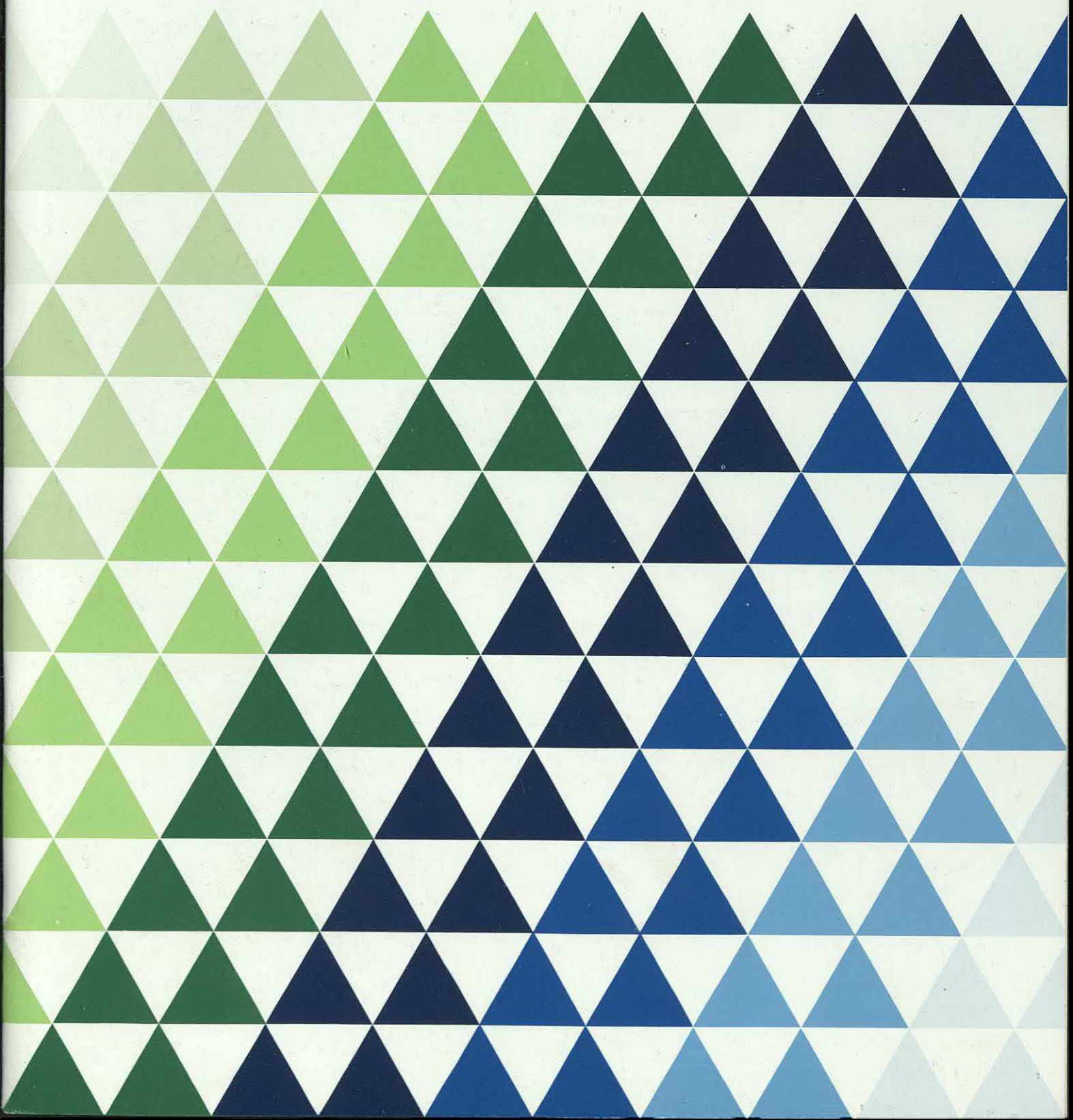
Management Summary

BUTLER COX FOUNDATION

Downsizing Computer Systems



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Management Summary
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Downsizing Computer Systems

Foundation Report 84, Downsizing Computer Systems, was published in December 1991. Downsizing is already feasible in a wide range of circumstances and it will become even more so as the costs of small systems continue to fall and as products mature. The report addresses the practical issues that systems departments will face as they downsize applications that, today, run on mainframes or minicomputers. This document summarises the main messages arising from our research. The full report is available only to members of the Butler Cox Foundation.

