The Impact of Information Technology on Corporate Organisation Structure

BUTLER COX FOUNDATION

Research Report 56, January 1987

BUTLER COX FOUNDATION

The Impact of Information Technology on Corporate Organisation Structure

Research Report 56, January 1987

Butler Cox & Partners Limited

LONDON
AMSTERDAM MUNICH NEW YORK PARIS

Published by Butler Cox & Partners Limited
Butler Cox House
12 Bloomsbury Square
London WC1A 2LL
England

Availability of reports and report summaries
Members of the Butler Cox Foundation receive three copies of each report upon publication; additional copies and copies of earlier reports may be purchased by members from Butler Cox. Reprints of the summary of research findings for each report are available free of charge.

Photoset and printed in Great Britain by Flexiprint Ltd., Lancing, Sussex.

BUTLER COX FOUNDATION

The Impact of Information Technology on Corporate Organisation Structure

Research Report 56, January 1987

Contents

BUTLER COX FOUNDATION

The Impact of Information Technology on Corporate Organisation Structure

Research Report 56, January 1987
Summary of research findings

That some systems, particularly those aimed at improved productivity, lead to redundancies is obvious. What is often less obvious is that many systems lead to changed ways of doing business, changed jobs, changed lines of reporting, and changed management roles. Yesterday's systems are built around yesterday's organisations, and vice versa. Change either and you have to change the other, to make the change effective.

The problem is that new systems are often thought up, designed, and even introduced without recognition or proper examination of the organisational implications. The result is operational problems and obstacles; staff and management with a (real or perceived) vested interest in opposing the change; and systems that fail to realise their full potential.

Why should this be? The reason is twofold. One is that senior management is all too often unaware of the impact. The other is that the systems team lacks organisational design and personnel skills and would rather not raise problems that might stand in the way of the acceptance of information technology.

The report highlights the need for management — specialised and general — to understand these issues and points the way forward.

THE IMPACT TO DATE

Information technology has produced changes in formal organisation charts (or organigrams); it has changed managerial roles, responsibilities, and influence; and it has changed the size and the composition of the workforce. Specifically, information technology has contributed to:

- The broadening of the base of the organigram (for example, by allowing a retail company to operate many more stores without a proportionate increase in levels of middle management). In some cases it has been possible to eliminate a complete layer of middle management.
- The distribution of central departments to lower levels in the organisation. Partly because of the rapidly falling costs of CAD/CAM systems, a manufacturing company was able to distribute its central research and development group amongst its product-based manufacturing divisions.
- The creation of new central departments to do work previously undertaken at lower levels in the organisation. Our most dramatic example of this was an insurance company that shifted responsibility for premium collection from the salesforce to a small staff department supported by information systems. As a result, the salesforce was reduced by two-thirds — shedding 1,000 staff — and still achieved sales growth.
- An increase in the centralised power and influence of senior managers, and the greater use of 'professional' central staff to support senior management. These changes have occurred in parallel with the progressive divisionalisation (often misleadingly called decentralisation) that has taken place in many companies, involving greater responsibility and accountability at lower levels in the organisation as well as the flattening or broadening of organigrams.
- An increase in the influence of those users responsible for important and high-value-added systems. The best illustration of this we found was in a manufacturing company where the implementation of a very successful production and stock-control system shifted influence away from line factory management to staff planners and coordinators in the factories. Another example was the removal of the responsibility for data entry from the regional administration departments in a bank; the implementation of an online branch network returned total responsibility for the accuracy of client accounts to branch management.
- The reduction of manning levels. However, we discovered evidence to support the view that a few organisations can, by using information technology, increase their level of employment in the longer term. These organisations will use information technology as a competitive weapon to increase their market share, or to generate new areas of business.

- A shift in the occupational skills mix, in favour of a smaller number of highly skilled and flexible professionals and technicians, and towards a greater number of female and part-time workers. While this shift was largely the result of complex economic, management, and social forces, the increasing adoption of information technology played an important role.

FUTURE IMPACT

Turning to the future impact of information technology, we concluded that, after macro-economic shifts in market size, and growth in the service and information sectors of the economy, information technology will be the most important underlying cause of organisational change.

Although all the types of organisational structures that exist today would continue, there will be a disproportionate shift towards simple structures (small-business forms of organisation) and 'adhocracies' (the form of organisation favoured by high-technology industries, amongst others) because these types are the most innovative and flexible — attributes that will be more important in an increasingly competitive and dynamic environment.

Information technology, as well as market pressures, will tend to encourage further and earlier divisionalisation of large organisations. We postulate that a new form of divisional structure (a 'confederation') could emerge. A confederation would require organisational change at the strategic apex of the organisation in order to permit the grouping of operating units according to their organisation type, rather than on the basis of product or market. In a confederation structure, information technology would play a key role in coordinating the activities of operating units.

