimental to informal social and local communication but beneficial to formal and long distance communication.

A comparison of the author's results with existing theories of office work indicated that there was a broad similarity between the dimensions derived from the author's study and the views of office work considered in the literature. For example, the communication view seemed to be broadly similar to the 'communication' dimension.

*B: The effect of situation characteristics on user perceptions of their use of technology*

Analysis of the choices made by subjects presented with a verbal description of 58 hypothetical office situations suggested that the subjects' perceived choice of

technology or non-technology for situations belonging to a similar category was influenced by the information available about the specific characteristics of a particular situation. For situations in the categories 'document preparation', 'information management', and 'communication' subjects chose technology significantly more often than non-technology, while for 'decision-making' subjects chose non-technology significantly more often than technology.

'Document preparation' and 'information management' may be perceived to be 'mechanical' situations for which technology is adequate whereas 'decision-making' and 'communication' are regarded as 'cognitive' and 'social' situations respectively where reliance on machinery is unsuitable.

*'The office as it could be': trends in the development of technology*

*A: User perceptions of the Ideal Office*

The information obtained from subjects' descriptions of their 'Ideal Office' suggested that the subjects shared broadly similar views of the nature of the 'Ideal Office' and the relative importance of the features which should be included.

Four 'Ideal Office' factors were identified - technology, communication, financial security, and paper-handling. These factors were similar to those produced by analysis of The Office section of the Free Response Questionnaire in *'User perceptions of the nature of office work'*.

Subjects perceived that most features would be available in the near future (within a year) or soon (within 5 years).

Consideration of user perceptions of the 'Ideal Office' in the light of current developments in office technology indicated that users and the computer industry have broadly similar perceptions of the 'Ideal Office'. However, developments in areas such as Agent Based Computing and virtual reality indicate a certain amount of discrepancy between users and the computer industry regarding the extent and pace of future developments. Users appear to want "evolution rather than revolution" (Schofield, 1992).

Frequent descriptions of scientists and technologists as "computer anoraks" and "nerds" were found in the literature which could provide a clue to the apparent reluctance of users to share the computer industry view of the future since these unflattering attributions may be generalised to the technology itself making users

suspicious of 'radical' changes in technology.

Since 'office' technology is increasingly used at home as well as in the office and current technological developments seem to be moving way beyond 'glorified typewriters' and 'adding machines', it is important to consider the impact of technology on society in general.

*B : An evaluation of current developments in computer-based office systems*

Information obtained from an evaluation of user perceptions of the usability and efficiency in particular situations of two prototype systems (System A and System B) made by leading companies indicated that subjects felt that it was important to be able to use a computer system for some situations but it was not felt to be essential to be able to use a computer system for every situation.

Subjects perceived computer provision to be most important for situations in the Information Management and Communication categories and least important for situations in the Decision-making category. These results coincided with the results obtained in *'The effect of situation characteristics on user perceptions of their use of technology'* when subjects stated that they would be more likely to use non-technology than technology for Decision-making and more likely to use technology than non-technology for Information Management.

Although subjects showed a slight preference for System A, overall both systems were thought to meet the requirements of a computer-based office system 'very well'.

A weighted factors evaluation questionnaire similar to the one used in *'An evaluation of current developments in computer-based office systems'* could provide a relatively quick, inexpensive, and portable method to evaluate user perceptions of a product in 'final' or prototype form. For example, the questionnaire could be used by companies to conduct comparative evaluation of sales videos.

**Portrayal of the computer industry by computer journalists**

*Content analysis of computer journalists' portrayal of the computer industry*

A content analysis of two publications - *The Guardian* and *PC Week* - for the period January 1991-June 1993 found that both the publications analysed mentioned most of the dimensions described in *'An investigation of user perceptions of the nature of office work'* but varied in the amount of coverage given to those dimensions. The dimension which consistently received the most coverage was technology and the

dimension which received the least coverage was health preservation. Issues concerned with financial security such as cost, sales, and prices also received a large amount of coverage.

The outcome of the content analysis provides additional evidence for the hypothesis that the dimensions described in *'An investigation of user perceptions of the nature of office work'* reflect perceptions held by a broader group of people than the subjects who participated in the author's research.

The minimal coverage given to certain issues may reflect a significant difference in perceptions between computer industry journalists and users or merely that certain issues are considered to be more interesting to the readers of particular publications. The computer industry journalists appeared to regard technical details and financial issues as paramount with less emphasis on face-to-face human contact and health issues. This could be an artefact of the current study but if it reflects actual computer industry priorities indicates areas which may need additional attention if user and computer industry perceptions are to coincide so that the usability and acceptability of computers can be enhanced.

The recent increase (1994-1995) in the number of supplements and articles dedicated to information technology supports the view that newspapers in general perceive interest in technology to be growing.

Since large numbers of people read newspapers, coverage of technology in the media may reflect or influence user perceptions of technology.

## METHODOLOGICAL REVIEW

Some methodological issues relevant to the empirical research described above are discussed below.

**How should we study user perceptions? - An evaluation of the author's approach**

Since the office and office technology were broadly defined it was not considered appropriate to adhere rigidly to the research instruments and literature associated with a single discipline. Thus the thesis considers issues thought to be of interest to readers with interests in various disciplines including psychology (cognitive, social, occupational, and marketing), ergonomics, sociology, and politics.

The research was completed by only one researcher although the assistance of judges

was required to assess the validity and reliability of the author's assessments in Study 1 and Study 5. Although subjects may need incentives to complete lengthy questionnaires - the *'What's in it for me?'* syndrome - the questionnaires used in this thesis were designed to be quick to complete while trying to maximise the information obtained. Good response rates were obtained for the questionnaires, possibly because they were issued to a specified population rather than being distributed at random to a large number of people.

*Subjects* - It may be suggested that since user perceptions are 'subjective' there are more 'valid' ways to investigate issues relating to office work and office technology since knowledge of user perceptions may not accurately predict actual behaviour or ability to use a specific system. A distinction can be made between **perceptions** and **reports** based on personal observations. The former may be valid regardless of experience with the topic in question while the latter do require some experience.

Since the emphasis in this thesis was on gathering data about thoughts and perceptions, direct personal experience of 'offices' and 'technology' was not considered a prerequisite for participation. A deep sea diver does not need to have worked in an office to have thoughts about the nature of office work. Similarly, an office worker does not need to be a soldier to have ideas about working in the army.

The subjects who participated in Studies 1 to 4 had both theoretical and practical knowledge of office technology since they consisted mainly of: undergraduate students on computing courses, IT professionals (postgraduate students on a part-time master's degree course in user-interface design who were already working in the computer industry) and 'professionals' working in a variety of occupations including clerical work and administration. Virtually all the subjects had some experience of using computers. Since many subjects had extensive experience of computers this increased the probability that their opinions and perceptions of computers were based on actual knowledge and experience rather than just speculation.

*Subjective vs. Objective data*

1. Although it may be necessary to supplement subjective data by objective data when implementing a specific application, subjective data (for example, the responses to the Free Response Questionnaire issued in Study 1) provide some insight into the user's thought processes and therefore any underlying user's model.

2. While it could be argued that hypothetical scenarios "rest upon accounts of

circumstances that are either imagined or recollected" (Suchman, 1987) there may be ethical and practical problems when using actual situations (for example, Study 2).

3. Although the emphasis in Study 4 was on user **perceptions** of whether a system or product is suitable for use in particular situations and not on **actual** use, the evaluations given could affect actual use and acceptance of the systems.

**Sources of evidence**

1. *Author's studies (Studies 1 to 5)*

Information concerning the perceptions of specific groups of subjects was obtained from the author's empirical studies (see Chapters 5-9).

2. *Casual observation - "I know, ... 'cos I was there" (Boyce, see Chapter 4)*

Some validation of the author's findings concerning predicted and actual behaviour was obtained from 'casual observation'. This involved observation of instances of use of technology such as mobile phones while waiting in bus queues, travelling by train, walking around London, and so on. As the name implies, this form of evidence involves opportunistic rather than systematic observations and may therefore be regarded as unreliable for generalization. However, if interpreted in conjunction with other forms of evidence it provides supplementary evidence for the author's findings.

*3. Literature review*

Additional confirmation for the author's findings was provided by surveying the literature. Information was collected from a wide variety of sources including 'academic reports' (CD-ROM databases, journals, books, and conferences in the areas of human-computer interaction, psychology, and ergonomics, and so on) and 'non-academic reports' (newspapers, magazines, television, radio, and so on). Consideration of a variety of sources was considered essential in the context of the thesis since the emphasis was on the perceptions of technology and the office of users in general. While academic journals and books tend to provide 'first-hand' sources of information such as models and experimental studies, newspapers tend to rely on reports and personal opinions. However, while there may be long delays between investigations and publication of the results in academic journals, newspapers supply up-to-date topical information concerning current developments in technology and current perceptions of technology. Table 3 shows the number of references included according to type of author, year of publication, type of publication, and type of evidence.

It could be argued that "we are all users now" as the number of people using computer-

based technology grows. The existence of diverse sources of information indicates that in addition to individual perceptions, there is a 'collective awareness' of technology. Individual perceptions may be both shaped and reflected by society. Reinforcement of particular perceptions may be influenced by specific experiences and membership of certain groups. This may result in differences in perceptions between 'users' and 'designers', and so on.

**TABLE 3 - REFERENCE CHARACTERISTICS**

| | FREQUENCY [N = 313] | PERCENTAGE |
|---|---|---|
| **TYPE OF AUTHOR [N = 313]** | | |
| [5] Academic | 157 | 50% |
| [4] IT professional | 34 | 11% |
| [4] Other professional | 17 | 5% |
| [3] Computer journalist | 19 | 6% |
| [3] Other journalist | 77 | 25% |
| [2] Fiction writer (Novelist, Poet) | 8 | 3% |
| [1] Unknown | 1 | 0% |
| **YEAR OF PUBLICATION [N = 313]** | | |
| [5] 1995-1991 | 147 | 47% |
| [4] 1990-1981 | 123 | 39% |
| [3] 1980-1971 | 22 | 7% |
| [2] 1970-1956 | 9 | 3% |
| [1] 1955 and earlier | 12 | 4% |
| **TYPE OF PUBLICATION [N = 313]** | | |
| [5] Academic book, journal, or report (published) | 180 | 58% |
| [4] Academic computer-based conference (unpublished) | 2 | 1% |
| [4] Academic lecture (unpublished) | 1 | 0% |
| [4] Computer magazine/journal | 18 | 6% |
| [4] Professional magazine/journal/newsletter | 9 | 3% |
| [3] 'Non-professional' magazine/journal | 14 | 4% |
| [3] Newspaper | 78 | 25% |
| [3] Television/radio programme | 2 | 1% |
| [2] 'Non-academic' book (e.g. novel; personal recollection) | 7 | 2% |
| [2] 'Non-academic' lecture/speech | 1 | 0% |
| [2] Film (fiction) | 1 | 0% |
| [1] Unknown | 0 | 0% |
| **TYPE OF EVIDENCE [N = 313]** | | |
| [5] Experimental (e.g interview, survey, case study, field study, laboratory study) | 84 | 27% |
| [4] Theoretical - model | 82 | 26% |
| [3] - technical | 17 | 5% |
| [3] - literature review | 11 | 4% |
| [3] 'Non-academic' report (newspaper, television,etc) | 91 | 29% |
| [2] Personal opinion/personal recollection | 14 | 5% |
| [1] Fiction (novel, film, cartoon, poem) | 14 | 5% |

**NOTES**
[] = dependability rating for that category
5 = high dependability
1 = low dependability
% rounded to nearest whole figure

*Dependability of sources - "I just read the Daily News and swear by every word" (Steely Dan song, 1970s)*

Since little research directly relevant to 'user perceptions of technology and the office' was identified (see Chapter 4) this made it difficult to make direct comparisons and evaluations of existing studies with the author's own studies. It was thought to be more important to assess the references as a whole rather than to undertake an in-depth analysis of specific studies. However, the author produced a framework for evaluating the dependability of the references included in the thesis. This is described in more detail in Chapters 1 and 4. Each reference was assessed using a 5-point rating scheme where a rating of 5 indicated that the reference was considered to be highly dependable by the author on all the criteria (type of author, year of publication, type of publication and type of evidence) and a rating of 1 that the reference was not considered very dependable.

Although some variation in the dependability of different references was found (see Table 4), all the sources are considered to provide valuable information in the context of gaining knowledge about user perceptions. The majority of references (95%) were considered to be highly dependable as they received dependability ratings of 4 or 5. The references which received ratings of only 2 or 3 tended to be those which were older or came from sources such as novels. However, novelists such as Orwell provide some of the most accurate predictions and observations.

**TABLE 4 - DEPENDABILITY OF REFERENCES INCLUDED IN THE THESIS**

| | DEPENDABILITY RATING | | | | |
|---|---|---|---|---|---|
| | **5** | **4** | **3** | **2** | **1** |
| **Chapter 1 [N = 16]** | 12 75% | 4 25% | 0 0% | 0 0% | 0 0% |
| **Chapter 2 [N = 46]** | 35 76% | 10 22% | 1 2% | 0 0% | 0 0% |
| **Chapter 3 [N = 51]** | 47 92% | 4 8% | 0 0% | 0 0% | 0 0% |
| **Chapter 4 [N = 56]** | 40 71% | 10 18% | 2 4% | 4 7% | 0 0% |
| **Chapter 5 [N = 64]** | 43 67% | 21 33% | 0 0% | 0 0% | 0 0% |
| **Chapter 6 [N = 66]** | 45 68% | 21 32% | 0 0% | 0 0% | 0 0% |
| **Chapter 7 [N = 65]** | 16 25% | 47 72% | 0 0% | 2 3% | 0 0% |
| **Chapter 8 [N = 30]** | 27 90% | 3 10% | 0 0% | 0 0% | 0 0% |
| **Chapter 9 [N = 25]** | 7 28% | 12 48% | 6 24% | 0 0% | 0 0% |
| **Chapter 10 [N = 10]** | 2 20% | 4 40% | 1 10% | 3 30% | 0 0% |
| **All Chapters [N = 313][1]** | 174 56% | 123 39% | 10 3% | 6 2% | 0 0% |

**NOTES**

[1] = some references were cited in more than one chapter

Final dependability rating: 5 = highly dependable, 1 = not at all dependable

% = percentage rounded to nearest whole figure

N = frequency

*"Can't we get you on Mastermind, Sybil: [...] subject 'stating the [...] obvious'?"*
*(John Cleese in Fawlty Towers, c. 1975)*

The extent to which research is considered innovative and exciting can be subjective. Research greeted with great enthusiasm by one person may be thought boring by someone else. Research may be regarded as exploratory or confirmatory. That is, research may consider a totally new area or it may seek to confirm 'common knowledge' of a particular phenomenon through systematic investigation. For example, researchers may seek to prove that 2 + 2 does indeed produce 4. The consequences of finding that it actually equalled 5 (as in Orwell's *Nineteen Eighty-Four*) could be immense. In the current study the author attempted to systematically investigate user perceptions to determine the extent to which they matched existing knowledge.

The following extract from Bunyan (1678) eloquently expresses the difficulty which may be encountered in attempting to please all readers:

> Thus I set pen to paper with delight,
> And quickly had my thoughts in black and white.
> [...]
> Well, when I had thus put mine ends together,
> I show'd them others that I might see whether
> They would condemn them, or them justify:
> And some said, 'let them live'; some, 'let them die':
> Some said, 'John print it'; others said, 'not so':
> Some said, 'it might do good'; others said, 'no'.
>
> (*The Pilgrim's Progress*, John Bunyan, 1678)

## FUTURE RESEARCH

Current developments in technology have resulted in the emergence of a wide range of research issues related not only to the techniques available for completing particular tasks but also to the way in which people live and work. Developments in areas such as artificial intelligence and virtual reality have the potential to break down or blur the boundaries between 'real' and 'unreal' and even between 'human' and 'non-human'.

Two main strands to the author's research have emerged, one related to user perceptions of office **work** and the other to user perceptions of office **technology**. Since the use of office technology is not necessarily restricted to office work, a wider range of research issues than those related to office work may be relevant. For example, telecommunications can be used for both business and recreational purposes. Possible areas for future research are outlined below.

**Research directly related to the author's earlier studies**

All the author's studies could be repeated to complement existing measures while providing convergent validity.

*User perceptions of the nature of office work*

The reliability of the eight dimensions identified in *'An investigation of user perceptions of the nature of office work'* could be investigated by repeating the study on subjects similar to those who participated in the original study. Predictive validity could also be assessed in future research.

*The effect of situation characteristics on user perceptions of their use of technology*

The extent to which 'document preparation' and 'information management' are perceived to be 'mechanical' situations for which technology is adequate whereas 'decision-making' and 'communication' are regarded as 'cognitive' and 'social' situations respectively where reliance on machinery is unsuitable could be investigated.

*Evaluation of technology*

The Evaluation Questionnaire derived by the author could be used to evaluate technology such as facsimile machines which is designed for use in situations belonging to a specific situation category. A wider range of office technology could also be considered to see whether this produced greater diversity in the evaluations given.

The use of videos for evaluation of prototypes could be investigated further. For example, the commercial applications of the Evaluation Questionnaire devised by the author could be investigated.

*Media portrayal of developments in the computer industry*

A more detailed investigation of technology and the media could be made. For example, a cross-cultural study of how technological developments are depicted in the media.

**Research inspired by issues considered in the author's research**

*The social impact of technology*

What are the rules governing technology usage, ('netiquette')? Are certain methods of communication considered more socially acceptable than others? What is the impact of the use of electronic mail on the laws of libel and defamation?

*The political impact of technology*

Is increased use of computer-based technology likely to increase democracy or result in increased repression and government surveillance? Who legislates over the Internet? Can the laws of individual countries still be enforced? Does the existence of access via electronic mail make some politicians more accessible? To what extent does increased access depend on whether the politician in question actually reads the electronic mail and whether they reply to such messages? Are there cultural differences in perceptions of technology?

*Reality versus 'virtual reality'*

A detailed investigation could be made of perceptions of the difference between:

'human' and 'non-human'
'real' and 'nonreal'
'work' and 'leisure'
technology/non-technology
home/office.

## CONCLUSION

### Overview of thesis

The results obtained in Studies 1 to 4 indicated that the subjects shared perceptions of office work and the role of technology in the office. The results of Study 5 showed some overlap between user perceptions and portrayal of computer industry perceptions in the media. Comparison of user perceptions with existing knowledge and current developments in technology showed similarities in the main dimensions considered - communication, information-management, and so on. The main difference between user perceptions, existing knowledge and current developments seemed to be in the emphasis given to these dimensions and in the extent and pace of change. Although users seemed to be reasonably happy with existing technology and to want gradual change, developments in technology seemed to be occurring very rapidly.

Where user perceptions coincided with existing models of the office and current developments in technology this could be attributed to market forces or manufacturer insight. That is, people may 'get what they want' due to consumer power or 'want what they get' due to the persuasive power of advertising and desire to avoid cognitive dissonance. There is probably a mixture of both possibilities - manufacturers conduct market research to find out what people are likely to buy then other people buy the product because that is what is currently available. Similarities in perceptions also indicate that there may be universal perceptions concerning the nature of office work and the nature of technology.

The author's research demonstrates that a knowledge of user perceptions can be applied to investigations of office work and office technology at various levels. Studies 1 and 3 (*'An investigation of user perceptions of the nature of office work'* and *'User perceptions of the Ideal Office'*) considered user perceptions of offices and office technology in general while Studies 2 and 4 (*'The effect of situation characteristics on user perceptions of their use of technology'* and *'An evaluation of current developments in computer-based office systems'*) considered user perceptions related to specific situations and specific technology. Study 5 (*'Content analysis of computer journalists' portrayal of the computer industry'*) demonstrated that the perceptions of the subjects who participated in the author's earlier studies could be compared with the perceptions of computer journalists thus providing additional evidence for the generalizability of the author's research.

**Technology is becoming invisible**

The level at which technology is studied may depend on the level of usability of that technology. As 'low' level usability problems are eliminated the technology becomes effectively 'invisible' and higher level issues become more important. Examples of technology which has become invisible include the telephone and motor car (Gale, 1989). Whereas the emphasis in the past may have been on teaching users the difference between the functions of "Button A" and "Button B", the emphasis now is on the cost of calls, profit margins earned by the telephone companies and 'social' issues such as 'nuisance calls', teenagers running up huge bills using chat lines, telemarketing, acceptable locations for using one's mobile phone, and so on. However, usability problems do not necessarily disappear completely as shown by the confusion following PhONE *[sic]* day in 1995 when an extra digit was added to British telephone numbers.

Technology may be seen as a reflection of society. For example, issues currently causing concern related to Internet use include crime (theft of data, theft of the technology itself, pornography, fraud, 'nuisance' messages), civil liberties (access to electronic mail), political uses (increased democracy or increased authoritarianism; anarchy versus regulation). Formal legislation and informal rules may develop to ensure that potential problems are recognised. For example, netiquette involves informal rules relating to Internet use. There may be unanticipated developments in the way in which technology is used. For example, video surveillance - little brother has been observed watching Big Brother with a camcorder (Hebert, 1994). An important point which should be recognised is that the use, misuse and abuse of technology is likely to depend on user perceptions and the circumstances in which the technology is used rather than

being intrinsic to the technology itself. Currently technology may be regarded as neither good nor bad. It is likely to remain so until human characteristics and attributes are replicated in machines.

**And finally...**

This thesis has considered user perceptions of the nature of office work and office technology. Some trends in the development of computer-based office technology seem to reflect user perceptions of office work and the role of technology in the office while others seem to vary to a great extent. For example, the increasing use of computer networks seems to closely match the perception of users that communication is an essential feature of office work. However, other trends such as the emphasis on artificial intelligence, intelligent agents, and virtual reality applications seem to differ significantly from user perceptions. Office work can be considered in terms of 'technology' and 'non-technology'. 'Technology' includes computers, telephones, photocopiers, facsimile, and so on. 'Non-technology' includes face-to-face communication (both formal and informal), the need for security, health preservation, and so on. Both the 'technology' and 'non-technology' aspects need to be considered when studying office work and the role of technology in the office. In addition there should be an understanding of how user perceptions may affect the acceptability and impact not only of technology in the office but on society as a whole.

Increased awareness of user perceptions may pre-empt potential misuses and abuses of technology while ignorance may result in problems ranging from the trivial to the catastrophic. If the internerds, deviants, criminally-inclined, and potential dictators are not to inherit the information superhighway, "frankly my dears" we **should** understand user perceptions of office technology.