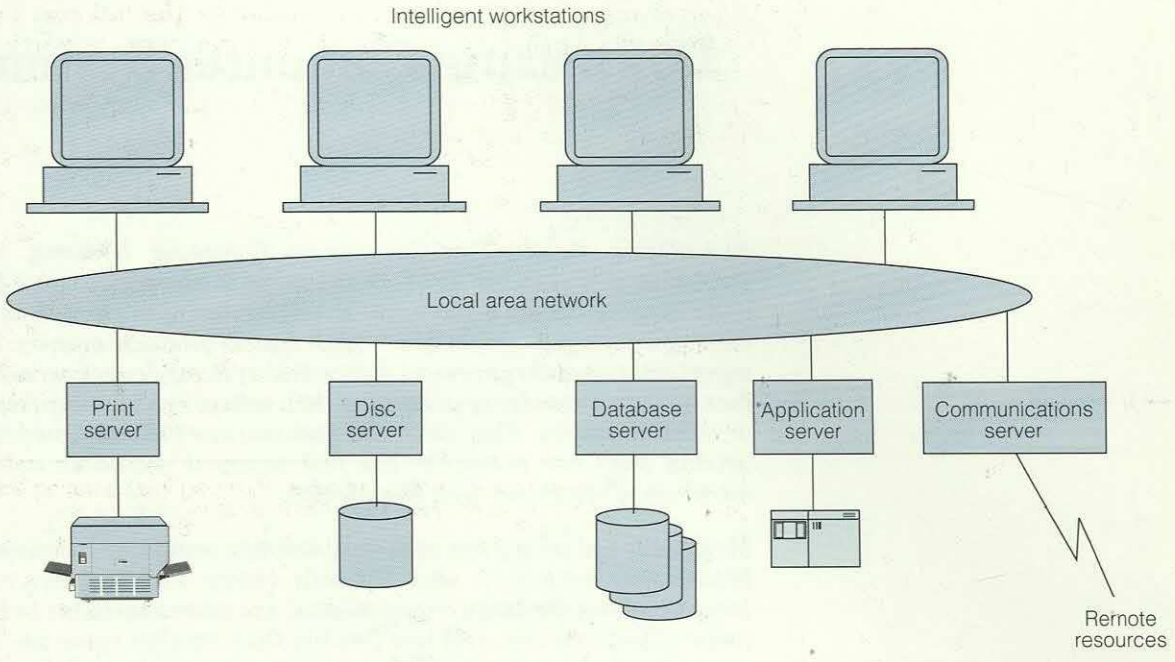
Most large organisations are using obsolete computer technology. Mainframe computers, once the only choice, and still the most common choice for large organisations, are more expensive to run, more difficult to use, and less flexible than smaller systems. The conclusion is obvious – sooner or later, organisations will have to transfer their applications from mainframe environments either to local minicomputers, or more likely, to networks of PCs configured in a client-server architecture. We describe this transfer as downsizing.

We believe that the emergence of client-server systems heralds a sea change in the way in which data processing applications will be provided in large organisations. Throughout the rest of the 1990s, there will be an increasing trend away from centralised mainframe systems to downsized client-server systems. Downsizing is therefore more than a tactical response to technical advances or an opportunity to save money. It is a strategic move that will lead to a distributed-computing environment that places computer power where the users are.

The general layout of a client-server architecture is depicted in Figure 1, overleaf. The distinguishing characteristic is that the different components of an application are partitioned over several computers. (The basic technology was described in Report 80, *Workstation Networks*.) Even though the technology is immature, the advantages of client-server environments are already evident and will increase rapidly, so the decision is when, rather than whether, to downsize.

