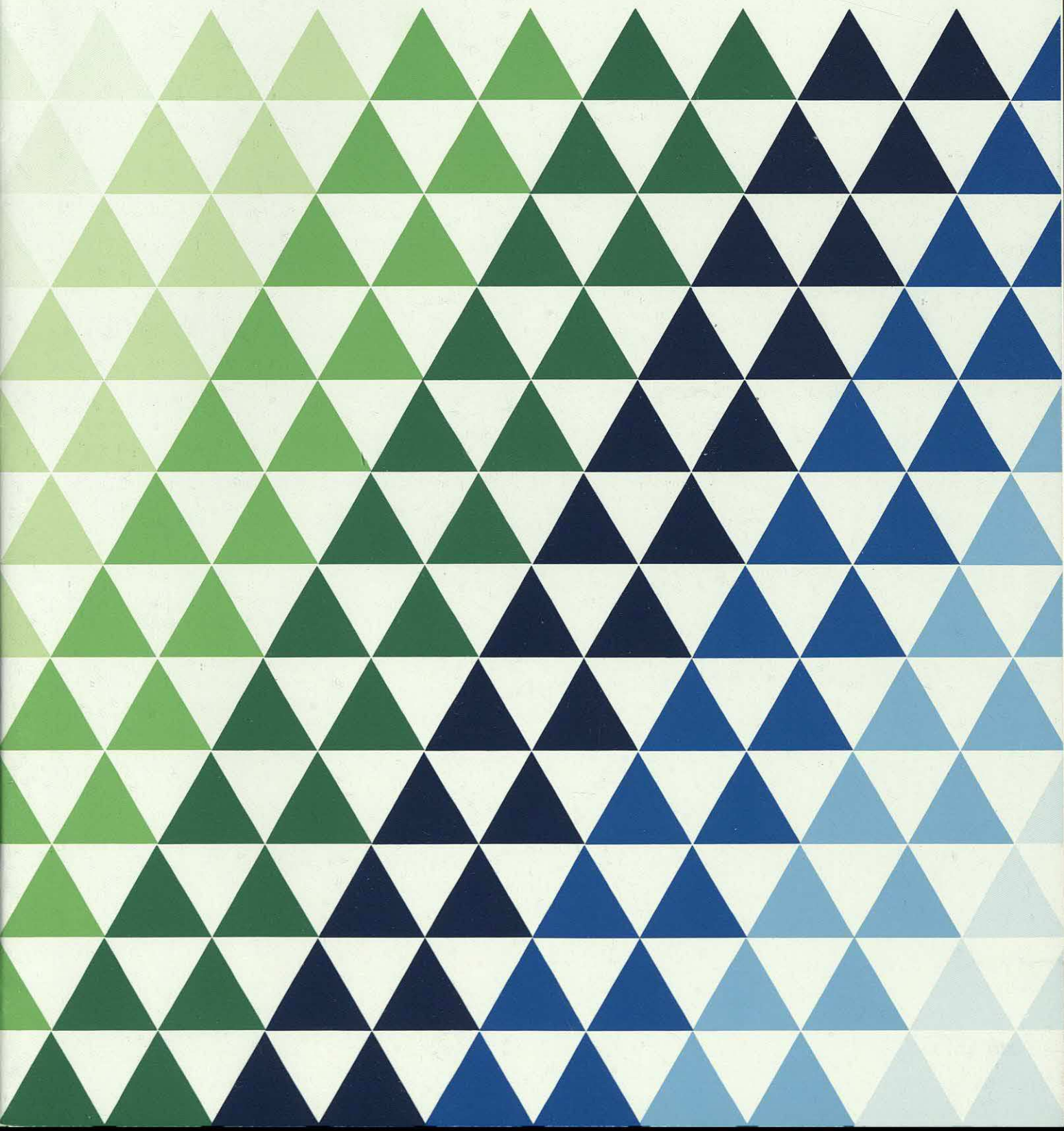
Management Summary

BUTLER COX FOUNDATION

Workstation Networks

A Technology Review for Managers



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Management Summary
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Management Summary

Workstation Networks
A Technology Review for Managers

Foundation Report 80, Workstation Networks, was published in April 1991. It is the Foundation's annual technology review for managers, and as such, concentrates on those areas of workstation technology that systems directors need to understand as they plan to install networks of intelligent workstations. This document summarises the main management messages to arise from our research. The full report is available only to members of the Butler Cox Foundation.