# APPENDICES

# APPENDIX A - SUPPLEMENTARY MATERIAL USED IN EMPIRICAL RESEARCH

## CHAPTER 5 - APPENDIX 1 - FREE RESPONSE QUESTIONNAIRE

## BACKGROUND INFORMATION

**INSTRUCTIONS**
Please answer all the questions below putting a tick [✓] in the relevant box/boxes or filling in the information requested in the space provided.
Please note that all personal information supplied is strictly confidential.

**AGE**

17 and under [ ]
18 - 34 [ ]
35 - 49 [ ]
50 - 64 [ ]
65 and over [ ]

**SEX**

male [ ]
female [ ]

**OCCUPATION**

student [ ] (please state which course you are attending)
_____
lecturer [ ] (please state which course you teach)
_____
clerical worker [ ]
administrative worker [ ]
other [ ] (please specify)_____

**COMPUTER EXPERIENCE**

Do you use a computer system in your present occupation?

yes [ ]
no [ ] If no, have you ever used a computer system?
yes [ ]
no [ ]

If you currently use a computer system (or used a computer system in the past) in what capacity do you use (did you use) that system? (You may tick more than one box if appropriate)

end-user [ ]
programmer [ ]
software designer [ ]
other [ ] (please specify)
don't know [ ]

If you use a computer system (or used a computer system in the past) how frequently do you use (did you use) that system?

frequently (every day) [ ]
quite often (once a week) [ ]
infrequently (once a month) [ ]
rarely (once a year) [ ]
don't know [ ]

## INTRODUCTION

This is a study of the characteristics of 'the office', in particular, the role of computers in the office. Please complete the tasks on the following pages. **PLEASE ENSURE THAT YOU COMPLETE THE TASKS IN THE ORDER THAT THEY HAVE BEEN PRESENTED.** Remember that there are no right or wrong answers. Do not worry if you cannot understand a question, just answer it as you think fit as all information provided will be useful to the research. Thank you for participating.

## THE OFFICE

Imagine a 'typical' office. Describe the activities which occur during a 'typical' day. Rank these activities according to how important you feel them to be. For example, if you have described 10 activities, write "1" against the activity you consider to be the most important, "2" against the activity you consider to be the second most important, "3" against the activity you consider to be the third most important, and so on until you reach "10". You may describe as many or as few activities as you like but please ensure that you rank all the activities you list.

**ACTIVITIES** **RANKING**

_____

## USING COMPUTERS IN THE OFFICE

Imagine a 'typical' office and the activities which occur during a 'typical' day. Assume that it is possible to assign those activities to a computer. Describe the advantages which you think may result from assigning office activities to a computer. Rank these advantages according to how important you feel them to be. For example, if you have described 10 advantages, write "1" against the advantage you consider to be the most important, "2" against the advantage you consider to be the second most important, "3" against the advantage you consider to be the third most important, and so on until you reach "10". You may describe as many or as few advantages as you like but please ensure that you rank all the advantages that you list.

**ADVANTAGES** **RANKING**

_____

## USING COMPUTERS IN THE OFFICE

Imagine a 'typical' office and the activities which occur during a 'typical' day. Assume that it is possible to assign those activities to a computer. Describe the disadvantages which you think may result from assigning office activities to a computer. Rank these disadvantages according to how important you feel them to be. For example, if you have described 10 disadvantages, write "1" against the disadvantage you consider to be the most important, "2" against the disadvantage you consider to be the second most important, "3" against the disadvantage you consider to be the third most important, and so on until you reach "10". You may describe as many or as few disadvantages as you like but please ensure that you rank all the disadvantages that you list.

**DISADVANTAGES** **RANKING**

_____

## THE IDEAL OFFICE

Imagine that you have been given the opportunity to assign any features of the office you like to a computer to create your ideal office. Describe the features that you would include assuming that there are no constraints on the technology or money available, and so on. Rank these features according to how important it would be to you for them to be included. For example, if you have described 10 features, write "1" against the feature you consider to be the most important, "2" against the feature you consider to be the second most important, "3" against the feature you consider to be the third most important, and so on until you reach "10". You may describe as many or as few features as you like but please ensure that you rank all the features that you list.

Assume that you are still creating your ideal office but are now limited by financial and technological constraints. When do you think that the features you would like in your ideal office could be implemented at reasonable cost? Write a number against each feature you have listed using the following list:

1 = never likely to be implemented
2 = likely to be implemented 25 years from now
3 = likely to be implemented 10 years from now
4 = likely to be implemented 5 years from now
5 = likely to be implemented 1 year from now

| FEATURES | IMPORTANCE RANKING | IMPLEMENTATION FORECAST |
|---|---|---|
| | _____ | _____ |

## CHAPTER 5 - APPENDIX 2 - CLASSIFICATION CHECKLIST EXTRACT

### INSTRUCTIONS

Please choose an item from the list below which you believe provides the most suitable label for describing the items on the list. Place an "X" against this item. Rate the remaining items on a scale of 1 to 5 according to how similar you feel them to be to the item you have chosen. "5" should be assigned to the item(s) you feel are most like the items you have chosen and "1" to any item(s) which you feel are totally unlike the item you have chosen. You may use the same rating for several items if you feel that they have a similar meaning.
Please repeat this process with each group of items you have been given.
The examples below provide an illustration of what is required.

**EXAMPLE 1**

| | | |
|---|---|---|
| | cat | 3 |
| | tiger | 4 |
| | dog | 1 |
| | cheetah | 4 |
| | lion | 4 |
| | puma | 4 |
| X | wild cat | 5 |
| | lizard | 1 |
| | leopard | 4 |

**EXAMPLE 2**

| | | |
|---|---|---|
| | lukewarm | 4 |
| X | temperature | 5 |
| | tepid | 4 |
| | icy | 3 |
| | fairly warm | 4 |
| | good | 1 |
| | boiling | 4 |
| | fiery | 4 |
| | hot | 4 |

**GROUP 1**
efficient system for recording and storing information
fact storing
information storing
keeping up-to-date records
keeping accurate information which can be got at quickly in order to answer customer enquiries
record-keeping
storing and retrieving information
typists
staff records (confidential)

**GROUP 2**
wordprocessing
word processing / documents
word processing, etc.
wordprocessing reports
word processing/typing
writing/word processing
receiving visitors

## CHAPTER 5 - APPENDIX 3 - LABELS CHECKLIST EXTRACT

### INSTRUCTIONS

On each line of the list below is a pair of labels (e.g. wordprocessing / expense). Using the rating scale below, please write a rating against each pair of labels to indicate the extent to which you feel that the 2 labels in the pair are related (i.e. How far do the labels mean the same thing?). A minus (-) sign should be written in front of a rating which indicates a pair of labels which have 'opposite' but related meanings.

### RATING SCALE

10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10

very strong negative connection ('opposite') — no connection — very strong positive connection ('same')

### EXAMPLES

| | |
|---|---|
| baking bread / bread-baking | 10 |
| baking bread / loaf preparation | 8 |
| happy / fairly happy | 4 |
| baking bread / happy | 0 |
| happy / quite sad | -4 |
| happy / fairly unhappy | -6 |
| happy / unhappy | -10 |

correspondence / using different types of communication
correspondence / meetings
correspondence / computer goes down
correspondence / easy data retrieval
correspondence / health hazards
correspondence / reduction of paperwork

## CHAPTER 6 - APPENDIX 1 - SAMPLE QUESTIONNAIRE

## BACKGROUND INFORMATION

**INSTRUCTIONS**
Please answer all the questions below putting a tick [✓] in the relevant box/boxes or filling in the information requested in the space provided.
Please note that all personal information supplied is strictly confidential.

**DATE**
**NAME**
**AGE**

| | |
|---|---|
| 17 and under | [ ] |
| 18 - 34 | [ ] |
| 35 - 49 | [ ] |
| 50 - 64 | [ ] |
| 65 and over | [ ] |

**SEX**

| | |
|---|---|
| male | [ ] |
| female | [ ] |

**OCCUPATION**

| | |
|---|---|
| student | [ ] (please state which course you are attending) _____ |
| lecturer | [ ] (please state which course you teach) _____ |
| clerical worker | [ ] |
| administrative worker | [ ] |
| other | [ ] (please specify)_____ |

On each of the following pages you will be given a verbal description of a work situation. Several situations are described. For each situation think about what you would do in a similar real-life situation then choose ONE of the alternatives given for solving that problem. Please work through the tasks in the order in which they have been presented and ensure that you complete all the tasks given. An example of what is required is given below.

**EXAMPLE**
You wish to purchase a new stapler for your office. You have a limited budget for this purchase. Which one of the following alternatives would you choose? [Please tick one alternative]

✓ manual model
'state-of-the art' electronic stapler
'Honest Sid's Cut Price' electronic stapler

You are preparing a report for an internal meeting of your department. The report must be ready by the end of today. Which one of the following methods would you use to prepare the report? [Please tick one alternative]

word processor
handwriting
typewriter
desktop publishing

## SITUATIONS PRESENTED TO SUBJECTS

**DOCUMENT PREPARATION (Situations 1-10)**

1. You are preparing a report for an internal meeting of your department. The report must be ready by the end of today. Which one of the following methods would you use to prepare the report?

2. You are preparing a report for an internal meeting of your department. The report must be ready by the end of next week. Which one of the following methods would you use to prepare the report?

3. You are preparing a report for circulation to new customers. The report must be ready by the end of today. Which one of the following methods would you use to prepare the report?

4. You are preparing a report for circulation to new customers. The report must be ready by the end of next week. Which one of the following methods would you use to prepare the report?

5. You are writing a memorandum to the Head of your department concerning a request for a new photocopier. Which one of the following methods would you use to prepare the memorandum?

6. You are writing a memorandum to a colleague concerning the date of the next staff meeting. Which one of the following methods would you use to prepare the memorandum?

7. You have finished your daily work schedule so have decided to write a personal letter to a close friend. Which one of the following methods would you use to write the letter?

8. You have finished your daily work schedule so have decided to write a letter to a business contact you met at a conference earlier this year suggesting a lunchtime meeting to discuss mutual business interests. Which one of the following methods would you use to write the letter?

9. You have been asked to take the minutes at a Board meeting. It is important that you record accurately what is said and circulate the minutes to staff immediately after the meeting. Which one of the following methods would you use to record the minutes?

10. You are recording ideas for a conference paper you are writing. You wish to record your ideas as they flow. You have three weeks before the final draft of the paper has to be submitted. Which one of the following methods would you use to record your ideas?

**INFORMATION MANAGEMENT (Situations 11-27)**

**Information Gathering (Situations 11-14)**

11. You are trying to determine the cost of buying new equipment for your firm. You need to know the prices in time for an internal meeting today. Which one of the following methods would you choose in order to determine the cost?

12. You are trying to determine the cost of buying new equipment for your firm. You need to know the prices by the end of next week. Which one of the following methods would you choose in order to determine the cost?

13. You wish to find out the annual profits of a rival company. Given that such information is freely available, which one of the following methods would you choose in order to determine the profits?

14. You wish to find out the annual profits of a rival company. Given that such information is carefully guarded, which one of the following methods would you choose in order to determine the profits?

**Information Storing/Retrieval (Situations 15-22)**

15. You have recently accumulated a large amount of information to which you will need to refer on a daily basis. You have limited physical space in your office. Which one of the following methods would you choose when deciding where to store your information?

16. You have recently accumulated a large amount of information to which you will need to refer on a daily basis. You have a large spacious office. Which one of the following methods would you choose when deciding where to store your information?

17. You need to store a few telephone numbers of people with whom you are in contact on a daily basis. You have a large spacious office. Which one of the following methods would you choose when deciding where to store your information?

18. You have decided to revise the way in which you store information (files, documents, etc). You are seeking a simple system which requires little or no training as there is no training budget in your department. Which one of the following methods would you choose when deciding where to store your information?

19. You have decided to revise the way in which you store information (files, documents, etc). You will have access to training facilities whichever system you choose as your department has a generous training budget. Which one of the following methods would you choose when deciding where to store your information?

20. You are deciding where to store some information (files, documents, etc). You anticipate that you will need access to this information on a daily basis. Which one of the following methods would you choose when deciding where to store your information?

21. You are deciding where to store some information (files, documents, etc). You anticipate that you will be unlikely to require access to this information for several months. Which one of the following methods would you choose when deciding where to store your information?

22. You are deciding where to store some information (files, documents, etc). You anticipate that you will need rapid access to this information as you receive many telephone requests for information which need an instant response. Which one of the following methods would you choose when deciding where to store your information?

**Information Protection (Situations 23-27)**

23. You have been asked to store some confidential information (client records). The power supply in your office block is unreliable due to extensive construction work on the road outside. Which one of the following methods would you choose when deciding where to store the information?

24. You have been asked to store some confidential information (client records). The power supply in your office block is considered very reliable as the building in which you work has recently been rewired. Which one of the following methods would you choose when deciding where to store the information?

25. You have been asked to store some confidential information (client records). You work in an open plan office which is freely accessible to both staff and clients. Which one of the following methods would you choose when deciding where to store the information in order to ensure that the records remain confidential?

26. You have been asked to store some confidential information (client records). You work in an open plan office which is accessible only to staff. Which one of the following methods would you choose when deciding where to store the information in order to ensure that the records remain confidential?

27. You have been asked to store some information which is not yet freely available to all staff. You work in an open plan office which is accessible to all staff. Which one of the following methods would you choose when deciding where to store the information in order to ensure that the records remain confidential?

**DECISION-MAKING (Situations 28-35; 52-58)**

**General decision-making (Situations 28-35)**

28. You have been asked to make 10% of your work force redundant. Many of your employees have been with the firm since leaving school. You wish to make a fair, impartial decision. How would you make the final decision who to "let go"?

29. You have been asked to choose a new colour scheme for the office carpets. How would you make the final decision which colour scheme to choose?

30. You have received a report of thick smoke in the basement of your office block. You are working on the 15th floor. How would you make the final decision whether to evacuate the building?

31. You have received a report that water is slowly seeping into the basement of your office block. You are working on the 15th floor. How would you make the final decision what action to take?

32. You are planning a major new project. Your plan must be ready by the end of the day. How would you decide on a plan?

33. You are planning a major new project. You have a month to prepare the plan. How would you decide on a plan?

34. You have been asked to buy photocopiers for several departments in your firm. You must buy reliable machines. You have a limited amount of money to spend. How would you decide which machines to buy?

35. You have been asked to buy photocopiers for several departments in your firm. You must buy reliable machines. You have a generous amount of money to spend. How would you decide which machines to buy?

**Choosing where to work (Situations 52-58)**

52. You have been given the opportunity to decide whether to work mainly at home or in the office. You currently spend two hours a day travelling to work but see many people when in the office. Where would you choose to spend most of your working time?

53. You have been given the opportunity to decide whether to work mainly at home or in the office. You currently spend two hours a day travelling to work. You see only a few people when in the office. Where would you choose to spend most of your working time?

54. You have been given the opportunity to decide whether to work mainly at home or in the office. You live within walking distance of the office and see many people when you are at work. Where would you choose to spend most of your working time?

55. You have been given the opportunity to decide whether to work mainly at home or in the office. You live within walking distance of the office but see only a few people when in the office. Where would you choose to spend most of your working time?

56. You have been given the opportunity to move to a new office. Your current office has no link to the computer network but is located near the staff common room. The new office has a link to the computer network but is in a separate building 20 minutes walk from the staff common room. Which office would you choose?

57. You are considering a change of employment. You attend interviews with two different companies and receive job offers from them both. There is very little difference between the two companies except that Company A provides a computer for each member of staff but allows only a short lunch break and coffee break while Company B has fewer computers but is very flexible about the length of lunch and coffee breaks. Which job offer would you accept?

58. You are considering a change of employment. You attend interviews with two different companies and receive job offers from them both. There is very little difference between the two companies except that Company A provides a computer for each member of staff but has a high incidence of industrial compensation claims for Repetitive Strain Injury/Occupational Overuse Syndrome awarded against it while Company B has fewer computers but has a comprehensive staff health care programme. Which job offer would you accept?

**COMMUNICATION (Situations 36-51)**

36. You wish to tell a colleague the time of the next staff meeting. Your colleague works in the next office. Which one of the following methods would you choose to send the message?

37. You wish to tell a colleague the time of the next staff meeting. Your colleague works three floors above you. Which one of the following methods would you choose to send the message?

38. You wish to tell several colleagues the time of the next staff meeting. You have two hours available before the meeting takes place. Which one of the following methods would you choose to send the message?

39. You wish to tell several colleagues the time of the next staff meeting. You have a week available before the meeting takes place. Which one of the following methods would you choose to send the message?

40. You wish to contact the Head of your department to explain why you will be unable to attend an important Board meeting. Your Head has an 'open door' policy so is easy to contact. Which one of the following methods would you choose to send the message?

41. You wish to contact the Head of your department to explain why you will be unable to attend an important Board meeting. Your Head is very busy and has to be contacted through a formidable secretary. Which one of the following methods would you choose to send the message?

42. You wish to give some confidential information to a business acquaintance. Which one of the following methods would you choose to supply the information?

43. You wish to give some confidential information to a colleague. Which one of the following methods would you choose to supply the information?

44. You face an indefinite delay in reaching work because the 'commuter special' from Livchurch Street station has broken down between stations and you are stuck in a closed carriage (i.e the train has no corridor). You need to contact your company urgently because you are due to make a presentation to an important client one hour from now. Which one of the following methods would you choose to contact your company?

45. You are driving to work. You face an indefinite delay because there is a lengthy traffic jam in front of you following an earlier oil spillage on the road. You need to contact your company urgently because you are due to make a presentation to an important client one hour from now. Which one of the following methods would you choose to contact your company?

46. The Head of your department is attending a conference in the U.S.A. You need to provide your Head with information from a long, complicated document for a meeting being held in the U.S.A. two hours from now. Which one of the following methods would you choose to supply the information?

47. The Head of your department is attending a conference in the U.S.A. You need to provide your Head with information from a long, complicated document for a meeting being held in the U.S.A. two weeks from today. Which one of the following methods would you choose to supply the information?

48. You need to discuss a project with a colleague. Your colleague works in an office two floors below your office and is often available due to a fairly relaxed schedule. Which one of the following methods would you choose to discuss the project?

49. You need to discuss a project with a colleague. Your colleague works in an office two floors below your office and currently has a very busy schedule so is rarely available. Which one of the following methods would you choose to discuss the project?

50. Your company is working on a project with an overseas company. Six people are working on the project (three from each company). You need to finalise certain details relating to the project by having a joint meeting. However, both companies have only a limited budget for travelling expenses. Which one of the following methods would you choose to discuss the project?

51. Your company is working on a project with an overseas company. Six people are working on the project (three from each company). You need to finalise certain details relating to the project and have a generous budget to cover travelling expenses. Which one of the following methods would you choose to discuss the project?

## CHAPTER 6 - APPENDIX 2 - TECHNOLOGY/NON-TECHNOLOGY CLASSIFICATION

T = technology / computer-based; N = non-technology / non-computer-based /'paper -based'

OF = office ('high' social contact); HO = home ('low' social contact)

T/H = 'high' technology availability (computer for each member of staff); T/L = 'low' technology availability (staff share computers)

**DOCUMENT PREPARATION (Situations 1-10)**
T - typewriter; word processor; desktop publishing
N - handwriting

**INFORMATION MANAGEMENT (Situations 11-27)**
**Information Gathering(Situations 11-14)**
T - database (on computer); 'phone suppliers, dealers
N - consult someone else at work (e.g. colleague, librarian); look through filing cabinet (in your office); hunt through papers in your office (on desk, floor, etc.); consult books, journals, newspapers; attend a conference (e.g. a scientific conference, business presentation, etc.)

**Information Storing /Retrieval (Situations 15-22); Information Protection (Situations 23-27)**
T - database (on computer)
N - rely on your own memory; filing cabinet; pile of papers on desk, floor, etc.

**DECISION-MAKING (Situations 28-35; 52-58)**
**General decision-making (Situations 28-35)**
T - consult computer (decision support system, intelligent system)
N - rely on your own judgement and experience; consult someone else (colleague, expert, etc); consult information sources (files, books, reports)

**Choosing where to work (Situations 52-58)**
**Home or office (Situations 52-55)**
OF - office
HO - home
**Current office or new office (Situation 56)**
T - new office
N - current office
**Company A or Company B (Situations 57-58)**
T/H - Company A
T/L - Company B

**COMMUNICATION (Situations 36-51)**
T - multi-media; pager; electronic mail/email; telephone; telex; facsimile/fax
N - write/send memorandum, letter, report; courier; have an informal face-to-face meeting (wait for chance encounter in corridor, coffee/lunch break, etc); arrange a formal face-to-face meeting (make an appointment, business lunch, etc)

## CHAPTER 8 - APPENDIX 1 - DETAILED DESCRIPTION OF VIDEOS

**NOTES**
1. [x seconds - COMMUNICATION] refers to the time allocated to this item in the video and the category to which the item was assigned.
2. The comments quoted below were made by the video presenters.