However, in practice, the decision is often complex. Downsizing is not always less costly. It depends partly on the cost of redeveloping existing applications and partly on the length of the transition period during which the old and new systems run concurrently. Nor will downsizing always be feasible, because of the problems of partitioning databases, maintaining reliability and security, and managing PC networks. This report provides guidance on the costs, risks and trade-offs, and identifies the aspects that require careful management in making the transition.

Figure 1 **With a client-server architecture, intelligent workstations or PCs (the clients) usually access shared resources (the servers) via a local area network**



Downsizing provides significant benefits

From the users' point of view, the main benefit of client-server systems derives from easier-to-use applications, which leads to improved business productivity. A client-server system enables the user-interface component of an application to be implemented on a personal computer or workstation, the processing power of which can be used to construct graphical user interfaces. This leads to shorter and more consistent response times. Users of such interfaces take less time to become familiar with the system and to learn new applications. They also make significantly fewer errors and make more effective use of the technology.

Client-server systems also make it easier to integrate office systems and data processing systems, because the same PC can access both types of application. This means, for example, that data can be transferred between an application running on a central computer and a local application, such as a spreadsheet. Database extracts can also be downloaded to servers for local access by PCs, which have better data-access and manipulation tools than mainframes.

Downsizing often involves a move from a proprietary architecture to some form of open architecture – typically a mixture of Unix and MS-DOS systems. By making such a move, organisations will be able to take advantage of the open-systems-based client-server hardware and software products likely to become available over the next few years. Organisations that downsize to client-server systems will also be able to get early access to innovative technologies, because most of them are introduced first in the area of

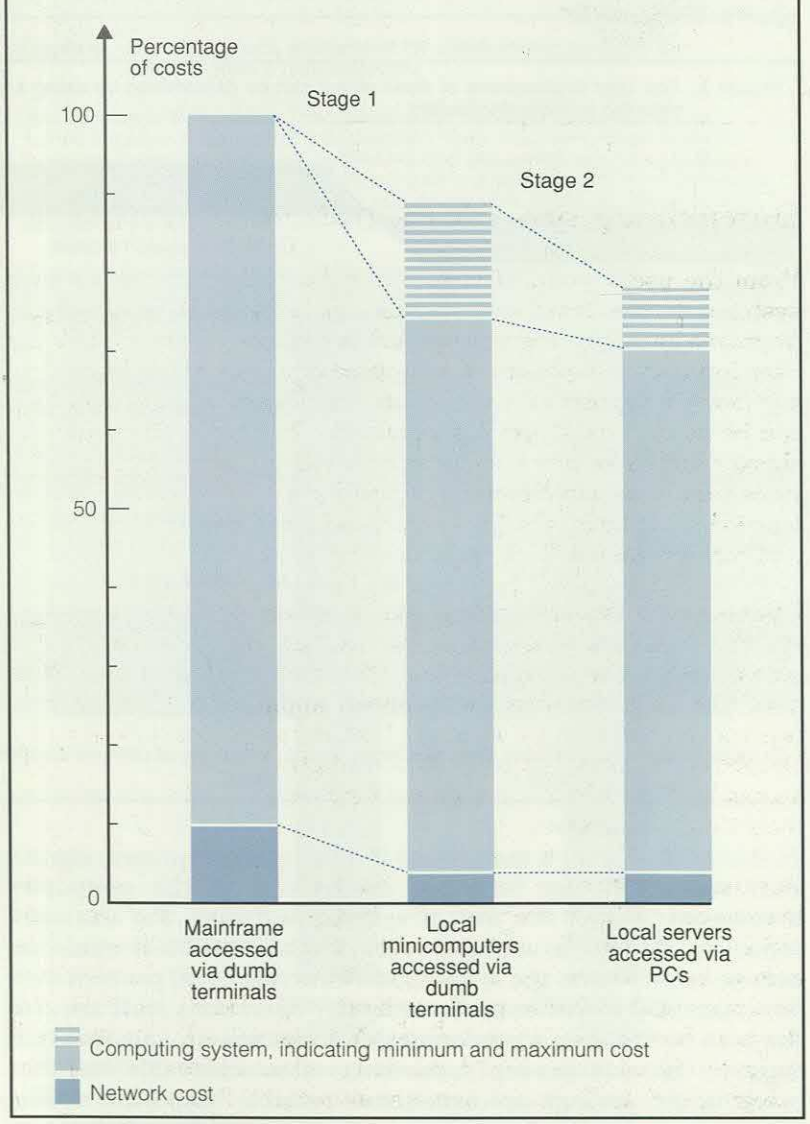
workstations and PCs, rather than mainframes and minicomputers.