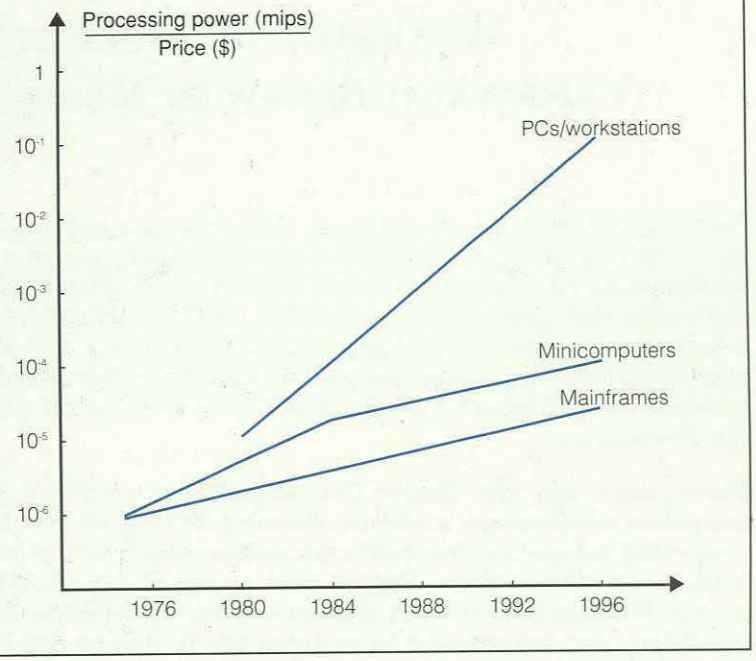
Three years ago, the Butler Cox Foundation predicted that computing architectures would move towards a two-level structure comprising networks of personal workstations supported by mainframes and other servers. We are now on the threshold of this change. Workstation networks promise opportunities both to make significant cost savings and to increase the flexibility and ease of use of computer systems.

Until recently, networks of personal computers have been established in offices mainly to enable users to share printers and other resources. The technology has been relatively primitive, and while many have experimented with small systems, only a few pioneering organisations have attempted to use such networks for mainstream business applications. The major vendors, too, have been cautious, preferring to provide tried and tested hardware and software rather than new, unproven technology. Now, however, a growing number of large organisations are planning to base their future computing infrastructures on this technology.

During the last decade, the economics of computing have changed completely. Small, personal computers now deliver computer processing power much more cheaply than mainframes (see Figure 1, overleaf). However, there has been no easy way of harnessing this power to handle mainstream applications involving large databases, multiple users and high transaction rates. Client-server systems based on workstation networks provide the answer. By dividing applications between personal workstations (PCs), mainframes and other specialised machines, client-server systems enable organisations to take advantage of the technologies that can handle different parts of their applications most cost-effectively. They are set to become the most important part of many organisations' IT infrastructure.

To gain the full benefits of workstation networks, workstation operating systems need to become more sophisticated and graphical user interfaces should be implemented. In the full research report, which is the Foundation's 1991 technology review, we therefore examine the technologies associated with client-server systems, workstation operating systems and graphical user

Figure 1 The price/performance of PCs and workstations is outstripping that of other types of computers



interfaces. Systems directors will have to make important decisions about these technologies before implementing business applications on workstation networks.