### SYSTEM A

1. Name of project appears on screen. [10 seconds - OTHER]

2. The title of the project appears on screen. [10 seconds - OTHER]

3. Music (classical). [5 seconds - OTHER]

4. The title of the project is repeated. [5 seconds - OTHER]

5. The presenter gives a brief description of the project and mentions that the "aim is to set the standards for the next generation of audiovisual systems" and "to build a multimedia desktop conferencing system" in order to increase understanding of how users can benefit from teleconferencing. [20 seconds - QUOTES]

6. A diagram of a computer system is shown and the information given that the ISDN2 (Integrated Services Digital Network) Service is generally available throughout Europe and the world and makes possible a whole range of new services. [20 seconds - OTHER]

7. The terminal uses a standard personal computer together with "some extra equipment" to provide a complete multimedia communications system. [The screen shows a man sitting at a personal computer with plants and a curtain in the background]. Up to eight locations can be connected together in the same conference. Each terminal works in the same way no matter how many locations are involved. All operations are controlled by a mouse and "simple pull down menus" to make the system "easy to use". [A close-up of a menu is shown]. [20 seconds - COMMUNICATION]

8. A telephone number is entered on the computer screen which produces ringing at the 'called' terminal. "High quality sound" is produced. A hand set or loudspeaking telephone or a headset ("for best quality") can be used. [20 seconds - COMMUNICATION]

9. **Videophone** A tiny camera mounted on the computer screen shows a picture in the video window on the screen. The self-view option enables users to show their own picture. [A man is shown performing this operation]. "No special training is needed just sit and talk naturally". [20 seconds - COMMUNICATION]

10. Other options available include facsimile, file transfer, and a photovideotext display. [10 seconds - COMMUNICATION]

11. "Our" research has shown that it is useful to know who is connected to the conference. The current speaker appears in a special window called the 'participant's box' and is highlighted by a loud speaker symbol. [10 seconds - COMMUNICATION]

12. Non-conducted conferences have no chairman and anyone can speak at any time. Conducted conferences have a chairman who can control the operation of the participants' microphones.This is useful for formal meetings. Someone who wishes to speak must attract the attention of the chairman by clicking on the 'request box' and waiting for the chairman to enable his or her microphone. [A close-up of the computer screen is shown]. An icon on the computer screen shows when 'you are being seen and when your camera is active'. The chairman can control pictures as well as microphones and can show everyone "his" (presenter's term) picture by using the VIP control in formal meetings. [60 seconds - COMMUNICATION]

13. **Meeting aids** These include facilities for showing slides and discussing documents. The facsimile machine can be used by inserting a (paper) document into the machine. The mouse and 'fax menu' can be used to send documents. 'Start' is pressed on the facsimile machine. The mailing list facility enables the intended recipients to be selected, otherwise documents can be sent to all sites simultaneously. [A document is shown being transmitted and appearing at its destination]. [60 seconds - COMMUNICATION]

14. The **file transfer** facility enables electronic documents in the form of files to be stored in personal computers and sent to other files during a conference. [A close-up of a file transfer menu is shown]. The file is selected from a directory list. One or more files can be chosen. The files can be sent to any or all locations. There are two sending speeds. The screen goes blank when the faster speed is chosen. Once the file has been received it can be displayed at all locations and the common document discussed. The group editor option can be used to enable the user at one terminal to change the document. At the end of the conference all participants hold an agreed version of the document. Any type of electronic information such as spreadsheets, data, text, or graphics can be sent. [60 seconds - INFORMATION MANAGEMENT]

15. "The picture window is fine for face-to-face discussions. However, for other applications such as slide presentations a larger and more detailed picture is needed. Photovideotext enables high quality pictures to be stored, displayed, and sent." [A close-up of the computer screen is shown]. These pictures can be prepared before, or during, the conference using a camera and a [System A] terminal. [A picture of the camera is shown]. The picture window can be used for maps, photographs, and solid objects. The pictures are stored as files within the [System A] terminal and transmitted in a similar way to the file transfer mechanism. Once transmitted, all participants can look at and discuss the same picture. For more formal presentations a number of documents can be prepared and transmitted like a slide show. [Different pictures are shown including flowers and an antique object]. An index allows any user to select and discuss any of the pictures. A pointer is provided to facilitate discussion of the pictures and highlight areas of interest. [60 seconds - COMMUNICATION]

16. For connection between two users a direct call is made from one terminal to another. For a multi-site conference a call is made to a central unit (the multipoint control unit - MCU) within the network. [A diagram and photograph of the MCU are shown]. A maximum of five sites can be linked together. Several MCUs can be connected together for larger conferences. [30 seconds - COMMUNICATION]

17. [Music] "So the [System A] system lets you hold face-to-face discussions easily with people in distant locations and gives you a range of meeting aid facilities to help your discussion." [more music] "Now that you have seen the main points of the system we hope you can see how useful this system can be. You can probably think of many applications for your business." [more music and man shown sitting at terminal holding a telephone receiver]. [30 seconds - COMMUNICATION]

18. The screen shows the names of the System A project partners, script writers, and video production team. The year the video was made was 1991. [30 seconds - OTHER]

19. The screen shows a computer screen containing a 'nobody left' icon. There is a click and the icon is replaced by the message 'OK'. [30 seconds OTHER]

**SYSTEM B**

1. Name of company appears on screen. [15 seconds - OTHER]

2. Music (classical). [15 seconds - OTHER]

3. Quick glimpses of the company's products are shown. [30 seconds - OTHER]

4. The presenter introduces the company: "Supplier of leading edge technology to the world", "The next generation of leading edge products", "Long term research into ...". Description of the company's offices in Great Britain and the U.S.A. [A view of workers at the British offices is shown.] [30 seconds - QUOTES]

5. The company is concerned with two main areas:
a) Information management [5 seconds - INFORMATION MANAGEMENT]
b) Networks and communication [5 seconds - COMMUNICATION]

6. The company has a distributed information systems department including multimedia which is involved with software engineering and knowledge-based systems which are PC-based (personal computer). [10 seconds - INFORMATION MANAGEMENT]

7. The presenter mentions the global nature of today's business. [10 seconds - COMMUNICATION]

8. The presenter mentions that a child's building blocks have a simple basis but this does not necessarily produce simple products. [30 seconds - OTHER]

9. The company takes an object-based approach [e.g. name of well-known company product]. There is an emphasis on team work. A mouse and icons are mentioned. The presenter mentions that:

applications are distributed "because people are"
text, numbers, images, and voices are important
"hardware is well understood" [60 seconds - COMMUNICATION]

10. The company takes into account:
a) the social needs of individuals working within distributed teams and aims to obtain a "single but multimedia network". [30 seconds - COMMUNICATION]
b) The company also aims to provide an information technology support system with access to information whatever its format and wherever it is located on the network. [30 seconds - INFORMATION MANAGEMENT]

11. The telephone, motorised transport, and electronic mail have facilitated communication and produced a "truly global business environment". [30 seconds - COMMUNICATION]

12. [The researcher is shown on screen] The researcher states that "networked multimedia systems will exist in the next decade" and that there is a "need to understand the effects of an internationally shared workspace". The emphasis of the company is on the development of products for five years from now. [The video was made in 1990]. [30 seconds - COMMUNICATION]

13. The system presented in the video was built from existing technology (television, ethernet, cable television). Eventually this technology will be combined in a single workstation combining:
a) conventional data processing [15 seconds - INFORMATION MANAGEMENT]
b) telecommunications [15 seconds - COMMUNICATION]

14. The researcher describes an experiment performed by the company concerned with the speed and quality of decisions. This experiment provided subjects with a shared workspace containing an audio and video channel and a shared whiteboard which was instantaneous and simultaneous so that everybody could type in information at the same time. No difference was found in the speed or quality of decisions although the researcher comments that greater realism in the situations could have produced greater effects. Subjects were found to show "an amazing adaptability to compensate for the lack of face-to-face communication". The subjects felt that multimedia was useful for team building over extended periods. [120 seconds - DECISION-MAKING]

15. The presenter states that the importance of informal aspects of teamwork cannot be underestimated. For example, the basis for one of the company's products was a conversation held in a corridor in the company offices. [15 seconds - COMMUNICATION]

16. The researcher notes the change in emphasis from human-computer to human-human communication and the emphasis on distributed teams. [15 seconds - COMMUNICATION]

17. The presenter comments that team dynamics are an important business issue, states that currently (video made in 1990) very few distributed teams exist as not much is available for supporting such work so the [System B] system will help improve team dynamics and that the proposed launch of the multimedia prototype is Spring 1990. [30 seconds - COMMUNICATION]

18. The camera in the system is included in the monitor housing. The video images are provided by [name of a well-kown company product using windows]. ISDN (Integrated Services Digital Network) links remote sites on a dial-up basis. Audio is provided by a PABX system on-site. The researcher comments that communication systems are merely a mediator of person-person communication. [30 seconds - COMMUNICATION]

19. The researcher states that the emphasis in the project is on "real people in real situations performing real tasks" and also on "the next generation of products". He continues "the next generation of products must provide the customer with exactly what they want to maximise their competitive advantage". [30 seconds - QUOTES]

20. The presenter concludes:
a) "No-one now considers the telephone as anything other than a vehicle for communication - the technology has become invisible." [15 seconds - COMMUNICATION]
b) "The next generation of computer users will view information technology in the same way. The computer system will become almost invisible to the user. It will become an information window on the world. [Name of company]'s multimedia research project will help prepare [name of company] for that day." [15 seconds - INFORMATION MANAGEMENT]

21. Contact address for further information. [music] The video was made in 1990. [30 seconds - OTHER]

## CHAPTER 8 - APPENDIX 2 - EVALUATION QUESTIONNAIRE

**NOTES** [N.B. These notes did not appear on the questionnaires issued to the subjects]
The categories to which the situations in the Evaluation Questionnaire belong are:
DOCUMENT PREPARATION (3, 5, 7, 12, 19, 27, 35)
INFORMATION MANAGEMENT (2, 6, 8, 11, 13, 16, 22, 24, 25, 32)
DECISION-MAKING (17, 28, 31)
COMMUNICATION (1, 9, 10, 15, 20, 21, 23, 33)
QUOTES (4, 14, 18, 26, 29, 30, 34)
OVERALL EVALUATION (36)

### PART 1 - USEFULNESS CRITERIA

### BACKGROUND INFORMATION

**INSTRUCTIONS**
Please answer all the questions below putting a tick [✓] in the relevant box/boxes or filling in the information requested in the space provided.
Please note that all personal information supplied is strictly confidential.

**DATE**
**AGE**

| | |
|---|---|
| 17 and under | [ ] |
| 18 - 34 | [ ] |
| 35 - 49 | [ ] |
| 50 - 64 | [ ] |
| 65 and over | [ ] |

**SEX**

| | |
|---|---|
| male | [ ] |
| female | [ ] |

**OCCUPATION**

| | |
|---|---|
| student | [ ] (please state which course you are attending) _____ |
| lecturer | [ ] (please state which course you teach) _____ |
| clerical worker | [ ] |
| administrative worker | [ ] |
| other | [ ] (please specify)_____ |

## INSTRUCTIONS

On each of the following pages you will find statements which could be made about a computer-based office system. For each statement decide on the extent to which you think that it is important for the statement to be true then circle the relevant number. For example, if you think that it is unimportant for the statement to be true, circle '1'. If you think that it is very important for the statement to be true, circle '5'. Please work through the statements in the order in which they have been presented and ensure that you provide an answer for each statement. An example of what is required is given below. Thank you for your participation.

**EXAMPLE**

The system can be used as a toaster.

| Unimportant | | | | Very important |
|---|---|---|---|---|
| 1 | ② | 3 | 4 | 5 |

## STATEMENTS

1. The system can be used to provide the Head of Department, who is attending a conference in the U.S.A., with information from a long, complicated document for a meeting being held in the U.S.A. two weeks from today.

| Unimportant | | | | Very important |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

2. The system can be used to store confidential information (client records) in an open plan office which is freely accessible to both staff and clients.

3. The system can be used to write a personal letter to a close friend.

4. The system allows people to compensate for the lack of face to face communication.

5. The system can be used to take the minutes at a Board meeting.

6. The system can be used to find out the annual profits of a rival company where such information is carefully guarded.

7. The system can be used to write a memorandum to the Head of Department concerning a request for a new photocopier.

8. The system can be used to store a large amount of information when there is limited physical space in the office.

9. The system can be used to discuss a project with a colleague who is often available due to a fairly relaxed schedule.

10. The system can be used to tell a colleague who works in the next office the time of the next staff meeting.

11. The system can be used to store some confidential information (client records) when the power supply in the office block is unreliable due to extensive construction work on the road outside.

12. The system can be used to prepare a report for an internal meeting of the department.

13. The system can be used to store some information (files, documents, etc) when access to the information is required on a daily basis.

14. The system can be used to provide "standards for the next generation of audio visual systems".

15. The system can be used to discuss a project with a colleague who currently has a very busy schedule so is rarely available.

16. The system can be used to store a large amount of information when the office is large and spacious.

17. The system can be used to make the final decision whether to evacuate the building by someone working on the 15th floor of an office block who has received a report of thick smoke in the basement of the office block.

18. The system can be used with "no special training".

19. The system can be used to prepare a report for circulation to new customers.

20. The system can be used to provide the Head of Department, who is attending a conference in the U.S.A., with information from a long, complicated document for a meeting being held in the U.S.A. two hours from now.

21. The system can be used by a company working on a project with an overseas company to hold a joint meeting to finalise certain details relating to the project when both companies have only a limited budget for travelling expenses.

22. The system can be used to store some confidential information (client records) when the power supply in the office block is considered very reliable as the building has recently been rewired.

23. The system can be used by someone who needs to contact his/her company urgently because he/she is due to make a presentation to an important client one hour from now but faces an indefinite delay in reaching work because the 'commuter special' from Livchurch Street station has broken down between stations and he/she is stuck in a closed carriage (i.e the train has no corridor).

24. The system can be used to find out the annual profits of a rival company where such information is freely available.

25. The system can be used to store some information (files, documents, etc) when access to this information is unlikely to be required for several months.

26. The system "must provide customers with what they want to maximise the competitive advantage".

27. The system can be used to write a letter to a business contact met at a conference earlier this year suggesting a lunchtime meeting to discuss mutual business interests.

28. The system can be used to make the final decision on what action to take by someone planning a major new project.

29. The system can be regarded as "the next generation of leading edge products".

30. The system is useful for teamwork.

31. The system can be used to make the final decision when choosing a new colour scheme for the office carpets.

32. The system can be used to store confidential information (client records) in an open plan office which is accessible only to staff.

33. The system can be used by a company working on a project with an overseas company to hold a joint meeting to finalise certain details relating to the project when one company has a generous budget to cover travelling expenses.

34. The system is "invisible" to the user and "merely an information window on the world".

35. The system can be used to write a memorandum to a colleague concerning the date of the next staff meeting.

## PART 2 - PERCEIVED USEFULNESS EVALUATION

**NAME OF SYSTEM TO BE ASSESSED:**_____

**EXPERIENCE OF THIS SYSTEM**

(If you are seeing the video for the first time today answer 'none')

| | |
|---|---|
| extensive | [ ] (have used system) |
| limited | [ ] (have seen video/demonstration on previous occasion) |
| none | [ ] (have no previous knowledge of the system) |

### INSTRUCTIONS

On each of the following pages you will find questions relating to the system you have been asked to assess. For each question decide on the extent to which you think that the system can be used for that purpose then circle the relevant number. For example, if you think that the system can not be used at all well for that purpose, circle '1'. If you think that the system can be used extremely well for that purpose, circle '5'. If you feel that you are really unable to make a decision, circle 'unable to decide'. However, try to circle a number between '1' and '5' wherever possible. Please work through the questions in the order in which they have been presented and ensure that you answer all the questions. An example of what is required is given below. Thank you for your participation.

**EXAMPLE**

How well can this system be used as a toaster?

| not at all well | | | | extremely well | |
|---|---|---|---|---|---|
| 1 | ② | 3 | 4 | 5 | 'unable to decide' |

### QUESTIONS

1. How well can this system be used to provide the Head of Department, who is attending a conference in the U.S.A., with information from a long, complicated document for a meeting being held in the U.S.A. two weeks from today?

| not at all well | | | | extremely well | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 'unable to decide' |

2. How well can this system be used to store confidential information (client records) in an open plan office which is freely accessible to both staff and clients?

3. How well can this system be used to write a personal letter to a close friend?

4. How well can this system be used to compensate for the lack of face to face communication?

5. How well can this system be used to take the minutes at a Board meeting?

6. How well can this system be used to find out the annual profits of a rival company where such information is carefully guarded?

7. How well can this system be used to write a memorandum to the Head of Department concerning a request for a new photocopier?

8. How well can this system be used to store a large amount of information when there is limited physical space in the office?

9. How well can this system be used to discuss a project with a colleague who is often available due to a fairly relaxed schedule?

10. How well can this system be used to tell a colleague who works in the next office the time of the next staff meeting?

11. How well can this system be used to store some confidential information (client records) when the power supply in the office block is unreliable due to extensive construction work on the road outside?

12. How well can this system be used to prepare a report for an internal meeting of the department?

13. How well can this system be used to store some information (files, documents, etc) when access to the information is required on a daily basis?

14. How well can this system be used to provide "standards for the next generation of audio visual systems"?

15. How well can this system be used to discuss a project with a colleague who currently has a very busy schedule so is rarely available?

16. How well can this system be used to store a large amount of information when the office is large and spacious?

17. How well can this system be used to make the final decision whether to evacuate the building by someone working on the 15th floor of an office block who has received a report of thick smoke in the basement of the office block?

18. How well can this system be used with "no special training"?

19. How well can this system be used to prepare a report for circulation to new customers?

20. How well can this system be used to provide the Head of Department, who is attending a conference in the U.S.A., with information from a long, complicated document for a meeting being held in the U.S.A. two hours from now?

21. How well can this system be used by a company working on a project with an overseas company to hold a joint meeting to finalise certain details relating to the project when both companies have only a limited budget for travelling expenses?

22. How well can this system be used to store some confidential information (client records) when the power supply in the office block is considered very reliable as the building has recently been rewired?

23. How well can this system be used by someone who needs to contact his/her company urgently because he/she is due to make a presentation to an important client one hour from now but faces an indefinite delay in reaching work because the 'commuter special' from Livchurch Street station has broken down between stations and he/she is stuck in a closed carriage (i.e the train has no corridor)?

24. How well can this system be used to find out the annual profits of a rival company where such information is freely available?

25. How well can this system be used to store some information (files, documents, etc) when access to this information is unlikely to be required for several months?

26. How well does this system "provide customers with what they want to maximise the competitive advantage"?

27. How well can this system be used to write a letter to a business contact met at a conference earlier this year suggesting a lunchtime meeting to discuss mutual business interests?

28. How well can this system be used to make the final decision on what action to take by someone planning a major new project?

29. How well does this system form "the next generation of leading edge products"?

30. How well can this system be used for teamwork?

31. How well can this system be used to make the final decision when choosing a new colour scheme for the office carpets?

32. How well can this system be used to store confidential information (client records) in an open plan office which is accessible only to staff?

33. How well can this system be used by a company working on a project with an overseas company to hold a joint meeting to finalise certain details relating to the project when one company has a generous budget to cover travelling expenses?

34. How well does this system meet the idea that the system is "invisible" to the user and "merely an information window on the world"?

35. How well can this system be used to write a memorandum to a colleague concerning the date of the next staff meeting?

36. Overall, how well does this system meet the requirements of a computer-based office system?

## CHAPTER 9 - APPENDIX 1 - CODING PROCEDURE USED IN CONTENT ANALYSIS

### INSTRUCTIONS

Please analyse the given articles following the instructions below:

1. Select the articles to be analysed as follows:

1.a *PC WEEK* FRONT PAGE
Select the 3 largest articles on the page. Size is related to the amount of space taken up by the article. If there are more than three articles choose the 3 articles with the largest number of paragraphs. In the event of two or more articles taking up exactly the same amount of space and having the same number of paragraphs choose one of the articles at random (e.g. by tossing a coin) and note the headline of this article on the recording form.

1.b *PC WEEK* BACK PAGE
Analyse the *PC FUTURES* article [Ignore the *FEEDBACK* column as this often covers several topics.]

1.c *PC WEEK* OFFICE UPDATE
Analyse the largest article on this page.

1.d *THE GUARDIAN*
BROADSHEET (1-1½ pages) Select the 3 largest articles on the page.

TABLOID (2 pages) Select the largest articles on the page (up to a maximum of 3).

2. Note the headline for each article.

3. Classify each unit of each of the selected articles (a unit is a headline or paragraph) according to your assessment of the context of that unit using the following categories: Information-handling, Human Contact, Paper-handling, Financial Security, Communication, Technology, Work, and Health Preservation. Choose the category which you think best describes the content of the whole paragraph. If you think that a unit does not fit into any of these categories classify the unit as 'None'. A unit may be classified in more than one category if it seems to belong to more than one category. Place a tick [✓] in the relevant column(s) for each unit.

4. The units to be classified for each of the chosen articles are the headline, first 3 paragraphs and concluding paragraph. Each unit should be regarded as self-contained. That is, try to code each unit independently without referring to the rest of the article.

5. A sample of a completed coding form is provided below [see SAMPLE CODING FORM].

6. A detailed description of the factors is provided below [see DETAILED DESCRIPTION OF FACTORS]. The constituents of each factor are provided for guidance only and are not exhaustive. Any units considered to contain semantically similar items to a particular factor may be coded with that factor.

**SAMPLE CODING FORM**

**TITLE OF PUBLICATION:** PC SUPERNEWS

**DATE PUBLISHED:** 3/2/98

**PAGE:** FRONT

| | FACTORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 INFORMATION-HANDLING | 2 HUMAN CONTACT | 3 PAPER-HANDLING | 4 FINANCIAL SECURITY | 5 COMMUNI-CATION | 6 TECHN-OLOGY | 7 WORK HEALTH PRESER-VATION | 0 NONE |
| **ARTICLE 1** New shopping hours<br>Headline | | | | | | | | ✓ |
| Para. 1 | | ✓ | | | | | | |
| Para. 2 | | | | | | | | ✓ |
| Para. 3 | | | | | | | | ✓ |
| Last para. | | | | | | | | ✓ |
| **ARTICLE 2** PC falls from tower block injuring man<br>Headline | | | | | | | ✓ | |
| Para. 1 | | | | | | ✓ | ✓ | |
| Para. 2 | | | | | | | ✓ | |
| Para. 3 | | | | | | | ✓ | |
| Last para. | | | | | | ✓ | | |
| **ARTICLE 3** Is there anybody out there?<br>Headline | | | | | ✓ | | | |
| Para. 1 | | ✓ | | | ✓ | | | |
| Para. 2 | | ✓ | | | | | | |
| Para. 3 | | ✓ | | | ✓ | | ✓ | |
| Last para. | | | | | ✓ | | | |

## DETAILED DESCRIPTION OF FACTORS

* = 'opposite' pole of dimension

**FACTOR 1: INFORMATION-HANDLING** Includes databases, etc

improved storage of data
file management
file maintenance
easy data retrieval
filing
data entry
ready information at hand

**FACTOR 2: HUMAN CONTACT** The emphasis is on face-to-face contact including conferences. The means of communication (networks, telecommunications, etc should be coded under COMMUNICATION and TECHNOLOGY)

lunch
seeing clients
tea/coffee-making
meetings
communication
improved communication

* reduced job satisfaction
* lack of human contact

**FACTOR 3: PAPER-HANDLING**

dealing with post
mail
correspondence
photocopying
dealing with correspondence
document preparation

* reduction of paperwork

**FACTOR 4: FINANCIAL SECURITY** Includes semantically similar words and phrases such as cost, prices, cheap, sales, selling, investment, profits, income, revenue, economic, uneconomic, money, cut costs, and so on.

payroll
accounting
maintaining accounts
expense

**FACTOR 5: COMMUNICATION** Includes networks

telephone management
using different types of communication
telephone communication
voice processing
improved communication
communication

**FACTOR 6: TECHNOLOGY** Includes names of computer companies such as IBM, Microsoft, networks, LAN, computer games, multimedia, virtual reality, technical details such as 30 Mb RAM, and so on

printers
computerised typewriters without typist
wordprocessing
communications from computer i.e. videoconferencing (to include telephone, fax, etc.)
typing/wordprocessing
electronic mail
voice processing
quicker to do things
improved communication
data entry
ready information at hand
increased efficiency
photocopying
easy data retrieval

* power failure
* computer goes down

**FACTOR 7: WORK**

staff training
work

* loss of jobs
* lack of human contact

**FACTOR 8: HEALTH PRESERVATION** Includes any words or phrases related to health

health hazards

## APPENDIX B - PUBLICATIONS BY THE AUTHOR CITED IN THESIS

**Smith H. (1986) Devising an ergonomics checklist to assess the convenience of domestic irons. Unpublished MSc report. University of Birmingham.**


## ABSTRACT

The aim of this project was to devise an ergonomics checklist for use by the Consumers' Association to assess the convenience of domestic irons. This was required to supplement the current method of assessment - the user trial - which had been found to produce inadequate information.