Downsizing can also reduce costs, although the full cost implications will be highly specific to an organisation's particular circumstances. In the full report, we set out a framework that can be used to assess the costs of downsizing. A summary of our main findings on costs is set out below.

Downsizing can reduce costs

Our research shows that downsizing mainframe applications to local servers accessed via PCs can reduce the total costs of owning and operating the systems infrastructure over five years by between 20 and 30 per cent (see Figure 2). Further reductions can be made either by taking the opportunity to use packages to imple-

Figure 2 Downsizing may reduce the costs of owning and operating the systems infrastructure by as much as 30 per cent over five years



ment applications in the downsized environment or from the improved development productivity that can often be obtained in a downsized environment.

These reductions have to be offset by the costs of actually making the transition to a downsized system, when it will be necessary to run both the old and the new systems concurrently. The transition period can last from two to five years, and considerable costs may be incurred during this period for additional hardware, software and communications lines, for applications and data conversion, and for training. This implies that, in the short term, downsizing may increase overall costs. In the longer term, however, costs will decrease.

The difficulty of assessing the costs of owning and operating a downsized systems infrastructure is that many of the costs are dispersed into the user community, and can easily be 'hidden', making downsized systems seem cheaper than they really are. For this reason, we advocate the use of a cost model to assess both the acquisition costs and the continuing costs of owning a systems infrastructure and of developing and running the applications that use the infrastructure. The main components of the model are shown in Figure 3.

Figure 3 The cost implications of downsizing can be determined by using a model of the total costs of owning and running a computer facility

	Total cost, comprising:	
Cost category	Computing systems costs	Network costs
Infrastructure		
Equipment	For example, mainframes, minicomputers, terminals, PCs	For example, modems, multiplexors, cluster controllers
Systems software	For example, operating system, transaction processing monitor, database management system	Front-end processor software
Personnel	For example, system operators and support staff	Network operators
Communications	—	Lines
Facilities	Space and cost of servicing it	Space and cost of servicing it
Applications		
Packages	Purchase and support	—
In-house development	Staff, machine time and support	—

(Source: Adapted from Treacy, M E, and Index Group. *The costs of network ownership: a research report.* Cambridge, MA: Index Group, 1989.)

