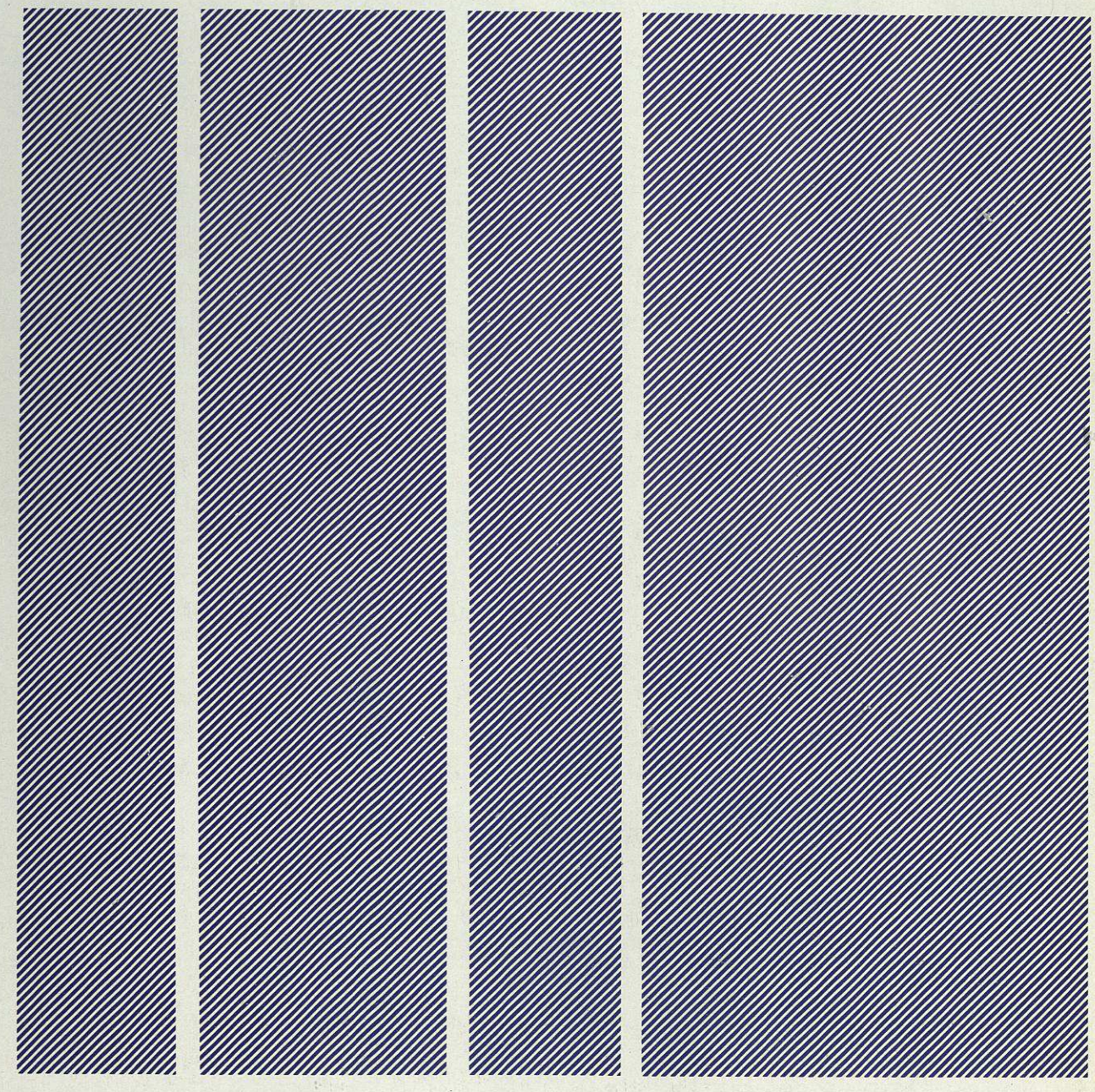
Report Series
No. 35

Multifunction Equipment

May 1983



The Butler Cox Foundation

THE BUTLER COX FOUNDATION

REPORT SERIES NO. 35

MULTIFUNCTION EQUIPMENT

ISSUED MAY 1983

Abstract

Multifunctionality can be provided by processing power, software and storage contained in a multifunction workstation, or by unintelligent terminals accessing remote processing and storage facilities. Products that contain both local and remote facilities are also available. Multifunction applications may be specific — when they perform particular systems-related procedures; or they may be general purpose — when they are used to assist staff in their general administrative work. Experience with multifunction products is currently limited, and many users are still at the pilot trial stage of development. Many of these pilot trials have been inconclusive, leading organisations to seriously question the role of multifunction products.

The purpose of this report is to guide Foundation members in the use of multifunction products. In doing this we have drawn upon user experience to date, our predictions of future developments in multifunction products, and research into the opportunities for multifunctionality.

The report concludes that there are genuine opportunities for using multifunction products, but that an ill-considered approach in early installations will inhibit the achievement of real benefits.

Research team

The team that researched and authored this report was:

John Daly: a consultant with Butler Cox specialising in telecommunications and network design. He has conducted surveys to establish the market potential for communications products involving both users and manufacturers.

Neil Farmer: a consultant with Butler Cox specialising in office automation studies. He has installed multifunction office products and has worked on a major office systems multiclient project, as well as carrying out many studies in the office systems field.

Fred Heys: a consultant with Butler Cox responsible for all studies carried out for equipment and service suppliers. He has extensive experience in the data communications and office automation fields.

Photoset and printed in England by Flexiprint Ltd., Worthing, Sussex.

THE BUTLER COX FOUNDATION

Butler Cox & Partners
Butler Cox is an independent management consultancy and research organisation, specialising in the application of information technology within commerce, government and industry. The company offers a wide range of services both to suppliers and users of this technology. The Butler Cox Foundation is a service operated by Butler Cox on behalf of subscribing members.

Objectives of The Foundation
The Butler Cox Foundation sets out to study on behalf of subscribing members the opportunities and possible threats arising from developments in the field of information systems.

The Foundation not only provides access to an extensive and coherent programme of continuous research, it also provides an opportunity for widespread exchange of experience and views between its members.

Membership of The Foundation
The majority of organisations participating in the Butler Cox Foundation are large organisations seeking to exploit to the full the most recent developments in information systems technology. An important minority of the membership is formed by suppliers of the technology. The membership is international with participants from Belgium, Denmark, France, Italy, the Netherlands, Sweden, Switzerland, the United Kingdom and elsewhere.

The Foundation research programme
The research programme is planned jointly by Butler Cox and by the member organisations. Half of the research topics are selected by Butler Cox and half by preferences expressed by the membership. Each year a short list of topics is circulated for consideration by the members. Member organisations rank the topics according to their own requirements and as a result of this process, members' preferences are determined.

Before each research project starts there is a further opportunity for members to influence the direction of the research. A detailed description of the project defining its scope and the issues to be addressed is sent to all members for comment.

The report series
The Foundation publishes six reports each year. The reports are intended to be read primarily by senior and middle managers who are concerned with the planning of information systems. They are, however, written in a style that makes them suitable to be read both by line managers and functional managers. The reports concentrate on defining key management issues and on offering advice and guidance on how and when to address those issues.

Additional report copies
Normally members receive three copies of each report as it is published. Additional copies of this or any previous report (except those that have been superseded) may be purchased from Butler Cox.

Previous reports
No. 1 Developments in Data Networks
No. 2 Display Word Processors*
No. 3 Terminal Compatibility*
No. 4 Trends in Office Automation Technologies
No. 5 The Convergence of Technologies
No. 6 Viewdata*
No. 7 Public Data Services
No. 8 Project Management
No. 9 The Selection of a Computerised PABX
No. 10 Public On-line Information Retrieval Services*
No. 11 Improving Systems' Productivity
No. 12 Trends in Database Management Systems
No. 13 The Trends in Data Processing Costs
No. 14 The Changing Equipment Market
No. 15 Management Services and the Microprocessor
No. 16 The Role of the Mainframe Computer in the 1980s
No. 17 Electronic Mail
No. 18 Distributed Processing: Management Issues
No. 19 Office Systems Strategy
No. 20 The Interface Between People and Equipment
No. 21 Corporate Communications Networks
No. 22 Applications Packages
No. 23 Communicating Terminals
No. 24 Investment in Systems
No. 25 System Development Methods
No. 26 Trends in Voice Communication Systems
No. 27 Developments in Videotex
No. 28 User Experience with Data Networks
No. 29 Implementing Office Systems
No. 30 End-User Computing
No. 31 A Director's Guide to Information Technology
No. 32 Data Management
No. 33 Managing Operational Computer Services
No. 34 Strategic Systems Planning
**These reports have been superseded.*

Future reports
No. 36 Cost-Effective Systems Development and Maintenance
No. 37 Expert Systems: Their relevance for business users

THE BUTLER COX FOUNDATION

REPORT SERIES NO. 35

MULTIFUNCTION EQUIPMENT

CONTENTS

MULTIFUNCTION EQUIPMENT

REPORT SYNOPSIS

The advent of multifunction office workstations — terminals handling text, data, voice and images in an integrated way — is proving to be a much slower process than was envisaged only a few years ago. Such workstations are not yet in widespread commercial use, though in theory they would appear to offer significant benefits to users in flexibility and convenience. In many respects what the manufacturers are offering does not match the real needs of the user.

The starting point in the arguments for multifunction equipment is the fact that, with few exceptions, office workers tend to perform not one task but many. Attempts to increase productivity by automating or otherwise improving only one of the tasks — whether for managers, professionals, secretaries or other clerical staff — can have only a limited impact.

Compared with the use of single-function products to achieve the same overall purpose, multifunction terminals are in principle more compact, less expensive and more convenient. On the other hand they are more complex to use and, if they break down, the consequences are more serious.

Multifunction equipment appears well suited to a range of types of office work which apply to many organisations: clerical transactions, clerical casework, professional analysis, engineering, project management, general management, secretarial work and document preparation. But, as chapter 1 of the report goes on to emphasise, effectiveness of use in practice will depend heavily on comprehensive, user-friendly software.

Against this background, the actual experience of organisations which have attempted to introduce multifunction systems in various ways is reviewed in chapter 4. A number of general lessons for management emerge. Slow growth in the use of multifunction office products is accounted for by three main causes: the difficulty of cost-justification, the high cost of products, and the lack of maturity in the products.

There is evidence that suppliers have tended to design terminals with more functions than are needed by most users, and hence the available machines are unnecessarily expensive. Users' experience shows also that it is not sufficient to implement systems which provide a general set of office tools; an organisation's specific requirements and current practices should be investigated fully before deciding which products are appropriate.

Most of the organisations we interviewed found that current products failed to match their particular needs. Suppliers had expended much effort on the ergonomics of terminal design, but had failed to ensure that their products addressed the real needs of the users. Until both sides gain a fuller understanding of office automation, users should adopt approaches which offer flexibility and a low-cost entry level.

Though organisations may find it difficult to cost-justify their multifunction systems, they should nevertheless specify clear objectives and monitor the effects of change. We were surprised to note in our research a general neglect of these key factors.

The self-contained multifunction workstation represents only one approach to multifunction systems. Two other system architectures are possible: a multifunction network consisting of terminals and processors linked by a local area network; and a system based on dumb terminals connected to a shared minicomputer. In practice, there can be considerable overlap between these three approaches.

Technical details of the various architectures are included in the product technology discussion in chapter 2. Designers have concentrated much effort on input techniques for the multifunction products; the use of keyboards could be a problem for middle and senior managers, for example. Other possible input methods include handwriting, voice, screen input, hand control and image input; each of these has both advantages and disadvantages. For output, almost all users will require both a visual display and hard copy for data, text and graphics. Voice output will be appropriate in certain applications. Different degrees of physical, logical and functional integration are possible; users should beware of the term "integra-

ted" without precise definition.

Multifunction products on the market today (chapter 3) are evolving from six directions — from telephones, from data terminals, from shared computers, from personal computers, from local area networks, and as specifically designed multifunction products. A wide spectrum of products, confusing to the user in its variety, is available.

How will the marketplace and the use of multifunction methods develop? Will the present mismatch get worse or better? We look at likely future trends in chapter 5, and see the introduction of multifunction systems being driven by two main factors: user demand, and the fall in price of personal computers. We expect personal computers to become widely used as multifunction devices, and the main immediate need of the marketplace to be for relatively simple products with growth potential.

Suppliers' strategies will reflect their various backgrounds (as manufacturers of mainframe/mini computers, terminals, office terminals, personal computers, telecommunications products, or local area networks). They will converge to give a common set of features:

— Each user will have processing power immediately available at the terminal.

— Each terminal will be able to communicate with other terminals.

— Each terminal will have access to shared resources such as powerful processors, large files and quality printers.

— The design of the terminal will differ according to the needs of the individual.

These features lead us to suggest that six distinct families of products (see chapter 5) will emerge.

As products mature in the future, the match between what suppliers offer and what users need will improve. But what should managers do today? Key issues are identified in chapter 6 of the report. At the present time, multifunction products may make sense in four main situations:

— Natural extensions to existing data processing systems where individual users need new facilities.

— Specific new applications for individual users who, for example, need to incorporate computer data in various documents.

— Very specific applications where groups of people need to communicate (data and text) to serve a common, well-defined purpose.

— Systems to improve general office efficiency across one or more departments of an organisation.

In terms of implementing multifunction systems, we favour an approach based on personal computer terminals linked together by a local area network. Terminals and software are relatively inexpensive; expensive devices can be shared; no large initial investment in central resources is required; and users have considerable autonomy in using the system. We attach low priority to the use of sophisticated multifunction workstations such as the Xerox Star or Apple Lisa.

To be successful, multifunction products need to address specific user requirements rather than provide general purpose office tools. This implies that each product will need a certain amount of adaptation to meet individual needs, but this will involve less effort than traditionally has been the case in developing data processing applications. Most multifunction application software will be based on easily adaptable packages.

Management services staff will need to provide some technical support to users, however, together with interfaces between multifunction systems and existing data processing systems. They will also need to train and educate end users in multifunction theory and practice. Indeed, management services groups have a wide and significant role to play in providing the right environment in which organisations can make the best use of multifunction products.

At present, many organisations are wasting time and money on poorly conceived trials of multifunction products. Each application should have well defined objectives against which performance can be measured. We foresee a gradual introduction of multifunction products over the next two or three years, with this process gaining momentum as user experience grows.

PREFACE

In December 1977, Foundation Report No. 4 — Trends in Office Automation Technologies — predicted that "within perhaps four or five years it is likely that the first truly multifunction office workstations will become available . . . They will be integrated systems incorporating the complete range of text, voice, numeric and image services ...". This prediction has proved to be optimistic. Although some progress has been made in developing products that combine various media, multifunction workstations are not yet in widespread commercial use.

The concept that multifunction workstations are the key to 'the office of the future' is, nevertheless, still widely held. Office system vendors are selling various combinations of facilities and almost all terminals, however simple, are now being promoted as 'workstations'. Some market forecasters are still predicting large sales of workstations over the next five years. This implies that little has changed since December 1977 except that the timeframe in which multifunction workstations will become widely used has been moved forward by five years. But is the multifunction workstation concept valid, or may we be in a similar position again in another five years time? What are the factors that have hindered the spread of multifunction workstations, and are they a permanent feature of the office systems environment?

Purpose and intended readership

Office systems are becoming increasingly important to Foundation members. Pressures from end users demanding cheap microcomputers, together with pressures from vendors (and government departments) promoting various stand alone, semi-integrated and integrated products present the information systems manager with an ever increasing amount of conflicting advice. Is the multifunction workstation the right approach and, if so, what should we do about it? How far does the integration of office functions imply complete physical integration within a terminal? How can multifunction workstations be justified when compared with alternative approaches? Will prices fall significantly? How do multifunction workstations fit into the office environment, and what are the implications for office communication networks? Do standards need to be set, or will communication protocol conversion be required at the terminal or in the network?

The purpose of this Foundation report is to provide some of the answers to these wide-ranging questions.

The report is intended primarily for those who are responsible for planning and implementing office systems. But it should be of interest also to existing or potential end users of office systems, and to office system suppliers.

Scope of the report

The report does not concentrate solely on multifunction workstations but also examines alternative ways in which multifunction office facilities can be provided. For example, we consider non-intelligent terminals linked to mainframe computers or minicomputers, and terminals which access multifunction facilities through different types of local area network. The scope of the report, therefore, includes those terminals or systems that, from a user's point of view, provide more than one type of office function.

In order to answer the questions on multifunction facilities raised by Foundation members, we have carried out research to:

- Identify the main factors that have limited the use of multifunction workstations over the last five years.
- Examine current products and predict how these products are likely to develop in future.
- Examine alternatives to multifunction workstations and predict how these alternatives are likely to develop in future.