Finally, we concluded that emerging technologies, such as factory automation and robotics, expert systems, and voice and image processing, will have a very significant impact on the manufacturing, retail and distribution, financial, and professional services sectors (health care and education in particular). The impact will include major reductions in the workforce of some sectors, and the wider dispersal of expert knowledge — even in some sectors such as education, into the home.

MANAGEMENT IMPLICATIONS

It is important for senior managers to understand the fundamental nature of the organisational changes that can be caused by information technology. Long-term systems plans and the use of new or emerging technologies should be reviewed against the ways in which they can affect the organisation, as identified in this report.

The systems director should in particular be aware of the effect that new systems can have on user managers' jobs, and must ensure that user managers whose roles will change are not in a position to frustrate the implementation of the systems.

The systems director should also seek opportunities to initiate trials of ways in which information technology can support new types of organisational structures — telecommuting and home working in particular.

RESEARCH METHOD

Research for this report was carried out in mid-1986 and was led by Tim Chapman, managing director, Butler Cox BV in Amsterdam. He was assisted by David Butler, chairman of Butler Cox, and Warren Waldbrand, a senior consultant for Butler Cox Inc. in New York.

Our desk research covered organisational theory and practice, the impact of information technology, futurist speculation on post-industrial society and organisation, and advanced technological impacts. (A bibliography listing the publications that influenced our thinking is included at the end of the report.) We also analysed the findings of a study conducted by the Institute of Manpower Studies (IMS) entitled "UK occupation and employment trends to 1990", which was published in the last weeks before the report was drafted. This study contained the results of questions asked of a large sample of organisations in the United Kingdom, including questions on the adoption of technology, changes in organisation structure, and employment.

Our field research was conducted in five countries (Belgium, France, the Netherlands, the United States, and the United Kingdom) and included interviews with senior managers (including systems managers, but especially business managers) in a representative cross section of industries. The organisations interviewed were from the banking, insurance, petroleum, welfare services, manufacturing, stockbroking, construction, retailing, and government sectors. Several of the organisations requested that any references to them in the report should be anonymous. For consistency, all such references have been presented anonymously.

Chapter 1

The observable impacts of information technology

Senior managers, especially those in the information-technology industry, often overestimate the impact that information technology will have in the short term. They also underestimate the fundamental and strategically important long-term impacts of information technology. We have found clear evidence that this is true of the impact on corporate organisation structure.

The most commonly perceived short-term impact is that new and more cost-effective technologies allow management to plan and make organisational changes. But beneath the surface there is an undercurrent of change resulting from the adoption of information technology that gradually, and over a long period, produces fundamental changes in organisational structures, roles, responsibilities, and influence, and in employment and occupational skills. This process has been going on since the advent of the first batch-processing mainframe computer systems. It continued through the use of distributed minicomputers, online systems and microcomputers. It continues today as value-added network services, CAD/CAM/CIM systems, electronic-banking services, and databases come into widespread use. It will continue in the future, as expert systems, factory automation, and voice and imaging technologies develop.

The organisational impacts will vary according to the type of technology. Consider, for example, the changes that have taken place during the past 30 years in the financial record-keeping activities of many large organisations:

- In the 1950s, before the arrival of computers, financial record keeping was carried out by operating units, and the primary function of the departmental accounts managers was to supervise a large army of semiskilled clerks.
- In the 1960s, with the installation of the first batch-processing mainframe computers, financial record keeping was centralised to achieve the economies of scale necessary to justify the investment in information technology. Local accounting departments lost many of their responsibilities to the centre (for example, invoicing), and the semiskilled clerks were replaced by unskilled form fillers. Some local jobs may have been lost but an army of card-punch operators were recruited at the centre. The finance director became responsible for data processing and had to learn to manage a department of well-meaning and competent technicians full of enthusiasm for their computer and what it could do, but with little understanding of the needs of the business.
- In the 1970s, distributed minicomputers were installed to decentralise financial record keeping, to speed the production of accounts, and to increase the responsiveness of the accounting function to local management. The local accountant now became responsible for his own data processing department and had to learn new management skills. His form fillers became keypunch operators as form filling was distributed to user departments. The central data processing function took on a new support role with responsibility (but little authority) for ensuring that all the systems worked.
- In the 1980s, local systems, based on personal computers and online terminals, have been installed in most departments. Accounting information is now often captured as a by-product of these local financial record-keeping systems. The local accounting department is smaller, and its manager is able to spend a higher proportion of his or her time on budgeting, costing, and helping local management to resolve business problems.