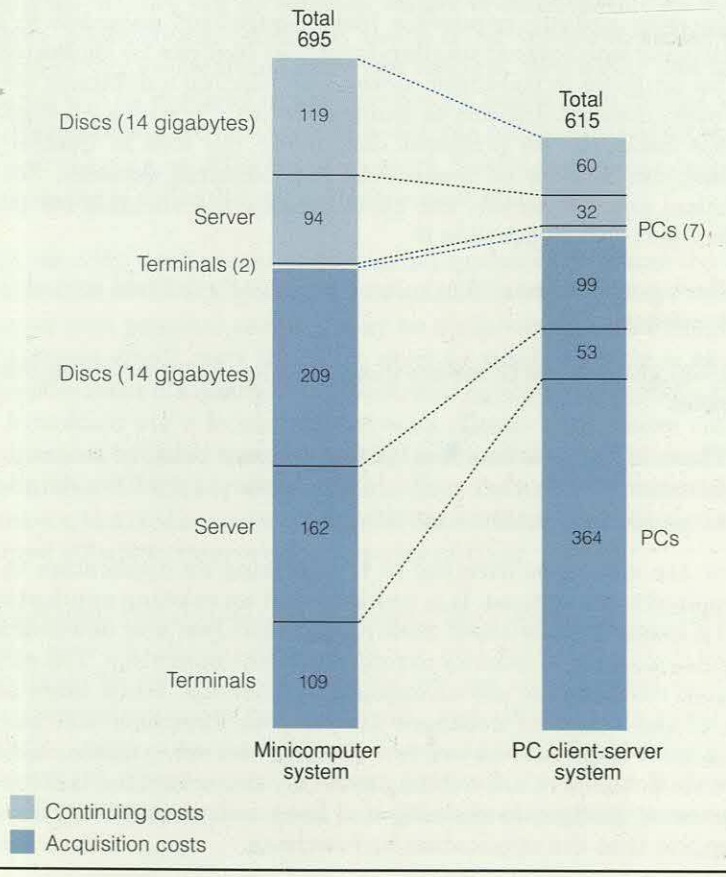
In downsizing from a mainframe to local minicomputers, significant reductions can be made in the cost of the computers themselves and in the cost of systems software. For example, replacing an IBM mainframe with DECsystem 5500 minicomputers would reduce the systems software cost by 90 per cent over five years. Personnel costs for computer operations staff are also likely to be lower in a minicomputer environment. Our research suggests that a 30 per cent reduction is often achievable, and that much larger savings are sometimes possible. Communications

costs will also be lower in the minicomputer case. Downsizing to minicomputers will usually mean migrating from a centralised to a decentralised network, and in general, such networks are cheaper to own and operate than centralised networks.

An important finding from our research is that if a mainframe system can be downsized to minicomputers, it can also be downsized further to client-server systems, and that the client-server systems will be cheaper than the equivalent minicomputers. Figure 4 shows the five-year equipment costs for a minicomputer system and a PC client-server system for a representative 128-user 14-gigabyte configuration. The client-server equipment costs are about 12 per cent lower than the minicomputer costs. In practice, most Foundation members will already have a significant proportion of the PCs required to implement the client-server systems, making the client-server cost case even more favourable. In addition, much of the benefit of client-server systems comes from the ability to implement graphical user interfaces on the PCs. To add such interfaces to the minicomputer would increase its cost substantially.

Figure 4 Over five years, equipment for client-server systems is cheaper than a minicomputer

All costs are in $ thousand. The minicomputer costs are based on UK list prices supplied by Digital for a DECsystem 5500. The client-server system costs are based on an Olivetti NetFRAME ONF200 server with 14.4 gigabytes of disc storage. The PCs are Dell PCs (20 MHz 80386 cpu with 4 megabytes of RAM, 40 megabytes of disc storage and colour VGA displays). They run DOS and Windows 3.0.



Most of the experience with client-server systems to date (and hence, most of the cost data) relates to systems implemented at a single site. The costs of a multi-site client-server system are more difficult to assess, particularly for personnel and communications. Among the costs that must be considered are those for a central management system, a separate client-server system for integration and usability testing, and training and support for both local and central management staff. Experience also shows that inter-site communications volumes in such systems are difficult to estimate.

Applications costs are, however, likely to be lower in a downsized environment. The trend will be to make greater use of packages (although, as yet, few application packages are available for client-server systems). Any in-house development is likely to be easier and more productive because the effort will be directed towards PC applications. Our research shows that PC developments require about half the effort required for mainframe developments, because of the use of more productive programming languages and environments.

The benefits provided by client-server systems, and the cost reductions that can be obtained, are compelling reasons for downsizing. However, any decision to downsize must be based on an understanding of the risks, some of which relate to the inherent nature of client-server systems and others to the immaturity of the technology.