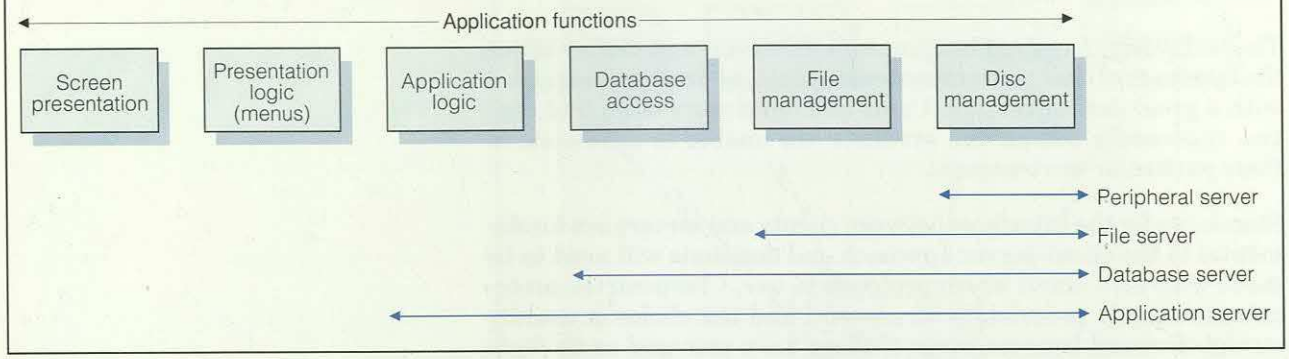
Client-server systems

Many attempts have been made in the past to use workstations as 'intelligent terminals' linked to mainframes or minicomputers so that the computing workload can be shared between them. These attempts have often failed because of a lack of workstation processing power, immature standards and over-complexity. The client-server approach is emerging as the most successful and practical method of developing and managing corporate distributed systems.

The client-server concept is straightforward: individual workstations (called clients) are connected via a network to one or more multi-user computers (called servers). The workstations do what they are best at — providing inexpensive processing power, formatting data and presenting it to the user in a way that is consistent and easy to use. The servers do what they are best at — handling large databases and high transaction volumes.

The servers permit information to be made available to many client workstations; the client workstations have the capability to integrate it in different ways depending on the requirements of individual users. Workstations can be of different types and capabilities to suit the needs of the individuals who use them; servers can be of different types to suit the data processing and computing functions that they have to perform. Figure 2 indicates how application functions can be partitioned in different ways, depending

Figure 2 Different types of servers handle different functions



on the type of servers available. The full report provides guidance on technical issues and details of some emerging products.

This simple concept has taken some years to reach the point where it is a practical proposition, mainly because of the difficulty that the various vendors have had in agreeing on standards. Now, however, client-server systems can provide undoubted business benefits, providing that organisations are prepared to devote attention to the management implications of introducing them. From a management perspective, there are several risks that need to be managed and procedures that have to be established if the benefits of client-server systems are to be achieved. These concern the choice of interface standards, and the needs to manage the network, to introduce new systems development approaches and skills, and to ensure that business managers are aware of their responsibility for the accuracy of integrated information.

Client-server systems offer significant business benefits

Hardware and software now exist to build client-server systems and there are examples of organisations that have based their entire systems architecture on the client-server concept. The benefits of client-server systems are that they offer considerable cost savings over conventional systems and are more flexible in their use. These benefits arise from the modular basis of the concept, which permits an application to be divided into discrete components interlinked by standard interfaces. The components can then be implemented using the most cost-effective combination of hardware and software. This means that the organisation can take advantage of the better price/performance provided by small computers, and can use specialised machines. Database servers are an obvious example. The modular concept also means that systems are easier to change and that applications and information can be easily integrated in various ways to give business advantage.

Interface standards must be carefully chosen

No supplier is currently able, and none appears to be attempting, to provide all the components of a client-server system. Instead, suppliers are making distinctive contributions and supporting

de facto standards where they believe it commercially expedient to do so. As a result, client-server systems are 'open' in ways that are important to users.

The technology involved is immature, however, and claims about the openness of client-server systems should, at present, be treated with a great deal of caution. Users and developers often find that two supposedly compatible products are unable to interwork in their particular environment.

Standards for the interfaces between clients and servers are fundamental to the client-server approach and decisions will need to be made with care about which protocols to use. Client-server protocols are largely proprietary at present, and the choice is usually straightforward because some of these have emerged as *de facto* standards.

The network must be effectively managed

Effective control of the network must be established at an early stage. There is a risk that client-server applications can bring down the entire network, and disciplines need to be in place to ensure that new applications are thoroughly tested. These are the same disciplines that are required for centralised mainstream systems but they are much more difficult to enforce in a distributed environment.