The research carried out for this report consisted of:

- Interviews with staff responsible for installing multifunction facilities (workstations and alternatives) in user organisations.
- Interviews with relevant staff in office system suppliers.
- An extensive literature search.

Since current user experience of multifunction products is limited, we have also made use of system requirement surveys and questionnaire results from recent Butler Cox consultancy studies. (In particular, we have used material from a very large office technology study sponsored by the Department of Industry and a number of office system suppliers. During this

study, investigative work was carried out in the United Kingdom and Scandinavia.) These studies were carried out to identify the probable main areas for multifunction product application in the future, rather than to record existing applications or to obtain current user views.

Structure of the report

The report has six main chapters. In chapter 1, we review the need for multifunction terminals and the alternative ways in which multifunctionality can be provided to the end user. Chapter 2 describes the various ways that information can be input, stored, processed and output using multifunction products. Chapter 3 examines some of the products that are available today and compares them with user requirements. Chapter 4 reviews the experiences of some current users of multifunction products. Chapter 5 presents our conclusions about the ways in which office systems will develop — specifically, we predict the applications and areas where multifunctional facilities will be used in future, and describe how current products will evolve to meet future needs. In chapter 6 we identify the key issues for potential users of multifunction workstations and give guidelines on how users should resolve these issues. Finally, in the conclusion, we summarise our main findings on the role of multifunction workstations in the office.

CHAPTER 1

THE NEED FOR MULTIFUNCTION WORKSTATIONS AND SYSTEMS

The term multifunction tends to be used in a rather vague way in relation to terminals and systems. Before we look in detail at multifunction products and their application, we need to explain what we mean by 'multifunction' and its significance to users of these products. We do this in the context of the needs of the office worker, considering not only the multifunction workstation but also other ways in which multiple functions can be delivered to the user.

THE MEANING OF MULTIFUNCTION

Although some office workers (such as typists and data preparation clerks) have jobs that involve only a few routine activities, most office workers perform a variety of tasks and regularly use different types of equipment. Office tasks often involve the production of paper or electronic documents that contain various combinations of text, data and graphics. Documents may be communicated within an organisation or to outsiders by traditional means (such as mail or telex); alternatively, they may be communicated by using more recently developed electronic techniques (such as electronic mail or facsimile transmission).

Virtually every office worker uses speech as an essential form of communication. Traditionally, speech has been confined to personal meetings or telephone conversations. But advances in technology have enabled speech to be used as a form of electronic mail, and also to annotate electronically recorded documents.

In the context of this report we refer to terminals and systems as being multifunction if they assist the user to perform more than one kind of task, or to deal with information in more than one medium.

By 'kind of task' we mean, for example:

—To file and retrieve information.

—To generate information.

—To transcribe information.

—To process information.

—To communicate information to other people.

The various media by which the information may be communicated are:

—Data.

—Text.

—Speech.

—Images (facsimiles).

—Graphics (structured images).

—Video (moving images).

In defining multifunction systems in this way, we necessarily imply some degree of integration within the system. But varying degrees of integration are possible. The lower levels of functional integration are already familiar. For example, the use of an unintelligent terminal to access various application programs on mainframe computers is commonplace. In this report, we concentrate on the higher levels of integration where one application encompasses information in different forms (such as data and text, or text and images, or text and speech).

WHY USE MULTIFUNCTION TERMINALS?

Single-function terminals are limited in application because they are often suited only to particular jobs. Indeed, certain jobs tend to be designed to suit the terminal — data entry to a computer system for example. In contrast, we might expect that multifunction terminals will be able to match the requirements of a variety of jobs more closely. We now look at these user requirements and discuss the effectiveness of single and multifunction devices in meeting them.

User requirements

Some office workers — such as typists, filing clerks and data preparation staff — have relatively straightforward jobs that may be adequately supported with a single-function terminal rather than a more sophisticated multifunction product. Office systems are generally provided for use by these staff as an essential requirement of the job (for example, in data preparation), or to increase staff productivity (for example, in document typing). But most office workers perform a mixture of tasks. Managers, professionals, secretaries and many clerical workers perform jobs that involve many functions.

Office equipment and office systems that affect only one type of task are of limited value to multi-task office workers. Word processors, for example, may improve

typing productivity very significantly (100 per cent is not atypical) but are of little significance to a secretary who types for less than 20 per cent of her time. Tools to improve the productivity of multi-task office workers need to address more than one office task if they are to have any significant impact on productivity.

Traditional data processing systems typically have addressed only a subset of tasks within a business function (for example, sales accounting or payroll). Early office system tools such as word processors and electronic mail systems have also concentrated on only one element of office work.

To bring worthwhile gains in productivity, office systems will have to be integrated so that they address the overall performance of business functions. Traditional data processing systems, individual office system tools and business function requirements are contrasted in figure 1. Multifunction terminals do have the potential to address the overall performance of business functions.

Traditional office equipment

Traditional office equipment has been designed to perform, or assist with, specific office tasks. Three examples are the telephone, the typewriter and the conventional computer terminal. Equipment of this sort is manufactured in large volumes at relatively low unit cost, and its use has generally been justified on grounds of convenience rather than cost benefit. Most organisations would not even consider cost justifying the purchase of telephones or electronic calculators — these items are now purchased as a matter of routine administration. More expensive items of office equipment, such as photocopiers, are normally shared between occasional users.

As prices fall there is a general tendency for equipment to become more widespread and for it to be justified on the grounds of convenience. Some office equipment will continue to be shared, however, because of its nature — for example, a communications network or a file of information common to several users.

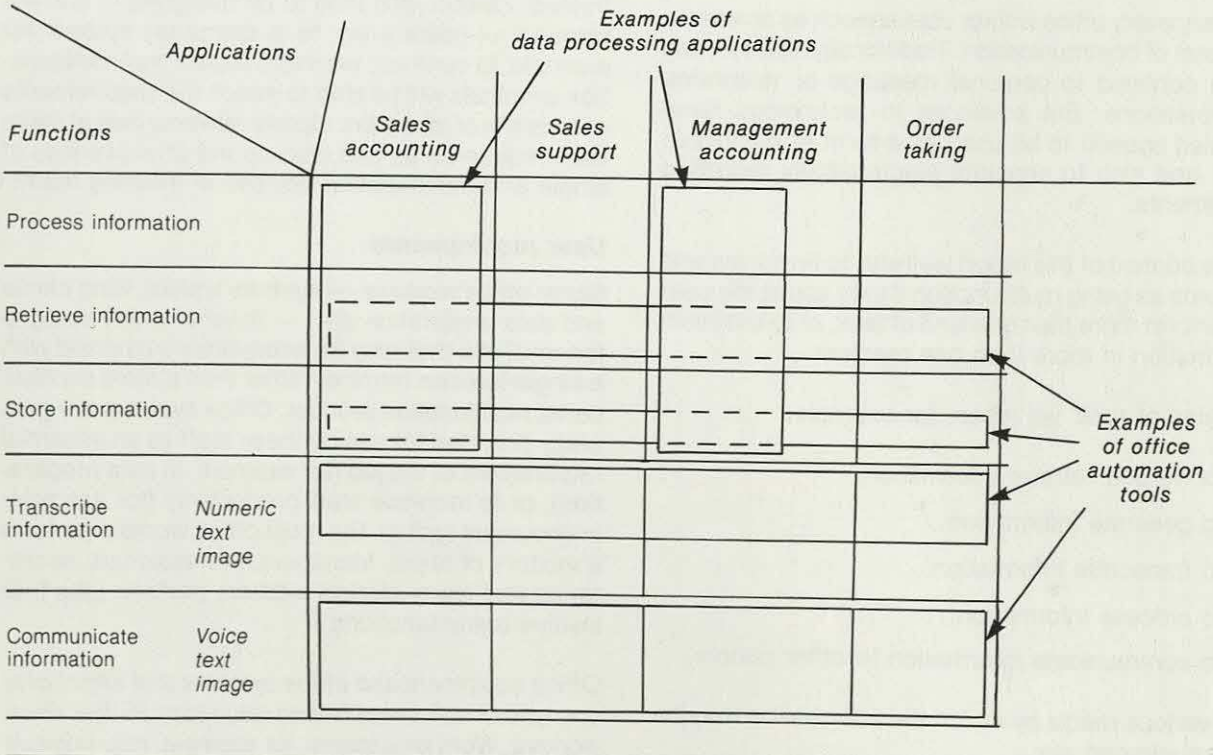
Advantages of multifunction products

Multifunction products have six main advantages over their single-function counterparts:

— A multifunction terminal takes up less space than two or more single-function terminals — an important consideration for desk-top installation, for instance.

— A multifunction terminal should be less expensive than two or more single-function terminals — because of the common use of screens and keyboards. At present, this is often not the case, but only because single-function devices are sold in much larger volumes, and so benefit from economies of scale. We expect this position to change in the future.

Figure 1 Data processing versus office automation



—Multifunction devices are usually more convenient. With single-function terminals, it can be difficult to transfer data from one device to another, and it may be impractical to combine certain communications media (such as text and recorded voice).

—Multifunction terminals are less likely to introduce problems of incompatibility between functions. For example, a combined data/text terminal is likely to have fewer communication problems in linking data and text, compared with separate data and text terminals.

—Multifunction terminals can be designed to offer a uniform interface to the user, irrespective of application. This will make the systems easier to use and will require less user training.

—New (possibly marginal) applications are often easier to justify on a multifunction terminal. There may well be spare capacity on the terminal which can be used to accommodate further applications. A single-function terminal will be more restricted in the possible range of additional applications.

Disadvantages of multifunction products

As well as advantages, multifunction products have some disadvantages when compared with the alternative of several single-function terminals:

—Multifunction products are more vulnerable to breakdowns. If the multifunction workstation fails, all facilities are lost.

—Multifunction products are more complex to use. More training is required, which discourages occasional users such as temporary staff. (This is already a familiar problem confronting temporary typists required to operate word processors.) As a result, organisations will be tempted to impose more rigorous controls to standardise on one particular system. In the absence of any universally accepted standards this means, in effect, a particular vendor's product.

TYPES OF MULTIFUNCTION APPLICATION

Although many office workers carry out several of the functions listed in figure 1, the mix of functions performed varies between jobs and between different types of office. A comprehensive multifunction workstation provides more functions than are needed by most office workers. A selection of functional options is required, therefore, to match the needs of individual jobs. The range of functions and the capabilities needed will vary considerably. For example, engineering designers may need high resolution graphics whereas general managers may be content with low resolution and some clerks may not require graphics at all.

Our research suggests that there are eight types of multifunction office work that apply across a wide variety of organisations.

Clerical transaction work

In this type of work a team of clerks receives paper documents and processes them as part of a transaction routine. This routine may be manual or it may involve input to, and output from, a computer system. Examples of clerical transaction work include the pricing of invoices from price lists, and answering simple queries on account balances or stock levels.

Clerical casework

In this type of work each clerk is responsible for progressing a number of individual subject (or case) files. Examples of clerical casework include a correspondence section in a mail order company (or insurance company) and clerks handling requests for re-coding in a tax office.

Professional analysis

In this type of work professional staff perform individual analysis tasks which generate information for use in business operations or decisions. Examples of professional analysis workers include accountants, planners, marketing staff and management services staff.

Engineering work

Engineering work is rather like professional analysis. The difference is that the staff exercise control over engineering products and are usually dependent on precise drawings and complex calculations. The engineers may be supported by draughtsmen and CAD (computer aided design) systems.

Project management

The main purpose of project management work is to co-ordinate and control activities both within and outside the organisation. Project managers receive information regarding project plans (and progress) in many different forms. Some use may be made of computerised project control techniques such as PERT (Program Evaluation and Review Technique). Large projects are a feature of the heavy engineering and construction industries but they occur also in many other types of organisation.

General management

General managers are responsible for the performance and direction of one or more separate facilities which may be depots, factories, offices, or even entire companies.

Secretarial work

Secretaries and personal assistants support general

management and professional staff in carrying out their activities.

Document preparation

Document preparation staff compile and edit information to be incorporated in a formal document of some kind. They collect and process information from both internal and external sources. They may not be involved in the physical production of the documents but will certainly be involved in checking and proofreading. They may also access computer and paper files, and carry out computations. The quality of the document is important and there may be several authors collaborating to produce a single document. The document may be an incidental part of the business operation. Alternatively it may be a prime product, as in a publishing or consultancy organisation.

The office system facilities required to meet the needs of these types of office work are analysed in figure 2.

MULTIFUNCTION TERMINAL REQUIREMENTS

In future, most users of multifunction office systems will not be trained typists, nor will they be familiar with traditional programming languages. They will use some of the system facilities regularly, and others only occasionally. They will not willingly attend lengthy training courses, preferring instead nothing more demanding than a simple introductory course. For these reasons a multifunction device must be easy to use, logical and 'friendly' if it is to be accepted and used effectively.

What are the features that will make multifunction terminals easy to use by the ordinary office worker? They are concerned with two different aspects of the terminal's operation:

—The direct physical interaction between the user and the terminal hardware.

—The selection and use of appropriate software tools.

Hardware features

The conventional alphanumeric keyboard is the almost universal means of inputting text and data into existing data processing systems. But keyboards are slow and awkward to use for the untrained typist. There are also social pressures discouraging senior executives from using keyboards, as they might consider it demeaning to be seen 'typing'. Hence, we might expect alternative means of input relying on the user's more natural abilities to be preferable. Speech recognition (requiring no real skill at all) would be an obvious example. As we shall see in the next chapter, the suppliers of multifunction terminals and also research establishments have put considerable effort into developing alternative input and control devices.

Figure 2 Functions required by different types of office work

Facilities required	*Job/work categories*							
	Clerical (Transactions)	Clerical (Casework)	Professional (Analysis)	Engineering	Project management	General management	Secretarial P.A.	Document preparation
Information processing								
data	✓	✓	✓	✓	✓	✓	✓	●
text	✓	✓	✓	✓	✓	●	✓	✓
graphics		●	✓	✓	✓			✓
image				●	✓	✓	●	✓
Information storage/retrieval								
data/text	✓	✓	✓	✓	✓	✓	✓	✓
graphics		●	●	✓	✓	✓	●	✓
image		✓	●	●	✓	✓	●	✓
voice		●	●		✓	✓	✓	●
Information communications (within function)								
data	✓	✓	✓	✓	✓	✓	✓	✓
text	✓	✓	✓	✓	✓	✓	✓	✓
graphics		●	✓	✓	✓	✓	●	✓
image		●	●	●	✓	✓	●	✓
voice	●	✓	✓	✓	✓	✓	✓	✓
Information communications (in-house)								
data	✓	✓	✓	✓	✓	✓	✓	✓
text	✓	✓	✓	✓	✓	✓	✓	✓
graphics			✓	✓	✓	●	●	✓
image		●	●	●	✓	●	●	✓
voice	●	✓	✓	✓	✓	✓	✓	✓
videotex	●		●			●	●	●
Information communications (public services)								
data	●	●	✓	✓	✓	✓	●	✓
text	●	●	✓	✓	✓	✓	✓	✓
telex/teletex	●	●	●		✓	●	✓	●
graphics			●	✓	●		●	●
image		●	●		✓	✓	●	●
voice	●	✓	✓	✓	✓	✓	✓	●
videotex	●		●			●	●	●

Key: ✓ Common need
● Optional need

Software features

Even more important than terminal hardware features is the requirement that users should be able to make the multifunction product perform useful tasks. Ideally, the software should have the following basic features:

- —Commands which are standard across the range of applications, even when the terminal is being used to access proprietary systems such as an IBM mainframe or a public videotex service.
- —Adjustable screen instructions and "help" facilities, to accommodate the changing skill levels of individual users. (For example, skilled users have less need than trainees for simple prompts.)
- —Multi-tasking, allowing users to switch between functions without having to sign off from one function and sign on to the next. Multi-tasking may even allow several applications to be run in parallel without requiring the user's involvement in any detailed control or switching. (For example, a user may need to alternate information retrieval from a mainframe with document preparation on a multifunction workstation. Multi-tasking would enable the user to interrupt the typing in order to access the mainframe just by making a few keystrokes, to select the relevant information, and then immediately to switch back to the now-expanded text document to continue typing. That contrasts with the laborious alternative of signing off and on at each step, together with identifying, saving and moving each item of retrieved information.)
- —The facility logically to interrelate stored information input via different communications media. (For example, facsimile images may be logically stored with the text or data they relate to. Again, recorded voice comments on a draft document may be logically stored together with that document. From a user's point of view this logical storage arrangement allows captured information related to any one item to be easily accessed, regardless of the communications media.)

To the supplier, these software features are not trivial. They imply very considerable software development costs. Thus it is perhaps not surprising that very few existing products, if any at all, are seen as ideal by potential purchasers.