Why have these changes taken place — changes which in the 1950s could not have been anticipated (or if they were, would have seemed beyond the realm of credibility) — and what are the changes that may occur over the next 25 years?

In this first chapter we identify and examine the impacts that information technology has had on corporate organisation structures to date. Based on the historical perspective of the changes brought about by information technology, we then (in Chapter 2) indicate the likely nature of future changes. Finally, in Chapter 3, we suggest actions that senior business managers and senior systems managers can take in order to benefit from the positive effects, and to minimise the negative effects, that information technology may have on corporate organisation structure.

But first, before presenting the results of our research, it is useful to define the terms 'information technology' and 'corporate organisation structure' as they are used in this report.

DEFINITION OF INFORMATION TECHNOLOGY

Information technology, a catch-all expression coined in the United Kingdom in the early 1980s, is used to describe technologies concerned with information storage, manipulation, and distribution. The term therefore includes computers, telecommunications, office-automation products, 'home' information systems, and related software. This definition also embraces military systems, avionics, robotics, and factory automation, as well as process control, automated warehousing, and many medical and research tools.

In this report, we adopt a narrower definition and confine ourselves to those technologies used to deliver information 'products', rather than physical products — that is to say, we restrict ourselves to those aspects of information technology that are of primary concern to the systems departments of Foundation members.

DEFINITION OF CORPORATE ORGANISATION STRUCTURE

The term 'corporate organisation structure' is widely used but poorly understood. It is frequently used to mean the hierarchy of management control and reporting relationships that exist in all organisations. We use the term 'organigram' to describe this aspect of corporate organisation structure. A distinction needs to be made between the formal organigram, which may be represented as an organisation chart, and the informal organigram, which reflects the complex world of interpersonal relationships, power and influence structures, and information flows. The most obvious of these relationships may be shown on the formal organigram as 'dotted-line' relationships or matrix structures, but many more exist than are formally described.

A second aspect of organisation structure is the roles and responsibilities of the individuals and departments that constitute the nodes of the organigram. These roles and responsibilities determine the influence that the departments and their managers have. Influence is a function of the contribution that the department makes towards achieving corporate goals and/or the decisions that are made by others, as well as the personal authority or power of the managers of the departments.

A third aspect of organisation structure is the size of the departments that make up the organisation — which is also likely to affect managerial influence — and the characteristics of the individuals who constitute them. Thus, organisation structure is concerned with staffing levels and with the occupational characteristics of the workforce.

Finally, there are three other factors that determine the way in which an organisation functions and is structured:

- The geographic location of its various sites.
- Special characteristics of its management style, especially (for this report) matrix management.
- Its relationship with external parties such as its customers, suppliers, and subcontractors.

The rest of this chapter is structured to reflect these aspects of corporate organisation structure. In the following sections we examine the impact of information technology on each of these aspects as observed by us and by others who have published their findings in this very specialised field.

IMPACT ON THE ORGANIGRAM

During our research we were surprised by the number of individuals (many of them systems managers) whose initial response was that information technology had had no impact on the organigram, except that a computer department had been added. However, in one case, on probing further we discovered that the organisation had grown from 27 branches to 400 over a 25-year period, but with no increase in the number of levels of management. Furthermore, it was acknowledged that this expansion could not have taken place without the use of computer systems.

We concluded that information technology did produce changes in the organigram, but that these changes were not recognised as resulting specifically from the adoption of information technology. In particular, our research led us to conclude that:

- The main impact of information technology on the organigram is to increase the span of management control, for example by enabling a 'flatter' and broader organigram to be maintained than would be possible without information technology.
- In some organisations, the use of information technology allows central activities to be distributed to lower levels in the organisation; in

other organisations, the use of information technology has permitted or encouraged the emergence of new central departments.

INFORMATION TECHNOLOGY INCREASES MANAGEMENT'S SPAN OF CONTROL

There are two ways in which management's span of control can be increased. The first is to 'flatten' the organigram, either by eliminating layers of management within an existing structure, or by widening the 'base' of the organigram without creating new tiers of management. The second way is by imposing tighter management controls and delegating routine decision making and responsibilities to lower levels in the organisation. In either case, management's effectiveness and overall efficiency are increased.

The relationship between the use of information technology and increased span of control arises from the systematisation and automation both of work and of routine decision making. One of the basic functions of line management is to consolidate operational information and to report on performance. Automating the routine part of the activities frees management time for other activities, such as supervising more subordinates. The same effect is produced by systematising routine decision making, which leads to increased delegation.

Consider, for example, a computer system that suggests replenishment orders for a chain of retail outlets. The store managers refer to their regional managers only for approval of orders that vary from those suggested by the system. This procedure frees the regional managers from a considerable workload and allows them to supervise more stores.