A new systems development approach and new skills will be required

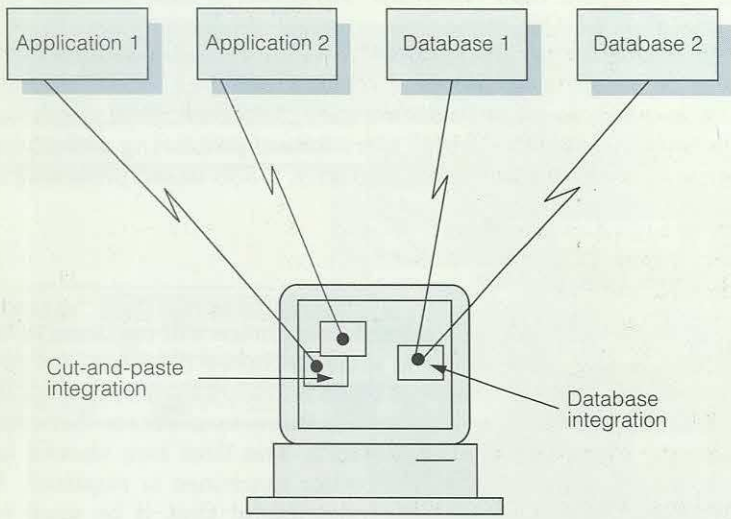
The development of applications designed to run as part of a client-server system requires a new approach to systems development. Above all, systems designers and development staff need to be able to construct applications that exploit the various components of a client-server system. In the past, systems departments have often had separate development teams for PC, minicomputer and mainframe applications. This approach is not appropriate for client-server systems, which require designers to understand the strengths and weaknesses of each kind of computer, so that they can allocate the functions between them in the best way.

Desktop integration can lead to difficulties

Client-server systems bring considerable computer power to the desktops of staff members (see Figure 3). Individuals can use this power to integrate and manipulate information to suit their individual needs; they can also use it to make mistakes. Business managers should be aware of this and ensure that their staff are properly trained and that proper controls are in place to ensure the accuracy of the information they produce.

Staff may also find difficulty in using such systems, particularly where they have access to a large number of different applications and information sources. Developments in workstation operating systems are making it easier for users to integrate information, and the growing popularity of graphical user interfaces is making systems easier to use and reducing the need for training and support.

Figure 3 Client-server systems help to integrate applications and data



Workstation operating systems

Workstation operating systems are developing rapidly. Our research identified four areas of particular importance — memory and application management, linkages between documents, linkages between applications, and convergence between independently developed workstation operating systems. These developments are described in detail in the main report, but the overall trend is for workstation operating systems to become less distinctive and less proprietary. In effect, they are converging on a common, though evolving, set of features.

By the year 2000, all workstation operating systems will provide similar facilities, with competition restricted to higher-level functions, and some aspects of system management. Many of the higher-level functions will be defined and provided, not by workstation suppliers, but by independent software developers and industry consortia.

The main personal computer operating systems in widespread use today are Microsoft's MS-DOS and Apple's Macintosh system. These are fairly limited systems, however. Unix, an inherently more advanced system, is well established for high-powered technical workstations and for minicomputers, but is rarely used in general-purpose workstations.

Windows 3.0 simplifies shorter-term choices

Apple will introduce a completely new operating system in 1991, providing many of the features mentioned above for Macintosh users. However, it has been difficult for users of MS-DOS (which has been widely installed on lower-powered PCs) to choose a migration path to escape from its inherent limitations.

The obvious choice, until recently, was to move to OS/2, which required more powerful and expensive hardware. Windows 3.0 has

completely changed this situation. The main advantage of Windows 3.0 from the user's point of view is that it provides a modern graphical user interface. However, it also extends the features of MS-DOS, removing many of its limitations. It will therefore extend the life of MS-DOS for many organisations until 1993 when, we believe, OS/2 plus Windows will be a viable upgrade path. Potential users should be aware, however, that graphical interfaces require considerable workstation processing power and memory. (To run Windows satisfactorily, a 386-based processor is needed.)

Unix has a role to play

For high-powered workstations, the best choice will continue to be Unix, and in our view, there is little to choose between the two main versions — AT&T's and the Open Software Foundation's. For intermediate-powered workstations, there is a choice between Macintosh, Unix, MS-DOS and OS/2. The first two should be chosen where compatibility with other machines is required. If MS-DOS or OS/2 is chosen, we recommend that it be used in conjunction with Windows 3.0, partly to provide future compatibility and partly because the future of IBM's OS/2 alternative, Presentation Manager, is unclear.

