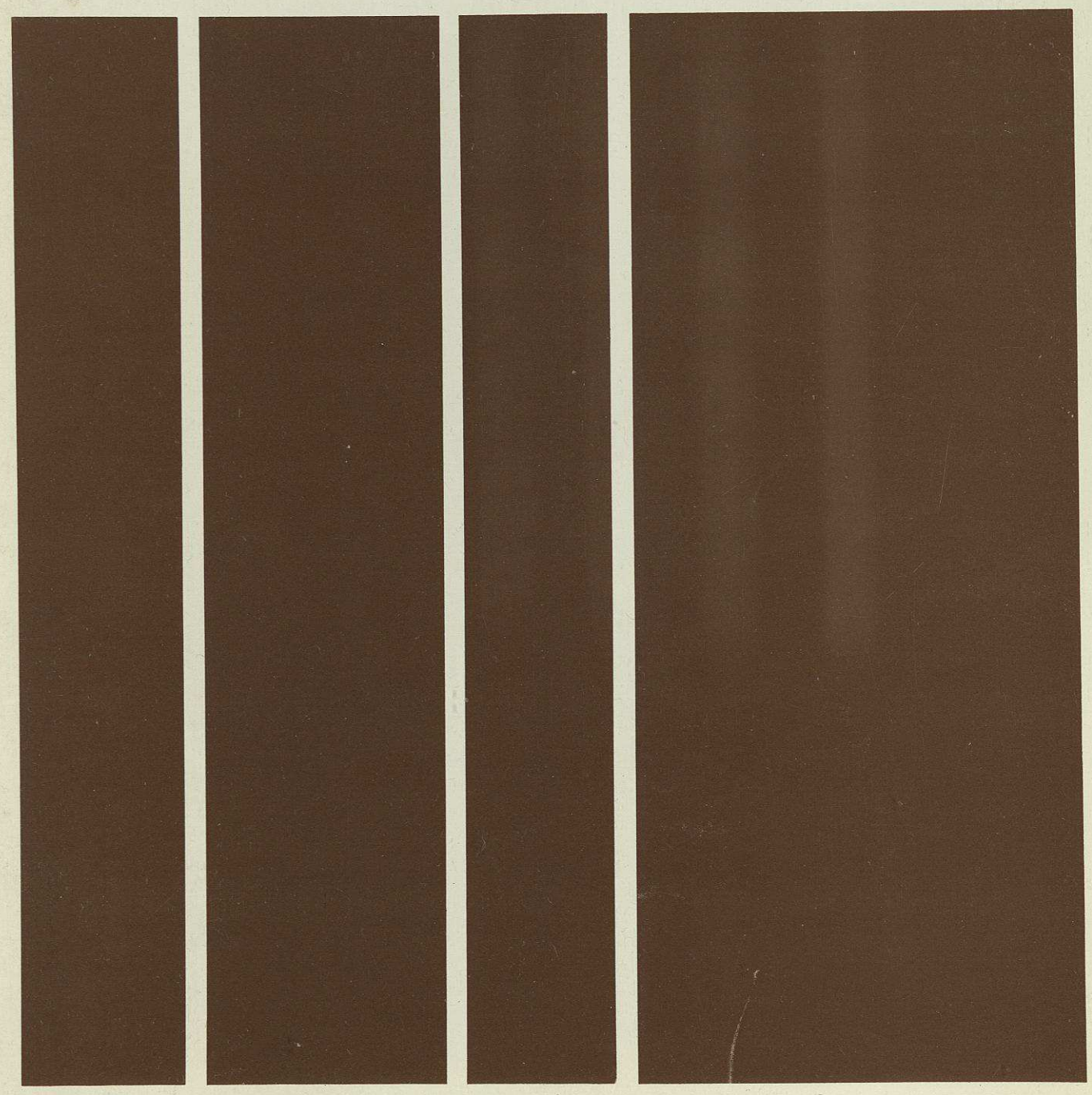
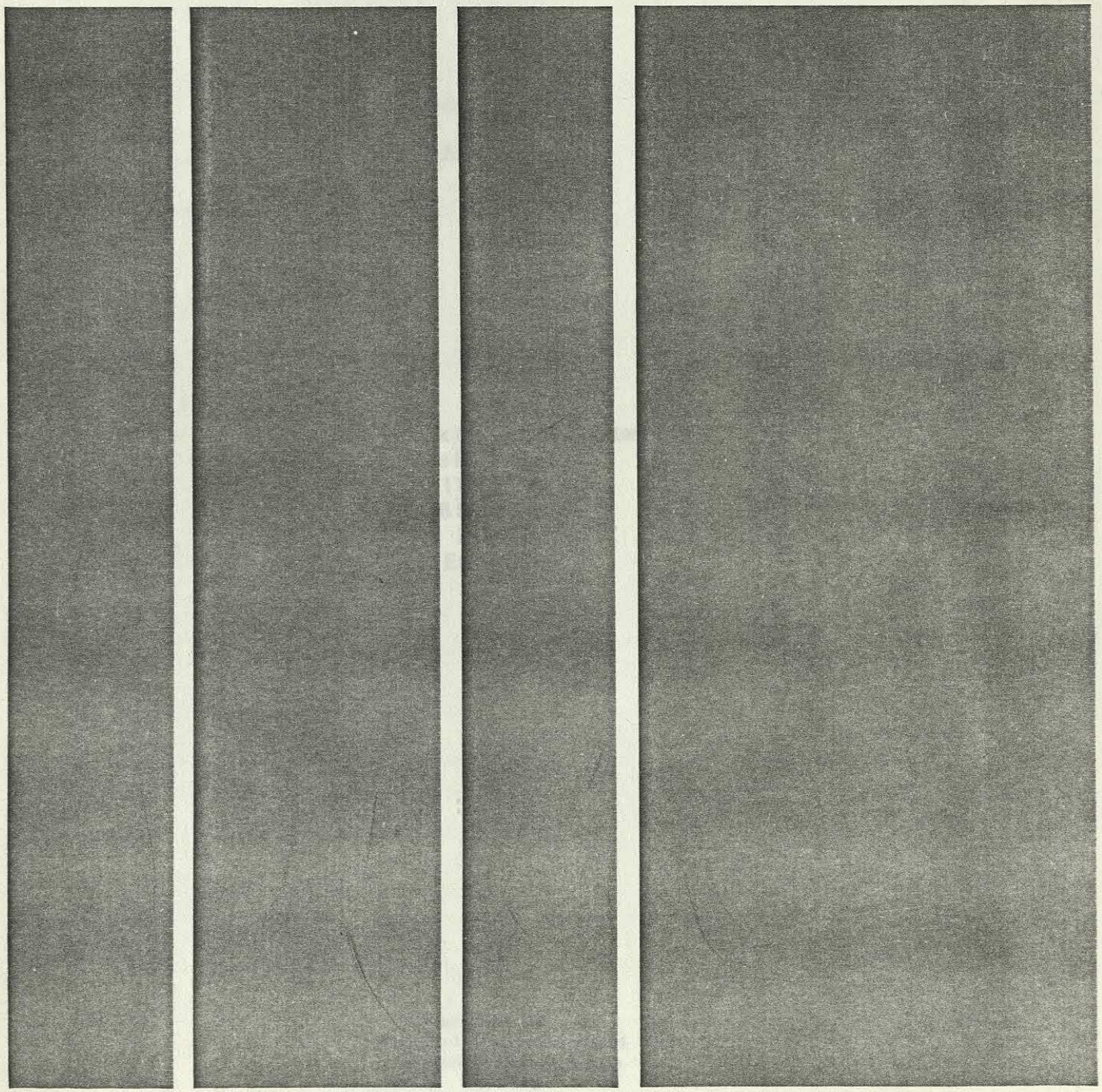


The Butler Cox Foundation

Report Series
No 4

Trends In Office Automation Technologies

December 1977



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December 1977

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I INTRODUCTION

A Purpose And Readership

The range of equipment for handling, storing and communicating information is likely to increase enormously over the next few years. It could significantly change office life. It could help government, business and the private individual to overcome the problem of dealing with the ever increasing volume of information that threatens to swamp modern society.

This report has been written to provide a guide to the technologies which are involved. It is intended both for the specialist manager concerned with information systems and the line executive concerned with their use.

It refrains from describing the technologies in great depth or detail but clearly sets out the main trends and the options likely to become available. The report avoids constructing yet another scenario of the "office of the future": it is more concerned with the technologies which will be *used* rather than those which will *exist*. The underlying belief is that technologies will only be used if they genuinely prove cost effective and this is reflected in the content of the report.

B Background

Managers in business today are required to cope with increased administrative complexity, handle more information, provide faster response, react with increased flexibility, and yet contain or reduce costs. This puts great pressure on improving the productivity of their administrative staff.

At the same time major developments in technology – mostly pioneered in the computer business – are beginning to be seen as having enormous application in the related fields of communications and office automation.

The implications of the combination of this market need and technical potential are not lost on commercial suppliers. Managers can expect substantial help from technology, but they are likely to be confused by the range of equipment and services offered by a host of suppliers, computer manufacturers, office equipment suppliers, telecommunications companies, the Post Office and others.

Some of the technologies have already started to hit the market. Many managers are today evaluating new equipment such as display word processors and stored program controlled telephone exchanges. Picking their way through the range of devices will get harder. Also, businesses which normally operate in a decentralised manner will need to consider carefully how to provide a sensible degree of equipment standardisation, particularly as many of the devices will communicate with one another across company and divisional boundaries.

Assessing the value of these new systems will also involve consideration of their impact on people's working lives and habits. Whether a device proves effective in a particular situation will depend as much on how people will use it as upon its technical merits.

These developments offer an exciting extension to the roles of systems specialists within a company. In the past their interest has too often been confined, necessarily, to those procedures readily adaptable to computer processing: a fraction only of the company's total information flow. Now, not only will computer processing continue to become cheaper and more adaptable, but it can be allied to a range of other technologies which handle information in such forms as voice, high quality printed text, and images. The potential is enormous.

All of these implications point to the need for a planned approach to the adoption and exploit-

ation of new office technology. Managers responsible for investment in office systems need to know how practical and cost effective these technologies will be, and when and how they will become available.

C Scope of the Report

This report seeks to clarify these issues by first surveying the needs of office workers, and then exploring both the technologies and the ways they are likely to be brought to the market.

It is structured as follows: Section II contains a brief overview of typical offices today – the people who work in them, what they do and what they need to help them do their jobs better. The next sections are each concerned with technologies in a particular area: text, voice, processable data and images. Finally Section VII examines the ways in which these can be integrated effectively.

II OFFICE WORKING TODAY

Most organisations have seen a considerable increase in the proportion of their staff engaged on administrative and clerical work: on average from around 20% in 1950 to as much as 40% today. This change is part of a trend towards information working which is prevalent throughout western society. Exhibit 1 shows how the proportion of information workers has increased in the US, and how there has been a general move away from more traditional industries towards service industries particularly in the US and to a somewhat lesser extent in Europe.

This section investigates office working: the people who work in offices, their productivity, and their equipment needs. It provides a background against which the purposes of the new office technologies can be evaluated.

A The People In Offices

Although very little quantitative data has been published on how people spend their time in offices, it is possible to draw some conclusions from limited observations and from specific studies which have been carried out usually internally for individual companies.

In considering how people work it is convenient to separate office staff into three broad categories: managers and professionals, clerks, and typists and secretaries. Exhibit 2, which is derived from UK labour statistics, shows the overall numbers of people employed in a variety of offices during the last ten years. Clerks form the biggest proportion in terms of numbers employed but they are exceeded, in terms of costs, by managers and professionals.

One can derive from these studies some insights into the major activities which these broad categories of office work entail, as shown in Exhibit 3.

From this the main needs of office workers can be identified and hence the aims of technology designed to meet the needs:

For managers and professionals

- To improve the efficiency of voice, text data and image communications so that more time is available for the key planning or designing role;
- To provide aids to assist with these key tasks.