Carried far enough, the systematisation and automation of work could lead to the elimination of some middle management positions, and eventually to the removal of a whole tier of management, probably accompanied by the appointment of 'staff specialists' to support the expanded role of the central management group now responsible for a large number of operating units.

There are many examples of the use of information technology increasing managerial span of control:

— A US insurance company eliminated its regional management tier following the introduction of an online branch-office system. This was not the intention of the system, but became necessary in order to make the system work: it was discovered that regional managers were obstructing the flow of information, in a subconscious effort to preserve their jobs.

— A British supermarket company grew from 27 to 400 stores over a 25-year period without needing to introduce additional tiers of supervisory management.

— A Dutch insurance company introduced an online sales-control and reporting system based on personal computers used by its salesforce, and is anticipating a 15 per cent increase in productivity by individual salesmen and an increase in the number of salesmen controlled by each sales manager.

— A British non-food retail company plans to use an online branch system to introduce greater standardisation in stores, and to replace its regional management tier by home-based, mobile 'troubleshooters'.

— A Danish manufacturing company was able to assign the responsibilities for running two factories to a single manager because an effective factory-management system existed.

— Computerised banking systems have allowed retail banks to expand their network of branches greatly without a proportionate increase in middle management.

INFORMATION TECHNOLOGY ENABLES DECENTRALISATION AND CENTRALISATION

The distribution of central functions within an organisation, which contributes to the flattening of organigrams, may also be made possible by using information technology. Distributing activities previously carried out at the centre of an organisation is generally considered beneficial because:

— It increases local accountability and management motivation.

— It brings central staff nearer the front line and out of their ivory towers and gives them a closer affinity to, and understanding of, the 'real' work of the organisation.

— It reduces conflicts and communication problems between central and local units.

— It reduces the size of 'corporate overheads' and enables the true performance of local units to be assessed.

But there are potential risks in distributing central functions, including:

— Loss of central control and cross-organisation coordination.

— Loss or dispersal of skills.

— Loss of economies of scale.

Information technology can help to reduce the risks associated with distributing central functions because:

— Systems (performance-reporting systems, for example) can maintain, enhance, or focus central management control.

— Intra-organisational coordination can be improved by providing local staff with access to corporate-wide information. For example, local credit controllers can be provided with access to information about customers' indebtedness to the group as a whole.

— Systems, such as electronic mail, databases (of projects under way locally, for example), and expert systems, allow dispersed staff to collaborate more effectively and can help to distribute and preserve skills.

— The falling cost of information technology makes it possible to install more sophisticated systems (CAD/CAM and online systems, for example) that permit functional distribution while minimising diseconomies of scale.

We found many examples where central functions had been distributed to local units or where such distribution was planned. In addition to the tendency for the systems function to become more distributed, other examples included:

— A Belgian bank that distributed the work of 700 data-entry staff to branches by introducing an online branch terminal system.

— A Danish electrical manufacturing company that distributed its central product-coordination and planning function to its factories and achieved major reductions in stock and interfactory work in progress, through the adoption of new factory-control systems.

— A French electronics and electrical manufacturing company that was distributing its central research and development activity to its divisions, a move assisted by new lower-cost CAD/CAM systems.

— Many organisations that had distributed, or were distributing, much of the work of their central accounting function to business units at lower levels in the organigram.

In some instances, however, the use of information technology has resulted in the creation of new central functions. Obvious examples are the creation of central systems and telecommunications departments and the growth of the central accounting function in the 1950s and 1960s with the installation of batch mainframe accounting systems. Other examples include:

— A Dutch insurance company that transferred the premium-collection activity from the salesforce to a newly created central department. This was made possible primarily by the development of a computerised premium-collection system, and secondarily by the growing computerisation of retail banking and the enhancement of banking facilities (such as automatic direct debiting). The company cut its salesforce by two-thirds (by around 1,000 people) while increasing its premium income. (This system was acknowledged to have helped save the company from imminent bankruptcy.)

— A British insurance company that created specialist central risk-assessment departments, making extensive use of computer-based statistics and modelling techniques, to improve its underwriting of nonroutine, large, and high-risk projects.

— A British retail group that expanded its central treasury — and the department's contribution to corporate profitability — by using systems to report on the cash available for overnight deposit.

These examples all produced a 'heightening' of the organigram, which is contrary to our earlier conclusion that the use of information technology produces flatter organigrams. Although we cannot be certain, we believe that the flattening effect is more prevalent and more significant than the heightening effect. In many organisations, the creation of new or larger central functions as a result of adopting information technology is, we believe, a transient effect. As information technology evolves and matures, the activities of some of these new central functions will again become more distributed.