Graphical user interfaces

Graphical user interfaces employ graphics to help users operate their computers (as opposed to using computers to produce graphics). They make use of visual analogies of commonplace objects such as desktops and accounting spreadsheets. Usually, they are operated via a mouse that is used to point to images on the screen to initiate and control various activities. To open a file, for example, the user moves the mouse to point at and select an image depicting the file, rather than keying-in a string of commands that specify the file and the action to be taken. Users working with graphical interfaces are more productive than those working with other kinds of interfaces, and there is little to choose between the products that are currently available. Systems developers will, however, require new skills.

Graphical interfaces increase personal productivity

The first computer to make a graphical interface widely available was the Apple Macintosh. An example of a Macintosh display is shown in Figure 4. There have been many studies comparing the ease of use of the Macintosh with that of other PCs. As Figure 5 shows, the results of these studies clearly illustrate that graphical interfaces enable substantial benefits in personal productivity to be gained. In particular, they reduce the need for training and ongoing support. They also make it easier for users to learn multiple applications and to move data between applications. Foundation members have reported to us that their practical experience supports the findings of these studies.

An important feature of graphical interfaces is their intuitive operation and the consistency of operation between applications. In

Figure 4 The Apple Macintosh still has the leading graphical user interface

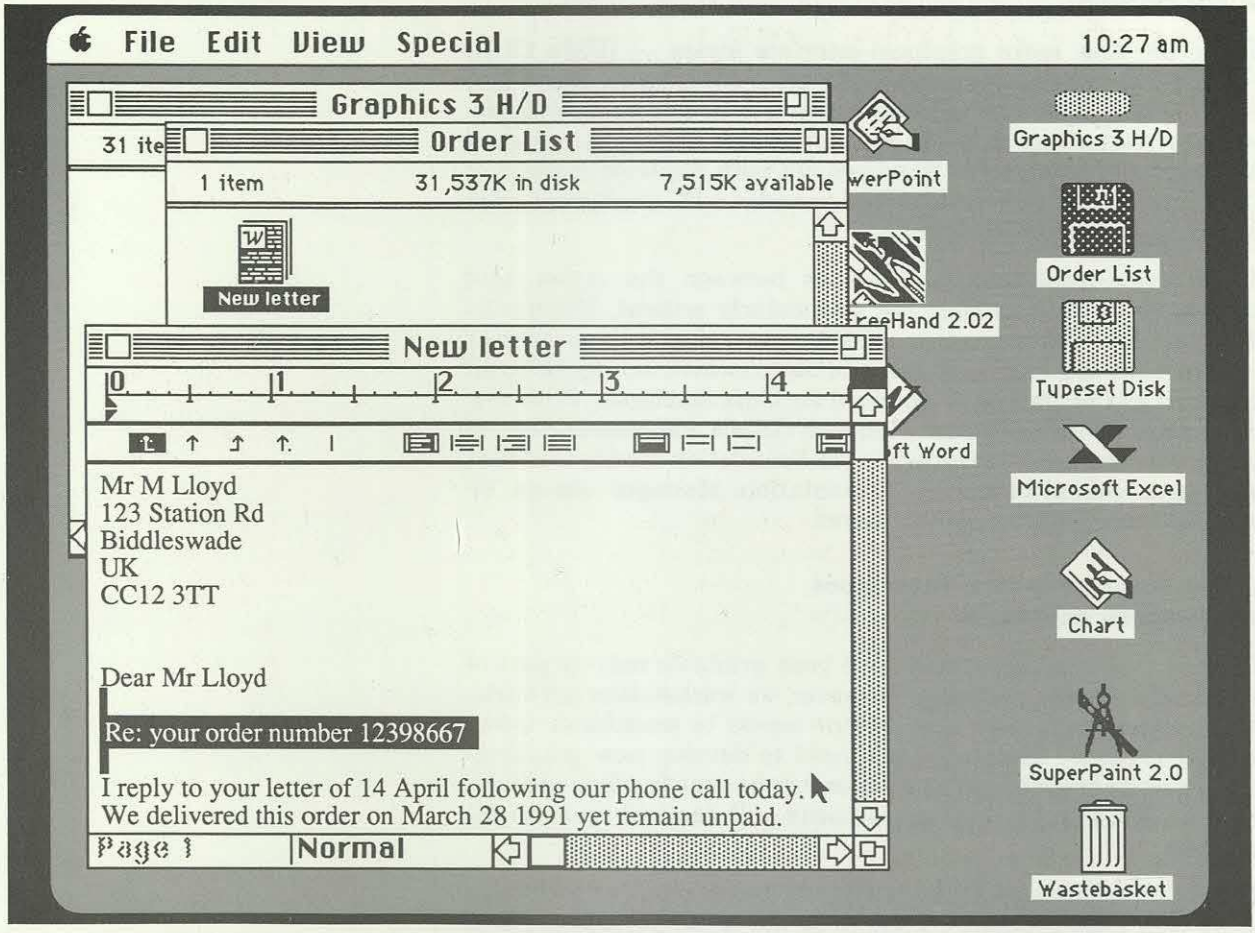


Figure 5 Independent studies have confirmed the advantages of graphical interfaces

These studies showed that users use more applications when they have access to a graphical interface. Personal productivity is improved by between 35 and 60 per cent. Further details of the studies are included in the full report.

	Graphical interface	Text interface
Time to learn the basics (hours)	1.8	20.4
Time to learn new applications (hours)	8.7	24.3
Support needed per user each month (hours)	14	30
Tasks in which there were errors (percentage)	9	26

practice, this means that there are considerable benefits for occasional users — it is easier for such a user to remember how to use an application that he has not used for some time, and once he has learned how to use one application, it is easy to learn others. Thus, graphical interfaces will make personal computers more like other office equipment, which anyone can use at any time without special training.

The choice of graphical-user-interface style is not critical

There are four main graphical-interface styles — IBM's CUA, Apple's Macintosh, the Open Software Foundation's Motif and AT&T's OpenLook. Each of these styles is available as several software products from different vendors. Thus, IBM's Presentation Manager and Microsoft's Windows are both implementations of CUA, and Digital Research's GEM provides a PC implementation of the Apple Macintosh style.