For clerical workers

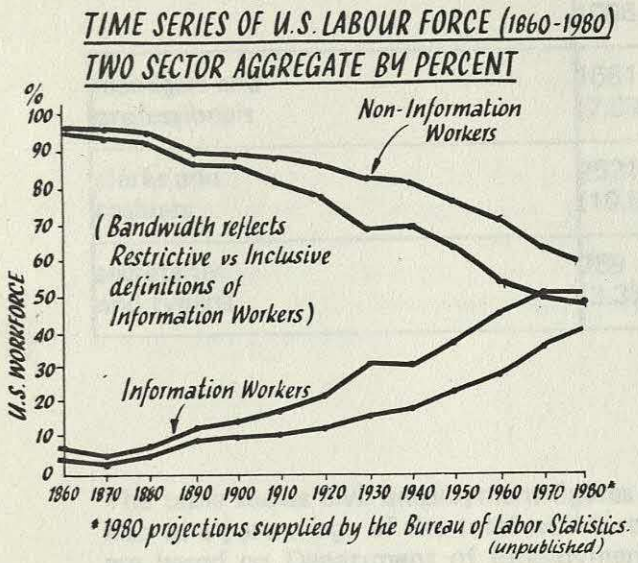
- To provide information processing systems, aids to improved voice and text communications, and improved filing and information retrieval systems.

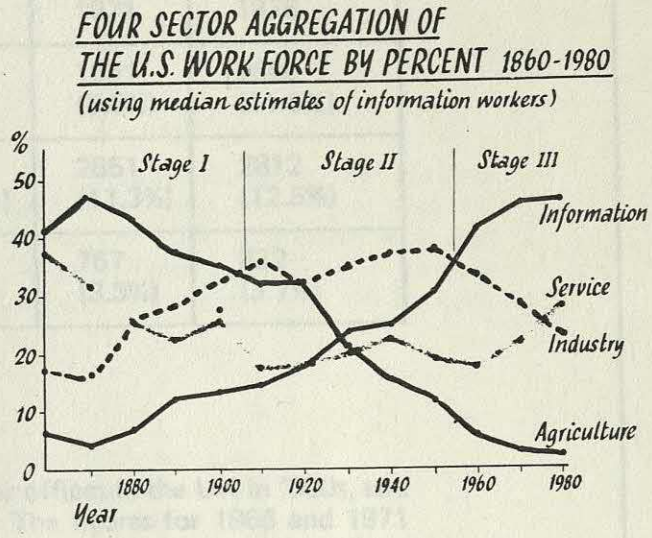
For typists and secretaries

- To improve voice communication systems and improved text origination and communication procedures, and to improve filing and retrieval systems.

These key aims for office technology are summarised in Exhibit 4. Many articles about the 'office of the future' have concentrated on word processing, but as the exhibit shows this is only one aspect of office automation. Indeed the benefit of word processing which is emphasised most strongly by equipment suppliers is the improved productivity of secretaries and typists, yet their costs amount to no more than a small proportion of total office costs.

Exhibit 1 Information workers in society





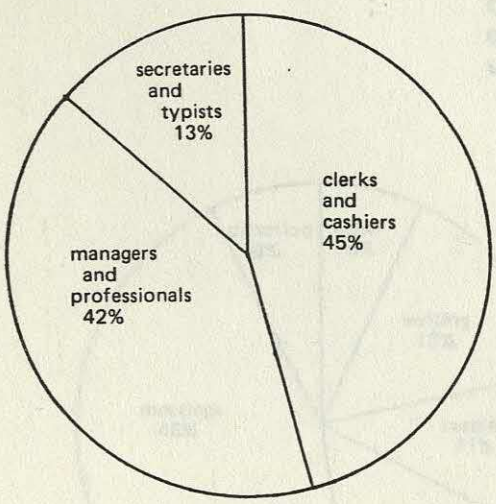
Proportion of workforce employed by industry

	US		Europe		UK	
	early '50s %	'72 %	early '50s %	'72 %	early '50s %	'72 %
construction & transport	15	11	14	15	14	12
services	42	61	29	38	38	49
manufacturing	30	24	33	37	43	37
agriculture	13	4	24	10	5	2

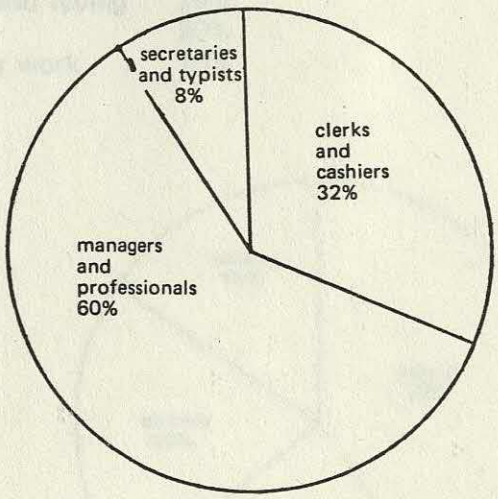
Exhibit 2 Office employment in the UK

	1966	1971	1976
managers and professionals	1681 (7.0%)	1961 (8.6%)	2609 (11.6%)
clerks and cashiers	2521 (10.5%)	2651 (11.3%)	2812 (12.5%)
secretaries and typists	789 (3.3%)	767 (3.3%)	832 (3.7%)

The table shows civil employment figures for offices in the UK in '000s, and also as a percentage of the total workforce. The figures for 1966 and 1971 are based on Department of Employment, British Labour Statistics. These particular statistics were discontinued in 1971; the figures for 1976 are based on an analysis of more recent information in other CSO publications.



distribution of office workers by number



..... and by cost

Exhibit 3 Office workers and activities

managers and professionals

dictation	8%
writing	13%
reading	11%
telephone	14%
meetings	46%
other	8%

The above figures, which are based on a recent sample of UK business managers and professionals, are representative of the category as a whole. However, there will be great differences between individual jobs and businesses, although paper handling, telephoning and meetings — all concerned with communications — will take a large proportion of the time of all managers.

clerks

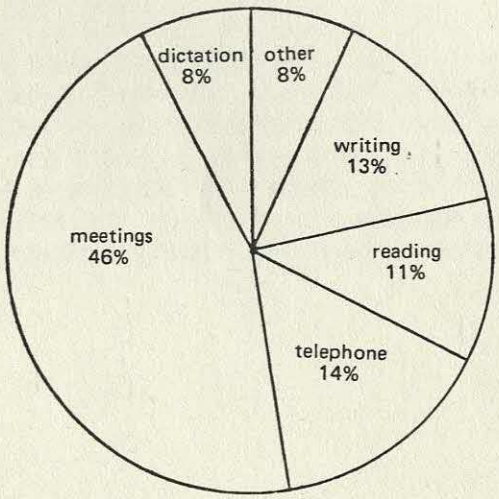
routine information processing
(eg processing of orders, placing purchase orders, credit control, invoicing, record keeping).

answering queries
filing and retrieving information

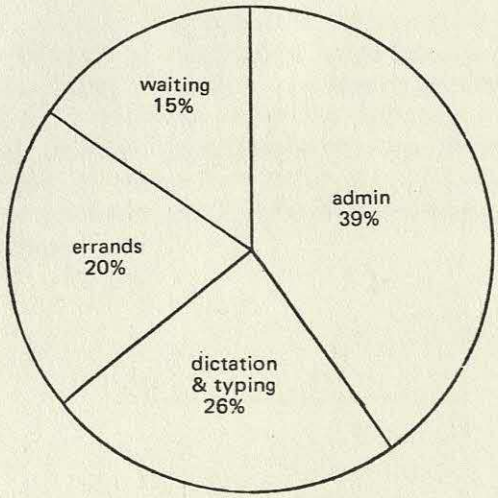
No proportions of time have been allocated to the three categories above because of the substantial variations between jobs and businesses.

secretaries and typists

administrative duties	39%
dictation and typing	26%
errands	20%
waiting for work	15%



analysis of manager's time ...



and his secretary's

Exhibit 4 Information processing in the office

summary of office information needs

	managers and professionals	clerks	secretaries and typists
communications			
written word	*	*	*
voice	*	*	*
face to face meetings	*		
images	*		
filing and retrieval systems	*	*	*
information processing systems		*	
aids to planning, design and other creative work	*		

B The Need For Office Automation

The office of today is characterised by low equipment investment and high labour costs. Exhibit 5 shows how office equipment investment compares with investment in other industry sectors in the US, and also how labour costs dominate the office budget. Perhaps not surprisingly office labour productivity has remained relatively static in recent years. For example it has grown only 4% in the US between 1960 and 1970 compared with 83% for manual workers in the same period, and the picture in the UK is similar.

A major reason for the relative neglect of the office as an area for investment has been that, for many businesses, it is a cost area, not a revenue-earning area. It is often easier to justify investment aimed at increasing revenue than cutting costs. Another reason stems from the nature of the jobs themselves. Generally office staff perform a variety of linked but different activities, but they are served by a conglomeration of non-standard, stand-alone devices. Each office device in general is engineered for a specific purpose.

Typewriters, copiers, calculators, and telex machines are all familiar examples of office devices which are essentially special purpose in nature. Again, many of the new devices which have been introduced in the past few years perpetuate this state of affairs: computer terminals, microfilm devices and word processors for example. Of course they may well be able to offer improvements in productivity which can justify their cost. But often they demand high utilisation as a basis for their justification, and this usually leads to specialisation of the labour involved.

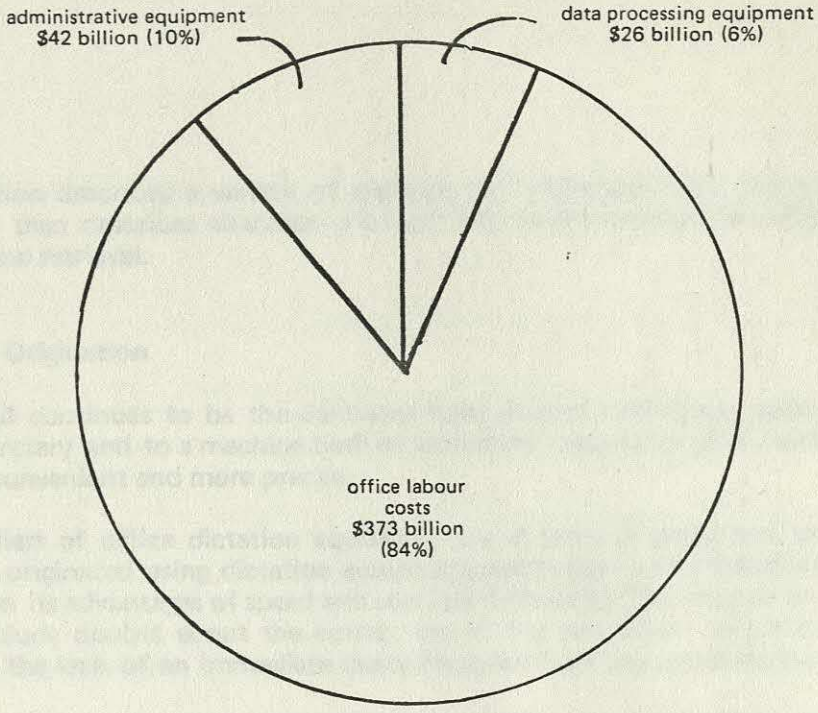
The automatic typewriter is a good example of a device which demands high utilisation, and suppliers have often applied considerable pressure to their customers to organise intensive typing pools in order to ensure this. Admittedly many businesses have benefited from making this organisational change quite apart from using automatic typewriters; but many others have discovered to their cost that social changes of this sort can be very difficult to introduce. It is probably true that in future there will be greater resistance amongst office workers to social change than in the past. The consequence, insofar as office equipment suppliers are concerned, is that their devices must not only be cost effective (able to show an adequate productivity gain to justify the extra cost) but also less demanding of intensive, specialist use.

There are two distinct categories of device which can fulfil these needs. The first is *specialist* devices which are cheap enough not to require intensive use. The second is *multifunction* devices, able to carry out a variety of functions which are matched to the particular job needs of their operators.

The successful office automation devices of the future are likely to fall into one or other of these two categories. We will return to this theme in Section VII, but first it is necessary to examine the nature of the developments which are occurring in the technologies aimed at the office.

It is clear that there are four main categories of information in the context of office working — text, voice, data and image. Each of these categories involves origination, transmission, and storage and retrieval. A problem in presenting a structured discussion of these categories of information and the technologies which serve them is the extent to which the categories overlap, and the way in which they are so closely related in office applications that they become hard to separate. Nonetheless, despite these problems, the next four sections of this report describe each category in turn, and each section addresses the questions of how technology can assist with origination, transmission, storage and retrieval.

Exhibit 5 Distribution of office costs



The above figures for the distribution of office costs are based on a US survey in 1974.

COMPARATIVE INVESTMENT $	
agricultural worker	35000
factory worker	25000
office worker	2000

III TECHNOLOGIES FOR TEXT PROCESSING

This section describes a variety of methods for originating text, from handwriting to voice input. It then describes character-oriented text communication, and finally systems for text storage and retrieval.

A Text Origination

Longhand continues to be the dominant form of text origination, with dictation to a shorthand secretary and to a machine both of secondary importance. For most executives longhand is more convenient and more precise.