IMPACT ON MANAGERIAL ROLES, RESPONSIBILITIES, AND INFLUENCE

Although the discussion above concluded that information technology does affect organigrams, it is possible that, in a given organisation, adoption of information technology may not have changed the organigram. However, it is less likely that an organisation can adopt information technology with no impact on the roles, responsibilities, and influence of the individual managers and departments.

We wanted to ascertain the way in which such changes would be manifested, and also to seek evidence to support, or refute, the claim that 'control of information enhances managerial power'.

Our overall conclusions are that:

— The adoption of information technology does change roles and responsibilities.

— Individuals and departments that use effective information systems can increase their influence, status, and power.

We also concluded (not surprisingly) that systems managers responsible for implementing 'good' systems — particularly those that top management perceives as having a fundamental impact on the profitability, competitiveness, or survival chances of the organisation — increase their own influence, status, and power.

THE ADOPTION OF INFORMATION TECHNOLOGY CHANGES ROLES AND RESPONSIBILITIES

In most of the earlier examples used to support our conclusion that information technology results in changes in the organigram, there was also clear evidence of changes in roles and responsibilities:

— The American insurance company that eliminated the role of regional managers distributed the residual work between the branches, senior management, and staff functions.

— The Dutch insurance company that reduced the size of its salesforce transferred the responsibility for premium collection from the salesforce to the finance section.

— The Belgian bank that introduced a branch terminal system gave full responsibility for the accuracy of client account records to the branches, removing it from the regional administration centres.

— The Danish manufacturing company that distributed factory-production coordination shifted responsibilities from works managers to production planners (an impact that was not anticipated at the outset — at least not by by the works managers).

— The British insurance company that created central risk-assessment departments removed some responsibility from line managers.

— An American financial services company developed a securities-dealing system that had the potential to substantially de-skill (as well as improve the effectiveness of) the work of professional dealers. However, the dealers perceived the system as a threat to their professional status and rejected it.

These are all obvious changes in responsibility arising from the adoption of information technology. However, we also investigated one organisation where the change in responsibility was more subtle and possibly more profound. This type of change is likely to impact other organisations as information-technology applications move from the back office to the front office, and then onto the desks, or into the homes, of customers, suppliers, and third-party workers.

The organisation concerned is the French subsidiary of an international bank. The bank had introduced a telebanking service following the rapid spread into homes and offices of the French PTT's Minitel (videotex) terminal. The telebanking service provides clients with direct access to account information and permits them to initiate certain transactions, such as account enquiry and the transfer of funds between accounts, that were previously carried out by the bank's branch staff.

Responsibility for the project was given to the director responsible for systems and other back-office departments. In effect, a director with back-office responsibilities took control of a strategically important front-office service. Whether this director will retain control of the service in the future depends on many factors — not least the success of the project in its early stages, and how quickly the front-office directors perceive any threat to their responsibilities. The relevance of this example is that the opportunity to take on a potentially significant increase in responsibility arose because the individual concerned was also responsible for the systems function.

A similar shift in responsibility may arise in the Belgian bank mentioned earlier, where a cash-management system for business clients was offered by the head office, even though client contact was the prerogative of regional offices. The regional manager whom we interviewed in the Belgian bank did not believe that the system posed a threat to regional responsibilities. We are less certain.

Although these examples may seem insignificant, they are pointers to important impacts that will become more significant in the future:

— Responsibility for managing information technology can lead to additional strategically important business responsibilities.

— The desire of line managers to prevent the erosion of their responsibilities is likely to increase demands for changing the way information-technology activities are controlled, either by shifting the reporting from a back-office to a front-office director, or by the further distribution of responsibility for information technology to line units.

— The same desire by managers and professionals may lead to the rejection of plans for important systems, even though the systems may have the potential to bring considerable business benefit.

— The implementation of 'front office' applications may give information-technology managers an opportunity to raise their level of reporting, thereby reducing the conflict over who should have responsibility for information technology.

INFORMATION TECHNOLOGY CAN ENABLE USER MANAGERS TO INCREASE THEIR INFLUENCE, STATUS, AND POWER

The preceding section focused on the impact of information technology on roles and responsibilities, and implied that changes in managerial authority had arisen from the adoption of information technology. However, from the examples quoted it is not obvious that being responsible for an individual system, or acting on the information provided by the system, brings an increase in influence, status, and power. Nor was it easy to obtain evidence that such changes had occurred. Indeed, all our interviewees said there had been no change in authority arising from the adoption of information technology. However, the desire of many line managers to take control of their local information-technology activities leads us to view such claims with some scepticism.