Various methods were used to devise the checklist including a literature survey, task analysis using a video recording, and user trials.

The checklist produced was tested and the results compared with the ratings obtained from user trials.

The checklist devised is suitable for use by laboratory testers and contains recommendations to aid assessors in giving ratings.

All types of iron currently available on the market, including travelling and cordless irons, may be assessed using the checklist.

Smith H. (1990a) Single screens and multiple tasks. Proceedings of the 23rd Annual Conference of the Human Factors Association of Canada, Ottawa, Canada, September 26-28 1990, 197-201.

# SINGLE SCREENS AND MULTIPLE TASKS

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The user in a typical office environment may encounter problems when using an interface which has only a single display or screen as it may be necessary to perform more than one function at once. For example, sending an item of electronic mail while using a word processor. When using a single screen or display, the number of different functions which can be performed by the user is limited by screen size. A method to increase the amount of information available on the screen without physically increasing screen size is needed. Single screens could be improved in various ways to increase their effectiveness. Possible improvements include more effective utilization of the display area, the provision of more information on the screen, reminders to assist the user's internal memory, the ability to perform more than one task at the same time or have different representations of the same task, and the provision of multiple sources of information. Users performing complex or multiple tasks require more information to be displayed with the provision of access to multiple sources of information or ability to combine sources if necessary. In order to overcome the limitations of single screens and make computers more versatile and easier to use, it is important to understand the way in which the user views and cognitively processes information presented on the screen. There is a need to increase the versatility of the single screen but this should not result in the provision of distracting or irrelevant information which confuses the user.

## INTRODUCTION

When using a computer in an office environment, people usually work on several different jobs at once. For example, the office worker may wish to send an item of electronic mail while simultaneously using a word processor. Users of information technology in the office include not only traditional office workers such as secretaries and managers, but also executives, estate-agents, financial analysts, and many others who need to manage information efficiently (Herbach, 1983).

Consideration of human-computer interface development shows that users now expect support for multiple contexts (Reichman, 1986). However, traditional computer terminals or office work stations have a limited size, single screen, display which limits their usefulness as an all-purpose office and professional worker's tool (Card, 1985) because the single screen display restricts the number of different jobs or tasks which can be performed by the user. A method to increase the amount of information available on the screen without physically increasing screen size so that it matches user requirements more closely is needed.

## LIMITATIONS OF SINGLE SCREEN DISPLAYS

The tasks users wish to complete may vary in complexity as well as in number - the user may wish to complete a single simple task, a single complex task, multiple simple tasks, or multiple complex tasks. Sending an item of electronic mail could be regarded as a single simple task, editing a lengthy document as a single complex task, requesting a directory listing while performing minor editing operations as multiple simple tasks, and modifying a spreadsheet

while simultaneously editing another document and then inserting the spreadsheet into the edited document as multiple complex tasks.

The level of complexity of the tasks is defined in these examples according to software capacity in a single screen display rather than to subjective difficulty as this is likely to vary according to the level of expertise and experience of individual users.

Single screen displays (which may also be termed single window displays) have various limitations if the user wishes to use them for multiple single tasks, a single complex task, or multiple complex tasks. These limitations include the inability to: provide access to multiple sources of information; permit different types of information to be simultaneously displayed; permit independent tasks to be performed at the same time; provide different representations of the same task; provide memory aids; increase the size of screen available to the user.

**Access to multiple sources of information**
Users performing complex or multiple tasks require access to multiple sources of information and the ability to combine sources if necessary. For example, programmers may find it helpful to have independent control of multiple programs; a medical insurance claims agent may wish to retrieve various types of information simultaneously such as the client's medical history and a record of previous claims in addition to basic details such as name, address, and telephone number (Shneiderman, 1987). On a single display it may be difficult to get the user's attention if it is necessary to suddenly display an error message while the user is working on a task because only one source of information can be displayed.

**Display of different types of information**
It is necessary to enable different types of information to be shown simultaneously so that the user can compare and combine information (Norman et al., 1986). Single window displays allow only one type or source of information to be displayed at a time. This makes it more difficult and confusing to edit a document as only text or graphics can be displayed but not text and graphics together, and so on. If multiple sources of information such as text, graphics, or a combination of text and graphics, could be displayed at the same time the user's task when editing would be simpler, and possibly more efficient.

**Multiple tasks**
When performing complex tasks, it may be necessary for the commands in one window to differ from those in another window to enable independent tasks to be performed simultaneously. If a user needs to send some electronic mail while using a word processor, a method which enables the user to send the mail and return to the main task of word processing without losing context or needing to restart the work would be advantageous.

**Multiple representations of a single task**
Another problem that may be encountered when using a single screen is when different representations of the *same* task are needed. When editing a document such as an academic paper, the author may wish to undertake hierarchical browsing in order to view the synopsis, the text, and the bibliography simultaneously. If only a single window display is available, hierarchical browsing may not be possible.

**Memory prompts**
While performing a task, such as word processing, the user may need prompts as to available options, a command history, and other memory aids which do not interfere with the existing information on the screen.

Dix and Harrison (1986) mention the limitations of the user's internal working memory and suggest that a way of providing an external memory store is needed. When using a single screen for multiple sources of information, the user must switch from source to source to obtain the relevant information This can lead to problems caused by order effects and memory limitations.

**Screen size**

As the physical size of the screen cannot be changed, this limits the amount of information which can be displayed on a single screen. A method for increasing the size of the virtual screen where a physical increase in the size of the screen is impossible is needed. Card (1985) noted that the limited size of the screen and the fact that it is smaller than a desk is a problem which needs to be resolved when transferring work from the desk to the workstation.

## METHODS FOR INCREASING DISPLAY UTILITY

Single screens could be improved in various ways to increase their effectiveness. Possible improvements include the provision of more information on the screen, access to multiple sources of information, reminders to assist the user's internal memory, the ability to perform more than one task at the same time and to have different representations of the same task.

Various methods exist for increasing the effective size of a single screen display without physically increasing screen size. These methods may be collectively referred to as windowing as they involve the use of multiple windows. A window may be defined as an area on a computer display, usually rectangular, and usually delimited by a border containing a particular view of some data in the computer (Bury et al., 1985; Card et al.,1984; Teitelman, 1977 - all cited in Billingsley, 1988).

Windowing techniques currently available include the use of multiple windows (or virtual screens) on the same display to increase the virtual size of screen and the use of multiple screens i.e. several single displays used together.

## ADVANTAGES OF WINDOWING

There are several ways in which systems using multiple windows benefit the user: the screen is effectively made larger, helping to increase the amount of information available on the screen without physically increasing screen size; more than one piece of information can be seen and used at a time; more than one task can be run at a time; windows can act as reminders (Card, 1985). Other benefits of windowing systems include their capacity to allow the screen to emulate the office desk more closely so that it can 'fit in with a worker's daily routine' thereby permitting the user to interact with the workstation more effectively (Card, 1985), and the ability of windowing systems to enable human-computer interaction to approximate everyday communication between people (Reichman, 1986).

**Screen size**

The screen is effectively made larger without physically increasing the screen to the size of a desk. This is achieved by methods such as overlapping windows and using icons (small specialised windows) to represent various files and other office objects (Card, 1985).

**Access to more information**

The use of different windows on the same screen can enable multiple sources of information such as text, graphics, or a combination of text and graphics, to be displayed. In addition, more than one piece of information can be seen and used at a time. This is useful when creating a document as many office tasks involve looking at several documents at once and often creating a new document from material in existing documents (Card, 1985).

It is often necessary in office work to move blocks of information from one document to another (e.g. copying a chart or diagram from one document to another). Windows enable this sort of "cut and paste" operation to be carried out more easily.

**Multiple tasks and complex tasks**

One of the main advantages of windows is that the commands in one window can differ from those in another window which enables independent tasks to be performed simultaneously. For example, a user working on a spreadsheet analysis may add something from the spreadsheet to a report displayed in another window on the screen, and then return to the spreadsheet (Card, 1985). If a user needs to send some electronic mail while using a word processor, it is possible to send the mail using a separate window and return to the main task of word processing without losing context or needing to restart the work (Shneiderman, 1987).

In addition to allowing independent tasks to be completed, windowing can be used to provide different representations of the same task which is useful for complex tasks such as scanning a lengthy document. For example, one window could contain a synopsis for an academic paper, a second window the text, and a third the bibliography (Coats and Vlaeminke, 1987).

The use of windowing for multiple tasks may be the most natural way to express task concurrency because it makes use of a natural ability to communicate information among tasks and allows object-oriented data flow (Herbach, 1983).

**Memory prompts**

When using a single screen for multiple sources of information the user must switch from source to source to obtain the relevant information. This can lead to problems caused by order effects and memory limitations. Windowing systems may assist the user's internal working memory store by acting as reminders, providing an external memory store in the form of a display which does not interfere with other displayed information (Card, 1985; Dix and Harrison, 1986) and enabling multiple sources of information to be shown simultaneously so that the user can compare and combine information (Norman et al., 1986). For example, if someone is writing an article which contains several tables, the article and tables can be displayed together on the screen to save the author having to remember which tasks exist. Icons may remind the user of available options such as a clock or command history.

Windowing systems may assist users to remember information contained within a lengthy electronic text by bringing incidental spatial cues into the reader's interaction with the text. A multi-window display in which different windows on the screen were used to display specific sections of the text was found to be a significant help to readers locating information they had just read once they were familiar with the procedures (use of a mouse, etc.) for manipulating the text (Tombaugh et al., 1987).

**Communication**

Multiple window facilities enable human-computer interaction to approximate everyday interaction between people, unlike early communication procedures between people and computers which were quite limited, linear, and constrained (Reichman, 1986).

## LIMITATIONS OF WINDOWING

Although windowing has many potential advantages, poor design and layout may decrease the value of windows for displaying information (Streveler and Wasserman, 1984 - cited in Gardiner and Christie, 1987). In addition to window design and layout, potential limitations of windowing systems include: the effort required to manipulate multiple windows; the limited size of individual windows; a need to understand multiple activities, user requirements, and the

user's model of the system.

**Window design**
Windowing software should be designed to suit the uses to which it will be applied so that a system can be used easily and intuitively (Herbach, 1983). Windows need to be well-designed to avoid confusion, distraction, and visual problems, particularly if the size of the window is small.

The information presented in a window needs to be legible to avoid visual fatigue and perceptual confusion. Illegible or irrelevant information may distract or confuse the user as too much unrelated information may be shown at once so that the display becomes untidy, like an untidy desk, resulting in a reduction in working efficiency.

**Manipulation of multiple windows**
The effort involved in manipulating windows (opening, moving, deleting, and so on) can be time-consuming and may distract the user from the task being performed (Shneiderman, 1987). Manipulability and legibility are likely to be affected by such features as size and type of window (tiled or overlapping).

**Limited size of individual windows**
If a multi-window display is used on a small screen, the amount of information which can be shown in each window may be less than if the information was displayed in a single window which occupied the size of the full screen (Tombaugh et al., 1987).

**User requirements and user's model of the system**
It is important to have an adequate understanding of user requirements and the user's model of the system when designing windowing software. Emphasis on the ability to simultaneously view multiple tasks (rather than multiple views of the same task), may be counter productive as users may prefer to work on just one task. Computers should attempt to eliminate 'clutter' from the desk rather than reproduce it (Herbach, 1983).

In order to overcome the limitations of single window displays to make computers more versatile and easier to use, it is important to understand the way in which the user views and cognitively processes information presented on the screen, and the relationships among multiple windows or screens and the information they contain (Norman et al., 1986).

## RATIONALE FOR PRESENT RESEARCH

Further research is needed into the design and functions of windows and multiple screens. Shneiderman (1987) comments that there is a great need for testing to evaluate window design concepts, while Gardiner and Christie (1987) mention that little empirical data exists on which to base design decisions.

When designers consider windowing systems emphasis tends to be placed on how users physically communicate the various elements of the tasks they are trying to perform rather than on the functions of windows and the nature of the tasks themselves (Herbach, 1983). However, the growth of windowing standards such as OSF Motif and Open Look may mean that there is a decrease in emphasis on window design and an increase of interest in the functions of windows.

Empirical research is being planned by the author as part of her thesis which aims to investigate optimal ways to enable displays to match user requirements.

## CONCLUSION

Although the use of windowing systems is increasing, they will not fulfil their true potential if they are used on a screen which is too small or has insufficient resolution. However, properly implemented windows can provide a major contribution to make the computer-based office workstation function harmoniously and naturally in the typical office environment with its multitude of tasks and constant interruptions (Card, 1985). Although multiple windows may present confusing or distracting information, the advantages of multiple windows seem to outweigh any drawbacks.

## REFERENCES


Billingsley, P.A. (1988). Taking Panes: Issues in the design of windowing systems. In M. Helander (Ed.), Handbook of Human-Computer Interaction. (pp 413-436). Amsterdam: North- Holland.

Card, S.K. (1985). 'Windows': Why they were invented, how they help. The Office, March 1985, 52-54.

Coats, R.B., and Vlaeminke, I. (1987). Man-Computer Interfaces. (pp 238-273). Oxford: Blackwell Scientific Publications.

Dix, A.J., and Harrison, M.D. (1986). Principles and interaction models for window messages. In M.D. Harrison and A.F. Monk (Eds.), People and Computers: Designing for Usability. (pp 352-366). Cambridge: Cambridge University Press.

Herbach, M. (1983). How is a computer like an elephant? Byte, December 1983, 247-248.

Marshall, C., Christie, B., and Gardiner, M.M. (1987). Assessment of trends in the technology and techniques of human-computer interaction. In M.M. Gardiner and B. Christie (Eds.), Applying Cognitive Psychology to User-Interface Design. (pp 279-312). Chichester: John Wiley & Sons.

Norman, K.L., Weldon, L.J., and Shneiderman, B. (1986). Cognitive layouts of windows and multiple screens for user interfaces. International Journal of Man-Machine Studies, 25, 229-248.

Reichman (Adar), R. (1986). Communication paradigms for a window system. In D.A. Norman and S.W. Draper (Eds.), User-Centered System Design. (pp 285-313). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Shneiderman, B. (1987). Designing the User Interface: Strategies for Effective Human-Computer Interaction. (pp 342-355). Reading, Massachusetts: Addison-Wesley Publishing Company.

Tombaugh, J., Lickorish, A., and Wright, P. (1987). Multi-window displays for readers of lengthy texts. International Journal of Man-Machine Studies 26, 597-615.


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Smith H. (1990b) Using single screens for multiple and complex tasks. Proceedings of the 26th Annual Conference of the Ergonomics Society of Australia, Adelaide, Australia, 4-7 December 1990, 167-172.

# USING SINGLE SCREENS FOR MULTIPLE AND COMPLEX TASKS

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**Summary:** The user in a typical office environment may encounter problems when using an interface which has only a single display or screen as it may be necessary to perform more than one task at once. A method to increase the amount of information available on the screen without physically increasing screen size is needed.

## 1. INTRODUCTION

Consideration of human-computer interface development shows that users expect support for multiple contexts (Reichman, 1986) as they may wish to work on several tasks simultaneously. However, traditional office work stations have a limited size, single screen, display which limits their usefulness as an all-purpose office tool (Card, 1985) because the number of different tasks which can be performed is restricted. A method to increase the amount of information available on the screen, without physically increasing screen size, so that it matches user requirements more closely is needed.

## 2. LIMITATIONS OF SINGLE SCREEN DISPLAYS

The tasks users wish to complete may vary in complexity as well as in number - the user may wish to complete a single simple task, a single complex task, multiple simple tasks, or multiple complex tasks. Sending an item of electronic mail could be regarded as a single simple task, editing a lengthy document as a single complex task, requesting a directory listing while performing minor editing operations as multiple simple tasks, and modifying a spreadsheet while simultaneously editing another document and then inserting the spreadsheet into the edited document as multiple complex tasks.

Task complexity in these examples is defined according to software capacity in a single screen display rather than to subjective difficulty as this is likely to vary according to the level of expertise and experience of individual users (Smith, 1990).

Single screen displays (which may also be termed single window displays) have various limitations if the user wishes to use them for multiple and/or complex tasks. These limitations include the inability to: provide access to multiple sources of information; permit different types of information to be simultaneously displayed; permit independent tasks to be performed at the same time; provide different representations of the same task; provide memory aids; increase the size of screen available to the user.

### 2.1 Access to Multiple Sources of Information

Users performing multiple or complex tasks should be able to access multiple sources of information and combine sources if necessary. For example, a medical insurance claims agent may wish to retrieve various types of information simultaneously such as the client's medical history and a record of previous claims in addition to basic details such as name, address, and telephone number (Shneiderman, 1987).

### 2.2 Display of Different Types of Information

Single window displays allow only one type or source of information to be displayed at a time although tasks such as editing a document require different types of information to be shown simultaneously so that the user can compare and combine information (Norman et al., 1986).

### 2.3 Multiple Tasks

When performing complex tasks, it may be necessary for the commands in one window to differ from those in another window to enable independent tasks to be performed simultaneously. However, single screen displays are restricted to displaying commands in only one window.

### 2.4 Multiple Representations of a Single Task

When using a single screen, problems may occur when different representations of the *same* task are needed. For example, if only a single window display is available, hierarchical browsing when editing a document may not be possible.

### 2.5 Memory Prompts

When using a single screen for multiple sources of information, the user must switch from source to source to obtain the relevant information. This can lead to problems caused by order effects and memory limitations (Dix and Harrison, 1986).

### 2.6 Screen Size

On a single window display the virtual size of the screen cannot be changed which limits the amount of information which can be displayed. A method for increasing the size of the virtual screen where a physical increase in the size of the screen is impossible is needed. The limited size of the screen and the fact that it is smaller than a desk is a problem which needs to be resolved when transferring work from the desk to the workstation (Card, 1985).

## 3. METHODS FOR INCREASING DISPLAY UTILITY

Various methods exist for increasing the effective size of a single screen display without physically increasing screen size. These methods may be collectively referred to as windowing as they involve the use of multiple windows. A window may be defined as an area on a computer display, usually rectangular, and usually delimited by a border, containing a particular view of some data in the computer (Bury et al., 1985; Card et al.,1984; Teitelman, 1977 - all cited in Billingsley, 1988). While there is usually only one physical screen or window, there may be many virtual screens or windows.

Windowing techniques currently available include the use of multiple windows (or virtual screens) on the same display to increase the virtual size of screen and the use of multiple screens i.e. several single displays used together.

An early recognition of the need for the need for windowing systems was made by Page and Walsby (1979): "A mechanism for keeping several distinct items of information on one screen simultaneously is required."

## 4. ADVANTAGES OF WINDOWING

There are several ways in which systems using multiple windows benefit the user: the virtual size of the screen is increased, helping to increase the amount of information available; more than one piece of information can be seen and used at a time; more than one task can be run at a time; windows can act as reminders. Other benefits of windowing systems include their capacity to allow the screen to emulate the office desk more closely so that it can 'fit in with a worker's daily routine' (Card, 1985), and the ability of windowing systems to enable human-computer interaction to approximate everyday communication between people (Reichman,

1986).

### 4.1 Screen Size

Methods such as overlapping windows and the use of icons (small specialised windows) to represent various files and other office objects enable the effective size of the screen to be increased (Card, 1985).

### 4.2 Access to more Information

Multiple sources of information such as text, graphics, or a combination of text and graphics can be displayed by using different windows on the same screen. This is useful when creating a document as many office tasks involve looking at several documents at once and often creating a new document from material in existing documents (Card, 1985).

### 4.3 Multiple Tasks and Complex Tasks

One of the main advantages of windows is that the commands in one window can differ from those in another window which enables independent tasks to be performed simultaneously. For example, if a user needs to send some electronic mail while using a word processor, it is possible to send the mail using a separate window and return to the main task of word processing without losing context or needing to restart the work (Shneiderman, 1987).

In addition to allowing *independent* tasks to be completed, windowing can be used to provide different representations of the *same* task which is useful for complex tasks such as scanning a lengthy document. For example, one window could contain a synopsis for an academic paper, a second window the text, and a third the bibliography (Coats and Vlaeminke, 1987).

### 4.4 Memory Prompts

When using a single window display to access multiple sources of information the user must remember the location of the required information which can lead to problems caused by order effects and memory limitations. Systems using multiple windows may assist the user's internal working memory store by providing reminders and acting as an external memory store in the form of a display which does not interfere with other displayed information (Card, 1985; Dix and Harrison, 1986) and enabling multiple sources of information to be shown simultaneously so that the user can compare and combine information (Norman et al., 1986). For example, if someone is writing an article which contains several tables, the article and tables can be displayed together on the screen to save the author having to remember which tasks exist.

### 4.5 Communication

While early communication procedures between people and computers were quite limited, linear, and constrained, multiple window facilities enable human-computer interaction to simulate everyday interaction between people (Reichman, 1986).

## 5. LIMITATIONS OF WINDOWING

Although windowing has many potential advantages, poor design and layout may decrease the value of windows for displaying information (Streveler and Wasserman, 1984 - cited in Gardiner and Christie, 1987). Other potential limitations of windowing systems include: the effort required to manipulate multiple windows; the limited size of individual windows; a need to understand multiple activities, user requirements, and the user's model of the system.

### 5.1 Window Design

Windows need to be well-designed to avoid confusion, distraction, and visual problems such as being unable to read the contents of individual windows or distinguish one window from another, particularly if the size of the window is small.

Illegible or irrelevant information may distract or confuse the user as too much unrelated information may be shown at once so that the display becomes untidy, like an untidy desk, resulting in a reduction in working efficiency.