USER NEEDS FOR MULTIFUNCTION TERMINALS IN PRACTICE

A number of large user organisations have developed their own specifications for multifunction workstations. They have done this because they cannot find products on the market that meet their perceived needs. One frequent requirement, for instance, is for a word processing terminal that is capable of working with public and private videotex systems. (At the time of writing, this facility is available only on one word processor, which lacks some other desired facilities.)

User organisations recognise the need for different facilities for different types of staff, although the requirements are often expressed in terms of generalised staff categories such as managers, professionals, secretaries, clerks and typists. Although there is a large measure of agreement amongst these organisations over multifunction requirements, a common specification has yet to be formalised. Several organisations have expressed the hope (rather than the belief) that, if such a specification could be agreed by a group of influential users, then suppliers would be motivated to meet that specification. A typical list of requirements for a professional multifunction workstation is given in figure 3. This list of requirements was developed by a company which has a combination of IBM equipment, Digital Equipment minicomputers and a private switched data network.

Figure 3 Typical requirements for a professional multifunction workstation

Workstation feature		*Description of feature*
Essential Features	Processor	16 bit microprocessor with 64K-256K RAM
	Storage	Floppy discs + winchester disc option
	Keyboard	Soft keys
	Communications	V24 (RS232) DP terminal emulation (IBM3270/VT100) Wordplex communication Videotex communication
	Peripherals	Graph plotters and screen printers
	Software	Text editing, spread-sheet analysis, record keeping (local files), information retrieval, user-friendly.
Desirable Features	Display	Colour display for videotex graphics
	Communications	LAN interface (Ethernet) Multiterminal emulation
	Software	Multi-task operating system

WORKSTATIONS AND SYSTEMS

Our original intention was that this report should be concerned exclusively with multifunction workstations — self-contained terminals having an inherent multifunctionality. Input and output of information in various forms, processing power, information storage and

communications interfaces would all be incorporated in the one device. During our research, however, it quickly became apparent that:

— There were other ways of delivering multifunctionality to users, some of which might be preferable to multifunction workstations.

— There was in practice no clear-cut distinction between the totally self-contained workstation and systems with some of the functionality provided outside the user's terminal. In fact, there are very few multifunction workstations which are totally self-sufficient.

For these reasons, we decided to broaden the scope of the report to consider a spectrum of multifunction products. At one extreme is the self-contained workstation; at the other, a system in which unintelligent terminals can access a variety of functions on one or more shared processors.

Clearly these two approaches represent extremes in a spectrum of possible devices which may contain varying degrees of capability at the terminal.

Integrating every possible function into a single multifunction workstation implies working with information in the form of data, text, voice, graphics, image and video. Workstations encompassing this range of possibilities represent an ultimate in multifunction workstation design. In practice, even the most advanced multifunction terminals available today stop short of this degree of integration. Most multifunction terminals cater only for data, text and a limited range of graphics. The multifunctionality results from the software that is accessed by the terminals, rather than from any sophisticated hardware.

On the other hand, the unintelligent terminal can cater only for a limited range of tasks, regardless of the power of the software.

Practical multifunction systems tend to lie between these two extremes. We review their design in detail in chapter 2.

CHAPTER 2

MULTIFUNCTION PRODUCT TECHNOLOGY

In chapter 1, we concluded that we should look at multifunction systems as well as multifunction workstations. In this chapter, we describe the various architectures of multifunction products and their technology. Clearly, some aspects of terminal and systems design apply equally well to all computer systems — the need for legible, non-reflective displays on terminals, for example. But the use of multifunction equipment by unskilled operators does pose special design problems. We discuss the technological solutions to these problems under the following headings:

—System architecture.

—Information processing and storage.

—User input.

—System output.

—Communication between devices.

—Functional integration.

SYSTEM ARCHITECTURE

Three main types of system architecture are employed in multifunction systems. As depicted in figure 4, these are:

—The multifunction workstation, in which most of the intelligence to support the various user functions is concentrated at the terminal itself. The workstations have communication interfaces to enable them to exchange information with other terminals or processors. But the time spent in communications is small compared with the time spent processing information.

—The multifunction network consisting of intelligent terminals and processors dedicated to different tasks, all linked together by a local area network. Here, the terminals are not self-contained but rely on other microprocessor based servers to provide information storage, printing, and communication interfaces to wide area networks. Software is distributed around the network in the various units. Some software may be held permanently in the terminals; other software is downloaded from files as required.

—The multifunction office minicomputer (and mainframe) system, consisting of unintelligent terminals connected to a shared minicomputer, or network of minicomputers and mainframes. These systems are conventional data processing systems providing on-line access to a large number of users. The multiple functions are provided by software in the computers, shared by all users. Files, printers, and communication gateways all tend to be attached to the computers rather than to the terminals.

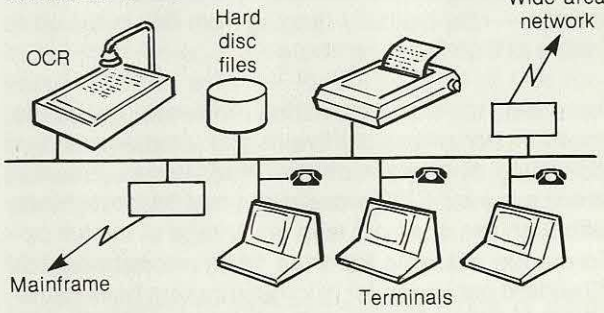
In practice, there is a considerable degree of overlap between these three alternative architectures. Most sophisticated workstations have been designed to

Figure 4 Alternative approaches to multifunctionality

Multifunction workstation

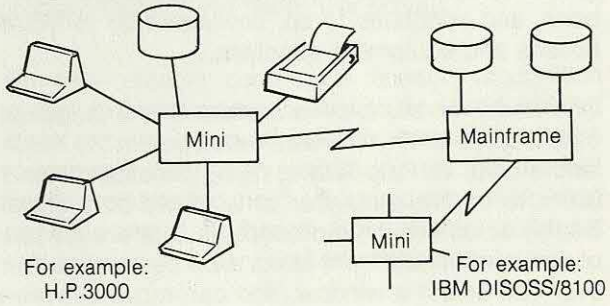
For example: Xerox Star

Multifunction network



For example: Xionics, Ethernet

Office minicomputer (and mainframe) system



work with local area networks; many require separate processors, albeit closely connected to the terminals. At the other extreme, very intelligent terminals may also be used in conjunction with separate minicomputers or mainframes.

Our research suggests that, ideally, every user should eventually be equipped with an individual terminal. Sharing terminals usually reduces benefits because of queueing and motivation problems. However, in the early stages of introducing multifunction applications, terminals may have low utilisations and can be effectively shared.

INFORMATION PROCESSING AND STORAGE

The nature of the processor and storage available to the user of a multifunction system depends on the basic architecture of the system. It is convenient to take each of the three approaches in turn.

Information processing and storage at the terminal

It is increasingly common for standard microcomputers to be incorporated into terminals to provide higher levels of sophistication. The need to handle improved graphics and to emulate industry standard visual display terminals (such as IBM 3270, etc.) has led to the use of more powerful 16-bit (and even 32-bit) microprocessors. These powerful microprocessors are steadily replacing 8-bit microprocessors. At the same time the random access memory storage (RAM) available in a single terminal has increased significantly — now typically ranging from 64k bytes up to half a million bytes or more.

In order to exploit existing software packages, multifunction products have usually adopted standard operating systems such as CP/M. For this reason, there are even CP/M emulations on 16-bit machines, although this does not take advantage of the full performance available from the 16-bit microprocessor. Standard packages for microcomputers have generally been developed independently as 'one-off' solutions to meet perceived market needs. They are, therefore, often difficult to link together into an integrated system. Software to solve this problem has been, and continues to be, developed by software houses and equipment suppliers.

One basis for this type of software is a language called 'Smalltalk' which was developed in the Xerox laboratories at Palo Alto in 1972. Smalltalk allows users to create a number of windows on a visual display screen which represent, say, different types of document or different tasks to be performed. The user can select a window, and can move between windows, by using simple commands which may be input using a keyboard, a 'mouse', or some other input device (see page 10).

Smalltalk is distinctive in that the windows on the screen can overlap, so that the range of documents or tasks on the screen at any one time is not constricted by the size of the screen. Users can select which window is to be in the 'foreground' (and, therefore, visible) if one window overlaps with another. Moreover, users can create sets of windows to represent different documents and tasks that are likely to be used in combination. The set of windows can be thought of as representing items of work arranged on a desk-top. One arrangement represents the 'budget preparation' desk-top, another the 'past period accounts analysis' desk-top, and so forth.

Smalltalk has been implemented on different products and in different ways by different suppliers. The idea of windows, and having one window per program, is now quite common. The penalty of Smalltalk is that it requires a high resolution display and about 250K bytes of random access memory (or about 100K bytes of RAM plus back-up storage on an efficient disc system).

Information processing and storage distributed on a local area network

In multifunction systems based on local area networks, the processing power is not only contained in the terminal itself, but is also distributed round the network in a number of separate microprocessor-based units dedicated to specific system functions. Each user terminal accesses whichever unit (such as file server or print server) is needed to carry out the function required. This arrangement of autonomous processor units allows multiple tasks to be carried out simultaneously. A file server, for instance, could be selecting data from a disc file while at the same time the user is working on a different task. Distributed processors are very resilient to failure of the terminals and the distributed processor units.

Some of the shared processor units may also be dedicated to specific office functions rather than just general information processing tasks. An example is a disc file unit fulfilling the role of electronic mailbox. Typically, it receives messages identified by addressee name and stores them until the recipient looks at his mailbox.

Information processing and storage in minicomputers and mainframes

Where most of an individual user's processing is executed on a shared computer, user terminals normally have online access to timeshared application programs.

Mainframes are not widely used for multifunction of-

fice systems. Users of these systems often experience problems in maintaining short response times, and in minimising costs as the number of terminals increases. Users also frequently have to learn to cope with the idiosyncrasies of the particular mainframe's operating system, and have to contend with the normal log-on and application selection commands used by professional data processing staff.

Dedicated 'office system' minicomputers offer the possibility of faster response times (and lower costs) than timesharing on a mainframe when large numbers of terminals are involved. Powerful software can be provided both for general purpose office functions such as text editing, information storage and retrieval, and for specific applications such as preparing legal documents. The software packages can be written to ease communication between them, and to offer simple menu selection commands that give a user-friendly interface.

USER INPUT

Designers of self-contained multifunction workstations have concentrated a great deal of their effort on user-to-system communications. Office system suppliers have anticipated that information input difficulties will be a major barrier to user acceptance of multifunction devices, particularly where the users are middle or senior managers. There are six main types of information input to multifunction products: keyboard input, handwritten input, voice input, screen input, hand control input and image input. Each of these methods has its own advantages and disadvantages.

Keyboard input

Traditional keyboards have two main disadvantages:

—Text and data input by untrained or sporadic users is very slow.

—In many countries the keyboard has a low status image, and is often seen as merely a typist's tool.

Most multifunction terminal users will not have to input large volumes of text or data, however. Instead, they will retrieve and manipulate information to meet their own specific requirements. So designers of multifunction products have concentrated on the development of commands and other facilities that allow users to access and manipulate information. They have attempted to improve the generally poor usability of traditional computer systems, which even computer professionals often find hard to accept. In doing this, workstation designers have developed a number of new facilities that have been incorporated in many multifunction workstations:

—Single keys that can be used to select system functions.

—'Soft' functions keys, that can be programmed to activate different system functions. (The variety of functions available can sometimes confuse users. Some systems have attempted to overcome this problem by indicating the functions in use as captions on the screen.)

—Functional choices that can be presented as 'menu selections' on the screen. (Designing menus is not easy. They must be carefully structured, particularly where many options and multi-level or multi-route commands are required. Experienced users find that poorly structured systems are tedious; inexperienced users find them complex.)

Handwritten input

There are three main methods of handwriting input through pads. In the first method, the user may point to letters or functions marked on a pad that is linked to a processor. This method of input is relatively slow, but it provides greater flexibility than a keyboard because characters on the pad may more easily be altered.

In the second method, the pad may be linked to a processor that records pen movements as digitised images that can then be viewed on a screen. This method of input allows the user to write normally but the system itself cannot logically interpret these images. Further processing of the information is, therefore, not possible. This method may, nevertheless, be suitable for user-to-user messaging, or for the handwritten annotation of electronic documents.

In the third method, the pad may be linked to a processor running software that is capable of free format recognition, but users must print in a particular way for recognition to be effective. Handwritten input using currently available products is of limited value and is not really satisfactory for widespread use.

Voice input

Human speech is the most natural mode of communication, but suffers from several drawbacks when it is used for information input to a system. The most important drawback is that the pattern recognition problem has not yet been fully solved.

No truly reliable continuous speech recognition system exists at present, although new products that claim to offer improved speech recognition performance are continually appearing on the market. These products are mostly slow and expensive when compared with keyboard input. Faster products generally have a very limited vocabulary.

Individual word recognition is, however, viable now.

At least one VDU with the capacity to respond to spoken commands has appeared on the market. This input method could be used as an alternative to the other forms of manual control described below.

Voice can be digitised and stored for limited applications such as user-to-user communication or voice annotation of electronic documents. Even in these limited applications, however, the storage requirements can be substantial. Without speech compression, about 64K bits of storage are required for every second of speech — over 3.5M bits of storage every minute. This can be improved by speech compression to about one million bits of storage for each minute of speech, which still compares unfavourably with the equivalent digital character storage of about 10K bits. Most products that offer speech recognition have been specifically designed for that purpose, and speech recognition is rarely offered as one of the functions of a multifunction product.

Screen input

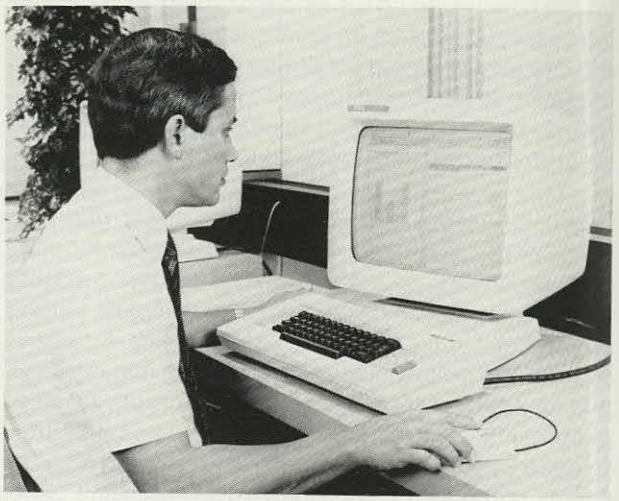
A touch-sensitive screen, or a light pen, can be used to give commands and to input information to the system. In most multifunction products using these techniques, one or more specific functions or commands are indicated on the screen either directly or by moving a cursor. This approach often exploits human skills in pattern recognition and spatial relationships (for example, in pointing to icons on a visual display screen). People can recognise the meaning of pictures much more quickly than they can understand the same information represented in the form of text or data. People tend to think of document files, for instance, in terms of their location (the green file on the lower shelf) rather than their content.

Hand control input

As an alternative to physically touching or pointing to items displayed on the screen, a cursor may be used to select the next action required. The cursor can be moved by control keys on a keyboard, but skill is required to do this efficiently. In addition to the use of a light pen, three further forms of control are available on current products: the 'mouse', the joystick and the pressure sensitive pad.

The mouse consists of a small pad under which there is a ball, or roller, whose rotation controls an electrical signal which in turn can be used to move the cursor. The ball or roller can move in two perpendicular directions, controlling the vertical and horizontal position of the cursor. The mouse is activated by rolling it across the desk-top or other flat surface. (A large area is not required — the mouse can be moved repetitively in the desired direction over a short distance.) The mouse is also fitted with two or three buttons that are used to generate additional control signals. The user presses the appropriate button to select the functions required. A typical mouse is shown in figure 5.

Figure 5 A mouse being used on the Xerox 8010 Star



Joysticks use the movement of a small lever to generate signals controlling the horizontal and vertical movements of the cursor. Normally, moving the lever from one side to the other moves the cursor across the complete width of the screen. The movement is very sensitive, and it is difficult to position the cursor precisely. If precise positioning is required (as in using the joystick to generate graphics) software can be incorporated in the terminal to give coarse and fine movement options. Like the mouse, the joystick can be fitted with control buttons for selecting the required functions.

The Xerox 860 word processing workstation has a pressure pad which moves the cursor horizontally, vertically, or diagonally according to where it is pressed. It is, in effect, a 'touch sensitive' joystick. This device has not been widely used.

Both the mouse and the joystick allow users to position the cursor very quickly. The mouse also allows the cursor to be positioned very precisely, down to the pixel level on graphics applications. But it is more expensive than a joystick (about $200 compared with $30). Both the mouse and the joystick have the disadvantage of being one more item on the desk, and they do not remove the need for a keyboard (or other form of input) for entering data and text.