Quantitative and anecdotal evidence of a shift in influence, status, and power resulting from the introduction of a computer system is provided in an article by Bjorn-Andersen and Pedersen of the Copenhagen School of Economics entitled "Computer-facilitated changes in the management power structure". The article concerns a computerised factory-planning and loading system in a Danish manufacturing company. The system was operated by production planners and had been introduced to coordinate the supply of components and assemblies between factories and thereby minimise intracompany stockholdings and work-in-progress. A study by the Copenhagen School of Economics set out to determine how the introduction of the system had changed the power of three groups of individuals: the production planners, the factory managers, and the works managers (who were responsible for sections of the factory). The planners and works managers reported to the factory managers on a day-to-day basis, although the planners reported through a 'dotted line': their formal line of reporting was to the central production-planning department.

The changes in the relative power of the groups are shown in Figure 1.1. In summary, the planners increased their power while the works managers especially felt they had lost influence and their 'power base' (particularly in the extent to which they commanded a key position in their organisation). All groups felt that the introduction of the computerised system had reduced their discretionary powers.

Figure 1.1 Summary of the major changes in power variables resulting from the introduction of a computer system

Power variable	*Production planners*	*Factory and works managers*
General influence	+	–
Key position in the work flow	+	–
Up-to-date knowledge	+	No change
Control of others' activities	+	No change
Discretion		
— Control	–	–
— Dependency	–	–
— Rules	–	–

+ = Increase in power
– = Decrease in power

(Source: N Bjorn-Andersen and P H Pedersen – see bibliography)

Another interesting point arising from this study (see Figure 1.2) is that self-ratings and peer ratings of changes in influence are different: the factory managers felt they had increased in influence far more than was perceived by their peers. Similarly, the works managers felt their loss of influence was greater than others saw it to be. For the production planners, the situation was ideal:

— Their bosses (the factory managers) thought their own influence had increased, when in fact it had not.

— The works managers felt weaker than they really were.

In terms of the factors that constituted their power bases (shown in Figure 1.3), the planners felt a significant increase in their status, in their key position in the organisation, in their expert knowledge, and in their access to up-to-date information. Factory and works managers recognised that their access to up-to-date information had increased, even though they were dependent on the production planners for this access. Works managers felt they had lost out on all but one of the other

Figure 1.2 Average changes in influence in day-to-day operations resulting from the introduction of a computer system

Type of staff	*Peer rating*	*Self-rating*
Planners	+1.9	+1.8
Factory managers	+0.1	+1.0
Works managers	−0.1	−1.3

Measured on a scale ranging from +2 (large increase) to −2 (large decrease)

(Source: N Bjorn-Andersen and P H Pedersen – see bibliography)

Figure 1.3 Perceived changes (self-rating) in the importance of power bases from the introduction of a computer system

Power base	*Planners*	*Factory managers*	*Works managers*
Formal status	+0.6	+0.3	−1.3
Key position	+1.9	+0.5	−1.0
Expert knowledge	+1.5	−0.5	−0.5
Up-to-date knowledge	+1.9	+1.0	+1.0
Positive/negative sanctions	0.0	−0.3	−0.8
Time available	+0.3	+0.3	−0.5
Personality	+0.3	−0.3	0.0
Influential friends	0.0	−0.3	−1.0

Measured on a scale ranging from +2 (large increase) to −2 (large decrease)

(Source: N Bjorn-Andersen and P H Pedersen – see bibliography)

elements of their power base; for the factory managers, the gains and losses largely cancelled each other out.

Each group felt that its area of discretion had been reduced in many or all aspects of day-to-day tasks — a finding that supports our earlier conclusion that information technology can be used to tighten control of an organisation. Figure 1.4 quantifies how each group felt its discretionary powers had been reduced and over what aspects of its work.

The study also commented on the subsequent career progression of planners and of factory managers. In one factory, where the planner had a stronger personality than the factory manager, the planner began to take over the management of the plant. In a later reorganisation the planner was promoted to become the central planner, while

Figure 1.4 Average perceived changes in discretion resulting from the introduction of a computer system

Area of discretion	*Planners*	*Factory managers*	*Works managers*
Orders and advice from superiors	+0.3	+0.3	−1.2
Orders and advice to subordinates	−0.8	0.0	−0.6
Control of the task	−1.1	−0.7	−1.2
Dependence on the work of others	−1.3	−0.7	−1.4
Rules, procedures, and methods	−1.6	−0.3	−1.0
Goals, policies, and plans	−0.8	−1.0	−1.2

Measured on a scale ranging from +2 (large increase) to −2 (large decrease)

(Source: N Bjorn-Andersen and P H Pedersen – see bibliography)

the factory manager was demoted. In a second plant, the factory manager was removed from his post (and made responsible for general quality control in the company), while responsibility for his factory was transferred to the new manager of the first factory. In a third factory, the factory manager was strong and the planner was (in the words of Bjorn-Andersen and Pedersen) "least able to take over the plant", and the two worked together effectively and in harmony.