As suppliers of office dictation equipment are at pains to point out, the proportion of text which is originated using dictation equipment rather than a shorthand secretary is surprisingly low, given its advantages of speed and cost (see Exhibit 6). The reasons for this are well known. They include doubts about the correct use of the equipment which can stem from lack of training, the lack of an immediate query feedback from the secretary/typist, and status issues.

Exhibit 6 also shows three alternative forms of text origination which have been suggested in scenarios of the future. Two of these – the use of an electronic tablet which can read handwriting, and voice input devices which can understand the spoken word – have both received their share of publicity recently. The third assumes that typing by the text originator can be made attractive through simplicity and training.

The electronic tablet is unlikely to have any significant impact in this area for the simple reason that it is unlikely to prove cheaper than the alternatives, and its speed is limited to handwriting speed. Nor is voice input to a speech recognising machine likely to have any significant impact in the foreseeable future. The reason in this case is the difficulty of solving the technical problems of continuous speech recognition. It is true that already machines exist which can recognise discrete words with high (>95%) reliability after a short period of 'training' – adaptation by the machine to an individual's specific voice patterns. As logic becomes cheaper and more widely available devices of this sort could become widespread, but their use will be effectively limited not by price but by application – for example to voice signature recognition in security systems, and sophisticated toys. But the difference between discrete word recognition and continuous language recognition is enormous, and the problems associated with the latter are unlikely to be solved in the next ten years.

The third alternative is direct typing. To make keystrokes at the same speed as handwriting is relatively easy and requires little training; but the reason why most executives in the UK eschew this form of text origination – leaving aside the issue of social acceptability – is the difficulties of laying out and error correction, which make the process uneconomic. However display word processors, which use a VDU to decouple the keyboard from the printer and allow text to be created and manipulated on the screen with powerful software aids to help with layout and to facilitate instant correction, could allow executives to 'type' without training as fast as they can handwrite (a lot faster for those taught to type: typing is part of the school curriculum in some European countries). Typing by the originator has the potential for widespread use, but only if the cost of display word processors drops sufficiently to justify what would inevitably be much less than intensive use. This could eventually be the case, but it can be safely discounted within the next five years.

In summary then, fundamentally new technologies are unlikely to have a significant impact on the text origination market in the next few years.

Exhibit 6 Alternative forms of text origination

Speed words/min	form of origination	intermediate operation(s)	output
10	longhand	typist	text
25	voice dictation	shorthand secy → typist	text
60	voice dictation	dictating m/c → typist	text
5-10*	typing		text
	longhand	handwriting reader	text
	voice dictation	voice input m/c	text

* assumes little or no training and experience

It is much more likely that longhand and dictation will continue to be used in conjunction with a separate typing operation, but there is no doubt that display word processors will have a major impact on the latter. Their main justification at present is to improve typing productivity. However, since managerial and professional staff account for a much higher proportion of office costs than typists, in the future other factors may be considered more important. For example a reduction in proof reading because only changes need to be checked; or improved quality of content because authors feel less inhibited in asking for small changes which previously may have entailed the retyping of the whole document.

At their current prices of around £7,000 - £10,000 per keyboard workstation typists need to raise their output to about 250% of the level they can accomplish with standard typewriters to achieve a payback in three years on a typical machine. Such productivity gains can be reached at present, but generally only with work which is specially selected from the average mix of office work, for example revision typing of multipage reports requiring extensive redrafting, repetitive texts (such as standard letters) and complex tabular work requiring to be carefully laid out. In this last case the availability of previously designed formats held in the machine's memory can be very helpful. Nonetheless the price of display word processors will drop some 40% in the next five years as a result of reduced component costs and much reduced overheads as the market grows. Display word processors will become readily justifiable compared with standard typewriters when used intensively for an average mix of office work.

Probably the use of dictation equipment in conjunction with display word processors will continue to grow slowly as the relative cost of the devices reduces and as their characteristics in terms of quality and ease of use continue to improve. And probably the use of shorthand secretaries will decline at last — although this prediction has been made before and the current demand for the skill continues to outstrip the supply.

B Text Transmission

In most western countries the physical mail service is both deteriorating in speed and escalating in cost, mainly as a result of rapid rises in energy costs and the essentially labour intensive nature of the business.

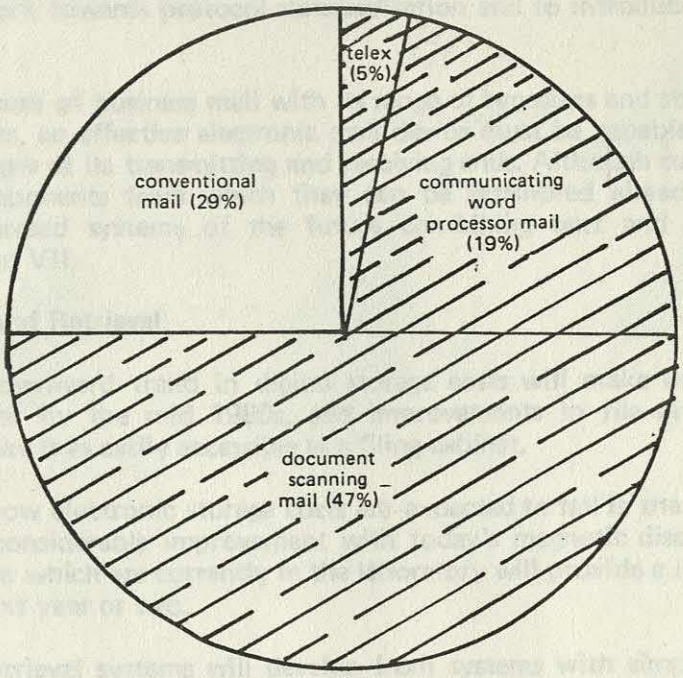
Against this, the potential for electronic mail is enormous. Exhibit 7 shows the proportion of incoming and outgoing business mail potentially deliverable by electronic means based on a recent survey undertaken in a large but representative business. Some 70% of the mail is amenable to electronic transmission. This proportion consists of documents containing text and numbers, which can be coded and transmitted as a stream of pulses or bits; and images such as illustrations and graphic designs, which can be scanned and resolved as a pattern of pulses for transmission in the same way. There is more than enough unused off peak capacity in the telephone system to accommodate this potential load.

The proportion which is not suitable includes sales brochures, books, technical manuals and other documents which demand high quality reproduction, contain multiple colours, or are rendered uneconomic for electronic transmission because of their bulk. This proportion might decline as electronic mail techniques improve and become widespread, but it will always remain significant.

One form of electronic mail which is already in widespread use is telex. The great advantage of telex at present is that it offers a standard worldwide text communication interface (protocol). In the short term its use will grow because new word processing equipment will allow the service to be accessed more easily. In the longer term the telex protocol will either evolve into or be replaced by a more comprehensive protocol for communicating word processors, and so the distinction between the two classes of service will blurr.

Like telex machines, communicating word processors are restricted to transmitting keystrokes. At present there are only some 10,000 word processors in the UK, and only a small proportion of these are equipped for communications. Those that are equipped are generally restricted to intra-company transmission to like machines having the same protocols, and in the UK the number of word processors which are actually being used in this way is probably no more than a few hundreds. The reason for this low use is not the cost of transmission: at 1200 bits per second a word processor can transmit two typed A4 pages each containing some 2500 characters over long distance (over 56 km) dial-up lines during peak rate periods for the cost of a first

Exhibit 7 The potential for electronic mail



This chart shows the potential for electronic mail (shaded) based on an analysis at one representative company site with 1600 staff, 600 telephones and an average total mail of 2900 pages/day. Here, electronic mail is the non-simultaneous communication of text and static image material (data communications is excluded)

class letter stamp. At off-peak rates, eg working unattended overnight, twelve such pages could be sent for the same price. Rather, the main reasons are first that few word processors are equipped for communicating, and the protocols are not standardised; and second communicating word processors are unable automatically to store and forward their messages. However, it is very likely that intra-company electronic mail by communicating word processors using both leased and dial-up lines will become a major growth area in the near future, thus stimulating suppliers to work towards protocol standardisation and to introduce a store and forward capability.

Because of the nature of business mail with its range of typesizes and styles, logos, signatures, diagrams and charts, an effective electronic mail device must be capable of handling a mix of both text and images at its transmitting and receiving ends. Although such devices are not yet available, the components from which they can be assembled already are as discussed in Section VI. Integrated systems of the future combining text and image processing are described in Section VII.

C Text Storage And Retrieval

The continuing downward trend in digital storage costs will make bulk electronic storage cheaper than paper by the mid 1980s, and improvements in file organisation and search techniques will make it as easily accessible as a filing cabinet.

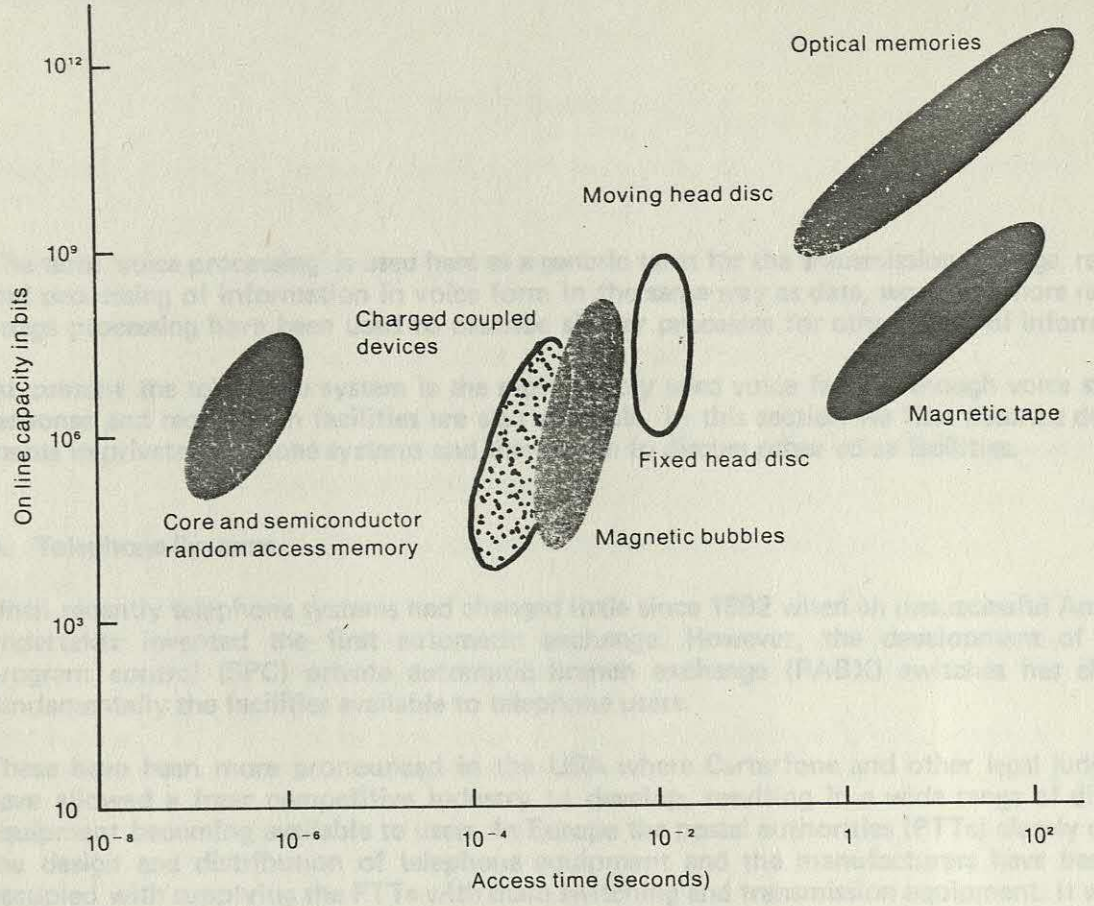
Exhibit 8 shows how electronic storage costs are expected to fall in the next few years. There is still room for considerable improvement with today's magnetic disc technology, but new methods of storage which are currently in the laboratory will provide a new impetus beginning probably in the next year or two.