Downsizing involves risks and trade-offs

Downsizing usually requires a large centralised database to be partitioned into several smaller databases that can be loaded onto a minicomputer or database server. Partitioning a database may, however, make it difficult to change the way in which an organisation conducts its business. Balancing the loss of flexibility against the benefits of downsizing is a business decision, not a technical one. Moreover, not all databases are suitable for partitioning; it will be possible if:

- Each proposed partition relates to a clearly defined part of the business.
- Changes to a partition are generated by that part of the business.
- There is likely to be a low level of demand both for access to a partition from other parts of the business and for detailed analysis of data across partitions.

There are also risks involved in transferring an application to a downsized environment. It is unlikely that an existing application can be transferred without making any changes, and downsizing provides a good opportunity to redevelop the application. The most efficient method is to use an application package. While there are tens of thousands of packages for PCs, workstations and minicomputers, there are, as yet, few for client-server systems. Major software developers are working to rectify this situation, however. At present, though, downsizing to a client-server system is likely to require that the application be rewritten.

Most of the tools to support client-server development have been available only for a relatively short time. Some have been found to have significant limitations, especially in the areas of performance, integrity and ease of use. Developers will also need new skills to make the best use of the tools. Prospective users of a new tool should weigh the risks against the benefits, and ensure that they have ready access to relevant experts – perhaps even to the individuals who developed the tool, rather than just the supplier's local support staff. Figure 5 indicates the levels of risk, cost and benefits associated with the main approaches to downsizing applications.

Figure 5 The main approaches to downsizing have different levels of cost, benefit and risk

Approach	Cost	Benefit	Risk
Use a package:			
– Unchanged	$	√√	!
– Modified	$$ – $$$$	√√√√	!!!
Make minimum changes	$	√	!
Rewrite, but do not change functionality	$$	√	!!!
Rethink	$$$$	√√√√	!!!!

The immaturity of systems software for downsized systems means that there is a risk that applications, particularly client-server applications, are not as reliable, secure or manageable as mainframe applications. Although there is no inherent reason for client-server applications to be less reliable, new skills and techniques will be required in systems design and testing to cope with the transmission of messages between the components of an application running on different processors. Cabling problems can also be a cause of difficulty with client-server systems.

The security weaknesses of downsized systems arise from the fact that much of the equipment is not located in a data centre (which means that physical security may be compromised) and that it is physically small, and therefore easy to steal. Data in a client-server system is vulnerable to electronic eavesdropping because it is broadcast via a local area network. These weaknesses can be minimised by good security-management measures. The inherent 'openness' of Unix, which makes it vulnerable to attacks by hackers, is a real concern at present, but vendors are making determined efforts to improve the security of Unix.

At present, the systems-management facilities (such as network-load monitoring, database back-up and reconfiguration tools) available for client-server systems are not as advanced as those for proprietary mainframe systems, and this situation will not change in the immediate future. Those organisations intending to implement client-server systems, particularly over a wide-area network, may therefore need to build their own systems-management tools.

The move to downsized systems must be managed carefully

Because of the immaturity of the technology, the implementation of downsized systems, especially client-server systems, presents some technical and management problems. On the technical side, the major components of client-server systems (systems software, servers and local area networks) must be chosen with care. On the management side, the problèms of managing distributed systems must be recognised and systems-management responsibilities allocated accordingly. Users must also be educated so they can fulfil their new responsibilities, and the required support functions must be established.