Image input

Although products that capture, store, transmit and print digitised facsimile images are available, they are not yet fully developed. In particular, these products have a significant electronic storage requirement (about ten times that required by text or data) and (with a few exceptions) they do not provide for viewing by commercially available visual display terminals.

Also, the images are not stored in machine readable form. As a result, they cannot be modified or manipulated in the same way as text or data characters. (A few pioneering user organisations are beginning to use image terminals connected to optical character recognition devices.)

SYSTEM OUTPUT

For the foreseeable future, nearly all multifunction product users will require both a visual display and hard copy output for data, for text (with a growing variety of fonts), and for graphics.

Visual displays

To meet the needs of users for graphic information, many multifunction products will incorporate graphics displays (usually raster-scanned displays with bit-plane memories). High-resolution graphic displays (of around 1,000 x 800 pixels) are not usually required in the office, except for specialised applications such as engineering design (and, in future, for image display). Currently most users of multifunction office products will be satisfied with low-resolution graphics of about 250 x 200 pixels. This is adequate for routine business graphics such as bar charts and graphs. Colour displays will sometimes be needed, for videotex and certain types of business graphics. (Monochrome displays are capable of higher resolution than colour displays, however.)

The use of icons on a small screen terminal does, however, imply the use of higher resolution screens, and hence higher cost than ordinary VDUs.

Printers

To meet changing user requirements, hard-copy output is becoming more flexible. Printers that are able to plot graphics as well as print data and text over a range of quality levels are becoming available.

Low quality output will continue to be provided by dot matrix printers. High quality output will be produced by a variety of impact printers, ink jet printers, pen plotters and laser printers. But because most users will not require a high volume of hard-copy output, the printers — particularly the more expensive, high quality printers — will usually be shared between several users. Our research suggests that sharing will not seriously reduce the multifunctional benefits, providing each user can easily access a suitable printer.

Voice output

There are four main applications of voice output:

— Telephone facilities incorporated in the terminal (for use in a voice store and forward message system, for example).

— Voice annotation of documents, where voice and data or text records are logically integrated by the system.

— Telephone facilities associated with the display of documents as part of an interactive voice/electronic mail system.

— Access to voice response systems, typically used for information retrieval or user guidance.

As an alternative to the telephone handset for voice communication, a loudspeaker may be incorporated directly in the terminal. This is appropriate where the voice application is not conversational, such as in equipment voice response.

COMMUNICATION BETWEEN DEVICES

Multifunctionality implies the need for a wide variety of communication options to link together multifunction terminals and systems, either in the same building or at remote locations. The following examples illustrate typical arrangements:

— Corporate data processing systems using proprietary protocols (such as IBM's SNA).

— Remote bureau services using a variety of wide-area network protocols and transmission speeds (such as asynchronous data transmission using the public switched telephone network (PSTN) and standard modems, or packet-switched data transmission using CCITT X.25 standard public networks).

— Remote users sending and receiving electronic mail via the public telex or teletex networks.

— Remote users sending and receiving voice messages or interactive voice communications using PSTN or private voice networks.

— Remote users sending and receiving facsimile images via PSTN or private networks.

Communication facilities must not only be compatible with the physical interface to the multifunction product, but must also incorporate higher levels of communication protocols (up to level 6 or level 7 of the OSI model for proprietary network architectures and terminal types — see Foundation Report No. 23 — Communicating Terminals, page 36). Very few users, however, will require all, or even most, of the different communication facilities that could be made available. Because of this limited requirement, most multifunction products adopt one of two approaches for communicating with remote systems. Either they do so through an optional communication interface, or they communicate via a gateway which is shared by a number of multifunction users. The gateway can be a processor connecting the various user terminals

to the organisation's message switch for telex traffic. Alternatively, it can be an X.25 gateway on a local area network, connecting to the public packet-switching network.

If a terminal connects to a shared processor (minicomputer or mainframe) it will usually communicate by using the normal protocols for that processor. Distributed processing systems will use a local area network or a data-switching PABX to link local terminals and processors together. Since no single recognised standard for local communications exists, terminals and networks supplied by different manufacturers are often incompatible.

FUNCTIONAL INTEGRATION

Just as the term 'multifunction' tends to be applied without a precise definition to office workstations, so also does the term 'integrated'. We need to be wary of descriptions using the term because the degree of integration and its application can have very significant implications for the user. At the lowest level of integration, it can refer to purely physical integration of separate items in a single box with no direct connection between them — say a telephone and a visual display unit, each with its own communications interface to the outside world. Such a device offers little more to the user than the two separate devices — perhaps even less. At the highest level of integration, a device would have complete physical, logical, and functional integration, and be capable of processing and relating information generated in any mode — speech, text, images, or video. For example, users of such a device would be able to search through electronically stored documents for any references to 'sail boats' and extract automatically any spoken references to 'sail boats', or pictures of 'sail boats', or written references to 'sail boats'. Clearly we are a long way from having such a degree of integration in any commercially available product.

Current multifunction terminals exhibit three kinds of integration:

—Simple physical integration of terminal hardware.

—Logical integration of similar system functions.

—Integration of more than one mode of communication.

Simple physical integration

The simplest form of integration found in current terminals is that of sharing certain physical features for different purposes. Examples are the use of key pads for both input of data and for dialling a data or telephone call; and the use of a common communications interface for both speech and data traffic — albeit not simultaneously. The advantages are mainly convenience and cost-saving. This simple form of integration is usually achieved by appropriate hardware design.

Logical integration of similar system functions

In this form of integration, the same hardware is used for similar system functions, such as the emulation of an IBM 3270 type terminal and emulation of a Digital VT100 terminal. The integration is achieved mainly by using different software and the benefits are again convenience and, more importantly, cost saving. Another example is the use of text editing and calculation software within the same processor to integrate word and data processing on the same terminals. Generating and processing graphics is also a common facility on most intelligent terminals. But this level of integration does not allow users full interplay between the different modes of operation. The terminal may be used for text editing and data processing — but may not allow the results of calculations to be incorporated within a piece of text without the data being re-entered or transferred via some file record — a very cumbersome process.

Logical integration of different modes of communication

The highest level of integration available in current products is the ability to interrelate information communicated or stored in different modes. The most straightforward instance is the merger of data and text within the same document — indeed some would argue that data is just a form of highly structured and coded text. Such integration is largely a matter of appropriate software tools and packages. But multitasking is important if the user is not to be hindered by having to switch between application programs for data generation and text editing. It is not just integration that is important, but transparency of integration as well.

More difficulty is encountered when speech or images have to be integrated with data or text. First, specialised hardware is required to digitise the original information. Secondly, the digital code generated has to be logically related to the corresponding data or text. If the speech element is limited to a few words (tens or hundreds), or the images are of certain stylised forms, the input devices may be used to recognise their significance. But speech recognition and OCR equipment is still expensive and unlikely to be widely used for some years. So the interrelationship between speech or image and text depends on the user directing it in some way. Speech annotation of electronically stored documents is an example of the use of this kind of integration which is available in a few multifunction workstations today. As yet, none allows for the incorporation of images within documents, though the necessary coding and protocols to handle that facility are under development.

Other developments in progress on the logical integration of different modes of information are:

—The use of videodiscs with intelligent terminals to integrate data, text, image and video.

—The integration of data and text with high resolution graphics in computer aided design.

CHAPTER 3

EXAMPLES OF MULTIFUNCTION PRODUCTS

The current market for multifunction products is clearly dominated by 'supplier push' in which suppliers aggressively market their own products and ideas, rather than by 'demand pull' in which users demand products to meet their own identified needs. In this environment it is useful to examine the ways in which commercially available multifunction products are evolving from single-function products, and to use the source of the product as a basis for classification. Six different categories can be identified:

—Products evolving from telephones.

—Products evolving from data terminals.

—Products evolving from shared computers.

—Products evolving from personal computers.

—Products evolving from local area networks.

—Specifically designed multifunction products.

In this chapter we describe each of these products in turn, emphasising the continuing trend towards convergence of multifunction products from different starting points. The discussion also highlights the continuing enhancement of multifunction products, and demonstrates how a number of important developments (in voice and image recognition) have yet to be realised.

PRODUCTS EVOLVING FROM TELEPHONES

These products, known as display-phones, combine traditional telephone facilities with screen displays for data and text (and sometimes business graphics as well). Display-phone terminals usually contain little or no local intelligence for running user programs, but they may contain a microprocessor to provide advanced telephony features such as autodialling and automatic call transfer. Each terminal is connected to other remote terminals and processors via the switched telephone network, providing the user with telephone functions as well as the ability to access remote computers to retrieve or input data.

One product of this type, the Northern Telecom Displayphone, has two telephone connections, allowing the user to place a telephone call and display data simultaneously. The feature is useful if two people wish to look at the same information displayed on their screens while conducting a discussion on the telephone. Some of the latest generation of PABX equipment can do this by transmitting data and speech simultaneously on the same extension line. (An example is Plessey's workstation used in conjunction with their IDX digital PABX.)

In today's generation of display-phones, there is no integration of speech processing with data or text in the terminal. Rather, the microchip logic within the terminal is shared between telephone functions and data functions, and the keyboard (or keypad) is also shared between these different media. In this way, the keyboard (or keypad) can be used to input telephone numbers as well as to input commands to retrieve and display information from a remote database.

Display-phones are sophisticated telephones, able also to provide database access for staff whose requirements are not intensive. By keeping the display screen small (say 15cm diagonally), suppliers have produced very compact terminal units that occupy only about 25cm square of desk space. In this respect, they compare favourably with separate telephones and conventional terminals.

At present, display-phone terminals cost from $1,000 to $2,000 each. In volume production, we expect display-phone terminals to cost less than the equivalent separate telephones and conventional terminals.

Simple display-phone terminals do, however, have a number of potential disadvantages:

—Functionality is limited. Display-phones have no processing power to manipulate data locally.

—Screen size is restricted if the terminal is to be small. This may cause problems with high-definition graphic applications, although small screens are adequate for displaying bar charts and graphs.

—PTT regulations may constrain the opportunities for combining data and telephone units.

In summary, display-phone terminals are best suited to the needs of senior managers for limited computer access, electronic messages, and telephone communication. The main advantage of the display-phone over alternative products is the convenience of its enhanced telephone facilities, the comparative savings in desk space, and (in future) comparatively low

Figure 6 Example of a display-phone product

Northern Telecom's 'Displayphone' terminal was announced early in 1981 and marketing started in North America early in 1982. Negotiations to approve its use in several European Countries are currently in progress. The main features of the 'Displayphone' are:

— A 'hands-free' telephone facility.

— An 81-number auto-dialler (and last number re-dial).

— A call timer.

— A monochrome data and text display (25 cm diagonal).

— A keypad with telephone dial and function keys, including five 'soft' keys.

— An alphanumeric keyboard.

— A built-in modem, and two telephone line connections to allow simultaneous use for both data and interactive voice communication.

The soft function keys may be programmed to access remote computer systems by pressing a single key rather than having to dial a phone number and enter commands, identity numbers etc. There is, however, no facility to process data locally, although a clock and an appointments reminder system are provided.

The price of the 'Displayphone' is currently about $2000. Future enhancements, including a user-programmable processor and various industry standard terminal protocol emulations, are under development.

costs. A display-phone product is illustrated in figure 6.

PRODUCTS EVOLVING FROM DATA TERMINALS

Earlier in this report (on page 6) we referred to the use of unintelligent terminals as multipurpose devices. The functionality of these terminals depends on the software running on the computer system to which they are connected. Display terminal products that can be connected to different vendors' computer systems are now becoming available. Visual display terminals compatible with both Digital and IBM terminal protocols, for instance, have a wider applicability than terminals dedicated to the protocols of just one of these suppliers. Emulation features may be implemented either as firmware (software built into a microprocessor chip) or as software running on a microprocessor within the terminal. In the latter case, the flexibility of the terminal can be increased by loading software packages to provide local processing functions such as word processing or spreadsheet analysis.

Compared with two or more separate terminals, unintelligent terminals of this sort have two inherent advantages: saving in space, and saving in cost. Unintelligent terminals, however, are generally intended for use by trained operators rather than by non-specialist office staff. In other words they are primarily data terminals rather than office automation products. Examples of data and text terminal products are outlined in figure 7.

Figure 7 Examples of data and text terminal products

The Ericsson Alfaskop System 41 supports individual terminals as well as clusters of terminals. Both monochrome and colour displays of text and data are available. Various keyboard options are also offered. The system emulates various IBM 3270 and Sperry Univac UTS units, and various communication protocols such as:

— IBM SNA/SDLC

— IBM and Univac BSC

— Digital VT100

— Honeywell VIP 7250.

The Alfaskop System also has the facility to act both as a word processor and as a remote batch terminal to various host computers, allowing the user to edit files and programs offline.

The Wordplex 80.3 G system is an example of a product where multifunctionality has been added to a text editing system. This product now has options that allow the user to connect the terminal to the telex networks or to a videotex system as well as emulating other data terminals. Local user-programmable facilities are also provided.

PRODUCTS EVOLVING FROM SHARED COMPUTERS

Several minicomputer and mainframe computer manufacturers offer multifunction office systems based on their own computer products. The terminal's multifunctionality is provided by software running on a shared processor, rather than within the terminal itself. The software is usually a mixture of application packages to support general office functions (such

as text editing and electronic messages), and application packages for particular office environments (such as accounts and legal applications).

Compared with self-contained workstations, multifunction products of this sort have three main advantages:

— They can provide services that are shared between several users (such as electronic mail and common databases).

— The software packages can be more sophisticated because mainframes and minicomputers are more powerful than personal microcomputers, although the difference will become less in future.

— They are based on equipment from existing minicomputer or mainframe suppliers, and so are less likely to experience problems when interfacing with data processing systems from these suppliers. (This advantage is less apparent in organisations having equipment from a mix of suppliers.)

Against these advantages, multifunction products evolving from shared computers have three main disadvantages:

— Starting costs are higher than with personal microcomputers. A minimum number of users is needed to justify a relatively large investment in central systems. (For instance, it is usually easier to justify a stand-alone word processor than a shared-logic word processor.)

— All the terminals on a mainframe or minicomputer system depend heavily on central facilities, and so all are vulnerable to any failure of the central machine.

— When mainframes and minicomputers become overloaded, the response degrades. In contrast, personal microcomputers do not suffer from this kind of problem.

The cost of a typical office system based on a mainframe or minicomputer currently ranges upwards from about $60,000.

These centrally based systems are aimed primarily at organisations wishing to set up comprehensive office automation systems, rather than organisations limiting their systems to individual application opportunities. Figure 8 describes an example of a minicomputer based system, while figure 9 describes an example of a mainframe based system.

Figure 8 Example of a minicomputer-based product

The Hewlett Packard 'Interactive Office System' is based on the HP3000 series of minicomputers, which can support up to 144 simultaneous users on one system. A variety of data terminals, text terminals, printers and plotters can be connected to the system in various combinations. For example:

— Word processing terminals and daisy wheel printers (for use by secretaries and typists).

— Small display terminals (for use by managers).

— Personal computers capable of local processing as well as sharing the resources of the minicomputer (for use by professionals).

— Monochrome or colour graphics terminals and plotters (for use by specialists).

A common operating system (MPE IV) is used by these systems. The software available includes:

— A database system (IMAGE/3000).

— A networking system (DSN).

— A document management system (text editing).

— A decision support system (management report generator and business graphics).

— A personal computing facility is provided by the HP125 personal computer. This product uses the CP/M operating system for local processing of data (which may be extracted from the mincomputer's files).

— An 'organisational communications' facility which consists of an electronic mail system and a graphics package (which is used to prepare slides for presentations).

— Application software for particular business functions such as accounting and personnel systems.

An 'Interactive Office System' with 30 to 40 users will currently cost about $200,000.

PRODUCTS EVOLVING FROM PERSONAL COMPUTERS

Most of the personal microcomputers sold today are operated as stand-alone devices. But many of the more recently announced products offer optional communication interfaces to the basic product. These interfaces enable the personal microcomputer to act as a terminal, communicating with other computer systems and terminals (including personal microcomputers) over the public telecommunication networks or local office networks.

The difference between these products and those described earlier in this chapter is only a matter of emphasis. Rather than emulating industry-standard computer terminals, personal microcomputers emphasise the local processing of data and text. The cheaper, smaller personal microcomputers often have limited display capabilities (they may be unable to cater for 80 x 24 character format) and the range of emulation packages available may be very limited (they may use videotex rather than IBM 3270 protocols, for example).