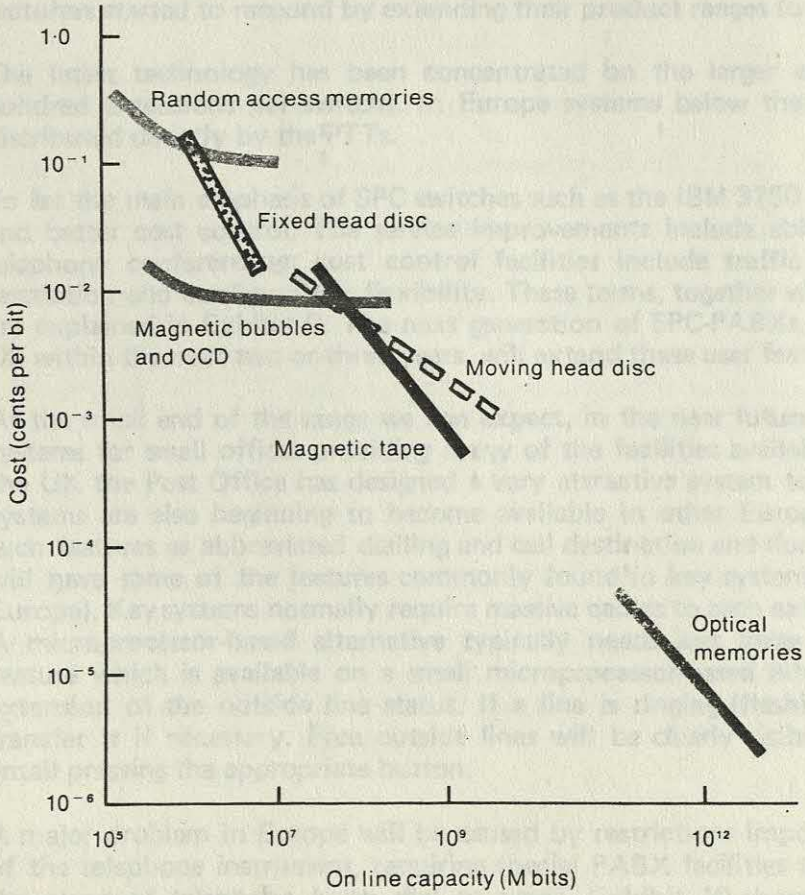
Text filing and retrieval systems will develop from systems with simple access via an index (such as recipient, date and subject), to complex full inverted file systems of which IBM's STAIRS package is an example. In this system an index is set up containing all the occurrences of every meaningful word in every document held in storage. It is then possible to ask questions such as "how many times do the words 'office', 'equipment' and 'insurance' appear in the same document in storage?" The system can search for all the occurrences of combinations of these keywords, responding immediately through a visual display unit (VDU). If there are too many occurrences to be manageable, a further word or words can be combined until a manageable number of documents is identified. They can then be either displayed or printed in full.

Systems of this type have obvious applications in situations where each document has a different structure and content and where there are a large number of them with a high degree of commonality — for example in libraries of research papers. In the past high on-line storage and data entry costs have inhibited the use of systems like this, but as costs fall they will become more widespread and will very probably find at least limited use in business.

The falling cost and improved accessibility of electronic storage, together with the proliferation of display word processors, will encourage the establishment of electronic files of text alongside conventional text filing systems. Converting from old to new will probably be a problem, and it is here that optical character recognition (OCR) techniques are likely to be able to help. OCR uses an electronic reader to scan and recognise individual characters. The characters have to be in a font appropriate to both machine and human reading. One of these fonts (OCR-B) is available on several models of office typewriter and can be read by machine usually with close to 100% reliability. Some businesses will recognise the need for file conversion in the future, and will bring OCR fonts into general use in the office in anticipation.

Exhibit 8 Developments in digital storage technology





Source: Plessey

IV TECHNOLOGIES FOR VOICE PROCESSING

The term 'voice processing' is used here as a generic term for the transmission, storage, retrieval and processing of information in voice form in the same way as data, word and more recently image processing have been used to describe similar processes for other forms of information.

At present the telephone system is the most widely used voice facility though voice storage, response and recognition facilities are also available. In this section we first describe developments in private telephone systems and then go on to discuss other voice facilities.

A Telephone Systems

Until recently telephone systems had changed little since 1892 when an unsuccessful American undertaker invented the first automatic exchange. However, the development of stored program control (SPC) private automatic branch exchange (PABX) switches has changed fundamentally the facilities available to telephone users.

These have been more pronounced in the USA where Carterfone and other legal judgments have allowed a freer competitive industry to develop, resulting in a wide range of different equipment becoming available to users. In Europe the postal authorities (PTTs) closely control the design and distribution of telephone equipment and the manufacturers have been preoccupied with supplying the PTTs with main switching and transmission equipment. It was not until IBM attacked the end user market with the 3750 PABX that the traditional manufacturers started to respond by extending their product ranges to the users.

The latest technology has been concentrated on the larger end of the market (over one hundred extensions per switch). In Europe systems below that size are often designed and distributed directly by the PTTs.

So far the main emphasis of SPC switches such as the IBM 3750 has been on improved service, and better cost control. The service improvements include abbreviated dialling, paging, and telephone conferencing; cost control facilities include traffic monitoring, class of service restriction and configuration flexibility. These terms, together with additional PABX facilities, are explained in Exhibit 9. The next generation of SPC-PABXs, which will be revealed in the US within the next two or three years, will extend these user features still further.

At the small end of the range we can expect, in the near future, to see microprocessor-based systems for small offices providing many of the facilities available on larger SPC switches. In the UK the Post Office has designed a very attractive system to be marketed in 1980. Similar systems are also beginning to become available in other European countries. In addition to such features as abbreviated dialling and call destination and duration recording, these systems will have some of the features commonly found in key systems in the US (but not often in Europe). Key systems normally require massive cables to each extension – thirty pairs or more. A microprocessor-based alternative typically needs just three pairs. The main key system feature which is available on a small microprocessor-based alternative is the display at each extension of the outside line status. If a line is ringing (flashing) anyone can answer it and transfer it if necessary. Free outside lines will be clearly visible and gaining one will simply entail pressing the appropriate button.

A major problem in Europe will be caused by restrictions imposed by the PTTs on the design of the telephone instrument, requiring special PABX facilities to be controlled by the use of the standard telephone (with dial or keys). Exhibit 10 shows a list of typical dial codes.

Exhibit 9 PABX facilities

system features		
automatic call distribution	—	spreads incoming calls on a group of lines smoothly to assigned stations
control of numbering scheme	—	allows changes to telephone numbers without re-engineering
automatic route selection (ARS)	—	selects alternative or lowest-cost connections
outgoing trunk queuing	—	in conjunction with ARS, provides a means for users to queue on a busy outgoing trunk
call information logging	—	maintains a record of all outgoing calls for analysis
code restriction	—	for selected telephones, denies access to certain outgoing call types (eg by specified number, international calls)
station hunting	—	routes a call to an idle line in a pre-arranged group when the called telephone line is busy
user features		
intrusion	—	allows specified users to break in to other calls (accompanied by a warning tone)
privacy	—	prevents intrusion
automatic call back	—	provides call back when free
call waiting	—	provides a caller-waiting warning tone
call pick up	—	allows anyone within a group to accept a call
call transfer	—	allows a user to transfer to an alternative number (without involving the operator)
call forwarding	—	automatic diversion to another designated extension on busy or no answer; can also be established by the user to divert all calls temporarily to another extension
paging	—	connects the radio paging system to the telephone
abbreviated dialling	—	provides a list of abbreviated codes for numbers frequently dialled
conferencing	—	allows three or more telephone users to simultaneous contact
external number repetition	—	allows users to recall the last number dialled with a single key depression

Exhibit 10 Typical PABX dial codes

	FEATURE ACCESS CODES	STANDARD (RECOMMENDED) SETTING	
		PUSHBUTTON TELEPHONES	ROTARY DIAL TELEPHONES (MIXED OR ALL ROTARY SYSTEMS)
EXTENSION USER	Connect	•1	111
	Add-On	•4	114
	Pick-up	•3	113
	Group Pick-Up	••3	133
	Park	•6	116
	Hold	•9	119
	CIL Account Coding	•2	112
	Camp-On	#1	122
	Repeat Number Dialled	#7	127
	—— Save Number Dialled	#4	124
	Extension Abbreviated Dial Call	#3	123
	—— Set Extension Abbreviated Dial Call	##3	143
	System Abbreviated Dial Call	#6	126
	Call Diversion	#9	129
	—— Cancel Call Diversion	##9	149
	Private Call	#2	122
	Do Not Disturb	#5	125
	—— Cancel Do Not Disturb	##5	145
	Executive Intrude	#8	128
	Direct Trunk Select (main use is for test telephone operational)	##8	148
OPERATOR	Set Time	###8	-
	Set Date	###3	-
	Direct Trunk Select/Intrude	#8	-
EXTENSION USER & OPERATOR	Direct Outward Dialling	9	9

Many users have difficulty in learning and remembering the codes and therefore make little use of the facilities. Moreover there is no indication that a given facility (for example 'do not disturb') is in action. In the USA some systems such as the Northern Telecoms SL/1 have overcome this problem by producing a special instrument with its own function keys which light up when in use (see Exhibit 11). Although some sort of instrument with user functions similar to this seems to be necessary in Europe it would be too constraining at this time for the PTTs to produce a standard version. The SPC-PABX industry is still too young, and standards imposed at such a relatively early stage would restrict development.

Computer logic will also invade individual telephones in the business and domestic environments. The principal facility to be provided will be abbreviated dialling. Typically an instrument might have a solid state memory adequate for ten full numbers plus a display and a 'dial' button. A user could allocate digits 1-9 to commonly used numbers, leaving zero to recall the last full number dialled. The display could show the number in store zero or the number being dialled — how often does one have to redial because of doubts about whether it was right first time?

B Voice Recognition and Response

Several voice recognition systems are available today but they have a limited vocabulary and are at present used for special applications. In particular they are used where keyboards would be inappropriate, for example where the operator's hands are otherwise occupied. In addition they normally need to be 'trained' to recognise a particular operator's voice. It is probable that in the future systems of this type will become cheaper and more tolerant of different voices, and the range of applications for which they are suited will therefore become broader. Nevertheless, for office purposes their use will be limited for two reasons: their use disturbs other workers, and for numeric information keyboards are faster and will always be cheaper. An example of a very cheap numeric keypad is the touch-tone telephone which can be connected to an IBM 3750 PABX and used for numeric data entry.

Voice response however is a different matter — in the example above the PABX (or a computer system) can respond by repeating the numbers entered to verify their accuracy and can also give voice-form answers to enquiries. This can eliminate the need for special enquiry terminals for some applications.

At present voice response units either use pre-recorded speech, in which case word combinations tend to have a staccato sound, or they generate synthetic speech. In the future more acceptable systems will become available.

C Voice Storage And Retrieval

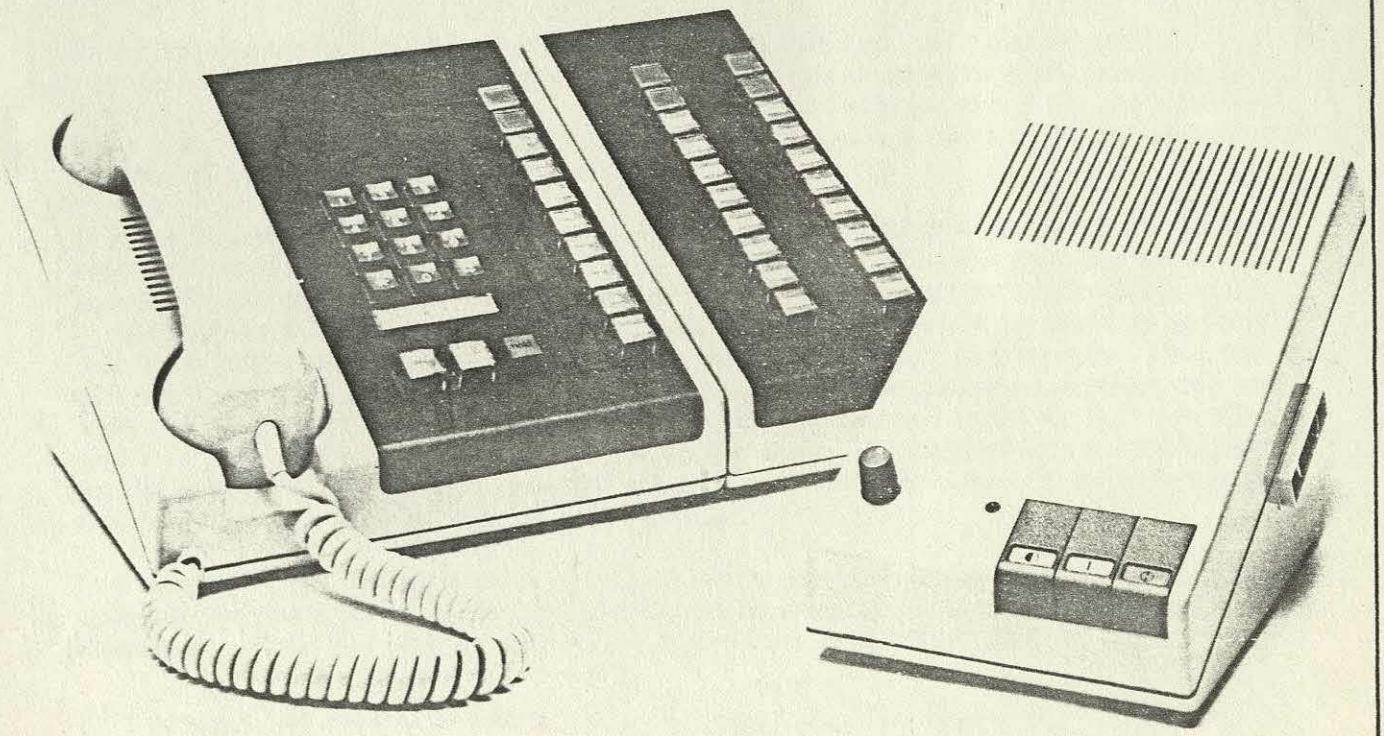
Perhaps the most important future PABX feature for most business users will be the ability to store voice messages, or voicegrams. The procedure might be as follows. A telephone caller dials a number but it is engaged or does not answer. In the former case the caller could 'camp-on' and wait for the PABX to make the connection when the recipient's handset is free; but if the caller is in a hurry to go out or wants to get on with something else then he can press the message key to record the message, simultaneously lighting a 'message waiting' lamp on the recipient's handset. To take the message — and extinguish the lamp — the recipient lifts the receiver, and presses the 'receive message' key. The same facility but without the lamp could be provided for external numbers by the PABX continuing automatically to try the recipient's number at intervals.