### 5.2 Manipulation of Multiple Windows

The effort involved in manipulating windows (opening, moving, deleting, and so on) can be time-consuming and may distract the user from the task being performed (Shneiderman, 1987). Manipulability and legibility are likely to be affected by such features as size and type of window (tiled or overlapping).

### 5.3 Limited Size of Individual Windows

If windowing systems are used on a small screen, the amount of information which can be shown in each window may be less than if the information was displayed in a single window which occupied the size of the full screen (Tombaugh et al., 1987).

### 5.4. User Requirements

An adequate understanding of user requirements is important when designing windowing software. Emphasis on the ability to simultaneously view multiple tasks (rather than multiple views of the same task), may be counter productive as users may prefer to work on just one task. Computers should attempt to eliminate 'clutter' from the desk rather than reproduce it (Herbach, 1983).

### 5.5 User's Model of the System

In order to overcome the limitations of single window displays to make computers more versatile and easier to use, it is important to understand the way in which the user views and cognitively processes information presented on the screen, and the relationships among multiple windows or screens and the information they contain (Norman et al., 1986).

## 6. RATIONALE FOR PRESENT RESEARCH

Further research is needed into the design and functions of windows and multiple screens (Shneiderman, 1987; Gardiner and Christie, 1987). When designers consider windowing systems emphasis tends to be placed on how users physically communicate the various elements of the tasks they are trying to perform rather than on the functions of windows and the nature of the tasks themselves (Herbach, 1983). However, the growth of informal windowing standards such as OSF Motif and Open Look may mean that there is a decrease in emphasis on window design and an increase of interest in the functions of windows.

Empirical research is being planned by the author as part of her thesis which aims to investigate 1) optimal ways to enable displays to match user requirements 2) user requirements for office systems. Page and Walsby (1979) refer to the idea of an 'electronic desk': "Workstations will be highly intelligent and highly interactive computer systems intended to replace the traditional desk, filing cabinet and other information handling aspects of office work." One aspect of the author's thesis is to investigate whether the computer screen can and should be used for this purpose i.e do people really want a fully electronic office?

## 7. CONCLUSION

Although multiple windows may present confusing or distracting information, the advantages of multiple windows seem to outweigh any drawbacks. Future research on the use of windowing systems should concentrate on user requirements and user models of the system rather than on window design and management.

## 8. REFERENCES


Billingsley, P.A., 1988, Taking Panes: Issues in the design of windowing systems. In: *Handbook of Human-Computer Interaction* (Edited by M. Helander) (Amsterdam: North-Holland) pp. 413-436.

Card, S.K., 1985, 'Windows': Why they were invented, how they help. *The Office*, **March 1985**, 52-54.

Coats, R.B., and Vlaeminke, I., 1987, *Man-Computer Interfaces* (Oxford: Blackwell Scientific Publications) pp. 238-273.

Dix, A.J., and Harrison, M.D., 1986, Principles and interaction models for window messages. In: *People and Computers: Designing for Usability* (Edited by M.D. Harrison and A.F. Monk) (Cambridge: Cambridge University Press) pp. 352-366.

Herbach, M., 1983, How is a computer like an elephant? *Byte*, **December 1983**, 247-248.

Marshall, C., Christie, B., and Gardiner, M.M., 1987, Assessment of trends in the technology and techniques of human-computer interaction. In: *Applying Cognitive Psychology to User-Interface Design* (Edited by M.M. Gardiner and B. Christie) (Chichester: John Wiley & Sons) pp. 279-312.

Norman, K.L., Weldon, L.J., and Shneiderman, B., 1986, Cognitive layouts of windows and multiple screens for user interfaces. *International Journal of Man-Machine Studies*, **25**, 229-248.

Page, I. and Walsby, A., 1979, Highly dynamic text display system. *Microprocessors and Microsystems*, 3(2), 73-76.

Reichman (Adar), R., 1986, Communication paradigms for a window system. In: *User-Centered System Design* (Edited by D.A. Norman and S.W. Draper) (Hillsdale, N.J.: Lawrence Erlbaum Associates) pp. 285-313.

Shneiderman, B., 1987, *Designing the User Interface: Strategies for Effective Human-Computer Interaction* (Reading, Massachusetts: Addison-Wesley Publishing Company) pp. 342-355.

Smith, H., 1990, Single screens and multiple tasks. *23rd Annual Conference of the Human Factors Association of Canada*, 26-28 September, 1990.

Tombaugh, J., Lickorish, A., and Wright, P., 1987, Multi-window displays for readers of lengthy texts. *International Journal of Man-Machine Studies*, **26**, 597-615.



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Smith H. (1990c) Project MIDAS: Developing metrics for user interface design. In E.J. Lovesey (ed.) Contemporary Ergonomics 1990: Proceedings of the Ergonomics Society's Annual Conference, Leeds, England, 3-6 April 1990, (London: Taylor and Francis), 328-333.

# PROJECT MIDAS[1]: DEVELOPING METRICS FOR USER INTERFACE DESIGN

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[1]*Project MIDAS is a PCFC/NAB-funded research project being undertaken by Heather Smith, Robert Scane and Maureen Joyce at the City of London Polytechnic*

There are many ways of providing guidance for users of computer systems - standards, guidelines, metrics, and so on. These forms of guidance vary not only in terminology but also in the amount of information and flexibility they provide. A review of the research literature for the past ten years indicates that designers often encounter problems when they attempt to apply existing design principles to user interface design. Metrics are considered to provide recommendations which are precise and easy to apply. Project MIDAS (Metrics for Interface Design and Support), a project following on from earlier work initiated under the ESPRIT programme, aims to produce metrics suitable for assessing user interface design, with emphasis on office systems.

## INTRODUCTION

Interfaces should be designed which are flexible and easy to use as systems are likely to be used by people with varying amounts of computer expertise and for many different applications. The user interface consists not only of hardware or software elements but also text on the VDT screen and documentation (Shackel, 1984).

Although many recommendations have been made concerning user interface design, there seems to be a gap between theory and practice as designers may find existing recommendations difficult to implement. Standards tend to be inflexible while guidelines are often imprecise and based on insufficient testing or 'intuition'. Metrics are quantitative evaluation tools based on empirical testing which seem to avoid the drawbacks of guidelines and standards. However, while metrics for software design and evaluation are well-established, there is a lack of metrics in the area of user interface design (Gardiner and Christie, 1987).

Project MIDAS (Metrics for Interface Design and Support), which follows on from earlier work initiated under the ESPRIT programme, aims to survey and verify existing metrics relevant to user interface design and devise new metrics suitable for assessing the usability of computer systems. Emphasis will be placed on office systems as this is a major area in which information technology is used. The rationale for Project MIDAS is discussed below in the context of a review of features of various types of design recommendations.

## REVIEW OF TYPES OF DESIGN RECOMMENDATION

Many types of design recommendation for assessing and designing the user interface exist - for example, standards, guidelines and metrics. There are differences not merely in terminology but also in the characteristics of the various types of recommendation. Smith (1986) defines four

main types of design guidance:

1) Standards - a series of generally stated requirements for user interface design imposed in a formal way such as by legislation.

2) Guidelines - a series of generally stated recommendations for user interface software with examples, added explanation and other commentary.

3) Rules - a series of design specifications for a particular system application, stated in such a way that they do not require any further interpretation by user interface software designers.

4) Algorithms - computer programs implementing (and imposing) design rules which may control automatic generation of user interface software.

A fifth category of design guidance which is not defined by Smith is metrics. The term metric is considered by the author to refer to recommendations which are:

1) precisely stated, usually in a quantitative form so that they are not open to subjective (and therefore variable) interpretation.

2) sufficiently flexible to be relevant to a variety of applications.

3) validated (by empirical research, etc).

**Standards**

There is a growing trend towards specifying standards for the ergonomic design of the user interface (Marshall et al., 1987). In addition to the standards which already exist for aspects of the work environment and hardware, standards are now being developed which are concerned with cognitive aspects of the user interface (e.g. DIN draft release 66234, Part 8). Formal standards may improve hardware design, but be ineffective in improving software design as they can be too restrictive (Smith, 1986). The value of standards in interface design is illustrated by Sarson (1989) who describes an Esperanto for international trade - Edifact (Electronic Data Interchange for Administration, Commerce and Transport) which has been accepted by most countries in the world for use in international trade.

**Guidelines**

Guidelines are more flexible than standards but need to be translated into system specific design rules and/or computer-based algorithms in order to be effective (Smith, 1986; Mosier and Smith, 1986). They should also have mechanisms for enforcement, modification and granting of exemptions (Shneiderman, 1988). Guidelines are often derived largely from expert judgement, 'informed opinion' and accumulated practical experience rather than from research on quantitative performance measures or high-level cognitive processes (Gould and Lewis, 1985; Smith, 1986; Marshall et al., 1987). Foley (1983) advocates caution when using guidelines to design a system as 'they are not cast in concrete'.

If they are to be useful guidelines must be 'specific and quantitative in statement' (Granda, 1980 - cited by Marshall et al., 1987) and tested empirically (Gould and Lewis, 1985). If a guideline says 'provide a limited range of choices in a menu', the number of choices considered to be 'limited' is likely to vary between individuals and possibly the same individual on different occasions. However, if the guideline gives a set range or fixed value for the number of choices, such as 'provide 5 choices in a menu' or 'provide between 4 and 6 choices in a menu' there is more chance of the guideline being interpreted in a specific way. However, guidelines which are too specific are likely to have only limited applications (Mosier and Smith, 1986).

Guidelines are not necessarily imprecise. Williges and Williges (1984) reviewed 16 source documents containing a variety of guidelines for software dialogue design. These ranged in precision from 'meaningful codes should be used whenever possible and consistent with the user's expectations' (how can the user's expectations be determined?) to 'a maximum of 11 colour codes should be used'.

Although many guidelines could be improved they can be useful as a checklist to aid design decisions and supplement designer intuition. Norman (1987) comments that 'quantitative methods are better than qualitative ones, but all are better than none at all'.

**Metrics**

Metrics provide precise measurements (either single values or a range of values) which make them easier to test and implement than guidelines but not as inflexible as standards. The need for quantitative design tools such as metrics has been mentioned by various authors. 'Usability must be explicitly defined in terms of metrics which directly reflect users' experience with the system' (Wixon and Whiteside, 1985). A usable system will not be achieved merely by an empirical definition of usability. 'In addition, it is important to set levels that one plans to attain' so that estimates can be made of the resources required to attain the desired objectives (Wixon and Whiteside, 1985). Design principles should be sufficiently general to survive changes in technology and at the same time sufficiently precise to be of use. 'We need more precise principles' (Norman, 1987). User engineering principles may be formalised as theorems over specifications of interactive systems (Harrison and Thimbleby, 1985). Brooke (1986) comments that usability should be stated in clear, measurable terms.

Although not many metrics exist for assessing user interface design, metrics are well-established in the field of software design and development. Various properties for metrics which could be applied to usability metrics as well as software metrics are suggested by Birrell and Ould (1985):

1) The performance of a metric should correspond to intuition, e.g. a complexity metric should ascribe a high complexity value to designs which look and feel complex to the designer.

2) The performance of a metric should correlate with factors that it is supposed to influence, e.g. a complexity metric should rate as highly complex modules which will be difficult to change or understand.

3) A metric should be sensitive to changes in the system, that is, if a system is changed, the change in the value of the metric should be proportional to the size of the change to the measured property of the system.

Various examples of metrics relevant to user interface design include tradeoff analysis (Norman, 1987), attitude questionnaires or 'System Independent Evaluation Metrics' (SIEMs) for use in evaluating and comparing the effects of different computer systems on users (Kirakowski and Dillon, 1987), and a metric devised by Whiteside et al., 1985 (cited by Brooke, 1986) to describe the work rate of users on specified tasks. [ S = 1/T PC where T = time spent on task, P = percentage of task completed, C = arbitrary constant based on fastest possible task solution for a practised system expert and S = user's performance score]. Brooke (1986) was able to use this metric to assess user performance on office products undergoing development. Williges (1987) cites Gould and Lewis (1985) who describe specific metrics of user acceptance such as learnability, flexibility, throughput and attitudes in a survey of 447 system designers. Good et al. (1986 - cited by Williges, 1987) describe a usability engineering process for software interface design which involves defining usability through quantitative metrics. Tullis (1984) describes four metrics which affect how well users can extract information from alphanumeric displays:

1) overall density - the number of characters displayed expressed as a percentage of the total space available

2) local density - the number of characters near each other character

3) grouping - the extent to which characters on the display form well-defined groups

4) layout complexity - the extent to which the arrangement of items on the display follows a predictable visual scheme.

These metrics were measured by Tullis using objective methods and implemented in a

computer program.

**Conclusion**

The above review demonstrates that existing design recommendations have a limited role to play in interface design and assessment. The development of metrics for the user interface appears to provide a suitable alternative or supplement to traditional design recommendations such as guidelines. The type of format most suitable for ensuring that usable interfaces are designed will depend on the domain being analysed and range from direct inputs from a human factors expert, to paper-based guidelines, to automated implementation of evaluation principles and metrics (Marshall et al., 1987).

## PROJECT MIDAS

A review of research papers published in the area of human-computer action over the last 10 years supports the idea that there is a need to develop metrics for assessing and designing the user interface. While a large proportion of the papers reviewed contain loosely-defined guidelines or 'potential metrics' which need further research to verify or formally define the recommendations they contain as metrics, very few give formally-defined metrics relevant to user interface design. Often metrics are defined which concern hardware issues such as key size and shape rather than the user interface itself. Relevant metrics which have been found relate mainly to menus (e.g. the number of choices should be < 8). Very few papers actually use the term metric - the metrics they contain may be called algorithms or guidelines and so on.

It is intended that the literature review undertaken as part of Project MIDAS will be followed by empirical research to verify the metrics described in the literature and develop additional metrics. The research should have practical applications, such as providing a form of user interface assessment suitable for designers in addition to enhancing theoretical knowledge of interface assessment. The findings of the research will be available in the form of a report presenting the metrics and software for applying the metrics to formal descriptions of user interfaces.

## CONCLUSION

There is a need for flexible, scientifically validated design recommendations for the user interface. Metrics are considered to satisfy this need. Project MIDAS aims to validate and develop metrics suitable for assessing existing human-computer interfaces and for use in the design of new interfaces.

## REFERENCES


Birrell N.D., Ould M.A. A Practical Handbook for Software Development, 1985, Cambridge University Press, pp 159-163

Brooke J.B. Usability engineering in office product development. In: People and Computers: Designing for Usability (eds.) M.D. Harrison, A.F. Monk, 1986, Cambridge University Press, pp 249-259

Foley J.D. Managing the design of user-computer interfaces Computer Graphics World 1983, 12, 47-56

Gardiner M.M., Christie B. (eds.) (1987) Applying Cognitive Psychology to User-Interface Design, John Wiley & Sons

Gould J.D., Lewis C. Designing for usability: Key principles and what designers think Communications of the ACM 28(3), pp 300-311

Harrison M.D., Thimbleby H.W. Formalising guidelines for the design of interactive systems In: People and Computers: Designing the Interface (eds.) P. Johnson, S.Cook, 1985, Cambridge University Press, pp 161-171

Kirakowski J., Dillon A. The computer-user satisfaction inventory IEE Colloquium on "Evaluation Techniques for Interactive System Design: II". Friday 2 October 1987, Digest no. 1987/78, 3/1-3/3

Marshall C., Christie B., Gardiner M.M. Assessment of trends in the technology and techniques of human-computer interaction. In: Applying Cognitive Psychology to User Interface Design (eds.) M.M. Gardiner, B. Christie, 1987, John Wiley & Sons, pp 279-312

Marshall C., Nelson C., Gardiner M.M. Design Guidelines. In: Applying Cognitive Psychology to User Interface Design (eds.) M.M. Gardiner, B. Christie, 1987, John Wiley & Sons, pp 221-278

Mosier J.N., Smith S.L. Application of guidelines for designing user interface software Behaviour and Information Technology 1986, 5(1), 39-46

Norman D.A. Design principles for human-computer interfaces. In: Applications of Cognitive Psychology: Problem Solving, Education and Computing (eds.) D.E. Berger, K. Pezdek, W.P. Banks, 1987, Lawrence Erlbaum Associates, Publishers, pp 141-162

Sarson R. Standard bearers The Guardian 1 June 1989

Shackel B. The concept of usability In: Visual Display Terminals: Usability Issues and Health Concerns (eds.) J. Bennett, D. Case, J. Sandelin, M. Smith, 1984, Prentice-Hall Inc., pp 45-87

Shneiderman B. We can design better user interfaces: a review of human-computer interaction styles Ergonomics 1988, 31(5), 699-710

Smith S.L. Standards versus guidelines for designing user interface software Behaviour and Information Technology 1986, 5(1), 47-61

Tullis T.S. Predicting the usability of alphanumeric displays. (1984) PhD Thesis, Rice University, Available from The Report Store, Lawrence, KS.

Williges B.H., Williges R.C. Dialogue design considerations for interactive computer systems In: Human Factors Review: 1984 (ed.) F.A. Muckler, The Human Factors Society, Inc., 1984, pp 167-208

Williges R.C. The use of models in human-computer interaction. Ergonomics 1987, 30(3), 491-502

Wixon D., Whiteside J. Engineering for usability: Lessons from the User Derived Interface In: Human Factors in Computing Systems-II (eds.) L. Borman, B. Curtis, 1985, North-Holland, pp 144-147

Smith H. (1991) Windows and multiple screens: Optimizing their utility in office systems. In E.J. Lovesey (ed.), Contemporary Ergonomics 1991: Proceedings of the Ergonomics Society's Annual Conference, Southampton, England, 16-19 April 1991, (London: Taylor and Francis), 240-245.

# WINDOWS AND MULTIPLE SCREENS: OPTIMIZING THEIR UTILITY IN OFFICE SYSTEMS

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The user in a typical office environment works on multiple tasks. Problems may be encountered when using an interface which has a single screen or 'window' when it is necessary to perform more than one task at once. Windowing allows the amount of information available on the screen to be increased without physically increasing screen size. Future research should concentrate on the functions and concepts of windowing rather than on the physical features of windowing systems.

## INTRODUCTION

The office may be considered in various ways, with a broad emphasis on the administrative and information-handling aspects of an organization. An office may be defined according to the type of people who are classified as 'office workers', the furniture and equipment used by those people, and the nature of the work undertaken. There will be basic similarities in these areas although the term 'office' is not restricted to a physical office in an office block. It includes hospitals, airports, academic establishments, and anywhere else where information is used, including the 'mobile' office. 'Office workers' include not only traditional office workers such as secretaries and managers but also executives, estate-agents, financial analysts and many others who utilize information (Herbach, 1983).

While modern research into the office stresses information technology, it can be argued that investigation of information technology *per se* is less important than gaining an understanding of what people do in the office. Technology becomes obsolete but the basic tasks remain the same. Papyrus is no longer used but the desire of people to 'write down' and communicate information still exists thousands of years later. Manual typewriters were superceded by electric and electronic typewriters which in turn were replaced by the word processor, and so on.

Consideration of human-computer interface development shows that users expect support for multiple contexts (Reichman, 1986) as they may wish to work on several tasks at a time and require access to multiple facilities. However, traditional office work stations have a limited size, single screen, display which limits their usefulness as an all-purpose office tool (Card, 1985) because the number of different tasks which can be performed is restricted.

## LIMITATIONS OF SINGLE SCREEN DISPLAYS

The tasks users wish to complete when using office systems may vary in complexity as well as in number - the user may wish to complete a single simple task, a single complex task, multiple simple tasks, or multiple complex tasks. Task complexity may be defined according to software capacity in a single screen display rather than subjective difficulty as this is likely to vary according to the level of expertise and experience of individual users (Smith, 1990a).

Single screen displays (which may also be termed single window displays) have various limitations if the user wishes to use them for multiple and/or complex tasks. The user is unable to have simultaneous access to multiple sources of information or different types of information. Single window displays do not provide memory aids, permit independent tasks to be performed at the same time or allow different representations of the same task. In addition, the size of screen available to the user is limited to the physical size of the screen.

Users performing multiple or complex tasks should be able to access multiple sources of information and combine sources if necessary. For example, a medical insurance claims agent may wish to retrieve various types of information simultaneously such as the client's medical history and a record of previous claims in addition to basic details such as name, address, and telephone number (Shneiderman, 1987).

Single window displays allow only one type or source of information to be displayed at a time although tasks such as editing a document require different types of information to be shown simultaneously so that the user can compare and combine information (Norman et al., 1986).

When performing complex tasks, it may be necessary for the commands in one window to differ from those in another window to enable independent tasks to be performed simultaneously. However, single screen displays are restricted to displaying commands in only one window.

Problems may occur when using a single screen if different representations of the same task are needed. For example, if only a single window display is available, hierarchical browsing when editing a document may not be possible.

When using a single screen to access multiple sources of information, the user must switch from source to source to obtain the relevant information which can lead to problems caused by order effects and memory limitations (Dix and Harrison, 1986).

On a single window display the virtual size of the screen cannot be changed which limits the amount of information which can be displayed. The fact that the screen is smaller than a desk is a problem which needs to be resolved when attempting to transfer work from the desk to the screen (Card, 1985). A method to increase the amount of information available on the screen, without physically increasing screen size, so that it matches user requirements more closely is needed.

## METHODS FOR INCREASING DISPLAY UTILITY

Various methods exist for increasing the effective size of a single screen display without physically increasing screen size. These methods may be collectively referred to as windowing as they involve the use of multiple windows. A window may be defined as an area on a computer display, usually rectangular, and usually delimited by a border, containing a particular view of some data in the computer (Bury et al., 1985; Card et al.,1984; Teitelman, 1977 - all cited in Billingsley, 1988). While there is usually only one physical screen or window, there may be many virtual screens or windows.

Windowing techniques currently available include the use of multiple windows (or virtual screens) on the same display to increase the virtual size of screen and the use of multiple screens (several single displays used together).

An early recognition of the need for the need for windowing systems was made by Page and Walsby (1979): " A mechanism for keeping several distinct items of information on one screen simultaneously is required."

The use of multiple windows or multiple screens provides a solution to the problem of limited space on a single window display by more effective utilization of the display area. Systems where multiple windows are available benefit the user in various ways: the virtual size of the screen is increased, helping to increase the amount of information available without physically increasing screen size; more than one piece of information can be seen and used at a time; more than one task can be performed at a time; different representations of the same task can be displayed; windows can act as reminders to assist the user's internal memory. Other benefits of windowing systems include their capacity to allow the screen to emulate the office desk more closely so that it can 'fit in with a worker's daily routine' (Card, 1985).

Windowing systems also enable human-computer interaction to approximate everyday communication between people (Reichman, 1986). This advantage is likely to gain in value as the interest in Computer-Supported Cooperative Work (CSCW) grows.