On the other hand, the range of software for personal microcomputers can be extensive, particularly for those products based on a widely used operating system such as CP/M. Indeed, the main criterion for choosing a microcomputer is often the availability of

Figure 9 Example of a mainframe-computer-based product

In this example we describe the current range of IBM office products. This product range has evolved from various separate products that were originally marketed by separate IBM divisions. We pay particular attention to the role of the mainframe computer, and its relationship with minicomputer-based products and terminal products.

IBM terminal-based office products include:

— The 'Displaywriter', which was originally a stand-alone word processor, but has recently been enhanced to act as a terminal to shared processors such as the IBM 8100 minicomputer and the IBM 5520 Administrative System.

— The IBM 8775 display terminal (a 3270 compatible terminal) which can act as a text and data terminal for the IBM 8100 minicomputer.

— The IBM 3278 and IBM 3279 display terminals which can be used as simple text editors (as well as data terminals) when connected to an IBM mainframe via an IBM 3274 control unit.

— The IBM Personal Computer which has limited communications capabilities at present. But it may be enhanced to act as an intelligent (user-programmable) office terminal.

IBM minicomputer-based office products include:

— The IBM 5520 Administrative System which is a shared-logic word processing system supporting up to 24 active connections at any one time.

— The IBM 8100 minicomputer running software called the 'Distributed Office Support Facility' (DOSF) which provides users with both shared-logic word processing and data processing facilities.

IBM mainframe-based office products include:

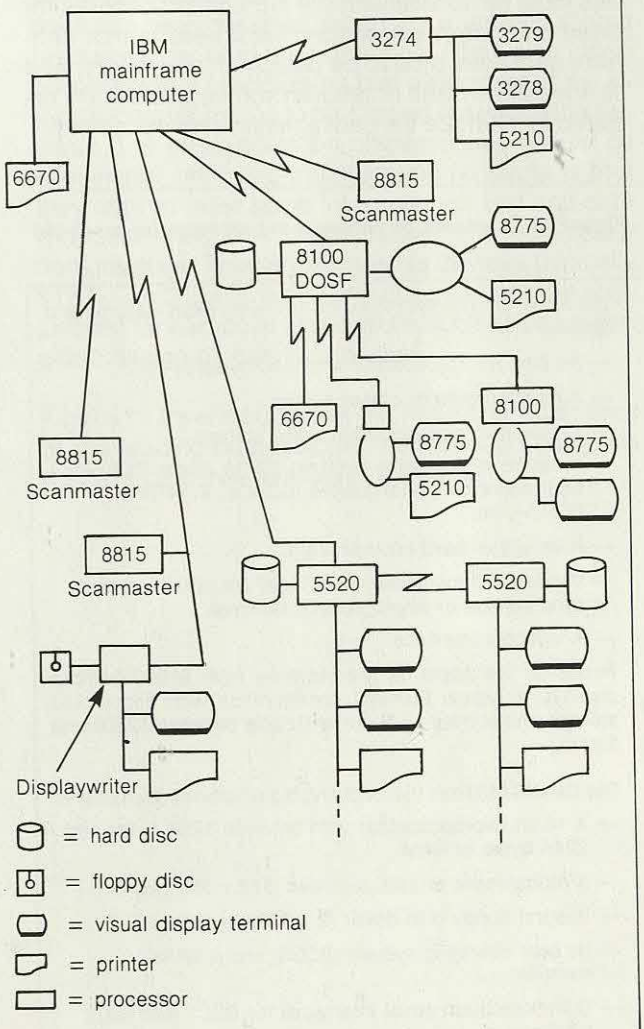
— The 'Distributed Office Support System' (DISOSS), which runs on IBM 370, 30XX and 43XX series computers. DISOSS provides an electronic system for the distribution and filing of documents across a multi-processor network. For example, documents may be created by a 5520 Administrative System, an 8100 (DOSF) system or a Displaywriter. They may then be transmitted to addresses on other IBM devices (5520 Displaywriters, 8100s etc.) via a DISOSS software routine running on an IBM mainframe computer. Also, documents may be filed by DISOSS and accessed by using DISOSS text search or by using more sophisticated retrieval software such as STAIRS (Storage And Information Retrieval Software).

— The 'Professional Office System' (PROFS), which is a software product aimed primarily at managers and professional staff. PROFS software runs under the VM operating system on any System/370 type computer. Standard visual display terminals (such as the 3278 and 3279) and standard printers (such as the 3280, 5210, 6640 and 6670) are used on the system. A single 43XX computer can support about 20 PROFS users — larger System/370 computers can support many more. PROFS facilities include time management (diary management, reminders), an electronic mail/intray system, document preparation, filing and retrieval. The terminals can also be used to access relevant computer files.

— The IBM 8815 'Scanmaster', which is a device that (together with an IBM mainframe computer using SNA/SDLC communication protocols) captures, stores and communicates digitised facsimile images. Physically the Scanmaster looks similar to a medium-sized photocopier. Documents are scanned by the machine, which digitises and compresses the images and then transmits them to an IBM mainframe computer. The digitised electronic images are either stored on discs (for future transmission) or transmitted directly to other Scanmaster units where the images are printed. Document identification, source and destination can be entered into the system on a control document or by using a keypad. Image documents can be stored and transmitted to various destinations by using DISOSS facilities running on the mainframe computer. (Alternatively, the Image Distribution System — IDS — is a PRPQ product which can be used for electronic image distribution in a CICS environment). The Scanmaster can be used also as a computer printer and as a photocopier.

— The 'Audio Distribution System' (ADS), which is a voice message system running on an IBM series 1 machine linked to an IBM telephone exchange (IBM — 1750 or IBM 3750). ADS provides a voice store-and-forward facility that at present is separate from IBM's mainframe computer products. It is probable, however, that ADS will be enhanced to interface with IBM's office systems, possibly using DISOSS as the central control facility.

An outline diagram showing possible communication links between the different IBM office products is given below:



application software, rather than hardware characteristics.

Current microcomputer products intended for the professional market are increasingly based on 16-bit processors rather than 8-bit processors. They generally contain their own back-up storage on floppy discs with an option to add 10 Mbyte hard Winchester discs for additional storage. Several terminals are often connected together, sharing the same Winchester disc, using a local area network developed specially for those terminals.

The main advantages to the user of personal microcomputers are the low cost of processing power, and the extensive software for office functions such as text editing, spread-sheet analysis, records file management, and graphics.

One common weakness of personal microcomputers is the absence of strong communications support within the product. (For example, users accessing mainframe computer or minicomputer-based data files must be familiar with the terminal procedures for these computers.) A second weakness is that software packages tend to be designed individually, and so specially written or tailored software is usually required to interface the packages on a microcomputer.

Figure 10 Examples of personal microcomputer products

The Apple IIE (Europlus) has the following main features and options:

— An 8-bit microprocessor with 64K bytes of RAM.

— A monochrome or colour screen.

— Floppy disc and winchester disc storage.

— A variety of operating systems (CP/M, Apple DOS, etc.) and programming languages (COBOL, FORTRAN, FORTH, etc.)

— A variety of hard copy printers.

— Various communication interfaces for operation as a synchronous or asynchronous terminal.

— A videotex interface.

Prices for the Apple IIE are currently from $1000 (without display). A typical terminal configuration with floppy disc storage and software will currently cost between $2500 and $3000.

The Olivetti M20 has the following main features and options:

— A 16-bit microprocessor with between 128K bytes and 224K bytes of RAM.

— A monchrome or colour screen (512 x 256 pixels).

— Integral floppy disc driver (2 x 320K bytes).

— Its own operating system (PCOS) and a BASIC compiler.

— Communication serial interfaces for BSC1 and BSC2 protocols.

Prices for the Olivetti M20 are currently from about $3000.

The main users of personal microcomputers in the business environment are professional staff who are able and willing to learn about the facilities that are provided. Accountants using financial planning and analysis packages are a case in point. In figure 10 we describe examples of personal microcomputer-based products.

Figure 11 Example of a local area network multifunction product

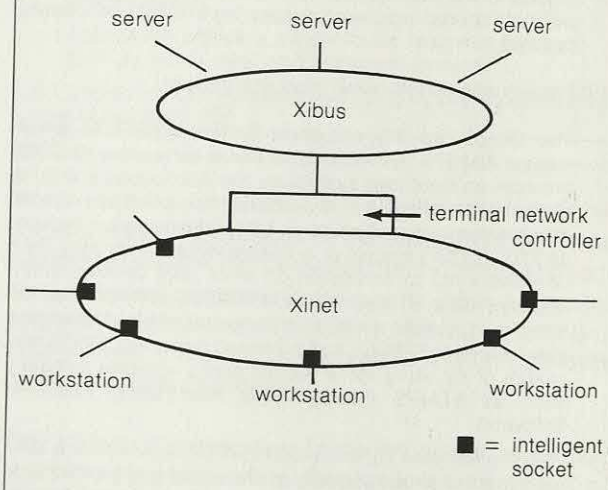
The Xionics local area network product consists of three main components:

— A 'Xibus' ring network which supports various specialised processors (servers) such as a file server, a network supervisor and a processor running software for text editing, information filing and retrieval, messaging, etc. 'Xibus' operates at a data rate of 10 Mbytes/sec.

— One or more 'Xinet' ring networks which provides intelligent sockets for local peripherals such as terminals and printers. 'Xinet' networks are connected to a 'Xibus' ring through a terminal network controller. 'Xinet' operates at a data rate of 1 Mbyte/sec.

— Intelligent workstations into which software required by the user is downloaded from 'Xibus' processors. The workstation has an optional printer interface. Workstation users can access 'Xibus' facilities and send messages to other workstations on the system.

The basic shapes of the Xibus/Xinet network is shown below:



Communication adaptors which can provide gateways to various computers, word processors, etc., are available. Up to 16 devices using up to four different communication protocols, can be attached in this way. Resilience to system failure may be increased by duplicating the rings and the processors. Micronodes that can operate as cluster controllers for small groups of terminals are under development.

Approximate prices for the Xionics system are:

— 'Xibus' from $25,000 (single ring) to $60,000 (duplicated ring).

— 'Xinet' intelligent sockets, from $700 each (single ring) to $1300 each (duplicated ring).

— Workstations, from $3000 each.

— Communication adaptors, $3500 each.

— Micronodes, from about $6000 (expected price).

PRODUCTS EVOLVING FROM LOCAL AREA NETWORKS

We mentioned above the connection of personal computers to local area networks (LANs). In a few cases, a local area network has formed the starting point for a similar configuration of intelligent terminals and shared resources. The capabilities of the resultant systems are very similar.

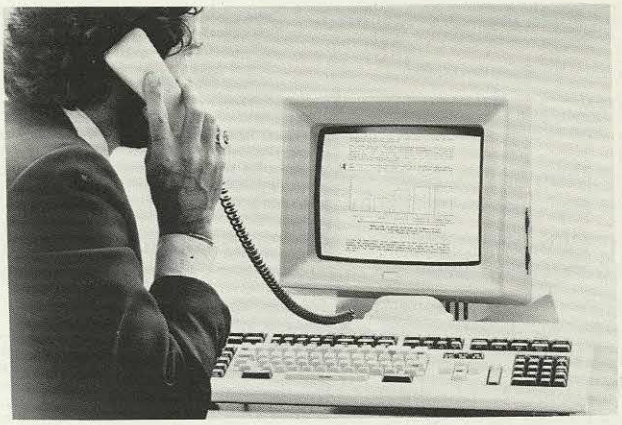
Multifunction products based on local area networks provide multifunctionality by giving the user access to a range of specialised processors (or servers) rather than concentrating all the processing in the terminal or in a central computer.

The main advantages of this approach are flexibility and capacity for growth. For example, processing units (such as file servers or electronic mail servers) may be added as the number of users and applications increase. In practice, however, this approach is limited currently by the absence of local area network standards, and the absence of low-cost LAN interfaces. An example of a multifunction product based on a local area network is outlined in figure 11.

SPECIFICALLY DESIGNED MULTIFUNCTION PRODUCTS

Over the last ten years a great deal of research effort has been concentrated on the design of terminals intended for general purpose multifunction office use. Because these terminals are for use by non-specialist staff, designers have tended to concentrate on the ergonomic aspects of both hardware and software design. The trend is illustrated by high-resolution visual display units, symbol commands on the screen, and alternatives to keyboards for information input.

Figure 12 A multifunction workstation: the OTL I.M.P.



An example of a multifunction workstation is shown in figure 12.

These terminals all have communications interfaces that allow them to access shared processors or shared computer files, and in nearly every case they have also been designed to communicate with shared resources via local area networks. They also incorporate powerful processors that allow most of the information processing to be carried out within the terminal. The other common characteristic shared by specifically designed multifunction products is that they offer at least some integration of text and data with other media — images, speech or high resolution graphics. They are expensive devices (typically $15,000 to $50,000 each) and often can only be cost-justified for particular applications such as computer-aided design or graphics design.

Figure 13 *(overleaf)* shows the main characteristics of the leading purpose-built multifunction terminals that are currently available in Europe.

Figure 13 Examples of purpose-built multifunction terminals

	Characteristics			
Supplier/Model	*Hardware*	*Software*	*Communications*	*Approx. price per workstation*
Convergent Technologies AWS/IWS	Keyboard Function keys 38cm diagonal display 34 rows by 80/132 columns 10 x 15 pixels/character soft character fonts multi-window 16-bit processor 128K-1M byte RAM Stand alone and 1-16 terminal cluster .5M byte floppy discs 5 to 32M byte hard disc	10 soft function keys Menu CTOS operating system Multi-tasking COBOL/FORTRAN/ BASIC/PASCAL Text editing Program development tools Business graphics Information storage/retrieval	Async/Sync to 19.2K bit/s IBM 3270/2780/3780 X.25/HDLC	$10,000
Office Technology Ltd I.M.P.	Keyboard Function keys Speech 38cm diagonal display 36 rows by up to 163 columns 9 x 16 pixels/character two 128 character set fonts 16-bit processor 128K bytes RAM Controller + 1 to 32 terminal cluster 80-640M bytes (approx. 10M byte/user)	Menu Text editing Electronic mail Diary Information storage/retrieval Voice annotation of documents	Async/Sync to 19.2K bit/s High speed controller to controller	$12,000
Apple Lisa	Keyboard Mouse/cursor/icons 30cm diagonal display 720 x 364 pixel bit plane 16-bit processor 1M byte RAM Stand-alone or network 1.5M byte floppy discs 5M byte hard disc	Soft function keys Multi-window Multi-tasking BASIC/COBOL/PASCAL Text editing Electronic mail Graphics Information storage/retrieval Spreadsheet analysis Project management	Async/Sync IBM 3270/DEC VT100/TTY (LAN being developed)	$12,000
Xerox 8011/8012 Star	Keyboard 24 function keys Mouse/cursor/icons 38cm diagonal display 1024 x 809 pixel bit plane Up to 8 character set fonts 16-bit processor 92K bytes RAM Stand alone and network of terminals/servers 1.2M byte floppy discs 8-23M byte hard disc	Icons Text editing Electronic mail Graphics Information storage/retrieval	Async/Sync IBM 3270/TTY Ethernet LAN	$15,000 to $20,000
Apollo Domain 400/420/600	Keyboard Function keys 38cm or 48cm diagonal display 1024 x 800 pixel bit plane or 1024 x 1024 pixel bit plane Colour option 32-bit processor .5 to 3.5M bytes RAM Stand alone or network 1.2M byte floppy discs 33-66M byte hard disc	Soft function keys Menu Multi-window Multi-tasking AEGIS operating system FORTRAN/PASCAL/C Text editing Program development tools Sophisticated graphics Information storage/retrieval	Async/Sync to 19.2K bit/s IBM 3270/HASP/TTY Apollo Domain token ring LAN (12M bit/s)	$15,000
Wang Alliance	Keyboard Speech Image promised 28cm diagonal display 16-bit processor 64K bytes RAM (+128K in controller) 1 to 32 terminals + controller 1M byte floppy discs 80-1100M byte hard disc	Menu Soft function keys CP/M operating system BASIC Text editing Electronic mail Diary/time management Information storage/retrieval Store and forward voice	Async/Sync IBM 3270/2780/3780/ 2741/TTY Wangnet/WISE LAN	$15,000 to $20,000
Three Rivers Perq	Keyboard Function keys Tablet (cursor control + buttons) 35cm diagonal display 1024 x 768 pixel bit plane Speech 16-bit processor .5-1M byte RAM Stand alone or network 1M byte floppy discs 24M byte hard disc	Multi-window Unix operating system PASCAL/FORTRAN/C Sophisticated graphics Information storage/retrieval	Async/Sync to 9.6K bit/s Interfaces to Ethernet and Cambridge Ring LANS	$30,000 +

CHAPTER 4

USER EXPERIENCE WITH MULTIFUNCTION APPLICATIONS

In this chapter we present five case histories that describe the application of multifunction products in user organisations. At present there are very few organisations with extensive experience of multifunction products — most users have not progressed beyond a pilot or experimental stage. Nevertheless, there are lessons to be learnt from their experiences to date.