The concept of telephone message recording is already familiar in business through the use of centralised dictation systems which can provide sophisticated recording procedures for dictation, and through the message recording devices available for attachment to individual handsets in offices, shops and homes. However, the relatively simple PABX facility just described will allow the concept to become more widely available at a generally lower cost. And whereas dictation systems are oriented towards the ultimate production of text by their very nature, voicegrams will be aimed at displacing part of the need for text.

The general direction of developments will be to allow messages to be stored more permanently. PABX systems will retain a record of each message together with the date and time it was sent and received. It is also possible that the voiceprint of the sender (and possibly receiver too)

Exhibit 11 The SL-1 telephone switch

Basic SL-1 Telephone Set Plus Add-On Key /Lamp Module



photos by courtesy of Northern Telecomms

might be stored. Facilities of this sort could reduce the need for some of today's text correspondence – for example, memoranda designed to record agreements. Of course, memoranda containing tables, diagrams and other forms of information which cannot conveniently be represented by speech would still involve alternative visual means.

Nonetheless, retrieving voicegrams from storage will give rise to problems. Whilst it is fairly easy to construct an automatic text retrieval system to find a particular reference, stored vocal information offers no such simple equivalent. Some sort of integrated text and voice system will probably be necessary. The PABX could maintain a text index for each message with access by message originator, recipient, date and time.

Enquirers could request the system to display a list of all their calls made to nominated people during a stated period. By using an integrated telephone, display and full keyboard device, enquirers could enter the reference information through the keyboard at the same time as recording the message, and use the display for accessing the voice storage system through the text references.

The voicegram messages will almost certainly be stored in digital form (rather than conventional telephone analogue form). Speech can be reproduced satisfactorily at 56000 bits per second, and digital trunks are being developed all over the world to carry voice messages in this form. At 10^{-5} pence per bit (see Exhibit 8 again) the cost of storing a 30 second voice message at 56000 bits per second is just a few pence pa. However, by employing encoding techniques which require a lower bit rate, the cost of storage can be brought down, though at the expense of reproduction quality. One such technique is called Delta Modulation. This cuts out the higher speech frequencies with the result that reproduction is still virtually true-to-life but the bit rate can be reduced to 32000 per second. Alternatively 'vocoder' techniques can be used with just sufficient bits for the meaning of the message to be preserved, but at the loss of the character of the original voice. Vocoder techniques can require as few as 2400 bits per second, giving an equivalent storage cost at 10^{-5} pence per bit of under a penny pa. Probably Delta Modulation will be used for short term storage, and vocoder techniques for storing messages in archival stores.

V TECHNOLOGIES FOR DATA PROCESSING

For many years now data (numerical) services in business have been undertaken to a greater or lesser extent by computer based data processing systems. During this time the technology of computing has made rapid strides. This section addresses the question of data entry and processing by first discussing recent progress making computers more accessible to users; then computer systems and networks; and finally developments in data storage systems.

A Computer Access

In general computers have been able to provide businesses with more accurate and more timely data processing information than the old manual methods. But it is probably true that they have not had a significant affect on overall staffing levels — apart from a few well known exceptions. In the past there is no doubt that their value has been constrained by three functional drawbacks: the cumbersome and time consuming process of batch data entry with its attendant problem of error generation (see Exhibit 12); the lack of ready access to files for enquiry purposes; and the restrictions inherent in highly structured magnetic files compared with the flexibility of traditional paper files.

The first two of these problems are concerned with the accessibility of computer systems for office users. Although in the past it has been technically possible to satisfy these problems by installing computer terminals in the office, the terminals themselves and the software systems to support them have been expensive, and few applications have been able to justify the cost. Nowadays VDU-based computer terminals are available at prices as low as £500 and mini-computer systems are designed for interactive rather than batch use, reducing the software overhead.

In the future computer systems will become more accessible via new types of terminals — for example, we mentioned earlier a touch-tone telephone can be used for some data entry and enquiry applications. These new devices are discussed more fully in Section VII but in general there is little doubt that the office of the future will contain a range of devices which are capable of communicating with computer systems.

This will benefit both clerical and managerial workers. For clerks, data processing systems will become more usable. Interactive rather than batch data entry will be the norm (see Exhibit 12 again) and data will be available for immediate enquiry. For managers and professionals, access to computer timesharing systems for planning and problem solving will be easier. In addition this latter group of office workers will increasingly be equipped with personal 'desk top' computers. Personal computers are logical developments of the desk top calculator, and are with us already. The IBM 5100 and Hewlett Packard 9800 are two examples. Both can offer high level languages with diskette or cassette storage though the range of software packages is restricted as yet and is oriented towards engineering and scientific work — in the same way as timesharing services were some six or seven years ago.

In the future there will tend to be a merging of the personal computer and the interactive terminal into one kind of device capable of operating in a stand-alone mode for simple local tasks, or connected to a large timesharing processor for more complex tasks.

B Computer Systems and Networks

During the last few years the cost of computer processing has fallen significantly when compared with the cost of employing personnel. And the economics of computing scale which have led to centralisation in the past are today less real and less attractive.

Exhibit 12 Benefits of interactive data entry

Example: accounts clerk allocates cash received against orders

batch data entry

- clerk looks up customer no. and enters it on a coding form
- clerk looks up printed sales ledger and codes items and amounts paid
- coding forms sent to data preparation dept for keying and processing
- data checked by computer for validity – errors returned for correction and balance processed and listed.

In each of the above steps further errors can be introduced, some of which will not be recognised by the computer. The process is time consuming, and expensive.

interactive data entry

- clerk keys first 3 characters of customer name and town and the total cash received, using interactive terminal device connected on line to the computer
- details of all corresponding customers displayed instantly, from which clerk selects the current one
- all outstanding invoices displayed, and clerk selects those to which the cash relates
- computer checks that the total allocated corresponds to the total received and allows corrections to be entered there and then.

In the future it will be economic for newer generation computers to spend much of their time idle but available; they will no longer be expensive capital investments justifying careful control and scheduling to safeguard their utilisation.

The reducing cost of computing is allowing processing power to be distributed amongst users either in the form of self-contained (stand-alone) devices, or terminals which are interlinked to a central computer – which can either be a local minicomputer or a local or remote mainframe. The arguments in favour of local minicomputers are very powerful, especially where they can be dedicated to a single application area. Perhaps their most important benefits are low cost and lack of reliance on vulnerable communications services.

Nonetheless, it is true that local interactive minicomputer systems have suffered some disadvantages compared with their larger mainframe counterparts. These disadvantages have included less certain reliability – many minis have lacked self-checking and memory parity checking facilities; less secure service, because suppliers have lacked an understanding of the service requirements of business users; and less adequate software. All of these deficiencies will be remedied in time. For example, as processor costs decrease more redundancy and self checking circuits will be incorporated and multiprocessor systems will become the norm.

Another important trend is the development of dedicated data networks enabling computers to communicate wth one another. These are particularly important at present for common user groups (for example banking) or for large decentralised businesses which have a number of geographically dispersed computers.

Early networks have been designed to be centrally controlled, usually by a mainframe computer. More recently the trend has been towards homogeneous networks in which terminals and computers are attached in such a way that the network complexities are transparent to the user. These homogeneous networks offer improvements in four main areas.

The first of these is quicker response times – cutting down the time loss which is the inevitable consequence of either making a connection over the switched telephone network, or waiting in a queue with polling.

The second improvement is a reduction in errors. Buffered terminals can detect errors and call for retransmission if they know how to notify each other about errors, and how to recognise requests for retransmission.

Reduced user costs through resource sharing is the third way in which homogeneous networks can offer an improvement over more conventional arrangements. Polling systems are inefficient because polling messages have to be sent continually even when no data needs to be transferred. A homogeneous network avoids the need for this constant interaction.

Finally, homogeneous networks can offer improved reliability. Fault isolation is easier because the protocol provides a means of identifying error sources.

As more and more minicomputer systems are installed to serve individual departments within businesses there will be a need for them to communicate with each other to exchange interdepartmental information and to collect central management information. It is here that data networks will become important even for quite small businesses.

C Data Storage And Retrieval

For business information where information structures and content are repetitive, special types of filing systems are necessary. To resolve the problems of record duplication, many different approaches to data base design have been used in the computer industry during the last decade.

Even though considerable effort has been expended on the design of data base management systems the vast majority are installed not to satisfy business needs but to help ease internal data processing problems. For example, a key requirement of a DBMS is usually that programs should be independent of the physical data storage method. This 'extra bonus' of most DBMS systems is only relevant in that it can allow the data processing department to be more flexible in implementing system amendments or changes in hardware configuration – it has no func-

tional business relevance.

It is therefore not surprising that the two most successful data base management systems – IMS and TOTAL – have achieved their prominence not because they offer the best method of representing data relationships but because they are the most aggressively sold, the simplest to understand, and the best supported.

In the future, when computer systems become more accessible, there will be more pressure for the data base to satisfy real business relationships and to be accessible to users using very high level command languages. It is possible that the 'relational' data base, now still a research subject, will be developed to fill this need. The availability of very large low cost storage and cheap powerful processors will help to make this a practical proposition.

VI TECHNOLOGIES FOR IMAGE PROCESSING

There are many business applications for which a picture is worth a thousand words. Pictorial information can either be static or moving, and both are embraced by image processing. Static image information includes graphics such as logotypes and special typestyles, as well as illustrations, signatures and graphs. Moving image information includes video, Picutephone, TV and video-conferencing.

A Creating Static Image Information

Static image information can be generated by computer from internal data and displayed using a graphic display unit. Alternatively it can be created interactively using a special pen in conjunction with a sensitive terminal able to track the pen movements. But much the most important is the conventional way, by a variety of non-computer methods; in this case the contribution of technology in the context of this report is reduced to one of reading, transmitting and storing the images.

Graphic displays are not nearly as widely used as the applications for which they are appropriate would seem to indicate. The reasons for this include technical difficulties, and cost. Until a few years ago the only form of graphics terminal was the mechanical plotter which tended to be unreliable and somewhat restricting. More recently a range of high resolution graphic cathode ray tube (CRT) devices has been developed with capabilities including multiple colours and shape forming of virtually unrestricted ability.

At present graphic CRT displays are expensive, and the software necessary to support them is complex and hard to use. However, this position is beginning to change as the price of the hardware falls and as computer memory power and storage becomes available at a cost which will make the use of the displays much more economical. User-oriented software and operator prompting will allow the displays to be more easily controlled, enabling people without a mathematical or scientific background to use them without difficulty.