There are considerable similarities between the styles, and the choice of style is thus not particularly critical. Microsoft's Windows 3.0 implementation of CUA is emerging as the dominant standard for MS-DOS systems, and Motif (which is largely based on CUA) as the dominant standard for Unix machines. However, the future of Presentation Manager (IBM's implementation of CUA) is in some doubt. Our advice to Foundation members is that long-term commitments to Presentation Manager should be avoided until the situation is clearer.

Introducing graphical interfaces will require new skills

To date, graphical interfaces have been available only as part of standard software packages. However, as workstation networks become more pervasive and provide access to mainframe information systems, there will be a need to develop new graphical interfaces for bespoke systems. Once they become familiar with the benefits of a graphical interface, users will demand them on all systems.

The design of these interfaces is a highly creative task and requires skills that most systems designers do not have. To help to solve this problem, we expect that software suppliers will produce user-interface 'templates' that developers can adapt or modify instead of developing their own interfaces.

Once an interface has been designed, implementing it can also be difficult. Programmers are used to writing programs where the program is in control of the user. With a graphical interface, the user is in control of the program. High-level tools are already available to help with this task.

Conclusion

In the next few years, workstation networks — in particular, client-server systems — will be a critical element of a user-oriented technical architecture. The power and ease of use of client-server systems and the ability of client workstations to access an organisation's entire information resources will place unparalleled computing power in the hands of business users.

Several of the Foundation Reports to be published later this year address different aspects of the move towards workstation networks. In particular, a forthcoming report will contain guidance for members on the practical issues involved in developing and gaining conformance to a technical architecture. In another report, we shall examine the experience of pioneering organisations in 'downsizing' their computer systems.

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The Butler Cox Foundation

The Butler Cox Foundation is a service for senior managers responsible for information management in major enterprises. It provides insight and guidance to help them to manage information systems and technology more effectively for the benefit of their organisations.

The Foundation carries out a programme of syndicated research that focuses on the business implications of information systems, and on the management of the information systems function, rather than on the technology itself. It distributes a range of publications to its members that includes research reports, management summaries, directors' briefings and position papers. It also arranges events at which members can meet and exchange views, such as conferences, management briefings, research reviews, study tours and specialist forums.

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— The events combine access to the world's leading thinkers and practitioners with the opportunity to meet and exchange views with professional counterparts from different industries and countries.

— The Foundation represents a network of systems practitioners, with the power to connect individuals with common concerns.

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