The case histories illustrate five different approaches to multifunction installations:

—The use of data terminals as multifunction devices.

—The use of microcomputer systems.

—The use of a mainframe computer system.

—The use of a local area network system.

—The planned use of self-contained multifunction workstations.

At the end of the chapter, we draw some general conclusions based on these case histories and on the experiences of other organisations that we have investigated.

CASE HISTORY A — THE USE OF DATA TERMINALS AS MULTIFUNCTION DEVICES

This case history describes two applications where specially developed multifunction data terminals were installed to meet specific requirements.

Company A is a merchant bank that has considerable experience of mainframe and minicomputer systems. Two departments in this bank have replaced data terminals with intelligent terminals to perform multifunction tasks.

Following an internal reorganisation the first department (which had been responsible for various banking transactions) was given additional responsibilities for insurance transactions. These transactions involved a considerable amount of textual work which could not be handled conveniently by existing data terminals. The department therefore faced a choice between separate terminals (with separate operators) and multifunction terminals. It chose to adopt a multifunction terminal solution; separate terminals would have been more costly and (with separate operators) less flexible.

In the second department, the need was to provide foreign exchange dealers with terminals they would use in two ways. First, for online access to a variety of different information sources (external services such as Reuters Money Dealing Service and A.P. Dow Jones, as well as an internal information service). Second, to enter data into the internal data processing system. In this environment, the main benefits of using multifunction terminals rather than data terminals were that dealers could retrieve information and process exchange transactions more quickly. This was an important business advantage in the foreign exchange market.

To meet the requirements of the two departments the bank agreed on the need for two different types of terminal. Both terminals were specially built to the bank's specification because the requirements could not be met by commercially available products.

For the banking and insurance function, the visual display terminals incorporated a Z80 microprocessor and RAM to give the operators a local text editing function. Clerks using these banking/insurance terminals could generate the special clauses and descriptive items needed in an insurance policy. The terminals were connected to the bank's mainframe computer in a star network so that completed transactions could be entered into the main business systems. In some cases, the transactions resulted in telex messages being generated automatically by the mainframe computer.

The foreign exchange dealer terminals consisted of two display screens and a keyboard linked to a local microprocessor. The microprocessor allowed users to switch between the different information services by entering commands through the keyboard; it also provided a calculation facility for foreign exchange negotiations.

The hardware for each banking/insurance terminal cost about $2,000 each. Software development costs totalled about $25,000 for the system. The foreign exchange dealer terminals cost about $5,000 each. To date 30 banking/insurance terminals and 35 foreign exchange dealer terminals have been installed.

Both the clerks and the foreign exchange dealers needed more training on multifunction terminals than they had needed previously on data terminals.

The banking/insurance terminals may be enhanced in the near future to provide an electronic mail system for internal use, and to connect users to the public teletex service.

The foreign exchange dealer terminals also may be enhanced to provide colour displays and connection to the United Kingdom Stock Exchange's private videotex service (Topic).

CASE HISTORY B — THE USE OF MICROCOMPUTER SYSTEMS

This case history describes the replacement of an existing data terminal system by a multifunction system based on a microcomputer.

Company B is a multinational automobile manufacturer. The company makes extensive use of IBM mainframe computers for data processing.

The company has encouraged its dealers to purchase Olivetti M20 microcomputers for ordering cars and spare parts. By the end of 1982, ten dealers had replaced their existing data terminals with Olivetti microcomputers able to communicate with the company's IBM mainframe computers.

For placing orders, the Olivetti multifunction system has two main advantages over the previous data terminals system:

—It provides local intelligence to assist with order entry, and it speeds up the daily transfer of data to the company's IBM computers. (Dealer information is transmitted each night for processing.)

—It provides processing facilities for use by dealers themselves — a strong incentive for dealers to purchase the equipment in the first place. (An accounting system is planned for late 1983.)

The company also hopes that the system will increase its share of the market by making it easier for dealers to place orders with it rather than with its competitors.

The Olivetti microcomputer was chosen because of its competitive price (about $5,000) and storage capacity. Company B spent about 18 months specifying and developing communication protocols to link the Olivetti microcomputer with its IBM mainframe computer. Olivetti subcontracted the communication software work to a software house which, in turn, subcontracted the work to a third company. There was an eight month delay in obtaining the communication software.

The dealers, however, have found the Olivetti system easy to use and there have been few difficulties in persuading them to adopt it. Little training was required because the dealers were already familiar with previous data terminal systems. In practice, the data entry time has been significantly reduced using the new system (to half an hour per day) and the daily transmission to the IBM mainframe computer now takes 30 seconds compared with 45 minutes using the old system. The company plans to develop the system to provide additional facilities for dealers. It also intends to increase the number of dealers using the system.

CASE HISTORY C — THE USE OF A MAINFRAME COMPUTER SYSTEM

This case history highlights how pilot projects based on recently developed multifunction products for use by senior managers can run into a variety of difficulties.

Company C is a large manufacturing and distribution organisation. It is a large user of IBM mainframe computers for conventional data processing applications.

In 1980 one of the operating divisions of the company launched a programme to improve its managerial efficiency. One goal was to reduce the number of management levels and to increase the average span of management control. An improvement in office procedures was seen as an important part of this exercise.

At that time no office automation system was available that could clearly improve managerial effectiveness. The company did not carry out a formal feasibility study. Instead, it set up a pilot trial with a very broad objective — to move towards a paperless office for managers and secretaries.

It selected IBM as the supplier because it was familiar with IBM, and because it anticipated a need for compatibility between office systems and its existing IBM SNA network. It recognised the pioneering nature of the pilot study and restricted the applications to data and text systems only.

IBM's recommendation was that the pilot trial should be implemented on the then recently announced DISOSS and DOSF systems on existing mainframes and a number of 8100 minicomputers. (See chapter 3 for descriptions of DISOSS and DOSF.)

These products provided a number of 'office tools' for managers in finance, sales, and central management services. The main office tools were:

—Text editing.

—Electronic filing/retrieval of information.

—Electronic messaging (mailbox, intrays).

—Access to data held in mainframe files and the ability to incorporate this data into office system documents. (This facility was provided by software developed by the company.)

A trial installation was planned with 57 terminals and three IBM 8100 machines connected to the SNA network. The terminals selected were a mixture of IBM 8775 display terminals for managers and IBM 3732 text terminals for secretaries.

The pilot trial was started in the autumn of 1981 with staff training sessions scheduled for November. At that point, it became clear that the system had some serious deficiencies. For example:

—The procedural language used on the 8100s resulted in long response times.

—There were inconsistencies within the system. For example, the commands used in DOSF and DISOSS were inconsistent.

—There was no facility to refer to users by name. It was not easy to use the system directories relating name and document identifiers. (Users had to keep their own pencil and paper directories.)

—The 8775 terminals could not be used to amend text as they did not have the IDTF facility.

As a result, company C re-appraised the office system products on the market. Again, none of the products available matched the company's requirements, and the products then being developed by other suppliers would not be available quickly enough. IBM offered to implement the improved DISOSS II, which incorporated some of the changes requested by the company; and also made some of the IDTF versions of the 8775 terminal available in advance of their general release. The company decided to upgrade the products as suggested by IBM.

The new release of DISOSS was able to identify staff by name. An 'intray' facility that allowed users to index, delete or modify documents and send them to other users was also available as part of the standard product.

Training recommenced on the new system in November 1982. In the meantime, however, the mix of users had changed. The sales staff had largely opted out of the pilot trial since the system least suited their needs. (Field sales managers were used to a full secretarial service handling their mail and other documents during the day. They were provided with a 'processed' package of information when they briefly called in the office at the end of each day.)

Within two months of re-starting the trial using DISOSS II, the main sponsoring user decided that the expected benefits could not be achieved with the system and withdrew from the trial.

When we interviewed this company, the outcome of its trial was uncertain, although some facilities will probably be retained:

—One or more of the 8100s will be retained to provide a word processing system.

—Some financial analysts will continue to use terminals for personal computing on the IBM mainframes.

—A few directors and managers will also continue to use terminals linked to the mainframe for specific applications.

The management services department recognised that it had encountered problems in using recently developed products and that adverse user reaction had limited the scope of the pilot trial. And although they believe that the IBM approach follows the right strategic route, they consider that price and performance levels need to be improved.

CASE HISTORY D — THE USE OF A LOCAL AREA NETWORK SYSTEM

This case history describes a large trial of multifunction terminals used by managers, professionals and their support staff. The multifunction terminals are based on a local area network.

Company D is a division of a large process manufacturing organisation. Its data processing systems are based on IBM, DEC and Prime computers. It also makes extensive use of word processors (mainly Vydec and Wordplex) and personal computers (mainly Commodore and Apple). The company has a private data network (giving asynchronous terminal users access to different computers via a data switch) and several IBM SNA networks.

Company D has been actively investigating the use of office systems over the past four years. The priority requirements identified for office systems were:

—To support managers and professionals who might need access to different computers for commercial data processing applications, financial modelling work and text editing.

—To provide these facilities in such a way that information could easily be shared by users via an electronic messaging/mail system.

The company recognised that these requirements could be met in one of two ways:

—Either, each user could be provided with the appropriate number of single-function terminal products.

—Or, each user could be provided with a multifunction product capable of meeting his requirements.

The single-function terminal approach was rejected on the grounds of excessive cost and space requirements. Instead, the company chose to adopt a multifunction terminal approach.

In 1979, when this decision was taken, suitable multifunction terminals were not available. So the company chose a local area network (LAN) for inter-connecting terminals and providing access to a range of facilities, including flexible access to different computers. The Xionics Xinet (described on page 18) was the product that came closest to matching the requirements with a high level of reliability. Since 1980 company D has worked closely with Xionics to develop the facilities required.

The system was developed to provide managers, professionals and secretaries with easy and economic computing and word processing. A further attraction was that electronic mail, messaging, telex and personal computing were also provided as integrated facilities.

One particular business area was chosen for the first installation. This area consisted of some 70 managers, professionals, clerks and secretaries, nearly all of whom were on one site. About 50 Xionics workstations have been installed. The facilities provided include:

—Access to a local DEC 10 computer via a Gandalf data switch.

—Access to remote IBM 3081 machines via leased lines using 3270 protocol emulation.

—Personal computing (CP/M compatible).

—Private diary and information filing for each user.

—Word processing (and links to Vydec word processors).

—The ability to receive and generate telexes that can be communicated via a telex message switch.

The company invested a great deal of effort both in specifying the requirements of the system prior to installation and in training the users. The specifications were generated by working parties comprising both systems staff and users who were familiar with current office practices.

The training of new users included initial awareness training using informal seminars (and video films) for small groups of about six people. Individual detailed training lasted about ten hours on average but varied between one hour and 35 hours depending on individual needs. Follow-up training was also provided to resolve any problems encountered by users.

The company has identified the following benefits from its use of the system:

—A much easier interface to its existing computer systems. (For example, before the multifunction system was installed, DEC computer users would first go through a sign-on dialogue with the data switch, then through a second dialogue with the computer before logging on. Now users need only press two function keys on the multifunction terminal to achieve the same result.)

—Savings in the time needed to prepare simple internal memos. (Despite the fact that managers do not have to learn to type to use the system, some have taken to typing their own short memos.)

—Telexes are generated and sent more quickly. And outgoing telexes now contain fewer errors — about 1 per cent of telexes have errors now, compared with 10 per cent previously. Now, managers see incoming telexes when they arrive rather than having to wait for the internal messenger.

—Some important documents are now produced earlier than before. (The annual marketing reports are produced three months earlier than in previous years.) And the electronic version can easily be kept up to date.

—Managers save time, estimated at between one half hour every two weeks and about 15 weeks per year.

—The company is able to respond more quickly to urgent demands.

Company D has found it difficult to cost-justify the investment of about $500,000 on the system because it has been difficult to gain a complete and accurate picture of the total benefits. Nevertheless, users have generally regarded the new system as a success. The cost of each terminal is about $9,000 including all the necessary shared resources and furniture. (The terminals themselves cost about $3,000.) Future enhancements will include the addition of videotex communication.

CASE HISTORY E — THE PLANNED USE OF SELF-CONTAINED MULTIFUNCTION WORKSTATIONS

This case history concerns one of the few organisations that is planning the widespread introduction of multifunction workstations, rather than just carrying out limited pilot trials.

Company E is a large bank with some 2,000 branches.

Its existing data processing systems support some 4,000 terminals based on IBM, Logabax and CII-Honeywell Bull machines.

The main impetus toward the use of multifunction workstations derives from a special study that was started in 1979 to report on how data processing systems should be developed to cater for branch automation. (Existing equipment in the branches was nearing the end of its useful life.) The study identified the need to meet a range of branch requirements without introducing a variety of different devices.

The study has led to the specification of a new computing and communications infrastructure consisting of a main computing centre, a number of intermediate computer centres, and multifunction terminals in the branches.

At first, the main applications in the branches will be the consolidation and monitoring of loan files, other data processing applications, and general office applications such as word processing. Online transaction processing, electronic messaging and personal computing will be added later.

The plan is for about 1,000 terminals to be installed in the first phase. This number will grow to about 12,000 terminals over the seven year period 1983-1989.

To avoid dependence on a single supplier, the bank plans to select three different suppliers. The first two products have been selected — the Philips PTS 6000 and the Thomson Corail-B 4000 (this is the same product as the Convergent Technology workstation referred to in figure 13, chapter 3).

Invitations to tender were issued in March 1982 with the first terminals due for installation in mid 1983. The terminal suppliers are responsible for providing all the communications interfacing in the terminals. (Thomson has added word processing to its software.)

Training will be provided by special sections set up within each group, and will be carried out by the bank's own staff, who will be trained initially by the terminal suppliers.

The problems encountered have mainly involved negotiations with suppliers and the development of communication interfaces.

The new system has been cost-justified by replacing obsolescent equipment and by meeting new user requirements. Benefits are also expected from better business management (more independence by the branches, a higher quality of work, less time spent on administrative work, etc.).

LESSONS LEARNT FROM USER EXPERIENCE

Some general lessons can be learnt both from these case histories and from the other users and suppliers we interviewed during our research.

There are three principal reasons for slow growth in the use of multifunction products for office work:

— Difficulties in establishing firm cost-justification.

— The high cost of multifunction products ($10,000 + per user).

— The lack of maturity of multifunction products.

The most common applications of multifunction terminals arise where users already have a need for more than one single-function terminal. (For instance, for data processing on different computers, and for word processing.)

In this environment, the primary justification for multifunction products is to overcome the problems of space and inconvenience associated with multiple single-function terminals. Cost savings, if they exist, are of secondary importance.

We believe that suppliers have tended to design terminals with more functions than most users really need. So multifunction terminals are often unnecessarily expensive. While nearly all the organisations we interviewed did not believe that they should install multifunction products as a blind act of faith, most organisations had only a very broad, long term, economic justification for their proposed multifunction installations.

In practice, many multifunction products have been implemented as pilot trials in co-operation with suppliers. The underlying reason for such experimentation is often a recognition of the increasing cost of office staff — particularly managers and professionals — and the falling cost of electronics. But one lesson from the users' experience to date is that it is not sufficient to implement a system providing a general set of office tools and hope that users will gain benefits from them — the results are almost always disappointing.

In contrast, serious attention should be given to investigating the requirements (and current practices) in an office prior to deciding which particular tools are appropriate to those users.

Most of the organisations we interviewed that had analysed their requirements found that current products did not offer a close match to their particular needs. Most users had written special software to carry out the particular functions they required. Office system suppliers have often developed products that

do not meet criteria that are vital to product acceptance. For example, much effort has been expended on the ergonomics of terminal design. Much less effort has been given to ensuring that the products fulfil real user needs.

No evidence emerged from our research that multifunctionality is better provided by a multifunction workstation than by a multifunction system.

Until both users and suppliers gain a better understanding of office automation, approaches that allow flexibility and a low cost entry level will be preferable to approaches that restrict choice and demand a high initial investment.

Users of multifunction products must invest in a significant level of training. End-user involvement should start during the initial stages of system selection and design — not just during post-implementation training sessions. The more radical the change in jobs and procedures, the greater the need for user involvement and education.

Although user organisations may find it difficult to cost-justify every multifunction installation, they should, nevertheless, specify clear objectives and establish mechanisms to monitor the effects of change. During our research we were surprised to find that most pilot trials gave very little attention to these key areas.

CHAPTER 5

TRENDS IN THE USE AND DEVELOPMENT OF MULTIFUNCTION PRODUCTS

In chapter 3 we discussed the wide spectrum of products able to provide office workers with multifunction facilities. The long term trend toward higher staff costs and lower office equipment costs will increasingly encourage the use of multifunction products in the office. But the current position is one of supplier push rather than market pull. The variety of products confuses potential users, increasing the difficulty of making a rational choice. All too often, none of the products is exactly right.