Graphics can be created interactively either by using a lightpen attached to a CRT terminal, or by using a special pen in conjunction with a graphic tablet. At present the majority of such devices are used for scientific (e.g. weather forecasting, medical analysis) and engineering applications (e.g. structural design), but in future a new range of business applications will emerge such as the production of sales and financial data. The lightpen device works by projecting onto the CRT screen a beam of light which is sensed by a photodiode and transmitted to the CRT electronics in order to define its position. Positional information is fed continuously into the system as the beam of light is moved across the CRT. On the other hand, graphic tablets allow pens to be moved across paper, and here the incremental pen positions can be tracked by the tablet in a number of ways – for example by a pressure sensitive electrical grid, or by sonic digital converters in which a series of sparks at the tip of the pen generates sound waves which are picked up by strips of sensors located at the sides of the tablet. Graphic tablets have a number of advantages over CRT lightpen devices; the pen looks more normal, hardcopy is produced simultaneously, and the cost is lower. Nonetheless it is probable that high resolution CRTs will become available in offices as combined word processor/facsimile receivers and they may well be developed to provide interactive graphics capabilities as well.

B Facsimile Transmission

Graphic output displays and graphic input terminals as described above are both essentially

computer-dependent systems and so the procedures for communication are the same as for data processing. However, when images have been created in the conventional way, facsimile transmission can be used for sending copies to remote locations.

Two dimensional images can be scanned and digitised, then transmitted as a continuous bit stream rather than as a series of bit-encoded characters as with a communicating word processor. Most facsimile transceiver devices currently installed are of the 'Group 1' analogue type, rated at about six minutes per A4 page. The transceivers themselves are expensive to buy and to use – the transmission rate is equivalent to about three lines of a page over long distance dial-up lines during peak rate times for the cost of a first class letter stamp (one page at the local area rate). Moreover, the equipment is far from being standardised, so only like machines can converse with each other. Often they need special paper at the receiving end, and their resolution is barely adequate. However, the new digital facsimile devices are able to transmit an A4 page in less than a minute – equivalent to about eight pages over the local area dial-up lines during peak rate times for the cost of a first class letter stamp. Exhibit 13 compares the costs of an overnight delivery mail service with both analogue and digital facsimile systems. The new 'Group 3' digital facsimile standards are rapidly obtaining international agreement; not only are they faster than Group 1, but their signals are capable of being stored, processed, displayed and integrated into a more comprehensive system.

Compared with encoded character transmission, facsimile will remain more expensive because digital scanning requires at least ten times as many bits per character to give adequate resolution. Furthermore, encoded characters can be much more readily retrieved from storage using techniques such as indexing, string and keyword searching.

It is very likely that facsimile receivers will be developed with hard copy printers essentially identical to the latest types of character printer of the non-impact variety (character impressions are not formed by impacting shapes onto the page, but by techniques such as inkjet spraying), so the opportunity will exist for a common printing device to be shared for both purposes. The IBM 6640 inkjet printer is an example of a character printer already having character resolution nearly as good as an office electric typewriter, and with the potential to be developed into a printer capable of handling equally well a range of graphical, facsimile and character output.

C Static Image Storage And Retrieval

Image processing systems can share the same kind of storage devices as already described for data processing, but the coded data lacks meaningful 'handles' which might facilitate retrieval in just the same way as coded voice data. The solution, as for voice storage, is for the additional indexing information to be keyed in at the same time as the image data.

One special case of image storage system does deserve mention though, and that is microfilm. Computers can output data as COM (computer output microfilm) and suppliers have tended to market COM as an alternative to paper printout. In reality though it is a form of archival storage, ie data stored for reference or security rather than data which is either changed regularly or is transient in use. Its main benefit has been to save space whilst allowing relatively rapid retrieval of the data. A good example of the application of this technique is in motor car spare parts lists, where service centres require to be able to retrieve information from very large and relatively stable data lists.

However, microfilm techniques are likely to prove of restricted use in the longer term. Ultimately in many applications they will be almost entirely superceded by digital storage and on-line retrieval systems using VDU displays, which offer superior access speed and facilities.

D Moving Image Services

Closed circuit TV for security and surveillance and video films for education and training are two examples of moving image services which are already well accepted in the business environment. In recent years suppliers have tried to promote interest in a wider range of moving image systems for the office. Two in particular have received a great deal of attention in terms of development resources and publicity – Picturephone and video-conferencing.

Picturephone is the name of the US system developed by Bell for adding picture images to the

Exhibit 13 Overnight mail cost comparisons

Comparison of guaranteed overnight mail delivery service using mail bags with analogue and digital facsimile systems which assume 'midnight line' tariffs.

pages per night per station	comparative costs		
	facsimile		mail bags
	analogue	digital	
30	7	10	8
60	12	11	8
120	24	13	8
240	50	17	15
480		27	30
960		54	60

voice-only telephone (Viewphone is the name of the British equivalent). It permits the observation of facial expressions by means of attached display screens at both ends of a telephone connection. Picturephone is now operating on a limited basis in the US but it is very expensive — many times more than the cost of a simple telephone — and its resolution is insufficient for users to be able to read typed documents such as computer printouts, contracts and engineering drawings.

However, Picturephone has certainly stimulated interest in the allied area of video-conferencing. The justification for this application is the saving both in executive time and travel cost which can be gained. Personal meetings take up a large proportion of the time of administrative and professional staff, and this is the fastest growing sector of office workers with the highest per-hour cost. It would be unwise to suggest that video-conferencing can eliminate more than a small proportion of the need for personal meetings because so often a physical presence can add more than is possible through even the most sophisticated remote video-conferencing. What is likely to emerge is a range of types of meeting. Physical meetings allowing full face to face communications will be most expensive and time consuming, but also most rewarding. Next most expensive will be video-conferencing using specially designed rooms perhaps with TV screens and cameras and other equipment such as electronic flip charts and facsimile equipment; and finally simple telephone-only meetings without recourse to visual images, which will have the merit of being cheap, simple and convenient. Features already available on the latest switching systems make such telephone meetings possible.

These telephone conferences are likely to be widely used, not as a replacement for other types of conferencing but as a new office facility.

VII INTEGRATED INFORMATION PROCESSING

As mentioned in Section II, office managers will need devices which are either special purpose in nature and cheap enough not to require intensive use, or multifunction devices able to carry out a variety of functions which are matched to the job needs of their operators.

This section describes some examples of developments in the first category, then addresses the second category looking at some early examples which are already emerging and the kind of developments which are likely to follow.

A Cheap Specialised Devices

The telephone instrument is developing from being purely a voice instrument into a data terminal leading to a family of very cheap office terminals.

At the bottom end of the range the keypad of an ordinary touch-tone telephone can be used to enter numeric information into a computer system. If the computer is equipped with a voice response unit, simple two-way transactions or enquiries can be made. Some portable data capture devices use the same principle on an ordinary telephone. A separate battery-driven keypad held over the handset can generate the required multifrequency tones.

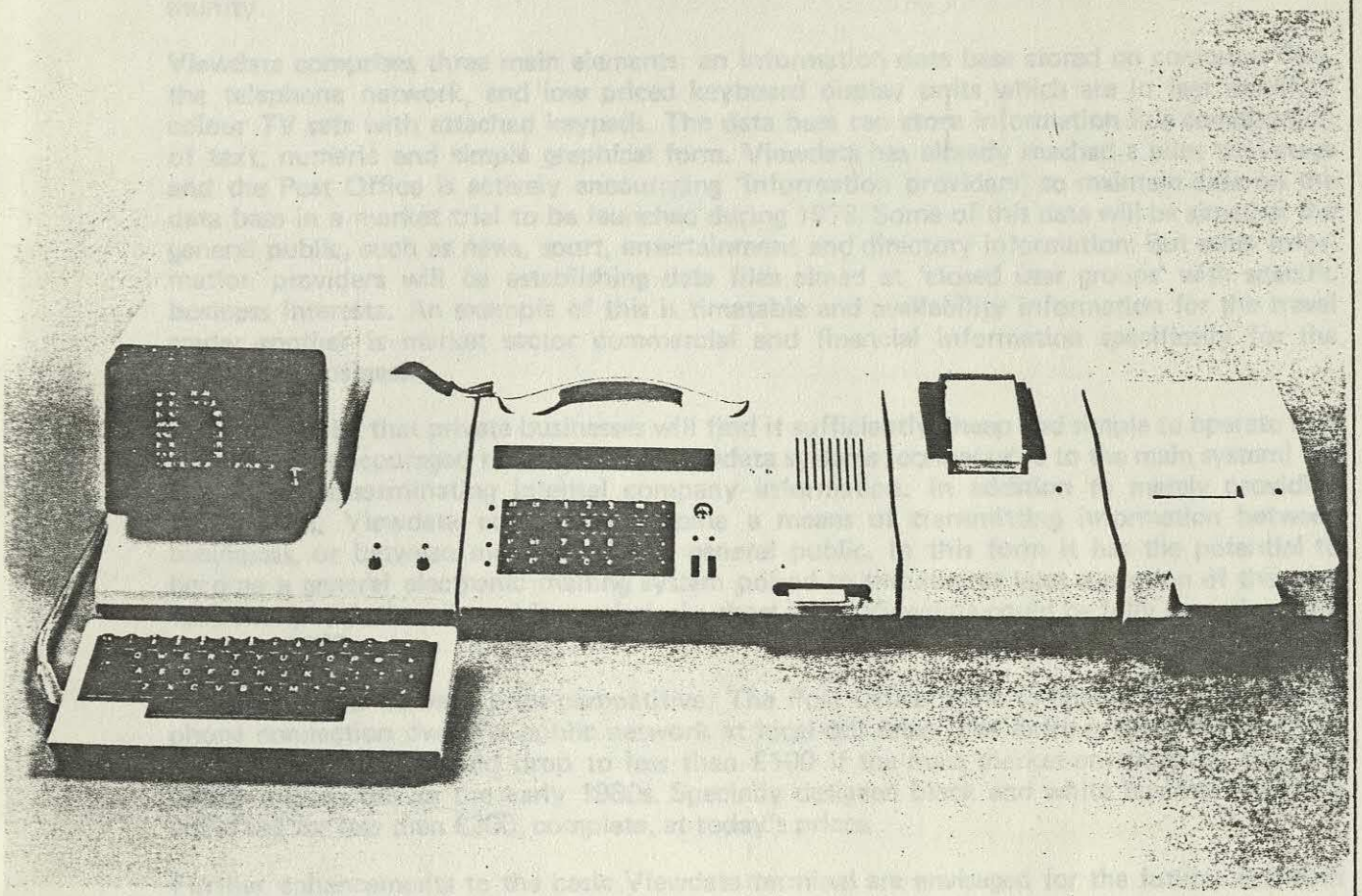
At a higher level some manufacturers are producing telephone instruments with extended functions. An example of this is the Nixdorf DATATEL illustrated in Exhibit 14. The basic unit comprises a numeric display, keyboard and modem. Optional add-on modules provide a choice of small printers, alphanumeric display, full keyboard, and badge and card readers. IBM has also developed a similar family of devices which use audible signalling, and not requiring a modem.

A major problem with this kind of device is the restrictive attitude of the European PTTs who tend not to sanction the attachment of equipment directly to handsets in the public switched network, thereby limiting the market opportunities of the types of device just mentioned. If the PTTs change their policy the outlook would be a great deal brighter.

In the US new designs of handset have been developed recently embodying a variety of both cosmetic and practical features. The recent report of the Carter Committee recommends for the UK a more liberal attitude by the Post Office, and it is therefore possible that similar types of equipment will become available here.

One of the problems of the telephone is that communication is restricted just to voice, whereas face-to-face conversations involve more than voice alone. A technique which recognises this shortcoming is the telephone notepad, in which a small screen is attached to the telephone handset and uses a small proportion of the voice channel. Many business people like to resort to simple sketches when trying to explain a complex point, and it is the purpose of the telephone notepad to cater for this need by allowing sketches to be drawn with a special pen on the screen at either end of a two way telephone connection, an identical sketch being displayed simultaneously at the other end. Telephone notepad devices are already available but they do not yet meet the requirements outlined above: at present they are clumsy, unidirectional and they need a separate dedicated voice channel. These early examples will undoubtedly be improved, but whether they can ever be made sufficiently cheap for widespread use is uncertain. It is quite likely that they will be overtaken by more ambitious developments in image processing.

Exhibit 14 The Nixdorf Datatel



System Nixdorf 8811

Courtesy Nixdorf Computer AG

The basic unit comprises a handset, loudspeaker, twelve button telephone keypad and sixteen character strip display with an integral microprocessor. Add-on peripheral devices include an alpha keyboard, a magnetic badge reader, a small 80 column card reader, a five inch CRT display and two small printers.