Methods such as overlapping windows and the use of icons (small specialised windows) to represent various files and other office objects enable the effective size of the screen to be increased (Card, 1985).

Windowing systems enable multiple sources of information such as text, graphics, or a combination of text and graphics, to be displayed simultaneously in different windows on the same screen so that the user can compare and combine information. This is useful when creating a document as many office tasks involve looking at several documents at once and often creating a new document from material in existing documents (Card, 1985).

One of the main advantages of windows is that the commands in one window can differ from those in another window which enables independent tasks to be performed simultaneously. For example, if a user needs to send some electronic mail while using a word processor, it is possible to send the mail using a separate window and return to the main task of word processing without losing context or needing to restart the work (Shneiderman, 1987).

In addition to allowing independent tasks to be completed, windowing can be used to provide different representations of the same task which is useful for complex tasks such as scanning a lengthy document. For example, one window could contain a synopsis for an academic paper, a second window the text, and a third the bibliography (Coats and Vlaeminke, 1987).

When using a single window display to access multiple sources of information the user must remember the location of the required information which can lead to problems caused by order effects and memory limitations. Systems using multiple windows may assist the user's internal working memory store by providing reminders and acting as an external memory store in the form of a display which does not interfere with other displayed information (Card, 1985; Dix and Harrison, 1986) and enabling multiple sources of information to be shown simultaneously so that the user can compare and combine information (Norman et al., 1986). For example, when writing an article which contains several tables, the main text and tables can be displayed together on the screen to save the author having to remember which tables exist.

While early communication procedures between people and computers were quite limited, linear, and constrained, multiple window facilities enable human-computer interaction to simulate everyday interaction between people (Reichman, 1986).

## LIMITATIONS OF WINDOWING

Although windowing has many potential advantages, poor design and layout may decrease the value of windows for displaying information (Streveler and Wasserman, 1984 - cited in Gardiner and Christie, 1987). Other potential limitations of windowing systems include: the effort required to manipulate multiple windows; the limited size of individual windows; a need to understand multiple activities, user requirements, and the user's model of the system.

Windows need to be well-designed to avoid confusion, distraction, and visual problems such as being unable to read the contents of individual windows or distinguish one window from another, particularly if the size of the window is small.

Illegible or irrelevant information may distract or confuse the user as too much unrelated information may be shown at once so that the display becomes untidy, like an untidy desk, resulting in a reduction in working efficiency.

The effort involved in manipulating windows (opening, moving, deleting, and so on) can be time-consuming and may distract the user from the task being performed (Shneiderman, 1987). Manipulability and legibility are likely to be affected by such features as size and type of window (tiled or overlapping).

If windowing systems are used on a small screen, the amount of information which can be shown in each window may be less than if the information was displayed in a single window which occupied the size of the full screen (Tombaugh et al., 1987).

The growth of informal windowing standards such as OSF Motif and Open Look may mean that there is a decrease in emphasis on window design and an increase of interest in the functions of windows.

An adequate understanding of user requirements is important when designing windowing software. Emphasis on the ability to simultaneously view multiple tasks (rather than multiple views of the same task), may be counter productive as users may prefer to work on just one task. Computers should attempt to eliminate 'clutter' from the desk rather than reproduce it (Herbach, 1983).

Although the use of multiple windows or multiple screens can make computers more versatile and easier to use by overcoming the limitations of single window displays, it is important to understand the way in which the user views and cognitively processes information presented on the screen, and the relationships among multiple windows or screens and the information they contain (Norman et al., 1986). Norman et al. use the term 'cognitive layout' to refer to the user's interpretation of and response to the physical or 'surface layout' of a display. The particular layout adopted by the user drastically affects the user's understanding and expectation of events at the user-system interface resulting in either great improvements or detriments in performance depending on the appropriateness of the layout adopted.

An early reference to the idea of an 'electronic desk' was made by Page and Walsby (1979): "Workstations will be highly intelligent and highly interactive computer systems intended to replace the traditional desk, filing cabinet and other information handling aspects of office

work. However, research is needed to investigate whether the computer screen can and should be used for this purpose. Do people really want a fully electronic office? (Smith, 1990b) Windowing systems may not achieve their full potential if an inappropriate model is used when developing the interface. Reichman (1986) suggests that where a system has been designed according to the desktop metaphor the main interrelationship between the contents of the desk is that which exists in the mind of the user which means that users must remember how they have organized their desks.

## CONCLUSION

Despite certain limitations, the advantages of windowing seem to outweigh any drawbacks. Further research is needed into the design and functions of windows and multiple screens (Shneiderman, 1987; Gardiner and Christie, 1987). Previous research has tended to concentrate on the physical design and management of windows rather than on the functions of windows and the nature of the tasks themselves (Herbach, 1983). Emphasis in future research should be on user requirements, office tasks, and user models of computer systems in order to understand the concepts rather than the physical features of windowing systems such as window design and management. Empirical research is being planned by the author which aims to investigate user requirements for office systems and optimal ways to enable displays to match user requirements.

## REFERENCES


Billingsley, P.A., 1988, Taking Panes: Issues in the design of windowing systems. In Handbook of Human-Computer Interaction, ed. M. Helander (Amsterdam: North-Holland) pp. 413-436.

Card, S.K., 1985, 'Windows': Why they were invented, how they help. The Office, **March 1985**, 52-54.

Coats, R.B., and Vlaeminke, I., 1987, Man-Computer Interfaces, (Oxford: Blackwell Scientific Publications) pp. 238-273.

Dix, A.J., and Harrison, M.D., 1986, Principles and interaction models for window messages. In People and Computers: Designing for Usability, ed. M.D. Harrison and A.F. Monk (Cambridge: Cambridge University Press), pp. 352-366.

Herbach, M., 1983, How is a computer like an elephant? Byte, **December 1983**, 247-248.

Marshall, C., Christie, B., and Gardiner, M.M., 1987, Assessment of trends in the technology and techniques of human-computer interaction. In Applying Cognitive Psychology to User-Interface Design ed. M.M. Gardiner and B. Christie (Chichester: John Wiley & Sons), pp. 279-312.

Norman, K.L., Weldon, L.J., and Shneiderman, B., 1986, Cognitive layouts of windows and multiple screens for user interfaces. International Journal of Man-Machine Studies, **25**, 229-248.

Page, I. and Walsby, A., 1979, Highly dynamic text display system. Microprocessors and Microsystems, 3(2), 73-76.

Reichman (Adar), R., 1986, Communication paradigms for a window system. In User-Centered System Design, ed. D.A. Norman and S.W. Draper (Hillsdale, N.J.: Lawrence Erlbaum Associates), pp. 285-313.

Shneiderman, B., 1987, Designing the User Interface: Strategies for Effective Human-Computer Interaction (Reading, Massachusetts: Addison-Wesley Publishing Company), pp. 342-355.

Smith, H., 1990a, Single screens and multiple tasks. Proceedings of the 23rd Annual Conference of the Human Factors Association of Canada, 26-28 September, 1990., pp. 197-201.

Smith, H., 1990b, Using single screens for multiple and complex tasks. Ergonomics Society of Australia National Conference 4-7 December 1990.

Tombaugh, J., Lickorish, A., and Wright, P., 1987, Multi-window displays for readers of lengthy texts. International Journal of Man-Machine Studies, 26, 597-615.

Smith H. (1994) Technology and the office: User perceptions. In S.A. Robertson (ed.), Contemporary Ergonomics 1994: Proceedings of the Ergonomics Society's Annual Conference, University of Warwick, 19-22 April 1994. (London: Taylor & Francis), 40-45.

# TECHNOLOGY AND THE OFFICE: USER PERCEPTIONS

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User perceptions seem to be given insufficient emphasis by the designers of technology. However, it is argued that it is important to consider user views since user perceptions will affect their reactions to, and acceptance of, technology. Factor analysis of a free response questionnaire issued to 75 subjects indicates that subjects share perceptions of technology and the office and that these perceptions can be described by eight factors.

## Introduction

Current office computing systems provide many of the features considered to characterize 'the office'. It has been claimed that computer systems, particularly those offering multiple windowing facilities, provide an effective means of completing office activities (Smith 1990a, 1990b, 1991). The continuing expansion in the use of computer systems in the office indicates that the value of using computers is widely recognised. However, it is argued that users continue to experience difficulty in the use of office systems and that not all the facilities available are used or understood. "It is becoming increasingly clear that the comfort of a good fit between man and machine is largely absent from the technology of the information age" (Sedgwick, 1993). One explanation for the discrepancy between what is available and what is used could be that users and designers of computer systems have different perceptions of what constitutes office work and of the role of computers in the office.

"Technology becomes obsolete but the basic tasks remain the same. Papyrus is no longer used but the desire of people to 'write down' and communicate information still exists thousands of years later." (Smith, 1991) In order to ensure optimal use of computer systems in the office it is necessary to establish 1) the nature of office work 2) the nature of technology 3) user requirements for office systems. A close match between these three areas will ensure more effective use of computers in the office.

Recent developments, such as the widespread use of systems permitting multiple-windowing, the increase in interest in multimedia, and developments in virtual reality, mean that aspects of 'the office' other than basic office tasks such as the provision of wordprocessing facilities are being allocated to the computer. It is therefore important to consider what constitutes an office and how far computer systems can and should provide or replicate office features. Is it intended that computer systems will simulate the entire office or that their prime function will be as a tool to support but not supplant office activities? Do people really want a fully electronic office? (Smith, 1990b).

The benefits to be gained from computer systems should be maximised without assuming that just because computers are advantageous for certain activities, they are suitable for ALL activities. Conversely, it should not be assumed that recognising the limitations of computers is the same as taking an 'ostrich' attitude towards technology, merely advocating a certain amount of caution.

Sedgwick proposes that a key principle of user-centred design is "not to assume that more technology is always better". To paraphrase *Animal Farm* (Orwell, 1945) a balance is needed between the attitude towards technology which is similar to the initial 'no technology good, technology bad' philosophy and the later chanting of 'no technology good, technology *better!*'

The ease with which people can use computer systems in the office and the usefulness of such systems is likely to depend to a large extent on the match between the activities in which the users wish to engage, their constructs regarding 'the office', and their expectations regarding the nature of the computer system which they are using. The greater the match between the user's constructs and the designer's constructs, the easier the computer system should be to use. Currently, many features of computer systems are misunderstood or under-utilized. Poorly designed user interfaces are considered to be responsible for the finding that less than 40% of the potential range of functions is used on many systems (Fischer, 1984).

The designer should dictate user requirements or 'forbid' the user to do anything only when there is a good reason for doing so such as technological limitations or potential harm to others.

User perceptions of the nature of office work and the role of technology in the office can be compared with current knowledge to determine the accuracy of user perceptions when compared with 'reality'. If there are vast discrepancies what are the implications for interface design? Should user perceptions be treated with scepticism, as appears to happen at present or should user perceptions be given greater prominence on the basis that even if those perceptions can be shown to be inaccurate using objective methods they are true to the user and will affect that user's interaction with a particular computer system?

It is assumed that people will have similar perceptions concerning the nature of office work and the role of technology in the office but vary in the importance they attach to those perceptions. Therefore designer assumptions about the user's model of a computer system are likely to be inadequate because although they may include the same basic concepts that the user expects, the emphasis given to the implementation of those concepts by the designer may not correspond to the emphasis expected by the user.

Users and designers are not assumed to always have different priorities but it is important to determine the nature of their perceptions about office work and technology and the importance they attach to those perceptions as differences in the priorities of users and designers may have a detrimental effect on the usability and acceptability of a system. For example, the user and designer may agree on the basic concept of providing an electronic storage system but while the designer may concentrate on producing a 'realistic' filing cabinet icon and assume that this is self explanatory, the user may be satisfied with just the words SAVE FILE so long as the words provide a clear instruction as to how to save a file. At a very basic level while both the user and designer may agree on the benefits of technology, the novice user may be primarily concerned with functions which are taken as self-evident by the designer such as locating the switch which turns the machine ON (or equally important OFF, particularly in an emergency!) rather than with 'Phil, the intelligent agent' or 'x megabytes RAM'.

## Technology and the office: User perceptions

The aims of the study described in this section ('User Perceptions') were to obtain information on user perceptions of office work and the role of technology in the office in order to determine whether there are differences between users and designers in perceptions of office work and the role of technology in the office and in the importance ranks given to those perceptions. (This study is described in detail in the author's thesis *'User perceptions of technology and the office'*).

75 subjects completed a free response questionnaire in which they were asked to list the activities which occur in a typical office, the advantages and disadvantages of using computer systems in the office and the features which they would allocate to a computer in their ideal office. 51 per cent of the subjects were students and 49 per cent non-students. The 'non-students' included clerical and administrative workers, an air hostess, a library assistant, a computer consultant, and a company director.

Factor analysis of responses to the free response questionnaire produced eight factors - information-handling, human contact, paper-handling, financial security, communication, technology, work, and health preservation. These factors are considered to be the main constituents of office work as perceived by the subjects who participated in the User Perceptions study. There was overall agreement between the subject groups on the factors which constitute office work and on the importance of those factors.

## Discussion

Different views have been expressed as to the extent of agreement which can be expected between the perceptions of different people. One view is to predict a high level of agreement: "Because of the continuity of the physical, biological, and social environment in which human beings live, their concepts will show a high degree of similarity" (Carroll, 1967). However, what people say and what actually exists may differ. "People's thoughts also really exist, though the correspondence between what people really think exists and what really does exist is a continually changing one." (Kelly, 1955) Kelly also states that "no-one has yet proved himself wise enough to propound a universal system of constructs".

Ideally a combination of subjective and objective techniques should be used when assessing a product as the use of a single technique may produce misleading results (Smith, 1986). For example, the data obtained from the User Perceptions study could be compared with the results of studies using objective methods such as the FOAR (Functional Analysis of Office Requirements) study (Schäfer et al., 1988) and also with the current provision of facilities in 'standard' office systems to see how far user perceptions are reflected in existing systems.

However, while it is recognised that subjective data should be supplemented by objective data when implementing a particular application, it is felt that subjective data have a value independent of their use for implementation for the following reasons:

1) User perceptions provide some insight into the user's thought processes and therefore any underlying user's model.

2) In the User Perceptions study users share similar perceptions even though those perceptions may not necessarily reflect reality. It is important to consider a) why people might have 'misperceptions' about the office and the role of technology b) the effect of any misperceptions on the user's interaction with technology and on system design. For example, in the User Perceptions study many subjects expressed anxiety about dependence on an unreliable power supply and about insecure systems. A user who thinks that a system is unreliable and insecure is likely to be reluctant to store vital information in that system or to spend time creating paper backups 'just in case the system goes down' even though the system can be shown to be very

reliable using objective criteria. Designers and retailers need to be aware of such user anxiety so that they can reassure users that a system is reliable. (The issue of user perceptions of their use of technology in specific circumstances is considered further in the author's thesis *'User perceptions of technology and the office'*.)

When designers ignore "the subtle and complex interactions between employees and new technology, and the way people are organised at work" the consequences can be serious (Patel, 1993). Patel cites as an example the collapse within 36 hours of the £1.5 million initiative by the London Ambulance Service for dealing with emergency calls. One of the causes of problems was poor training. The subjects who participated in the User Perceptions study mentioned training as an important aspect of office work which indicates that users can have valid perceptions.

"People generally care less about knowing the time to the nanosecond than about seeing how long they've got until lunch" (Sedgwick, 1993). In the User Perceptions study 'lunch' and 'tea/coffee making' appeared as constituents of the factor 'Human Contact'. This supports Sedgwick's assertion. However, the emphasis in some advertisements for computers appears to be on price and technical details such as a '486DX2 50 MHz processor', '4Mb RAM, upgradeable to 32 Mb', and '#9 GXE VL-Bus graphics accelerator with 3 MB Video RAM' (Dell Dimension advertisement, November, 1993).

The assumption that only experts such as designers can comment on technology seems to be incorrect. Common sense, hearsay and fiction may not have scientific validity but they should not be totally ignored as insight into a particular research issue may come from unlikely sources. The writer E. M. Forster (1947) seemed to anticipate the development of electronic forms of communication and multimedia and its possible drawbacks:
"....the round plate that she held in her hands began to glow. .... Presently she could see the image of her son who lived on the other side of the earth, and he could see her. [...]
'I want you to come and see me.'
Vashti watched his face in the blue plate.
'But I can see you!' she exclaimed. 'What more do you want?'
'I want to see you not through the Machine,' said Kuno. 'I want to speak to you not through the wearisome Machine.'
'Oh, hush!' said his mother, vaguely shocked. 'You mustn't say anything against the Machine.'
[...]
'You talk as if a god had made the Machine,' cried the other.'[...] Men made it, do not forget that. Great men, but men. The machine is much, but it is not everything. I see something like you in this plate, but I do not see you. I hear something like you through this telephone, but I do not hear you.' "

This extract from a work of fiction is interesting because it neatly illustrates a perspective on the impact of technology even though the author was writing well before the technology 'explosion' of the late twentieth century and was written by someone who does not have the credentials of a trained computer designer.

The phrase 'BIG BROTHER IS WATCHING YOU' has been quoted so often as to pass into everyday speech (Orwell, 1949). However, is it so far-fetched now that 'big brother' is indeed watching you through the surveillance cameras in the car park, at the railway station, in the supermarket, in the post office, ....? What are the potential implications for monitoring people via the video links in office-based multimedia systems?

User perceptions may not always reflect 'scientific' theories or how users actually interact with

technology but this does not mean that their ideas totally lack validity. "I disapprove of what you say, but I will defend to the death your right to say it." (Voltaire)

## References


Carroll, J.B. 1967, Words, meanings and concepts. In L.A. Jakobovits and M.S. Miron (eds.) *Readings in the Psychology of Language*, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc.) 567-586.

DELL, 1993, "Where the hell can I get my hands on a screamin' PC without paying an arm and a leg?" *Dell Dimension advertisement*, November 1993.

Fischer, G. 1984, Human-computer communication and knowledge-based systems. In H.J. Otway and M. Peltu (eds.) *The Managerial Challenge of New Office Technology*, (London: Butterworths) 54-79.

Forster, E.M. 1954, The Machine Stops. *Collected Short Stories* (London: Penguin Books Ltd.) (originally published by Sidgwick and Jackson, 1947)

Kelly, G.A. 1955, *The Psychology of Personal Constructs. Volume 1: A Theory of Personality* (New York: W.W. Norton and Co., Inc.)

Orwell, G. 1945 (reprinted 1981) *Animal Farm* (Harmondsworth, Middlesex: Penguin Books Ltd)

Orwell, G. 1949 (reprinted 1976) *Nineteen Eighty-Four* (Harmondsworth, Middlesex: Penguin Books, Ltd)

Patel, K. 1993, Erring on the side of you-manity. *The Times Higher* August 13 1993, 32.

Schäfer, G. with Hirscheim R. et al. 1988, *Functional Analysis of Office Requirements* (Chichester: John Wiley and Sons)

Sedgwick, J. 1993, Techno Fear. *Ergonomics Australia* 7(4) 25-30.

Smith, H. 1986, Devising an ergonomics checklist to assess the convenience of domestic irons. *Unpublished MSc project report*, University of Birmingham.

Smith, H. 1990a, Single screens and multiple tasks. *Proceedings of the 23rd Annual Conference of the Human Factors Association of Canada, Ottawa, Canada. September 26-28 1990*, 197-201.

Smith, H., 1990b, Using single screens for multiple and complex tasks. *Proceedings of the* 26th Annual Conference of the Ergonomics Society of Australia, Adelaide, Australia, 4-7 December 1990, 167-172.

Smith, H. 1991, Windows and multiple screens: Optimizing their utility in office systems. In E.J. Lovesey (ed.), *Contemporary Ergonomics 1991: Proceedings of the Ergonomics Society's Annual Conference, Southampton, England, 16-19 April 1991*, (London: Taylor and Francis) 240-245.

Smith, H. (to be submitted in 1994) *User perceptions of technology and the office*, PhD thesis under completion, Department of Computing and Information Systems, London Guildhall University.

Voltaire, (Attr. in S.G. Tallentyre, *The Friends of Voltaire* (1907) p. 199) *The Oxford Dictionary of Quotations*, Third Edition (1979) (Oxford: Oxford University Press) 561.

## BIBLIOGRAPHY


*Advertisers Annual* (1991) Advertisers Annual 91-92 - 66th Edition. Volume 2: UK Media, (East Grinstead: Reed Information Services Ltd.).

Aldenderfer M.S. and Blashfield R.K. (1984) Cluster Analysis, Sage University Paper Series on Quantitative Applications in the Social Sciences, 07-044, (Beverly Hills and London: Sage Publications).

*Applied Ergonomics* (1969) Applied Ergonomics Handbook. Part 1. Applied Ergonomics, 1(1), 25-41.

Argyle M. (1972 - reprinted 1976) The Social Psychology of Work, (Harmondsworth, Middlesex: Penguin Books).

Argyle M., Furnham A., and Graham J.A. (1981) Social Situations, (Cambridge: Cambridge University Press).

Armour H. (1986) New Technology in the Office Environment, (Aldershot: Gower Publishing Company Limited).

Arthur C. (1994) A spammer in the networks. New Scientist, 19 November 1994.

*The Australian Technical Journal of Science, Art and Technology* (1897) In The Australian Country Diary 1991, (1990) (Brookvale, NSW: Simon and Schuster Australia), 64.

Baecker R.M. (ed.) (1993) Readings in Groupware and Computer-supported Cooperative Work: Assisting human-human collaboration, (San Mateo: Morgan Kaufmann Publishers).

Baecker R.M. and Buxton W.A.S. (eds.) (1987) Readings in Human-Computer Interaction: A Multidisciplinary Approach, (San Mateo: Morgan Kaufmann Publishers, Inc.).

Barker P. (1989) Basic Principles of Human-Computer Interface Design, (London: Hutchinson).

Baron R. and Beslmüller E. (eds.) (1989) Field Test Report: Report on OSSAD Applications in Finnish, French, German and Italian Field Sites, (Munich: Institut für Organisationsforschung und Technologieanwendung (IOT)).

Baynes M. (1992) When the bumbling human holds up the whole show. PC Week Supplement, May 5 1992.

Berger A. A. (1991) Media Analysis Techniques - Revised Edition, (Newbury Park, California: Sage Publications, Inc.).

Bevan N. and Macleod (1994) Usability measurement in context. Behaviour and Information Technology, 13(1 and 2), 132-145.