In this chapter we try to predict how this mismatch between products and needs will be resolved, and we discuss the likely evolutionary paths that suppliers and users will follow. First, we examine trends in the use of multifunction products. Then we look at supplier strategies, and suggest the ways in which multifunction products will evolve.

TRENDS IN THE USE OF MULTIFUNCTION PRODUCTS

Some large organisations will continue to carry out pilot trials of sophisticated office systems — using multifunction workstations and local area network systems or minicomputer-based systems. This approach will be widespread in the early stages of market development when suppliers try to establish a position in the market. Suppliers often treat initial sales as part of the product development exercise, particularly if generous government support is available for funding pilot trials. But we do not believe that the experience of these pilot trials will encourage the pioneers to move quickly to install similar systems on a large scale — the costs will be too high and the benefits too intangible.

A few organisations will take a long term view of the 'office of the future' in the context of their long term business strategy, to establish the communications infrastructure that will be required to support complex interrelated office systems (see Foundation Report No. 29 — Implementing Office Systems). But many organisations will tend to react to more immediate pressures.

We see the introduction of multifunction systems being driven by two main factors:

— User demand for multifunctionality. This demand will often be limited to a narrow range of functions and specific applications — general purpose office tools often provide only partial solutions. The exceptions will be very specific applications, such as computer-aided design or the preparation of high quality printed documents incorporating graphics. Here, the more sophisticated purpose-built system will be justified by increased productivity.

— The fall in price of personal computers. Personal computers form a very low-cost equipment base that can be adapted to meet the needs of individual users. For this reason we expect personal computers to become widely used as multifunction devices. The entry of the IBM Personal Computer will also tend to make the use of the personal computer respectable in business.

Additional functions will increasingly be added to multifunction products at marginal cost. This trend will apply to simple personal computers as well as to more sophisticated multifunction products.

In the immediate future we see the predominant needs of the marketplace to be for fairly simple multifunction products that have the flexibility for growth and enhancement as the users gain experience.

SUPPLIER STRATEGIES AND PRODUCT EVOLUTION

The suppliers of multifunction office products have a variety of different backgrounds that are reflected in their products. Leading suppliers of multifunction products include:

— Computer manufacturers (mainframe and minicomputers).

— Terminal manufacturers (data/graphics).

— Office terminal manufacturers (text).

— Personal computer manufacturers.

— Telecommunication equipment manufacturers (PABX and telephone).

— Local area network manufacturers.

The first four of these are the most important sources of multifunction products.

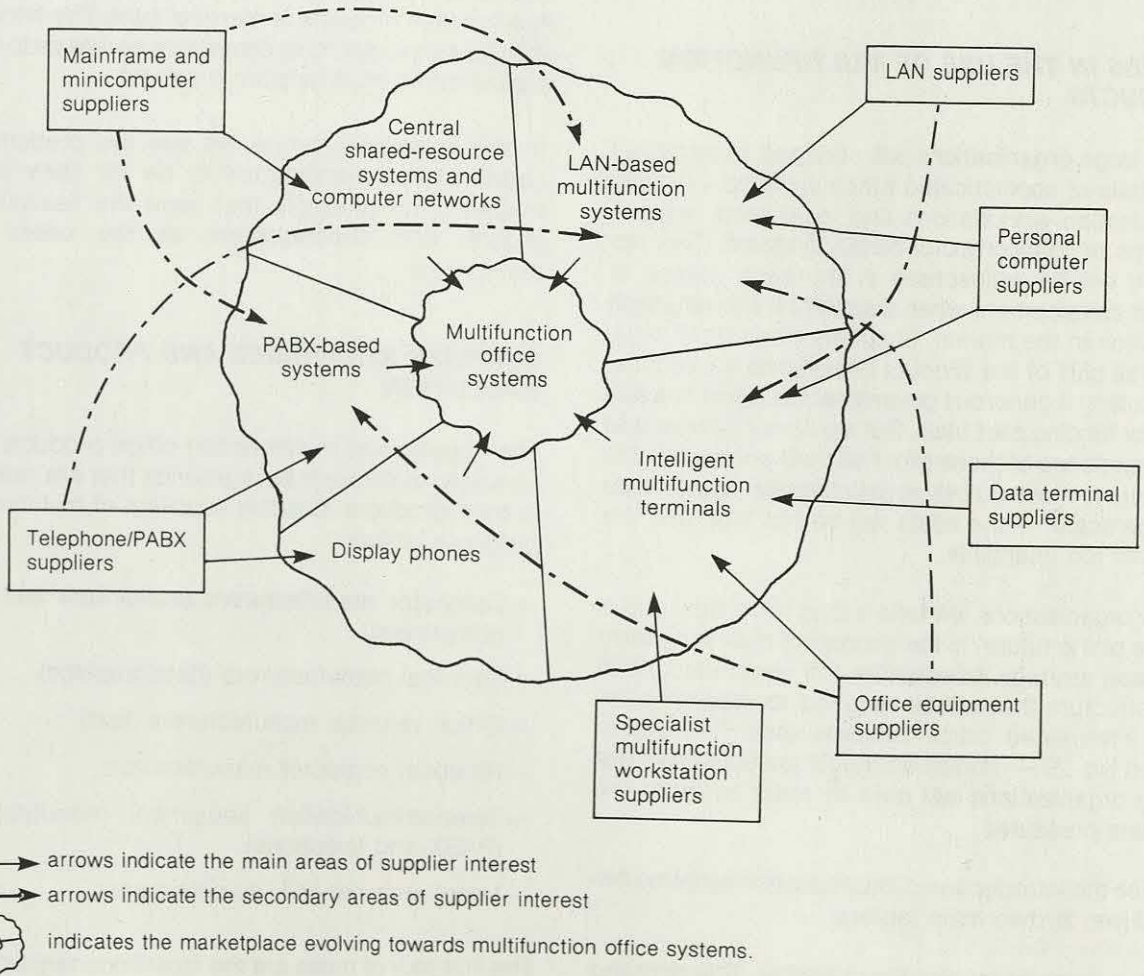
Most of the suppliers already have an established customer base for their existing products, and so have a clear incentive to build their new multifunction products business on that base. Suppliers often try to 'push' existing customers to adopt the kind of office system that suits their product line. For example, traditional computer suppliers often recommend multifunctionality based on a shared processor and unintelligent terminals; telecommunication suppliers recommend terminals based on a central data-switching PABX; and personal computer suppliers recommend intelligent terminals as a key element in a multifunction system.

Figure 14 illustrates the different supplier strategies and the types of multifunction product that result from these strategies.

These strategies are clearly evident in the continual stream of new product announcements from suppliers in the 'convergence' industries illustrated in figure 14. In practice, the distinctions between multifunction products are not as clearly defined as the figure might suggest. For example, all the major computer suppliers have at last recognised the importance of the personal microcomputer — the distribution of intelligence in computer networks will not stop at the minicomputer level. A key factor in the rapid growth of the personal computer market has been the very low costs involved. This has been achieved because of the economies of scale made possible by supplying a large home (entertainment) market. Many families now have a multifunction terminal (entertainment, accounting, educational) in their home, although few people yet have these facilities in their office.

As the business personal computer market grows, it will inevitably force down the price of other competing devices. A $500 microcomputer with $100 of software and a $1,500 printer can offer most of the functions of a word processor currently costing perhaps three times as much. Admittedly, the graphic facilities provided by a personal computer are not up to the quality standards of some purpose designed office products. But, given the stimulation of the market by low-cost

Figure 14 Multifunction product supplier strategies



hobbyist products, even the prices of professional workstations will fall. And, as prices fall, suppliers of conventional data processing systems will find it increasingly hard to control their traditional user base (except for user organisations having a strong centrally controlled management services group able to prevent the spread of low-cost personal computers).

Personal computer terminals can also become part of an office system based on a local area network. Users of personal computers can migrate from standalone terminals to a linked network of terminals, each able to operate independently, and each able to access more expensive items of equipment such as high quality printers or common file storage units. (For example, a Nestar network for Apple computers.) This particular aspect of local area network development is covered more fully in Foundation Report No. 38 — Selecting Local Network Facilities.

Looking to the future, we do not believe that any one particular means of providing multifunctionality will be adopted universally. But we do believe that it is possible to distinguish a common set of features that will result from the evolution paths being followed by the different multifunction product suppliers:

— Each user will have processing power immediately available at the terminal. Commonly used application software will be permanently resident in the terminal; less frequently used software will be quickly downloaded from a common store when required.

— Each terminal will be able to communicate with other terminals within the office, on the same site, or at remote locations. Local network facilities, wide area private networks and public networks of different types will all be used.

— Each terminal will have access to shared resources such as powerful processors, large files and quality printers. Local networks will have a key role in such systems.

— The design of the terminal, and its capabilities, will differ according to the needs of the individual. These needs will depend on the type of user (manager, engineer, secretary, etc.) and on the type of office work performed.

Recent research carried out by Butler Cox suggests the emergence of six distinct families of products, each with its own particular terminal options. The main characteristics of the six families, and their areas of application are shown in figure 15.

These product families are systems rather than individual terminals. They consist of terminals and other units linked by a local network that will be based either on a data-switching PABX or a local area network.

Figure 15 Multifunction office systems in the future

	System capabilities								
Type of system	Intelligence	Data	Text	Voice	Graphics	Image	Handprint	*Typical application*	**Typical cost per terminal in 1983*
Office Videotex System (OVS)		✓	✓		●			Sales orders from customers, field sales staff links	$6,000
Data Workstation Network (DWN)	✓	✓	✓		●			Professional and WP/DP related applications	$12,000
Integrated Workstation Network (IWN)	✓	✓	✓	✓	✓	●		Professional, DP related and specialised applications	$50,000
**Pseudo Paper System (PPS)	✓	✓	✓		✓	✓		Large paper files requiring facsimile images	$40,000
**Message Pad System (MPS)	✓	✓	✓		●		✓	Text and image communications (principals and secretaries)	$14,000
Display Phone Switch (DPS)		✓	✓	✓				Voice communications plus data/text retrieval for principals and support staff	$2,000

✓ = primary feature

● = secondary feature

*These costs are likely to fall rapidly over the next 5 years.

**These systems will not be extensively used over the next 5 years compared with the other types of system shown in the table.

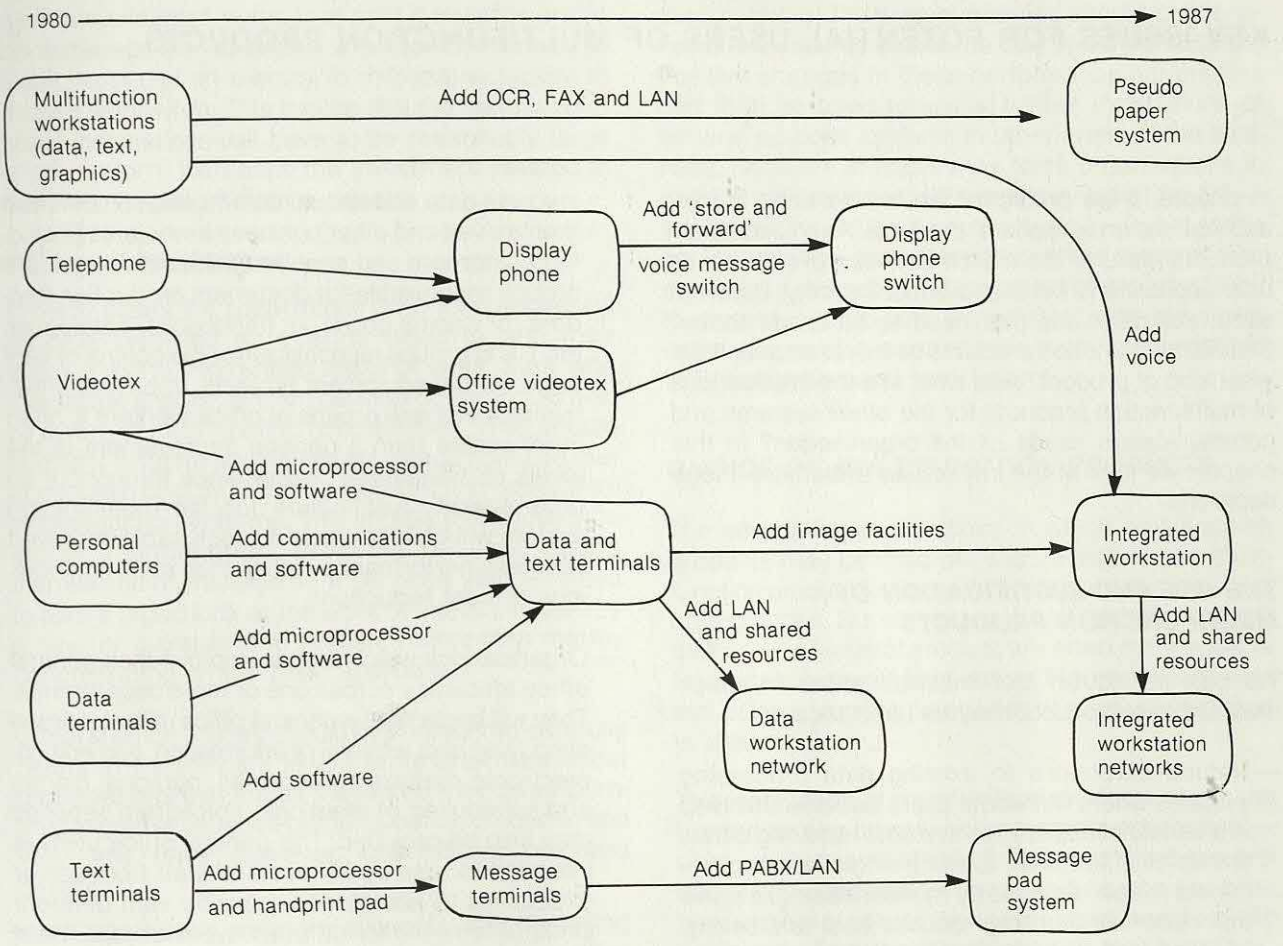
The main terminal options within each family are listed in figure 16. The way that existing products will evolve toward these six families is shown in figure 17.

In the next five years, the Data Workstation Network approach will be the most commonly implemented type of system. As users and organisations become more familiar with their capabilities, they will progress to the Integrated Workstation Network.

Figure 16 Typical product options within each office system family

Type of system	*Products*	*Options*
Office videotex system	1. TV based terminal 2. Purpose-built office terminal 3. Shared computer	 A colour display Communication gateways to public services
Data workstation networks	1. A workstation 2. A local area network 3. File servers 4. Print servers 5. A mailbox facility 6. Communication gateways and modems 7. OCR	 PSTN PSS ISDN Teletex SNA
Integrated workstation networks	1. Workstation 2. Voicegram switch 3. Other facilities as per data workstation networks	Colour display Printer Floppy discs Hard discs As per data workstation networks
Pseudo paper systems	1. Workstations (including scanners) 2. On-line storage system 3. Archive storage system 4. OCR 5. Communication gateways	 10M byte - 100M byte 1000M byte - 10,000M byte PSTN Telex/teletex
Message pad systems	1. Workstation 2. Shared processor 3. Electronic file 4. OCR	 Display Printer Office functions software Calculator/programming software Transaction processing software 10M byte - 100M byte
Display phone switch	1. Feature phone 2. Display phone 3. Communication gateways 4. Voicegram switch 5. Electronic mailbox 6. Shared processor 7. Telephone answering support	 Data channel Different screen sizes and keyboards PSS Data networks

Figure 17 Evolution paths for multifunction terminals



CHAPTER 6

KEY ISSUES FOR POTENTIAL USERS OF MULTIFUNCTION PRODUCTS

In chapter 5 we predicted the main trends in user applications and suppliers' products. As multifunction products mature, the match between products and user applications will improve significantly. But what about the decisions that need to be made today? Should multifunction products be installed and, if so, what kind of product? And what are the implications of multifunction products for the other systems and communication needs of the organisation? In this chapter we look at the key issues underlying these decisions.