B Viewdata

Another form of integrated service which could become very significant for office workers in the future is the Post Office's Viewdata system. In a sense this is another form of relatively cheap telephone-attached device. Although it was originally conceived as an information service for the general public with the aim of increasing the utilisation of the public telephone system, early trials have indicated the great potential of the system to the business user community.

Viewdata comprises three main elements: an information data base stored on computer files, the telephone network, and low priced keyboard display units which are in fact modified colour TV sets with attached keypads. The data base can store information in a combination of text, numeric and simple graphical form. Viewdata has already reached a pilot trial stage and the Post Office is actively encouraging 'information providers' to maintain data on the data base in a market trial to be launched during 1978. Some of this data will be aimed at the general public, such as news, sport, entertainment and directory information. But other information providers will be establishing data files aimed at 'closed user groups' with specific business interests. An example of this is timetable and availability information for the travel trade; another is market sector commercial and financial information specifically for the advertising business.

It could well be that private businesses will find it sufficiently cheap and simple to operate that they will be encouraged to use private Viewdata systems (connectable to the main system) for storing and disseminating internal company information. In addition to merely providing information, Viewdata could also become a means of transmitting information between businesses, or between members of the general public. In this form it has the potential to become a general electronic mailing system poised to threaten at least a portion of the conventional physical mail, and in a relatively short time: Viewdata could be fully operational by the early 1980s.

Viewdata could be very price-competitive. The Post Office plans to charge the time of telephone connection over the public network at local-call rates. The extra price of the modified TV set and keypad could drop to less than £100 if the mass market envisaged by the Post Office materialises in the early 1980s. Specially designed black and white business terminals could sell for less than £200, complete, at today's prices.

Further enhancements to the basic Viewdata terminal are envisaged for the future, as shown in Exhibit 15. These include a simple storage device (e.g. tape cassette) and hard copy printer. Equipped with these the Viewdata system takes on more of the appearance of a multifunction workstation. And there is no inherent reason why Viewdata terminals should not be used to communicate with other computer systems, providing they have the software to support the information interchange protocol. However, the Viewdata terminal, being an adapted TV set, does suffer some shortcomings. The screen is designed to be viewed from a distance of some six to eight feet whereas the office VDU is designed to be viewed close up; its screen format is restricted to 23 lines each of 40 characters, compared with the VDU industry standard of 24 x 80 characters (and some display word processors offer 'full page' displays of around 70 x 100 characters). And of course the Viewdata system uses its own special communications protocol.

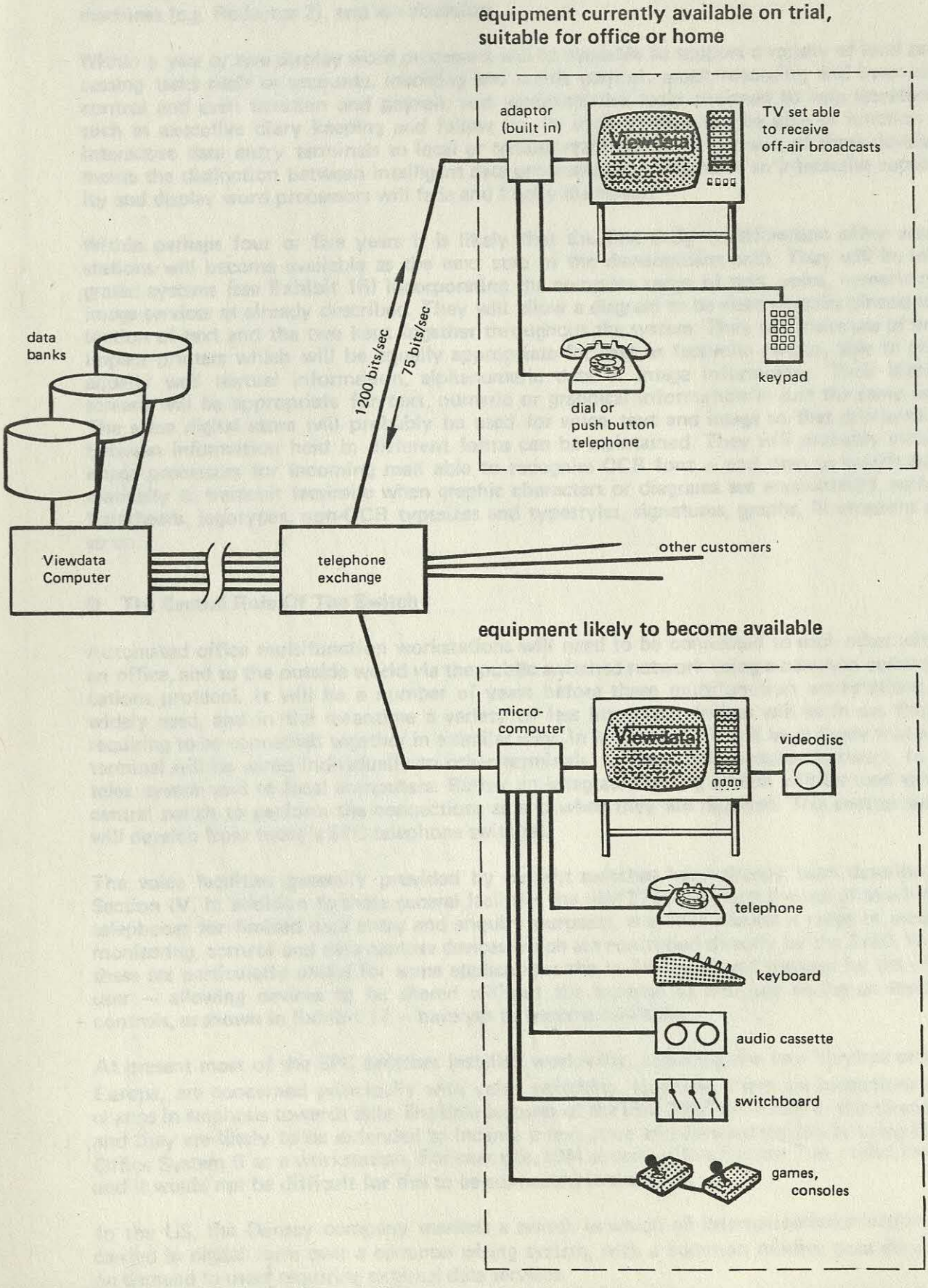
Nonetheless, Viewdata has the potential to offer an attractive alternative form of office information and message delivery system.

Scenarios of the future often describe a 'home office'. Viewdata could be developed to provide many of the features envisaged, such as the ability to access electronic mail boxes from home. If Viewdata is accepted as widely and as rapidly as the Post Office hopes, then a significant proportion of business employees and customers could have interactive terminals in their homes by the mid- to late- 1980s, and the opportunity for at least some of them to work from home for part of the time will become a real proposition.

C Multifunction Devices

It is clear from earlier sections that the technologies being developed to support text, data and image processing are converging. It is logical therefore that workstations will be developed in

EXHIBIT 15 Viewdata



the future able to handle all these information processing functions, and because they will usually be connected to each other over the telephone network, they will include voice processing as well.

Already some display word processors are being developed to provide services beyond the basic text editing, storage and transmission facilities. These enhancements allow them to be used as data entry and enquiry terminals to local or remote computers (e.g. IBM System 32), as telex machines (e.g. Redactor 2), and as calculators.

Within a year or two display word processors will be available to support a variety of local processing tasks such as accounts, invoicing and credit control, stock recording and inventory control and even taxation and payroll; and administrative tasks designed to help secretaries such as executive diary keeping and follow up. In addition they will be able to function as interactive data entry terminals to local or remote mainframes. As a result of these developments the distinction between intelligent data processing terminals with an interactive capability and display word processors will fade and finally disappear.

Within perhaps four or five years it is likely that the first truly multifunction office workstations will become available as the next step in the development path. They will be integrated systems (see Exhibit 16) incorporating the complete range of text, voice, numeric and image services as already described. They will allow a diagram to be electronically pinned to a section of text and the two kept together throughout the system. They will make use of non-impact printers which will be equally appropriate for text or facsimile output, able to print equally well textual information, alphanumeric data or image information. Their display screens will be appropriate for text, numeric or graphical information in just the same way. The same digital store will probably be used for voice, text and image so that relationships between information held in different forms can be maintained. They will probably include image processors for incoming mail able to recognise OCR font – and then to switch automatically to transmit facsimile when graphic characters or diagrams are encountered, such as letterheads, logotypes, non-OCR typesizes and typestyles, signatures, graphs, illustrations and so on.

D The Central Role Of The Switch

Automated office multifunction workstations will need to be connected to each other within an office, and to the outside world via the public switched network using a common communications protocol. It will be a number of years before these multifunction workstations are widely used, and in the meantime a variety of less integrated devices will be in use though requiring to be connected together in a similar way. In large offices it will be unlikely that each terminal will be wired individually to other terminals, to the public switched network, to the telex system and to local computers. Rather an integrated wiring system will be used with a central switch to perform the connections as and when they are required. This central switch will develop from today's SPC telephone switches.

The voice facilities generally provided by current switches have already been described in Section IV. In addition to these general facilities the IBM 3750 supports the use of touch-tone telephones for limited data entry and enquiry purposes, and IBM market a range of security monitoring, control and data capture devices which are controlled directly by the 3750. Whilst these are particularly useful for some applications the really significant features for the office user – allowing devices to be shared without the expense of multiple wiring or multiple controls, as shown in Exhibit 17 – have yet to become available.

At present most of the SPC switches installed worldwide, including the two hundred or so in Europe, are concerned principally with voice switching. However, there are indications of a change in emphasis towards data. The data features of the IBM 3750 are a step in this direction, and they are likely to be extended to include a text store and forward capability using IBM's Office System 6 as a workstation. For example, IBM already offers System 7 as a telex switch, and it would not be difficult for this to be connected to the 3750.

In the US, the Danray company markets a switch in which all internal communications are carried in digital form over a common wiring system, with a common modem pool allocated on demand to users requiring external data services.

Exhibit 16 The office multifunction workstation

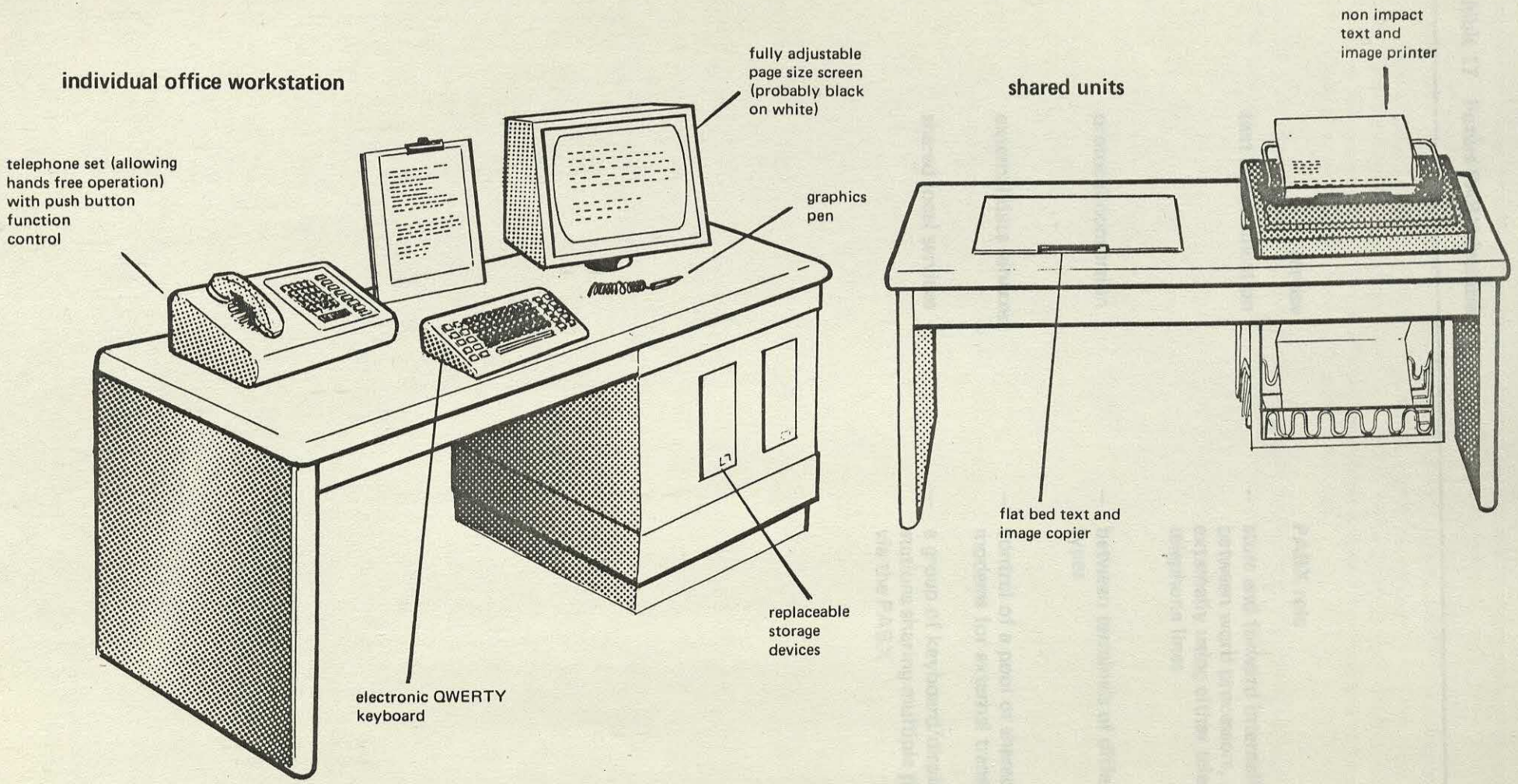


Exhibit 17 Future PABX facilities

service	PABX role
text communication	— store and forward internally between word processors, and externally using either telex or telephone lines
protocol conversion	— between terminals of different types
external data services	— control of a pool of shared modems for external transmission
shared local services	— a group of keyboard/display work-stations sharing multiple printers via the PABX

A potential problem in using telephone switches in this much wider role arises because the traffic patterns are less predictable. Traditionally voice switches have been designed with limited connection capability since even at peak times only about 25% of extensions are in use at any one time. To carry out the wider role, a switch will clearly need a much higher capacity. Fortunately the development of cheap high speed memories coupled with the shift to digital switching offers a solution to this problem – a solution which can already be found in another US device – the Wescom company's 580 switch, which allows all extensions to be connected simultaneously at a price competitive with other products.