Bjørn-Andersen N. (1983) The changing roles of secretaries and clerks. In H.J. Otway and M. Peltu (eds.) New Office Technology: Human and Organizational Aspects, (London: Frances Pinter), 120-137.

Bjørn-Andersen N. (1986) Understanding the nature of the office for the design of third wave office systems. In M.D. Harrison and A.F. Monk (eds.) People and Computers: Designing for Usability. (Cambridge: Cambridge University Press), 65-77.

Billingsley P.A. (1988) Taking Panes: Issues in the Design of Windowing Systems. In M. Helander (ed.) Handbook of Human-Computer Interaction, (Amsterdam: North-Holland), 413-436.

Blackler F. and Brown C. (1987) Management, organizations and the new technologies. In F. Blackler and D. Oborne (eds.) Information Technology and People, (Leicester: The British Psychological Society), 23-43.

Blackler F. and Oborne D.J. (1987) Preface. In F. Blackler and D. Oborne (eds.) Information Technology and People. (Leicester: The British Psychological Society), v-vi.

Blackler F. and Oborne D.J. (1987) Postscript. Information technology and people: A fresh view of the relationship. In F. Blackler and D. Oborne (eds.) Information Technology and People. (Leicester: The British Psychological Society), 251-258.

Boeller R.A., Stodder S.A., Meyer J.F., and Escobedo V.T. (1992) A large-format thermal inkjet drafting plotter (incorporating Wield P.J., DesignJet Plotter user interface design: Learning the hard way about human-computer interaction. Hewlett-Packard Journal, December 1992, 43(6), 6-15.

Bolt R.A. (1987) Conversing with Computers. In R.M. Baecker and W.A.S Buxton (eds.) Readings in Human-Computer Interaction: A Multidisciplinary Approach, (San Mateo: Morgan Kaufmann Publishers, Inc.), 694-702.

Booth P.A. (1989 - reprinted 1990) An Introduction to Human-Computer Interaction, (Hove: Lawrence Erlbaum Associates Ltd.).

Bowbrick P. (1995) Blowing the whistle on referees. The Times Higher, February 10 1995.

Boylan C. (1992) And friends. The Guardian, September 3 1992.

British Telecom (1993) Tell your staff you want to see less of them. British Telecom advertisement, November 1993.

Brosnan M.J. and Davidson M.J. (1994) Computerphobia - Is it a particularly female phenomenon? The Psychologist, February 1994, 73-78.

Bunyan J. (1678 - reprinted 1987) The Pilgrim's Progress, (London: Penguin Books).

Cakir A., Hart D.J., and Stewart T.F.M. (1980 - reprinted 1982) Visual Display Terminals, (Chichester: John Wiley and Sons).

Caldwell B.S., Uang S-T., and Taha L.H. (1995) Appropriateness of communications media use in organizations: situation requirements and media characteristics. Behaviour and Information Technology, 14(4), 199-207.

Card S.K. (1984) Human limits and the VDT computer workplace. In J. Bennett, D. Case, J. Sandelin, and M. Smith (eds.) Visual Display Terminals: Usability Issues and Health Concerns, (Prentice-Hall Inc.), 117-160.

Card S.K. (1985) 'Windows': Why they were invented, How they help. The Office, March 1985, 52-54.

Card S.K. and Henderson D.A. (1987a) Catalogues: A metaphor for computer application delivery. In H.J. Bullinger and B. Shackel (eds.) Human-Computer Interaction - INTERACT '87, (Amsterdam: North-Holland), 959-964.

Card S.K. and Henderson D.A. (1987b) A Multiple Virtual-Workspace Interface to Support User Task Switching. In J.M. Carroll and P.P. Tanner (eds.) Human Factors in Computing Systems-IV and Graphics Interface, (Amsterdam: North-Holland), 53-59.

Card S.K. and Moran T.P. (1980) Computer text-editing: An information-processing analysis of a routine cognitive skill. Cognitive Psychology 12, 32-74.

Card S.K., Moran T.P., and Newell A. (1980) The Keystroke-level model for user performance time with interactive systems. Communications of the ACM, 23(7), 396-410.

Card S.K., Moran T.P., and Newell A. (1983) The Psychology of Human-Computer Interaction, (Lawrence Erlbaum Associates).

Carroll J.B. (1967) Words, meanings and concepts. In L.A. Jakobovits and M.S. Miron (eds.) Readings in the Psychology of Language, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc.), 567-586.

Carroll J.M., Herder R.E., and Sawtelle D. (1987) TaskMapper. In H.J. Bullinger and B. Shackel (eds.) Human-Computer Interaction - INTERACT '87, (Amsterdam: North-Holland), 973-978.

Cattell R.B. (1978) The Scientific Use of Factor Analysis in Behavioral and Life Sciences, (New York and London: Plenum Press).

*Chambers English Dictionary*, (1988) (Cambridge: Cambridge University Press).

Champkin J. (1994) Let's be clear about this, you're not my type at all. Daily Mail, June 4 1994.

Charlesworth K. (1994) Cartoon (Polar bear). New Scientist, 23 April 1994.

Child D. (1970 -, reprinted 1979) The Essentials of Factor Analysis, (London: Holt, Rinehart and Winston Ltd.).

Christie B. (1975) The role of the electronic meeting in the decentralization of business. PhD Thesis, School of Environmental Studies, University of London.

Christie B. (ed.) (1985) Human Factors of the User-System Interface, (Amsterdam: North-Holland).

Christie B. (1987) The technological and work context: The office as the prototypical electronic workplace of the 1990s. In A. Gale and B. Christie (eds.) Psychophysiology and the Electronic Workplace. (Chichester: John Wiley and Sons), 33-62.

Christie B. and Holloway S. (1975) Factors affecting the use of telecommunications by management. Journal of Occupational Psychology, 48, 3-9.

Christie B. and Kaiser M.P. (1985) The office: A psychological perspective. In B. Christie (ed.) Human Factors of Information Technology in the Office, (Chichester: John Wiley and Sons), 24-56.

Coats R.B. and Vlaeminke I. (1987) WIMPs. Man-Computer Interfaces. (Oxford: Blackwell Scientific Publications), 238-273.

Coffee P. (1992) How the judges scored the competing products. PC Week, June 29 1992, 9(26), 108.

Coffey M. (1993a) The world in your palm. The Observer Computer Report, February 28 1993.

Coffey M. (1993b) Workers United! The Observer Computer Report, February 28 1993.

Cole G. (1994) Log off, lock up, look out. The Observer, May 22 1994.

Conrath D.W. and Dumas P.J. (eds.) (1989) Office Support Systems Analysis and Design, a Manual. (Munich: Institut für Organisationsforschung und Technologieanwendung (IOT)).

Cook S.W. and Sellitz C. (1973) A multiple indicator approach to attitude measurement. In N. Warren and M. Jahoda (eds.) (1973) Attitudes: Selected Readings - Second Edition, (Harmondsworth, Middlesex: Penguin Books), 364-394.

Cooper C. (1992) Baby boomers and computers. Computer Shopper, October 1992, 12(10), 77.

Cooper M. (1994) Video: Alternative documentation. The Manual, 1, 24-27.

Cooper Clarke J. (1994) Network South East. The Guardian, July 28 1994.

Coops J. and Hobson S. (1992) Go with the flow. The Guardian, September 17 1992.

Corbitt T. (1993) Videophones could cut executive trips abroad. Daily Mail, January 18 1993.

Coulouris G. (1979) Personal computers in offices of the future. Microprocessors and Microsystems, 3(2), 69-72.

Coulouris G.F. (1982) Designing interactive systems for the office of the future. Behaviour and Information Technology, 1(1), 37-42.

Czaja S.J. (1987) Human Factors in Office Automation. In G. Salvendy (ed.) Handbook of Human Factors, (Chichester: John Wiley and Sons), 1587-1616.

*Daily Mail* (1993) There's no workplace like home. Daily Mail, June 24 1993.

Damodaran L., Simpson A., and Wilson P. (1980) Designing Systems for People, (Manchester: NCC Publications).

Damos D. (1986) The effect of using voice generation and recognition systems on the performance of dual tasks. Ergonomics, 29(11), 1359-1370.

Davidson K. (1995) Liberté, egalité, interneté. New Scientist, 27 May 1995.

Davies W.H. (1870-1940) Leisure. The Oxford Dictionary of Quotations - Third Edition, (1979), (Oxford: Oxford University Press), 172.

Davis F.D. (1993) User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. International Journal of Man-Machine Studies, 38, 475-487.

Davis G.B. (1989) Caution: User-developed systems can be dangerous to your organization. In: R.R. Nelson (ed.) End-User Computing: Concepts, Issues, and Applications, (John Wiley and Sons, Inc.), 209-228.

DELL (1993) "Where the hell can I get my hands on a screamin' PC without paying an arm and a leg?" Dell Dimension advertisement, November 1993.

Diamond J. (1993) Small and perfectly informed. The Guardian, October 4 1993.

Dickinson J. and Goodman D. (1989) Human factors assessment of teleconferencing equipment. Proceedings of the 22nd Annual Conference of the Human Factors Association of Canada, 157-161.

Dix A.J. and Harrison M.D. (1986) Principles and interaction models for window managers. In M.D. Harrison and A.F. Monk (eds.) People and Computers: Designing for Usability, (Cambridge: Cambridge University Press), 352-366.

Dooley B., Byrne M.T., Chapman A.J., Oborne D., Heywood S., Sheehy N., and Collins S. (1994) The teleworking experience. In S.A. Robertson (ed.), Contemporary Ergonomics 1994: Proceedings of the Ergonomics Society's Annual Conference, University of Warwick, 19-22 April 1994, (London: Taylor and Francis), 494-497.

Doswell A. (1990) Office Automation: Context, Experience and Future, (Chichester: John Wiley and Sons).

Dourish P. (1993) Culture and control in a media space. Proceedings of the European Conference on Computer-supported Cooperative Work, 13-17 September 1993, Milan.

Dourish P., Adler A., Bellotti V., and Henderson A. (1994) Your place or mine? Learning from long-term use of video communication. Rank Xerox EuroPARC Technical Report 1994, (Cambridge: Rank Xerox EuroPARC).

Dourish P. and Bellotti V. (1994) Networked multimedia support for informal collaboration. Colloquium on "Integrating telecommunications and information technology on the desktop" Monday 21 March 1994, Digest No. 1994/073, (London: Institution of Electrical Engineers), 6/1- 6/4.

Durham T. (1993) Plotting a revolution. The Guardian May 13 1993.

Easterbrook G. (1988) The heart of a new machine. In J. Zerzan and A. Carnes (eds.) Questioning Technology: A Critical Anthology. (London: Freedom Press), 129-138.

Eiser J.R. and van der Pligt J. (1988) Attitudes and Decisions. (London: Routledge).

*The Electronic Frontier* (1993) The Electronic Frontier. Text adapted from the programme broadcast 7th June 1993, (London: British Broadcasting Corporation).

England D. (ed.) (1987) An Introduction to Windows. A Sun User's Guide. (Macmillan Education), 1-21.

*Ergonomics Australia* (1994) Mouse. Ergonomics Australia, 8(2), 18.

ESPRIT (1989) Introduction. The Project Synopses. Office and Business Systems. Volume 5 of a series of 8. ESPRIT (European Strategic Programme for Research in Information Technology), September 1989, XIII/321/89, (Commission of the European Communities).

ESPRIT (1990a) Human Factors Laboratories in Information Technologies (HUFIT) Project Number 385. Synopses of Office and Business Systems: Projects and Explanatory Actions. Volume 5 of a series of 8.. ESPRIT (European Strategic Programme for Research in Information Technology), September 1990, XIII/292/90, (Commission of the European Communities).

ESPRIT (1990b) Functional Analysis of Office Requirements (FAOR) Project Number 56. Synopses of Office and Business Systems: Projects and Explanatory Actions. Volume 5 of a series of 8.. ESPRIT (European Strategic Programme for Research in Information Technology), September 1990, XIII/292/90, (Commission of the European Communities).

ESPRIT (1990c) Office Support Systems Analysis and Design (OSSAD) Project Number 285. Synopses of Office and Business Systems: Projects and Explanatory Actions. Volume 5 of a series of 8., ESPRIT (European Strategic Programme for Research in Information Technology), September 1990, XIII/292/90, (Commission of the European Communities).

ESPRIT (1991) ESPRIT. Specific research and technological development programme in the field of information technology. Results and Progress 1991/92. Commission of the European Communities, DG XIII: Information Technologies and Industries and Telecommunications. RT&D: Information Technologies EUR 14451 EN (Luxembourg: The Office for Official Publications), 45-59.

*The Farmer and Grazier* (1900) Etiquette of Conversation. The Farmer and Grazier, 28 April 1900. In The Australian Country Diary 1991. (1990) (Brookvale, NSW: Simon and Schuster Australia), 88.

Field J. (1985) The office: a historical perspective. In B. Christie (ed.) Human Factors of Information Technology in the Office. (Chichester: John Wiley and Sons), 57-62.

*Financial Times* (1994) US Communications. Financial Times. March 8 1994.

Fischer G. (1984) Human-computer communication and knowledge-based systems. In H.J. Otway and M. Peltu (eds.) The Managerial Challenge of New Office Technology, (Butterworths), 54-79.

Fishbein M. and Ajzen I. (1975) Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research, (Reading, Massachusetts: Addison-Wesley Publishing Company).

Fisher L. (1990) Despite computers goal of paperless office remains elusive. The Ottawa Citizen, September 24 1990.

Fletcher P. (1992) CD-ROM is a Cinderella waiting for stardom - now it's time to shine. PC Week Supplement, May 5 1992.

Flower J. (1994) There's a starman waiting in the sky ... New Scientist, 19 March 1994.

Foley and Van Dam (1982) Fundamentals of Interactive Computer Graphics, (Addison-Wesley Publishing Company).

Foremski T. (1989) Homeward bound to the office. Computing, March 2 1989, 16.

Forster E.M. (1954) The Machine Stops. Collected Short Stories, (London: Penguin Books Ltd.), (originally published by Sidgwick and Jackson, 1947).

Freedland J. (1994a) Computer giants 'knew about RSI'. The Guardian, May 5 1994.

Freedland J. (1994b) A network heaven in your own front room. The Guardian, April 30-May 1 1994.

Furner S.M., Watkinson N., Clark W. (1990) An ISDN multipoint teleconferencing environment. IEE Colloquium on CSCW: Computer Supported Cooperative Work, Wednesday, 24 October 1990, Digest No. 1990/132, (London: Institution of Electrical Engineers), 4/1-4/9.

Furnham A. and Argyle M. (eds.) (1981) The Psychology of Social Situations: Selected Readings, (Oxford: Pergammon Press).

Gale A. (1985) Assessing product usability: a psychophysiological approach. In B. Christie (ed.) Human Factors of Information Technology in the Office, (Chichester: John Wiley and Sons), 189-211.

Gale A. and Christie B. (1987) Psychophysiology and the electronic workplace: The future. In A. Gale and B. Christie (eds.) Psychophysiology and the Electronic Workplace, (Chichester: John Wiley and Sons), 315-333.

Gale S. (1989) Adding audio and video to an office environment. EC-CSCW '89. Proceedings of the First European Conference on Computer Supported Cooperative Work 13-15 September 1989, 121-130.

Galer M. (1988) Human Factors in the design of office systems. In H.J. Bullinger, E.N. Protonatorios, D. Bouwhuis, and F. Reim (eds.) Eurinfo'88, (Amsterdam: North-Holland), 148-152.

Gallup Organization Inc. and Tandem Computers Inc. (1992) Technology impact: Gallup/Tandem Computers survey results show technology plays a critical role in the competitiveness of today's organizations. EDGE: Work-Group Computing Report, November 27 1992, 3(132), 6.

Gardiner M.M. (1986) Psychological issues in adaptive interface design. IEE Colloquium on Adaptive Man-Machine Interfaces, 4 November 1986, Digest No. 1986/110, (London: Institution of Electrical Engineers), 6/1-6/3.

Gardiner M.M. (1987) Contemporary models of information processing and the cognitive demands of user-system interaction. In A. Gale and B. Christie (eds.) Psychophysiology and the Electronic Workplace. (Chichester: John Wiley and Sons) 65-88.

Gilchrist M. (1993) Chips all round. The Guardian Education, December 7 1993, 18-19.

Godfrey M. (ed.) (1994) Mobile Communications. Evening Standard, March 29 1994.

Greenberg S. (ed.) (1991) Computer-supported Cooperative Work and Groupware, (London: Harcourt, Brace, Jovanovich).

Greene J. and D'Oliveira M. (1982 - reprinted 1985) Learning to use statistical tests in psychology. (Milton Keynes: Open University Press).

Gregory K. (1982) Determining the 'Consumer Object'. Applied Ergonomics, 13(1), 11-13.

Greif S. (1991) The role of German work psychology in the design of artifacts. In J.M. Carroll (ed.) Designing Interaction: Psychology at the Human-Computer Interface, (Cambridge: Cambridge University Press), 203-226.

Grossman W. (1994) Fantasy could look virtually real very soon. New Scientist, 26 March 1994, 17.

Gryn H. (1995) Our witness for eternity. The Guardian, February 9 1995.

*The Guardian* (1994a) Party people. The Guardian, July 21 1994.

*The Guardian* (1994b) Cartoon (Superhighway police). The Guardian, May 25 1994.

*The Guardian* (1994c) National Newspaper Circulation. The Guardian, May 16 1994.

*The Guardian* (1995a) Silent Witness. The Guardian, January 31 1995.

*The Guardian* (1995b) National Newspaper Circulation. The Guardian, June 12 1995.

Gutek B.A. and Winter S.J. (1990) Computer use, control over computers, and job satisfaction. In S. Oskamp and S. Spacapan (eds.) People's Reactions to Technology in Factories, Offices and Aerospace. (Newbury Park: Sage Publications), 121-144.

Hammond N., Gardiner M.M., Christie B., and Marshall C. (1987) The role of cognitive psychology in user-interface design. In M.M. Gardiner and B. Christie (eds.) Applying Cognitive Psychology to User-Interface Design. (Chichester: John Wiley and Sons), 13-52.

Hammond N., Hinton G., Barnard P., MacLean A., Long J., and Whitefield A. (1985) Evaluating the interface of a document processor: A comparison of expert judgement and user observation. In B. Shackel (ed.) Human-Computer Interaction - INTERACT '84, (Amsterdam: North-Holland), 725-729.

Harrison T. (1993) In reality, I'm rich! Daily Mail. October 20 1993.

Haynes S. (1994) Alert as hackers tap password secrets. Sunday Express. February 27 1994.

Hebert H. (1994) New chapter for books. The Guardian. December 1 1994.

Herbach M. (1983) How is a computer like an elephant? Byte. December 1983, 247-248.

Hiltz S.R. (1984) Online Communities: A Case Study of the Office of the Future. (Norwood, New Jersey: Ablex Publishing Corporation).

Hiltz S.R. and Turoff M. (1993) The Network Nation: Human Communication via Computer - Revised Edition. (Cambridge, Massachusetts: The MIT Press).

Hirschheim R.A. (1985) Office Automation: Concepts, Technologies, and Issues, (Addison-Wesley Publishers Limited).

Holleran P.A. (1991) A methodological note on pitfalls in usability testing. Behaviour and Information Technology. 10(5), 345-357.

Holleran P.A. (1992) An assessment of font preferences for screen-based text display. In A. Monk, D. Diaper and M.D. Harrison (eds.) People and Computers VII. Proceedings of the HCI '92 Conference. York. September. 1992. (Cambridge: Cambridge University Press), 447-459.

Hollnagel E. and Woods D.D. (1983) Cognitive Systems Engineering: New wine in new bottles. International Journal of Man-Machine Studies. 18, 583-600.

Holsti O.R. (1969) Content Analysis for the Social Sciences and Humanities, (Reading, Massachusetts: Addison-Wesley Publishing Company).

Horwell V. (1993) Television. The Guardian. June 8 1993.

*HOTT* (1994) A discussion with Xerox PARC's Mark Weiser on the future of computing. HOTT Internet-based electronic magazine. 21 December 1994.

Hudgens G.A. and Billingsley P.A. (1978) Sex: The missing variable in human factors research. Human Factors. 20(2), 245-250.

Hurwitz J.S. (1991) Positioning desktop options: How does Unix fit in the client environment. Patricia Seybold's Unix in the Office. 6(12) 3-7.

Huws U., Korte W.B., and Robinson S. (1990) Telework: Towards the Elusive Office, (Chichester: John Wiley and Sons).

Igbaria M., Schiffman S.J., and Wieckowski T.J. (1994) The respective roles of perceived usefulness and perceived fun in the acceptance of microcomputer technology. Behaviour and Information Technology. 13(6), 349-361.

*In Business* (1994) 17 April 1994, BBC Radio 4.

Institution of Electrical Engineers (1994) Colloquium on "Integrating telecommunications and information technology on the desktop" Monday 21 March 1994. Digest No. 1994/073. (London: Institution of Electrical Engineers).

Irwin A. (1994) Scientists seek to improve mad boffins image. The Times Higher. March 18 1994.

Johnson A. (1993) Keyboard injury does not exist, judge rules. The Guardian. October 29 1993.

Johnson P. (1992) Human-Computer Interaction: Psychology, Task Analysis and Software Engineering. (Maidenhead: McGraw Hill Book Company).

Jones M. (1994) The yuppie menace that won't go away. Evening Standard. May 3 1994.

Kammersgaard J. (1988) Four different perspectives on human-computer interaction. International Journal of Man-Machine Studies. 28, 343-362.

Kane P. (1993) The Man Machines. The Guardian Weekend. August 7 1993.

Karr A. (1849) *Les Guêpes*, Jan. 1849, vi. The Oxford Dictionary of Quotations - Third Edition, (1979), (Oxford: Oxford University Press), 288.

Katz J.E. and Hyman M.M. (1993) Dimensions of concern over telecommunications privacy in the United States. The Information Society. 9, 251-275.

Kelly G.A. (1955) The Psychology of Personal Constructs. Volume 1: A Theory of Personality, (New York: W.W. Norton and Co., Inc.).

Kemp N. (1987) Attitudes to information technology. In F. Blackler and D. Oborne (eds.) Information Technology and People. (Leicester: The British Psychological Society), 193-210.

Kiernan V. (1994) Internet wide open to hacker attack. New Scientist. 2 April 1994.

Kieras D. and Polson P.G. (1985) An approach to the formal analysis of user complexity. International Journal of Man-Machine Studies. 22, 365-394.

Kirakowski J. and Dillon A. (1987) The computer-user satisfaction inventory. Colloquium on "Evaluation techniques for interactive system design II", Friday 2 October, 1987, Digest No. 1987/78. (London: Institution of Electrical Engineers), 3/1-3/2.