THE USE AND JUSTIFICATION OF MULTIFUNCTION PRODUCTS

We can distinguish four main situations in which multifunction products may be used today:

- —Natural extensions to existing data processing systems where individual users become involved in a variety of application systems requiring different terminal features. Existing single-function terminals will be replaced by multifunction ones, the main justification being reduced cost and saving in office and desk space. Situations where this replacement is likely to occur include cases where users need to access both accounting data and technical information held on different computers, and where users need to incorporate computer-held data within text documents. The additional functions may be added over a period of time.
- —Specific new applications for individual users who, for example, need to access data or computer systems, manipulate the data, and incorporate it in various documents. Typically, the user will be a professional — either administrative or technical. The distinction between this situation and the one described above is that the requirement is very often identified by the user himself, rather than by management services staff. The terminal may not result in staff savings, but will enable reports and management control information to be generated more quickly and may result in improved business performance. Provided the cost of the terminal is low enough ($1,500, say), expensive professional staff may not need to provide firm cost-justifications.
- —Very specific applications where groups of office workers (not necessarily in the same department) have a common, well-defined purpose which involves data and textual communication between themselves and other business associates (including customers and suppliers). Two examples are groups responsible for document production (tenders for capital goods, or handbooks, catalogues etc.), and groups responsible for the control of very large capital equipment projects. Improved effectiveness in these groups of office workers is often more visible than a general improvement in the levels of managerial performance throughout an organisation. Justification for the multifunction system will be in terms of a measurably improved business performance rather than staff time savings or cost reductions.
- —Organisations which wish to improve their general office efficiency across one or more departments. They will implement a general office utility incorporating filing and retrieval of information, text editing, electronic messaging and mail, personal diaries and scheduling of meetings. Voicegram services may also be provided. The general office utility is intended for use by all levels of staff from senior executives to secretaries, possibly with different kinds of terminal for different types of job. There is usually no clear short-term necessity to introduce multifunction products. In the longer term, however, an investment in office automation may have to be made to minimise the effects of rising administrative staff costs. As the proportion of staff employed in the 'office worker' sector of the company increases, pressures will grow to replace staff by office equipment.

A theoretical calculation of benefits may be based on nominal savings in the time of principals and secretaries, although these savings will not generally be realised without a substantial re-organisation of tasks and responsibilities. The theoretical savings claimed for the introduction of managerial/secretarial support systems offering text editing, electronic mail, information storage and retrieval, etc. are typically about 15 per cent of the manager's time. Taking the cost of a manager at about $40,000 per annum, the time saving is equivalent to $6,000 per annum — theoretically sufficient to justify a moderately priced workstation (say $10,000). In practice, most users will also expect to benefit from improved quality and timeliness of office work. Such benefits could be much higher than the benefits from theoretical time savings, but are even harder to demonstrate in practice.

A further difficulty in justifying general purpose multifunction products is the need to install facilities for a certain minimum number of staff if benefits are to be achieved. For example, a sufficient number of users must use an electronic messaging facility to make it worthwhile. This implies that the 'general purpose' installations will have to be reasonably large which, in turn, increases the investment needed in the early stages of such a project.

Choice of application

In many cases the applications described above will become identified as existing systems, and their users, expand into related areas of work. Staff who investigate specific system developments should also be aware of multifunction opportunities. They should consider whether additional user needs could be met at marginal cost by installing multifunction rather than single-function systems. This implies that those who install multifunction products — end users themselves or management services staff — need to take a broad look at the work of users affected by a new (or replacement) system, rather than merely concentrating on the main application.

General office utilities should be considered carefully before any significant investments are made. Most organisations that install these systems do so primarily to gain experience of multifunction products, and very few have achieved quantifiable business benefits.

User experience strongly suggests that installing general purpose multifunction products at random, without an analysis of requirements and a clear definition of business objectives, will usually have disappointing results. Potential applications should be investigated to identify where general purpose facilities can be used effectively, and to identify where tailoring or adaptation of the system is needed. For a pilot trial to be meaningful, the key performance parameters of the area concerned should be identified and measured before the new system is installed. Positive changes in these performance parameters can then be used to justify further installations of general purpose systems in other areas of the business. Negative changes may force organisations to re-think their approach. (Foundation Report No. 29 — Implementing Office Systems is very relevant to the implementation of multifunction office systems. For example, it describes the selection of groups of staff to minimise problems associated with electronic messaging and it recommends specific approaches to investigation and installation.)

CHOICE OF MULTIFUNCTION PRODUCTS

The very different situations in which multifunction products may be used will ensure that no one multifunction product (or range of products) will suit all user organisations. But our research and analysis suggests that certain kinds of product are often more suitable for certain types of application. Figure 18 illustrates this point, using the categories of product described in chapter 3.

The installation of multifunction products should be treated as any other serious systems application — user requirements should first be identified and products evaluated against them. And, as with any other new system products, pioneers should beware of glib promises about the introduction of new features.

We believe that one particular approach to implementing multifunction products will offer considerable advantages to most organisations. This approach is based on personal computer terminals linked together

Figure 18 Choice of multifunction products

Opportunities for using multifunction products	*Appropriate type of multifunction product**
a) Extensions to existing data processing systems (clerks, professionals and support staff).	1. Multifunction data and text terminals. 2. Communicating personal computers.
b) Specific new applications for individual users.	1. Communicating personal computers evolving to multiple terminal systems based on local area networks.
c) Very specific applications for groups of users fulfilling a particular business function.	1. Multi-terminal systems with personal computers or specially designed multifunction terminals connected via a local area network. 2. Minicomputer systems with both intelligent and unintelligent terminals.
d) General purpose office utilities for one or more departments.	1. As for c) above. 2. Display-phones.**

*The approaches are listed in the order in which we expect them to be preferred.

**Display-phones do not offer the full range of functions that will be required by some users.

by a local area network. It has several advantages:

— The terminals and software are relatively inexpensive.

— Expensive devices can easily be shared between users.

— The system does not require a large initial investment in central resources.

— Users have more autonomy in using the system than if they were dependent on a shared minicomputer or mainframe computer.

This approach has been used quite successfully by many organisations (the experience of company D, described on page 23 is a case in point). There is a danger, however, that users will install different personal computers and different local area networks. This piecemeal approach presents two main problems:

— Incompatibility between the different terminals and networks.

— Difficulties in providing in-house user support for a variety of hardware and software products.

These problems have been discussed in earlier Foundation reports (particularly Foundation Report No. 29 — Implementing Office Systems and No. 34 — Strategic Systems Planning). Each organisation needs to develop a coherent approach to the use of multifunction products within its overall strategy for office automation. Such a strategy should contain guidelines for a communications infrastructure and for systems development support.

A feature of our preferred approach is the low priority given to the use of sophisticated multifunction workstations of the Xerox Star or Apple Lisa type. We feel that the suppliers have placed undue emphasis on perfecting the ergonomic design of the user interface, at the same time failing to understand why a user should want such a terminal, or how the high price can be justified. Human beings are very adaptable when they really want to use something and the critical success factor is to stimulate that desire. In particular, the emphasis on devices such as the mouse, designed to minimise the use of keyboards, seems misguided. Serious terminal users need to input text or data, which can at present most conveniently be done on a keyboard. Users can equally well use the keyboard with appropriate function keys to control and select the facilities they need. We do not suggest that ergonomics are unimportant, but we believe that the ergonomic design is a secondary consideration from the point of view of multifunction terminal users. The main consideration is what the terminal helps the user to do.

THE COMMUNICATION NETWORK

The use of multifunction terminals to support a high proportion of office staff will require considerable flexibility in adding and moving terminals. In future, organisations may need as much flexibility as is currently expected from their internal telephone networks.

Also, multifunction products will communicate using different types of network — in-house private data networks, external telex, teletex, telephone networks and so forth. Eventually, many organisations will integrate voice, data and image traffic on the same network. These requirements place stringent demands on those planning the structure of future corporate networks. Difficulties in predicting the levels of multifunction product use make this job even more difficult. Nevertheless, some organisations have attempted to plan their communication facilities — even if only in broad outline — for ten or 15 years ahead. In doing this they have tried to avoid costly network replacements as additional communication facilities are introduced.

Standardisation

In an ideal world, the environment would include recognised standards for communications between all the various terminal and processing devices; standards would also exist for operating systems and for basic aspects of application systems. For example, recognised standards would define the content and structure of documents (image, graphics, data and text). This would simplify the exchange of documents between various office systems. A recognised standard for defining user commands would greatly reduce the need for training and re-training staff. These factors will become increasingly important as multifunction products spread and begin to tackle a greater proportion of office work. It will be many years before universal standards are agreed for all layers of the OSI reference model. Indeed, this may never happen. Some standards, however, are much closer to definition. For example, CCITT is working to define teletex standards for documents incorporating image information. And some office system suppliers are encouraging recognition of their own products as industry standards. IBM for example, has defined a Document Content Architecture (DCA) and Document Interchange Architecture (DIA) which is used within DISOSS and associated products.

At present, potential users of multifunction products can only select the products that are best suited to their requirements, and adopt these products as internal standards. (External standards are often incidental to the selection process.) In some organisations it may be possible for a central management services group to enforce such internal standards, but

many organisations will only be able to encourage their use. Some management services groups that we interviewed provide internal support only for those products that they recommend. (This approach also encourages compatibility between systems used in different areas.)

SYSTEM DEVELOPMENT AND IMPLEMENTATION SUPPORT

One of our main conclusions on the use of multifunction products is that, to be successful, they need to address specific user requirements rather than just provide a set of general purpose office tools. This conclusion implies that each product will need a certain amount of adaptation to meet individual user needs. We believe that this adaptation effort will amount to much less than the effort traditionally spent on developing data processing applications. Most of the application software used on multifunction products will be based on packages with optional modules that can easily be adapted to suit individual users. Some end users will have (or will develop) the skills to customise their own systems. Many others will require technical support from management services staff.

Management services staff will have to provide interfaces between multifunction systems and existing data processing systems — for example, to give users access to the organisation's main data files while providing appropriate security. The other significant role for management services in this context will be in the education and training of end users. Several of the organisations we talked to emphasised the extent of the training required in terms of both intensity and duration. We believe that management services groups have a significant role to play in providing the right environment for making the best use of multifunction products. Considerable thought and care is required in planning future communication networks, in selecting appropriate standards for equipment and software, and in creating an internal support function for implementing multifunction products and training the users.

CONCLUSION

Although the original purpose of this report was to research the use of multifunction workstations, we have found it necessary in addition to consider other approaches to multifunctionality. Multifunction products may provide processing power and storage in a self-contained workstation; at remote processors and discs accessed by unintelligent terminals; or by some combination of these two methods. In other words, sophisticated multifunction workstations are at one extreme of a spectrum of products that can provide multifunctionality.

GROWTH IN THE USE OF MULTIFUNCTION TERMINALS

In the past, three major factors have inhibited the use of multifunction products:

- —The high cost per user.
- —Difficulties in identifying and demonstrating tangible benefits.
- —User resistance to products that did not meet their perceived needs.

Although these inhibiting factors are still evident today, the benefits of using multifunction products are slowly being recognised. Multifunction installations often result from the need to provide additional functions to existing users of data or text terminals. In these installations, the number of functions required is usually limited, and functions are often relatively unsophisticated. Many users of personal microcomputers are also beginning to recognise the need for multifunction facilities. (For instance, accountants who have used personal microcomputers for applications such as financial planning are now requesting access to corporate data files and text editing facilities.)

A low price-per-user is an important prerequisite to the widespread use of multifunction products. The more costly products will be used only where they fulfil a clearly defined, specialised application (such as computer aided design). Sophisticated products that integrate different communications media (such as data, text and speech) will not be widely used until prices fall considerably from their present high levels.

Unfortunately, most suppliers of self-contained multifunction workstations have concentrated on the ergonomic aspects of terminal design rather than considering the purposes for which multifunction terminals are really required. Although good ergonomic design of hardware, and (particularly) of software, is important, these are not the critical factors in gaining user acceptance. Human beings are highly adaptable. They will tolerate imperfect ergonomic design if the equipment meets a real need.

JUSTIFICATION OF MULTIFUNCTION PRODUCTS

The benefits from using multifunction products are most easily demonstrated where the alternative is to use several single-function devices. In this situation, cost and convenience comparisons can easily be made. The justification for multifunction products is more difficult where the alternative is to use manual systems, or to use a single-function terminal to perform one important task only.

The current high prices of many multifunction products will fall considerably as competition from cheap personal microcomputers increases. User (and supplier) understanding of multifunction applications will also increase over the next few years. Both these factors suggest that a cautious approach to the use of multifunction products is advisable. Organisations should carefully examine potential and existing system applications to see where a useful multifunction capability could be provided at marginal cost.

The best way to provide multifunctionality to particular users will depend on the scale and mix of user needs, and on the organisation's existing equipment. Products should be chosen to meet real user needs at an economic price, while avoiding high-risk investments and maintaining the flexibility to meet future changes in products and requirements.

In many cases, communicating terminals based on the powerful 16-bit microcomputers now appearing on the market, together with relevant software will be an appropriate starting point.

Although most users of multifunction products may initially communicate only with in-house computers, more widespread communication (such as electronic messaging) will become attractive as the number of terminal users increases. Local area networks will provide an effective basis for meeting this widespread

communication requirement. Conventional minicomputer and mainframe computer communication networks will be less attractive options in most cases. Voice and data switching PABXs offer a suitable alternative to local area networks where the main use of multifunction terminals is to access shared computers (mainframes or minicomputers). But the PABX approach will be less attractive if the applications involve access to shared local resources such as disc files or printers.

The use of personal computers as the basis of multifunction office systems does, however, have some inherent difficulties, including variable software quality and supplier support. Also, since there are few effective communication standards, organisations will have to establish their own internal standards if they are to avoid a proliferation of incompatible microcomputers. Both potential users and management services staff should be involved in selection and installation. Otherwise organisations may fail to achieve many of the potential benefits of multifunction products.

These benefits will be illusive unless an organisation clearly defines its objectives and sets a framework in which these objectives may be achieved. In other words, the installation of multifunction products should be considered as part of an overall strategic office automation plan. This plan should include provisions for any necessary infrastructures, including communications networks and shared resources such as electronic mail servers.

Many organisations are wasting time and money on poorly conceived trials of multifunction products. These trials often fail and, consequently, retard further installations that could produce real benefits. Multifunction applications should be treated in the same way as data processing applications. Each application should have well-defined objectives against which performance can be measured. Specific applications, rather than general-purpose applications, should be installed in early trials.

We foresee a gradual introduction of multifunction products over the next two to three years. This process will gain momentum as user experience is built up. We hope that this report will help organisations to generate that momentum in an effective way.

GLOSSARY OF TERMS

Bit plane (bit map)	A technique for displaying information where each picture element of the frame is defined in the terminal memory.
CCITT	Comité Consultatif International de Télégraphique et Téléphonique, the consultative committee of the International Telecommunications Union that establishes technical and operating standards and tariff guidelines for international networks.
Database	A collection of data held in a machine-readable form, typically on magnetic discs.
Dot matrix	Used to define a shape as a series of dots arranged in a grid (matrix).
Download	To transmit information (especially software) down the line from a central store to a terminal.
Frame	A screenful of information.
ISDN	Integrated Services Digital Network, providing digital end-user services on the telephone networks.
LAN	Local area network.
Mail box	Electronic message service based on the storage of messages for subsequent retrieval by recipients.
OSI reference model	The International Standards Organisation's 7 layer model of open system interworking.
PABX	Private automatic branch exchange.
Packet	An addressed data unit of convenient size for transmission through a network.
Packet-switching	A technique for transmitting data packets through a network.
Pixel	Abbreviation for picture element, from which pictures are created on the screen.
Protocol	The rules governing how two pieces of equipment communicate with one another.
Raster scan lines	A set of television type scan lines defining the picture.
Resolution	For a display terminal, the number of pixels into which the display can be resolved.
Store-and-forward	Term applied to terminal-to-terminal electronic mail systems involving intermediate message storage.
Voice message (Voicegram)	A digital voice message capable of being stored electronically.
WAN	Wide area network (as opposed to local area network).
X.nn	CCITT's reference numbers for different types of digital network interfaces.

Butler Cox & Partners Limited
Morley House, 26-30 Holborn Viaduct, London EC1A 2BP
☎ 01-583 9381, Telex 8813717 BUTCOX

Belgium & The Netherlands
SA Butler Cox NV
Avenue Louise – 479 – Louizalaan,
Bte – 47 – Bus.
Bruxelles 1050 Brussel
☎ (02) 647 15 53, Telex 61963 BUTCOX

France
Butler Cox SARL
Tour Akzo, 164 Rue Ambroise Croizat,
93204 St Denis-Cedex 1, France
☎ (1)820.61.64, Telex 630336 AKZOPLA

United States of America
Butler Cox & Partners Limited
P.O. Box 590, Morristown, New Jersey 07960, USA
☎ (201) 285 1500

Switzerland and Germany
Butler Cox & Partners Limited
Morley House, 26-30 Holborn Viaduct, London EC1A 2BP
☎ (London) 583 9381

Italy
Sisdoconsult
20123 Milano – Via Caradosso 7 – Italy
☎ 86.53.55/87.62.27, Telex 311250 PPF MI

The Nordic Region
Statskonsult
PO Box 4040, S-171 04 Solna, Sweden
☎ 08-730 03 00, Telex 127 54 SINTAB