It could be misleading to infer from this one study (and from our intuition and our experience in other organisations) that the adoption of information technology will inevitably enhance the influence, status, and power of system users. Nevertheless, we believe that a system that is perceived by senior management as conferring substantial benefits on the organisation can increase the influence of the individuals or departments that control the system. (Whether they wish, or are able, to translate that influence into 'political' power or personal benefit clearly is determined by other factors beyond the scope of this report.)

SYSTEMS MANAGERS INCREASE THEIR RESPONSIBILITY AND INFLUENCE THROUGH THE SUCCESSFUL ADOPTION OF INFORMATION TECHNOLOGY

Our research produced some interesting examples of instances where systems managers had been able to increase their responsibility and influence. The examples are interesting both because they illustrate this conclusion of our research and because they demonstrate the fickleness of fate:

- In the Dutch insurance company, the internal consultant from the finance department who proposed and project-managed the change (which was opposed by the systems manager) subsequently became responsible for the systems function, and eventually became the board member with responsibility for both systems and finance.
- In an American railway company, the line manager who made an outstanding success of the implementation of an operations-control system built using Sperry's Mapper was subsequently made responsible for the IBM-based systems department, with instructions to make it more responsive to users' needs.
- In a large retail bank, the central management services director had done a magnificent job regrouping, centralising, and redeveloping the company's information-technology activities and main systems — a job recognised to have brought great strategic benefits to the bank. However, because of the high regard the board had for his management capabilities, and the critical importance of one of the systems under devel-

opment, he was asked to project-manage that development, while the management of the systems function passed directly to a main-board director.

— At the Belgian bank, the individual who 'sold' the system to the board did so on the grounds that it could be cost-justified by increased market share (although another factor may have been management's desire to reduce its vulnerability to industrial disputes in the highly unionised data-entry departments). The system cost more to develop and took several years longer than was originally proposed, and it is doubtful if the anticipated growth in market share has materialised. However, the individual who 'sold' the system was promoted and became an advisor to the board several years before the system was completed.

IMPACT ON EMPLOYMENT AND OCCUPATIONAL STRUCTURES AND SKILLS

Information-technology projects are frequently justified as a means of reducing staff or containing the growth of personnel numbers and costs. The adoption of new technology is often resisted by unions and employees fearing just that. Even so, experts remain divided over the impact on employment of technology in general and information technology in particular, although most would acknowledge that it is likely to have some impact on occupational structures and skills.

Some claim that employment can be increased through investment in technology, which will result initially in greater competitiveness in the short term (through job shedding or containment), and subsequently in faster growth and hence greater employment (because growth will exceed the increase in personnel productivity). Another hypothesis supported by right-wing politicians (especially in the United Kingdom) is that while investment in technology in the manufacturing sector may reduce the demand for labour, employment will grow faster in the 'information' sectors of the economy (such as financial services), resulting in a net increase of employment. Again, there is no evidence to support this hypothesis, except the historical experience of the Industrial Revolution, when the adoption of new technology eventually created major growth in employment and living standards — but only after first creating massive unemployment in rural and handicraft industries. It took almost a century for the living standards of the mass of the population to return to the levels that had existed before the Industrial Revolution.

In this report we are concerned with the impact of information technology on staffing levels within Foundation member organisations and not with the more general issue of employment in society. In this context, it is clear that the adoption of information technology generally allows organisations to carry out their existing operations with fewer staff. However, there are a few examples where the effective use of information technology has enabled a company to gain market share and grow at the expense of its competitors. Sometimes this growth results in the need for additional staff.

The adoption of information technology is also changing the occupation skills structure. The trend is towards a polarisation of the workforce into a smaller number of highly skilled personnel and a larger number of unskilled part-time workers. In particular, this trend is creating more opportunities for part-time female workers.

We develop these points in the remainder of this section.

THE IMPACT OF INFORMATION TECHNOLOGY ON STAFFING LEVELS

We encountered few organisations that openly and directly attributed major job losses to the adoption of information technology. We have already referred to the Dutch insurance company where 1,000 salesmen were made redundant through the introduction of a central premium-collection system. More typical is the Belgian bank that eliminated 700 data-entry jobs by the introduction of its online branch terminal system, but absorbed the displaced staff in other departments and branches. It has only now, some three years after the system was fully implemented, agreed with the unions to shed 300 jobs over a two-year period by natural wastage and recruitment constraints.

There are many other examples of organisations that have increased personnel productivity significantly by introducing new computer systems. This increase has in some cases led to subsequent reductions in manning. Typically what happens when information technology is adopted (in the form of a major system implementation, for example) is that productivity increases, leading to staff surpluses. Then, over a period of one to three years, the surplus labour is shed — by redundancies, by natural wastage, and by recruitment constraint. Thereafter, the employment trend will be dictated by the overall fortunes of the organisation.