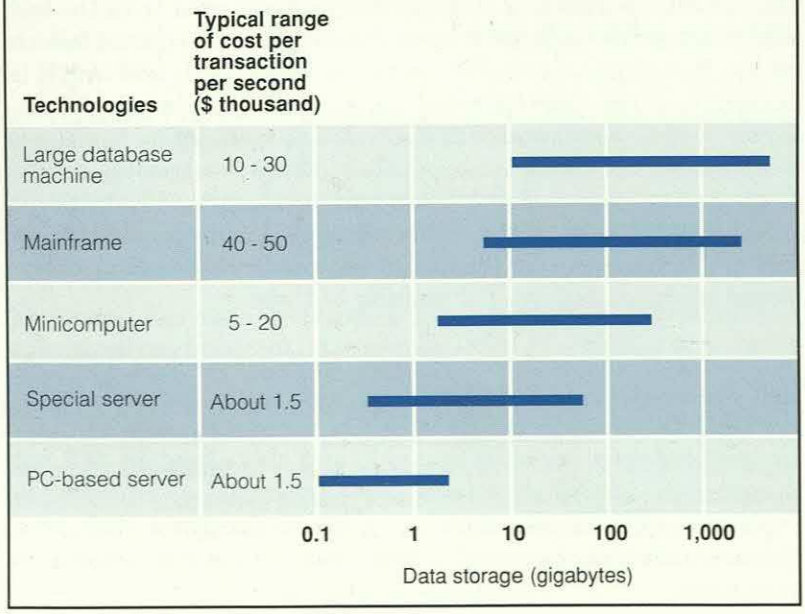
Choosing the systems software

The difficulty in choosing systems software, particularly workstation and network operating systems, is that the most popular products are relatively new. Moreover, the most popular workstation products and network operating systems are produced by different vendors (Microsoft and Novell, respectively). In most cases, additional systems software will be supplied by other vendors. It is inevitable that there will be difficulties getting the resulting mix of products to work together.

Choosing the server hardware

At present, PC-based servers can handle data stores of up to about 3 gigabytes. Specialised servers such as the NetFRAME can support up to about 90 gigabytes. Larger storage capacities can be supported by servers designed to support Unix workstations or by conventional (and parallel) minicomputers used as servers. However, as server storage capacity increases, price/performance declines (see Figure 6). This may, at present, undermine the case

Figure 6 There is a range of technologies for server machines, with differing price/performance



for client-server systems, but over the next few years, developments in server technology will result in progressively more cost-effective server machines for large databases.

Few organisations have yet implemented client-server systems with more than 150 workstations per server. In theory, a minicomputer used as a server can support very large numbers of concurrent users, although in practice, most support fewer than 100. For a PC-based server, the number of client PCs should be no more than about 20.

For PC-based servers and specialised servers, inter-server communication will be provided by the network operating system. In general, however, proprietary minicomputer systems provide better communications facilities than network operating systems, and this may be a powerful argument for using a minicomputer as a server.

Choosing the local area network

Both Ethernet and Token Ring networks have been used to implement client-server systems, and there is little to choose between their functionality and performance. However, Token Ring's superior network-management facilities make it preferable for widely dispersed networks that must be linked and managed centrally.

Allocating systems-management responsibilities

Downsizing usually results in a network of distributed systems that is inherently more difficult to manage than a mainframe-based terminal network. Effective management of such systems requires a clear allocation of responsibilities between systems staff and the user community and a shared understanding of those responsibilities. The most appropriate split in responsibilities will be heavily influenced by the degree of systems devolution that exists in the organisation. The main report provides advice about how to split the responsibilities in the most critical areas.

Educating the users

To enable them to carry out their responsibilities for downsized systems, users will require education on the care of printers, the need to take regular back-ups, password procedures, software copyright, the legal restrictions on storing personal data, the installation of software and disc-space management.

Establishing the support functions

PC and workstation users generally require more support than terminal users because they use a greater range of software and use their PCs for more complex tasks. The systems department should provide a well publicised support service that is perceived by users as the first point of contact when they encounter a problem. One support person for every 40 workstations is typical.

Minicomputers, PCs and servers need much less maintenance support than a mainframe, however. It is now quite practical to keep on-site spares for most PC components and to train local staff

to replace defective components. One large organisation has even gone as far as scrapping any PC that cannot be repaired on the spot and replacing it with a new one.

In summary, our research has shown that downsizing, particularly to client-server systems, is now feasible and will quickly become more widely applicable as the underlying technologies mature and as organisations acquire the skills required. Moreover, where downsizing is feasible, the cost of owning and operating the systems infrastructure over a five-year period will be reduced. At present, however, there are risks involved in implementing downsized applications, and systems managers must consciously weigh these risks against the benefits that can be obtained before deciding to downsize their core data processing applications.

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