Kline P. (1994) An Easy Guide to Factor Analysis. (London and New York: Routledge).

Kraut R.E., Fish R.S., Root R.W., and Chalfonte B.L. (1990) Informal communication in organizations: Form, function and technology. In S. Oskamp and S. Spacapan (eds.) People's Reactions to Technology. (Newbury Park: Sage Publications), 145-199.

Krippendorff K. (1980) Content Analysis: An Introduction to its Methodology. (Beverly Hills, California: Sage Publications, Inc.).

Latham R. (ed.) (1985) The Shorter Pepys. (London: Bell and Hyman Limited).

Laughery, Sr. K.R. (1993) Everybody knows ... or do they? Ergonomics Australia, 7(6), 31-36. (reprinted from Ergonomics in Design, July 1993).

Lemmons P. (1983) A guided tour of Visi On. Byte, 8(6), 256-278.

Lingaard G. (1992) HCI Here and there: How are we going? Ergonomics Australia, 6(5), 22-25.

Lloyd T. (1994) You can't beat IT for virtual corporeality. The Observer, January 16 1994.

Lohr S. (1992) Sit down and read this (no, not in that chair!). The New York Times, July 7 1992.

Lowe I. (1990) Flying in the face of human factors. The Weekend Australian, December 8-9 1990.

Magnusson D. (1981) An analysis of situational dimensions. In A. Furnham and M. Argyle (eds.) The Psychology of Social Situations: Selected Readings, (Oxford: Pergammon Press), 95-112.

Malone T.W. (1985) Designing organizational interfaces. In L. Borman and B. Curtis (eds.) Human Factors in Computing Systems-II, (Amsterdam: North-Holland), 66-71.

Manktelow K. and Jones J. (1987) Principles from the psychology of thinking and mental models. In M.M. Gardiner and B. Christie (eds.) Applying Cognitive Psychology to User Interface Design, (Chichester: John Wiley and Sons), 83-117.

Markus M.L., Bikson T.K., El-Shinnawy M. and Soe L.L. (1992) Fragments of your communication: email, vmail and fax. The Information Society, 8, 207-226.

Marshall C., Christie B., and Gardiner M.M. (1987) Assessment of trends in the technology and techniques of human-computer interaction. In M.M. Gardiner and B. Christie (eds.) Applying Cognitive Psychology to User Interface Design, (Chichester: John Wiley and Sons), 279-312.

Martocchio J.J., Webster J., and Baker C.R. (1993) Decision-making in management information systems research: the utility of policy capturing methodology. Behaviour and Information Technology, 12(4), 238-248.

Maslen G. (1993) V-Cs to probe E-mail abuse. The Times Higher, December 3 1993.

Maslen G. (1994) Damages for academic defamed on Internet. The Times Higher, May 6 1994.

McClellan J. (1993) Futures. The Observer, December 26 1993.

McClellan J. (1994) Netsurfers paradise. The Observer, February 13 1994.

McQuail D. (1977) Analysis of Newspaper Content, Royal Commission on the Press, (London: Her Majesty's Stationery Office).

McQuarrie E.F. and Langmeyer D. (1987) Planned and actual spending among owners of home computers. Journal of Economic Psychology. 8(2), 141-159.

Miles T. (1994) King bore Billy is the nerd champion. Sunday Express. February 27 1994.

*Mind Your Own Business* (1990) A green answer for business. Mind Your Own Business. 13(10), 24-25.

Mitchell N.B. (1992) A simple method for hardware and software evaluation. Applied Ergonomics. 23(4), 277-280.

Moll T. (1987) On methods of analysis of mental models and the evaluation of interactive computer systems. In M. Frese, E. Ulich, and W. Dzida (eds.) Psychological Issues of Human-Computer Interaction in the Work Place. (Amsterdam: North-Holland), 403-417.

Moody F. (1992) Just an ordinary guy ... but at 36 he's the richest man in America. ES Magazine. Evening Standard. April 1992.

Moore S. (1993) On fax and faxability. The Observer. April 18 1993.

Moran T.P. (1981) The Command Language Grammar: a representation for the user interface of interactive computer systems. International Journal of Man-Machine Studies. 15, 3-50.

Moscovici S. (1984) The phenomenon of social representations. In R.M. Farr and S. Moscovici (eds.) Social Representations. (Cambridge: Cambridge University Press), 3-69.

Moser C.A. and Kalton G. (1975) Survey Methods in Social Investigation - Second Edition. (London: Heinemann Educational Books Ltd.).

Mrs. M.S. (1993) Days gone by. My Weekly. April 3 1993.

Mumford E. (1983) Successful systems design. In H.J. Otway and M. Peltu (eds.) New Office Technology: Human and Organizational Aspects. (London: Frances Pinter - for the Commission of the European Communities), 68-85.

Murrell H. (1976) Motivation at Work. (London: Methuen).

Mutch R. (1991) Hard sell that locks in the innocent. The Guardian. March 21 1991.

Myerson J. (1993) The end of 9 to 5? The Guardian. December 3 1993.

'Name and address supplied' (1993) Humdrum reality of life tied to an office desk. The Guardian. December 6 1993.

Naughton J. (1995) Computers on perfect toast. The Observer. 2 April 1995.

Negroponte N. (1989) Beyond the desktop metaphor The 3rd Colin Cherry Memorial Lecture on Communication, organised by the Department of Electrical Engineering, Imperial College, University of London.

Newell A. and Simon H.A. (1972) Human Problem Solving. (Prentice-Hall, Inc.).

Newman J. and Newman R. (1991) Two failures in computer-mediated textcommunication. Computers and Writing IV. University of Sussex.

Newman J., Reynolds C., and Wilson P. (1990) HICOM: An interactive scientific community. IEE Colloquium on CSCW: Computer Supported Co-operative Work, Wednesday 24 October, 1990", Digest No. 1990/132, (London: Institution of Electrical Engineers), 2/1-2/7.

Newman W.M. (1987) Designing Integrated Systems for the Office Environment. (McGraw-Hill Book Company).

Newman and Woolley. (1994) Cartoon (Megalomultimedia Inc.). The Guardian, January 24 1994.

*New Scientist* (1994a) Alvin Toffler: still shocking after all these years. New Scientist, 19 March 1994.

*New Scientist* (1994b) Netropolis: How the meeting of tv, telecomms and computers is transforming the world. New Scientist, 16 April 1994.

*New Scientist* (1995) Circulation figure. New Scientist, 3 June 1995, 84.

Nielsen J. (1986) A virtual protocol model for computer-human interaction. International Journal of Man-Machine Studies, 24, 301-312.

Nielsen J. (ed.) (1994) Special Issue: Usability Laboratories. Behaviour and Information Technology, 13(1 and 2).

Norman D.A. (1986) Cognitive engineering. In D.A. Norman and S.W. Draper (eds.) User-Centred System Design, (Hillsdale, New Jersey: Lawrence Erlbaum Associates), 31-61.

Norman D.A. (1988) The Psychology of Everyday Things, (USA: Basic Books).

Norman K.L., Weldon L.J., and Shneiderman B. (1986) Cognitive layouts of windows and multiple screens for user interfaces. International Journal of Man-Machine Studies, 25, 229-248.

Norman M. (1993) Brave new world of Bill and the boffins. Evening Standard, June 8 1993.

Norman M. (1994) Celebrating for the minority. Evening Standard, May 24 1994.

Oborne D.J. (1985) Computers at Work: A Behavioural Approach, (Chichester: John Wiley and Sons).

Oborne D.J. (1987) Ergonomics at Work - Second Edition, (Chichester: John Wiley and Sons).

Oborne D.J. (1987) Psychophysiology and the ergonomic demands of visual display terminals (VDTs). In A. Gale and B. Christie (eds.) Psychophysiology and the Electronic Workplace, (Chichester: John Wiley and Sons), 139-162.

Oborne D.J. and Holton D. (1988) Reading from screen versus paper: there is no difference. International Journal of Man-Machine Studies, 28, 1-9.

*The Observer* (1993) Down from the altar. Open Sesame! The office technology of tomorrow. The Observer Computer Report, February 28 1993.

Orlikowski W.J. (1993) Learning from Notes: organizational issues in groupware implementation. The Information Society, 9, 237-250.

Orne M.T. (1962) On the social psychology of the psychological experiment: with particular reference to demand characteristics and their implications. American Psychologist, 17, 776-783.

Orr D. (1993) The admirable Crichton. The Guardian Weekend, July 3 1993.

Orwell G. (1945 - reprinted 1981) Animal Farm, (Harmondsworth, Middlesex: Penguin Books Ltd.).

Orwell G. (1949 - reprinted 1976) Nineteen Eighty-Four, (Harmondsworth, Middlesex: Penguin Books, Ltd.).

Page I. and Walsby A. (1979) Highly dynamic text display system. Microprocessors and Microsystems 3(2) 73-76.

Panko R.R. (1989) Directions and issues in end-user computing. In R. Nelson (ed.) End-User Computing: Concepts, Issues, and Applications, (Chichester: John Wiley and Sons), 23-40.

Paré G. and Elam J.J. (1995) Discretionary use of personal computers by knowledge workers: testing of a social psychology theoretical model. Behaviour and Information Technology, 14(4), 215-228.

Patel K. (1993) Erring on the side of you-manity. The Times Higher, August 13 1993, 32.

Patel K. (1995) Getting granny wired. The Times Higher, April 28 1995.

Paterson P. (1993) United lesson in loyalty. Daily Mail, June 8 1993.

*PC Week* (1993) News Analysis. PC Week, June 15 1993.

Pennington D.C. (1986 - reprinted 1991) Essential Social Psychology, (London: Edward Arnold).

Pennington H. (1994) Don's Diary. The Times Higher, June 10 1994.

Poppel H.L. (1982) Who needs the office of the future? Harvard Business Review, 60(6), 146-155.

HRH Prince Philip, Duke of Edinburgh (1993) Speech at the Inauguration Reception, Guildhall, London, Tuesday 25 May 1993, London Guildhall University NoticeBoard, 4 June 1993, 3.

Pritchard J.A.T. (1985) Image Filing Systems: A Practical Evaluation Guide, (Manchester: NCC Publications).

Purgavie D. (1994) Press one for confusion, two for frustration, and any other number to go completely mad. Daily Mail, April 26 1994.

Rachlis L. (1990) Business and Government Computer Show at Lansdowne Park, September 26 and 27. The Ottawa Citizen, September 24 1990.

Reason J. (1987) The Chernobyl errors. Bulletin of the British Psychological Society, 40, 201-206.

Reichman R. (1986) Communication paradigms for a window system. In D.A. Norman and S.W. Draper (eds.) User-Centered System Design, (Hillsdale New Jersey: Lawrence Erlbaum Associates), 285-313.

Reinecke I. (1988) Electronic illusions: A skeptic's view of our high tech future. In J. Zerzan and A. Carnes (eds.) Questioning Technology: A Critical Anthology, (London: Freedom Press), 211-215.

Reiterer H. and Oppermann R. (1993) Evaluation of user interfaces: EVADIS II - a comprehensive evaluation approach. Behaviour and Information Technology, 12(3), 137-148.

Richardson J.H. (1988) Reading electronic text. IEE Colloquium on "Emerging office technologies", 20 April 1988, Digest No. 1988/58, (London: Institution of Electrical Engineers), 5/1-5/4.

Rockart J.F. and Flannery L.S. (1989) The management of end-user computing. In R.R. Nelson (ed.) End-User Computing: Concepts, Issues, and Applications, (John Wiley and Sons, Inc.), 249-270.

Rosengren K.E. (ed.) (1981) Advances in Content Analysis, (Beverly Hills: Sage Publications).

Rothkopf M.H. (1994) Editorial: Refereeing - How blind should we be? Interfaces, 24(6), 14-18.

Russell B. (1952) The Impact of Science on Society, (London: George Allen and Unwin Ltd.).

Schäfer G., Hirschheim R., Harper M., Hansjee R., Domke M., and Bjørn-Andersen N. (1988) Functional Analysis of Office Requirements: A Multi-perspective Approach, (Chichester: John Wiley and Sons).

Schofield J. (1990) Realm of near reality. The Guardian, July 26 1990.

Schofield J. (1991) Rooms for manoeuvre. The Guardian, April 18 1991.

Schofield J. (1992) Gates' way to a new era. The Guardian, April 16 1992.

Schofield J. (1993) Free-wheeler from chaos. The Guardian, October 21 1993.

Schofield J. (1994a) Supernerd's new planet. The Guardian, March 28 1994.

Schofield J. (1994b) Internet: What it is and how it works. The Guardian, April 30-May 1 1994.

Schroeder E. (1992) Delrina bolsters forms software; PerForm Pro 2.0 will link forms to multiple databases. PC Week. March 23 1992, 9(12), 4.

Sedgwick J. (1993) Techno Fear. Ergonomics Australia. 7(4), 25-30.

Shackel B. (1984) The concept of usability. In J. Bennett, D. Case, J. Sandelin, and M. Smith (eds.) Visual Display Terminals - Usability Issues and Health Concerns, (New Jersey: Prentice-Hall, Inc.), 45-87.

Shackel B. (1986) Ergonomics in design for usability. In M.D. Harrison and A.F. Monk (eds.) People and Computers: Designing for Usability. (Cambridge: Cambridge University Press), 44-64.

Sharpe R. (1993) When the chips are down. The Observer, April 11 1993.

Shneiderman B. (1987) System messages, screen design, color, and windows. Designing the User Interface: Strategies for Effective Human-Computer Interaction, (Addison-Wesley Publishing Company), 311-355.

Shneiderman B. (1992) Designing the User Interface: Strategies for Effective Human-Computer Interaction - Second Edition. (Reading, Massachusetts: Addison-Wesley Publishing Company).

Short J., Williams E., and Christie B. (1976) The Social Psychology of Telecommunications, (London: John Wiley and Sons).

Siegel S. (1956) Nonparametric Statistics for the Behavioral Sciences, (Tokyo: McGraw-Hill Kogakusha Ltd.).

Silk B. (1991) Revolution in the office. Daily Mail, August 19 1991.

Smith D.C., Irby C., Kimball R., Verplank B., and Harslem E. (1982) Designing the Star user interface. Byte Magazine, 7(4). Reprinted in R.M. Baecker and W.A.S. Buxton (eds.) Readings in Human-Computer Interaction: A Multidisciplinary Approach, (San Mateo: Morgan Kaufmann Publishers, Inc.), 653-661.

Smith H. (1986) Devising an ergonomics checklist to assess the convenience of domestic irons. Unpublished MSc report. University of Birmingham.

Smith H. (1990a) Single screens and multiple tasks. Proceedings of the 23rd Annual Conference of the Human Factors Association of Canada, Ottawa, Canada, September 26-28 1990. 197-201.

Smith H. (1990b) Using single screens for multiple and complex tasks. Proceedings of the 26th Annual Conference of the Ergonomics Society of Australia, Adelaide, Australia, 4-7 December 1990. 167-172.

Smith H. (1990c) Project MIDAS: Developing metrics for user interface design. In E.J. Lovesey (ed.) Contemporary Ergonomics 1990: Proceedings of the Ergonomics Society's Annual Conference, Leeds, England, 3-6 April 1990. (London: Taylor and Francis), 328-333.

Smith H. (1991) Windows and multiple screens: Optimizing their utility in office systems. In E.J. Lovesey (ed.), Contemporary Ergonomics 1991: Proceedings of the Ergonomics Society's Annual Conference, Southampton, England, 16-19 April 1991. (London: Taylor and Francis), 240-245.

Smith H. (1994) Technology and the office: User perceptions. In S.A. Robertson (ed.), Contemporary Ergonomics 1994: Proceedings of the Ergonomics Society's Annual Conference, University of Warwick, 19-22 April 1994. (London: Taylor and Francis), 40-45.

Smith S. (1993) Holy grail or wholly fail? The Guardian, June 24 1993.

Spacapan S. and Oskamp S. (1990) People's reactions to technology. In S. Oskamp and S. Spacapan (eds.) People's Reactions to Technology. (Newbury Park: Sage Publications), 9-29.

Spinas P. (1987) VDU-work and user-friendly human-computer interaction: Analysis of dialogue structures. In M. Frese, E. Ulich, and W. Dzida (eds.) Psychological Issues of Human-Computer Interaction in the Work Place. (Amsterdam: North-Holland), 147-162.

Stafford J. (1992) VDT health issues: practising safe computing. Office Technology Management, 26(8), 31-33.

'Standard reporter' (1991) Commuters rage at Fenchurch St chaos. Evening Standard, August 28 1991.

Stewart T. (1984) The role of ergonomics in office systems design. Behaviour and Information Technology, 3(4), 319-327.

Stewart T. (1985) Ergonomics of the office. Ergonomics, 28(8), 1165-1178.

Suchman L.A. (1987 - reprinted 1990) Plans and Situated Actions. (Cambridge: Cambridge University Press).

Swain B. (1993) Better than the real thing? The Guardian, June 15 1993.

Taha L.H. and Caldwell B.S. (1993) Social isolation and integration in electronic environments. Behaviour and Information Technology, 12(5), 276-283.

Taylor L. (1994) Laurie Taylor. The Times Higher, January 21 1994.

Taylor P. (1993a) A revolution on the desk-top. Financial Times, October 26 1993.

Taylor P. (1993b) Small is beautiful. Financial Times, October 26 1993.

*Teleconnect* (1992) Personal productivity vs. customer focus; our "ultimate" office leans towards the latter, of course. And it all starts with openness. Teleconnect 10(5), 122-123.

Thackray J. (1994) The e-mail is deadlier... The Observer, May 1 1994.

*The Times* (1994) £50m computer waste. The Times, May 19 1994.

*The Times Higher* (1993) Disc flop. The Times Higher Education Supplement, October 1 1993.

Thimbleby H. (1990 - reprinted 1991) User Interface Design. (Wokingham: Addison-Wesley Publishing Company).

Thomas D. (1993) How the other half loves. Sunday Express. June 13 1993.

Thomas J.C. (1984) Organizing for human factors. In Y. Vassiliou (ed.) Human Factors and Interactive Computer Systems. (Norwood, New Jersey: Ablex Publishing Corporation), 29-46.

Thompson L. (1989) New office technology and the changing role of the secretary. WRU Occasional Paper, 44, (London: Advisory, Conciliation, and Arbitration Service, Work Research Unit).

Toffler A. (1970) Future Shock. (London: Pan Books Ltd.).

Toffler A. (1981) The Third Wave. (London: Pan Books Ltd.).

Tuck M. (1976) How do we choose? A study in consumer behaviour. (London: Methuen).

Ubois J. (1992a) When good ergonomics are good economics. MIDRANGE Systems. May 12 1992, 5(9), 49.

Ubois J. (1992b) Epidemic of job-related injuries puts ergonomics on managers' agendas: proper equipment, training reduces toll. MacWEEK. September 14 1992, 6(32), 22.

Utley A. (1993) Lost in the jungle? The Times Higher. June 25 1993.

Voltaire (Attr. in S.G. Tallentyre, The Friends of Voltaire, (1907), 199) The Oxford Dictionary of Quotations - Third Edition, (1979), (Oxford: Oxford University Press), 561.

Voss D. (1995) Are you waving at me? New Scientist. 28 January 1995.

Wainwright J. and Francis A. (1984) Office Automation, Organisation and the Nature of Work, (Aldershot: Gower Publishing Company Limited).

Walsh J. (1993) The write stuff, The Independent Magazine. December 4 1993.

Warr P. (1978 - reprinted 1983) Attitudes, actions and motives. In P. Warr (ed.) Psychology at Work - Second Edition, (Harmondsworth, Middlesex: Penguin Books), 227-263.

Warren N. and Jahoda M. (eds.) (1973) Attitudes: Selected Readings - Second Edition, (Harmondsworth, Middlesex: Penguin Books).

Weber R. P. (1990) Basic Content Analysis - Second Edition, (Newbury Park, California: Sage Publications, Inc.).

Weiser M. (1993) Some computer science issues in ubiquitous computing. Communications of the ACM, 36(7), 74-84.

Wells H.G. (1908) New Worlds for Old, (London: Archibald Constable and Co. Ltd.).

West R. (1991- reprinted 1992) Computing for Psychologists. Statistical Analysis using SPSS and MINITAB, (Switzerland: harwood *[sic]* academic publishers).

Whittaker S., Geelhoed E., and Robinson E. (1993) Shared workspaces: How do they work and when are they useful? International Journal of Man-Machine Studies, 39, 813-842.

Wickens C.D. (1987) Information processing, decision-making, and cognition. In G. Salvendy (ed.) Handbook of Human Factors (Chichester: John Wiley and Sons), 72-107.

Wicker A.W. (1973) Attitudes v. actions: the relationship of verbal and overt responses to attitude objects. In N. Warren and M. Jahoda (eds.) (1973) Attitudes: Selected Readings - Second Edition, (Harmondsworth, Middlesex: Penguin Books), 167-194.

Williges R.C. (1987) The use of models in human-computer interface design. Ergonomics, 30(3), 491-502.

Williges R.C., Williges B.H., and Elkerton J. (1987) Software interface design. In G. Salvendy (ed.) Handbook of Human Factors, (Chichester: John Wiley and Sons), 1416-1449.

Wilson G. (1994) Equal, but different. The Times Higher, March 25 1994.

Wilson J.R. (1990 - reprinted 1991) A framework and a context for ergonomics methododology. In J.R. Wilson and E.N. Corlett (eds.) Evaluation of Human Work: A practical ergonomics methodology, (London: Taylor and Francis), 1-29.

Wilson J.R. and Corlett E.N. (eds.) (1990 - reprinted 1991) Evaluation of Human Work: A practical ergonomics methodology, (London: Taylor and Francis).

Wilson K. (1993) Let the chip take control. Daily Mail, August 9 1993.

Wilson P. (1990) Ergonomic aspects of computer-supported personal filing systems. In E.J. Lovesey (ed.) Contemporary Ergonomics 1990, (London: Taylor and Francis), 92-97.

Wiltshire M. (ed.) (1993) Technology in the Office. Financial Times, October 26 1993.

Winchester S. (1992) I have seen the future and it is of sand, glass and air. The Guardian, August 20 1992.

Wise D. (1992) New lease of life for desks and in-trays. The Guardian, April 23 1992.

*Without Walls* (1994) Living for the present: Dennis Potter's last interview. The Guardian, April 6 1994, (Extract from *Without Walls* made by London Weekend Television, broadcast on Channel 4, April 5 1994).

Wyllie J. and Sprigge B. (1990) A Case for evolution. The Guardian, August 2 1990.

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