Exhibit 18 shows how a central mixed voice and data switch might be installed to perform the switching connections between a variety of internal office devices and the outside world.

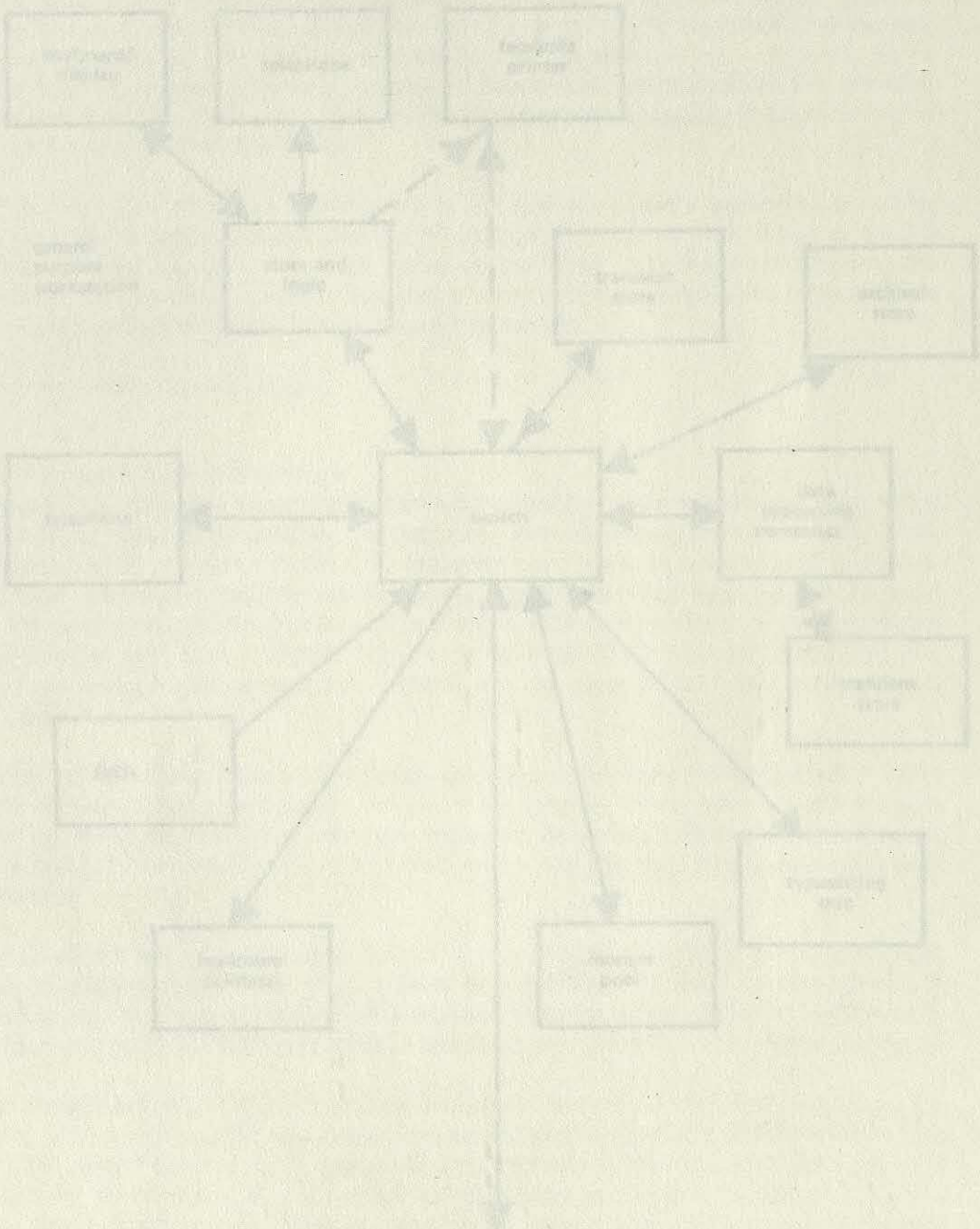
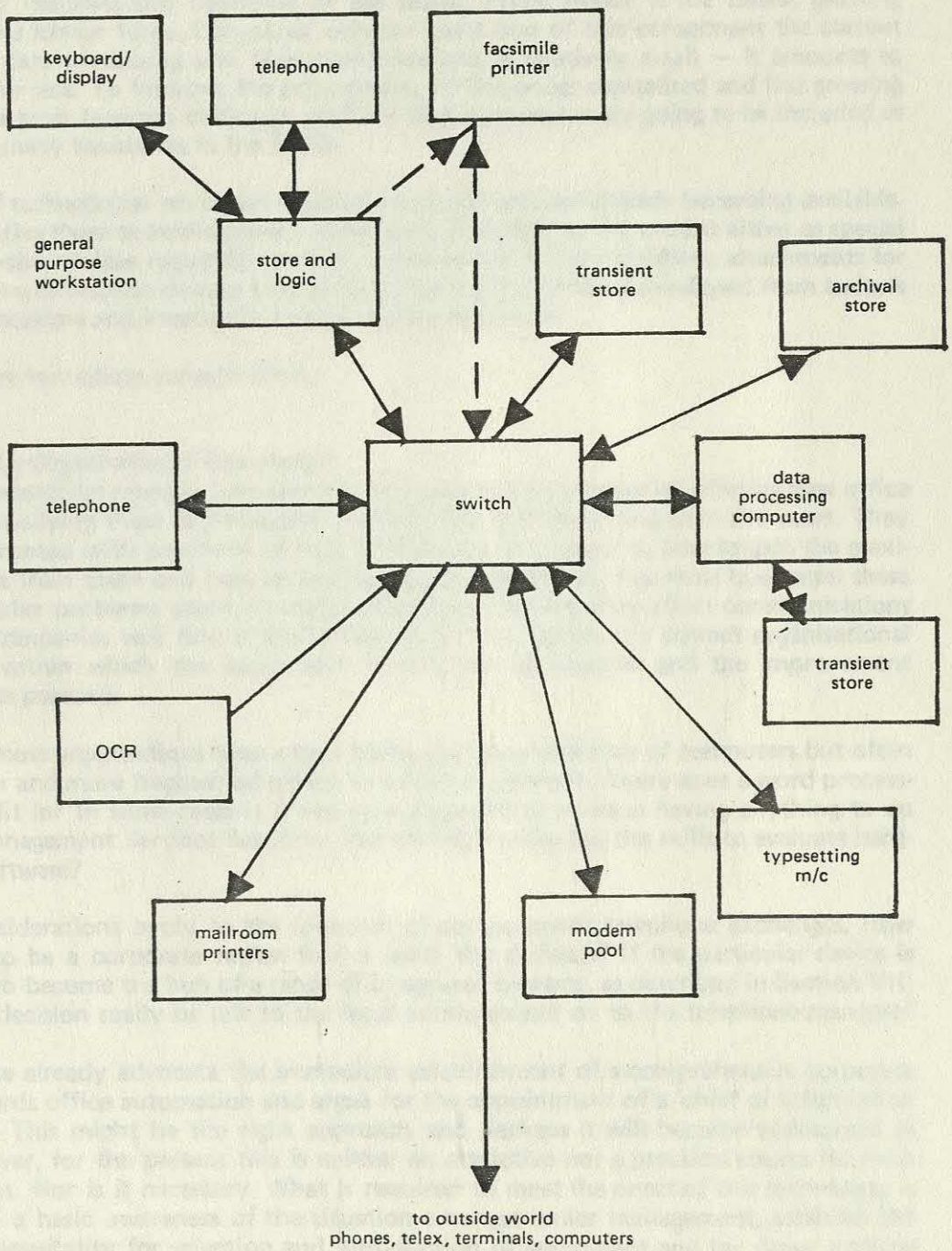


Exhibit 18 The central role of a mixed voice/data switch



VIII CONCLUSION

In the advanced industrialised countries of the world, office labour is the fastest growing component of the labour force. Compared with the total cost of this component the current expenditure on data processing and telecommunications is relatively small – it amounts to about one-fifth or less. To improve the productivity of this under-capitalised and fast growing area represents a great business challenge, and one that is undoubtedly going to be included as a major goal for many businesses in the 1980s.

A wide range of technologies which are appropriate to the task are already becoming available. To be fully effective these technologies will need to be presented to the market either as special purpose inexpensive devices requiring less than intensive use (cheap telephone attachments for example), or as multifunction devices able to support a variety of tasks developed from today's display word processors and intelligent data processing terminals.

Two areas require immediate consideration:-

1. **Setting Up An Organisational Framework**
   Office administration managers are going to be bombarded by salesmen offering new office products embodying these technologies, starting now and increasing over the years. They will be confronted with problems of how to evaluate the products, how to gain the maximum benefit from them and how to ensure their compatibility. For most businesses these will be complex problems assuming major proportions where they affect communications networks. Companies will find it vitally important to establish the correct organisational framework within which the equipment factors can be assessed and the improvement opportunities pursued.

   At present most organisations have a firm policy on the acquisition of computers but often have a looser and more fragmented policy on office equipment. Where does a word processing system fit in? In some cases it is not even regarded as an issue having anything to do with the Management Services function. Yet who else really has the skills to evaluate hardware and software?

   Similar considerations apply to the selection of computerised telephone exchanges. How far is this to be a corporate rather than a local site decision? If the particular device is eventually to become the hub of a range of integrated systems, as described in Section VII, should the decision really be left to the local administrator or to the telephone manager?

   Many people already advocate the immediate establishment of a comprehensive corporate policy towards office automation and argue for the appointment of a 'chief of information processing'. This might be the right approach and perhaps it will become widespread in time. However, for the present this is neither an attractive nor a practical course for most organisations. Nor is it necessary. What is required to meet the onset of this technology is to establish a basic awareness of the situation amongst senior management, establish the lines of responsibility for selection and introduction of equipment and lay down a policy and guidelines for its acquisition.

2. **Educating The User And The Specialist**
   Clearly line executives need to be made aware of the possibilities, just as in the past they have been educated (though not always too well) in the use of computers. There is a need then for a campaign to draw management's attention to the nature of, and the trends in, administration costs and to reveal the technologies which offer solutions.

Ideally, management should learn of these opportunities from their own systems specialists – rather than from equipment salesmen. However, there is a problem here: as yet, too many systems analysts and designers themselves fail to recognise the real potential of the new technologies. They mistakenly regard office equipment and telephones as rather mundane compared with mainstream computing. In fact these developments open up the way for far wider reaching company information systems. In their way these systems will be far more sophisticated: certainly in their integration with people's working behaviour. They may also have a bigger influence on the successful running of the business than most of today's computer systems.

It is essential that data processing staff are rapidly made aware of this potential and become familiar with the increased range of tools that systems designers can have at their disposal.

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