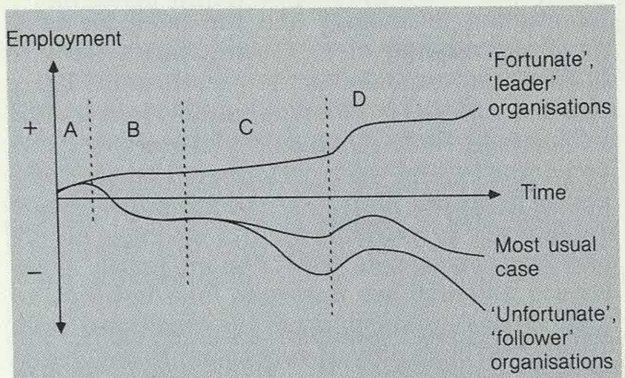
In most industries, a few organisations will increase the number of people they employ because of business growth enabled and supported by investments in information technology. We have already mentioned a major supermarket chain that increased its number of branches from 27 to 400 over a 25-year period with a consequent (and continuing) increase in employment. However, in the same period other supermarkets declined and went out of business, as did many small shops. Overall, the number of people employed in food retailing declined.

We have constructed a model that illustrates the general employment trends resulting from the adoption of information technology (see Figure 1.5). During the first phase (A) there is a slight increase in employment resulting from the need to invest in the technology and train the workforce to use it effectively. When applied, the technology will increase worker productivity, thereby creating surplus staff. During phase B, the surplus staff are either absorbed by business growth or shed — slowly or quickly, depending on the business situation and management style of the organisation. As a result, a few organisations will then be in a strong competitive position and during phase C will experience real business growth, which may lead to employment growth, as shown by the upper line in Figure 1.5. Most organisations will continue to operate at the lower staff levels during phase C, whilst others will continue to decline. During phase D, the whole cycle is repeated again with the next round of investment in information technology, but starting from a different base level of employment.

The types of organisation more likely to follow the upper line in the figure will be what we term 'fortunate' and 'leaders'. Fortunate organisations are well managed and inherently competitive, and they operate in a growth market. Natural market growth allows the level of employment to increase in phase C until it is slowed by the impact of further technology adoption. Leader organisations will apply information technology to achieve improved productivity before their competitors do, thereby reducing unit costs, which could lead to an increase in market share at the expense of their (follower) competitors.

By contrast, 'unfortunate' organisations experience a sharp fall in employment as a result of adopting information technology as they shed surplus manning in a declining market — a fall that is barely reversed before further information-technology adoption continues the cycle of employment decline. 'Follower' organisations invest in information technology when their competitors are already feeling the benefit of reduced overmanning. As a result, follower organisations experience a loss of market share and, instead of being able

Figure 1.5 Relationship between information-technology adoption and employment



Phase A Increase in employment while adopting information technology
Phase B Reduction in (or absorption of) surplus manning resulting from information-technology adoption
Phase C Having reduced or absorbed surplus manning, employment levels follow the fortunes of the organisation
Phase D Further adoption of information technology results in repetition of Phases A, B and C, but from a different employment base

to absorb the overmanning by an increase in market share, find they need to shed personnel.

The model depicted in Figure 1.5 assumes an industry sector with a reasonably stable marketplace. If all organisations in the sector adopt information technology at an equal rate, they all become more efficient, but none of them gains a competitive advantage. The net effect is that all the organisations reduce their levels of employment in the long term.

In a high-growth business sector, even the unfortunate/follower organisations may experience a growth in manning levels. On the other hand, in a declining sector the fortunate/leader organisations may still find it necessary to shed staff, although the rate of reduction will be lower than it would have been without the adoption of information technology.

INFORMATION TECHNOLOGY ENCOURAGES EMPLOYMENT OF HIGHER-SKILLED STAFF AND OF FEMALE AND PART-TIME LABOUR

In forming our views about the impact of information technology on overall employment patterns, we reviewed the data published in 1986 by the Institute of Manpower Studies (IMS). The IMS surveyed 2,830 organisations in all sectors in the United Kingdom to determine occupational and employment trends to 1990. The IMS study concluded that there would be a progressive shift towards higher-skilled workers, and a growth in part-time and female employment. The conclusions of the study on occupational skills changes are summarised in Figure 1.6. The study also noted that the trends were influenced by the adoption of information technology and the need for technically competent and better-qualified staff to operate and maintain the new equipment. There was also a tendency towards employment of staff willing to be more flexible both in working hours and in the type of work performed. Female workers are in general prepared to be more flexible and are likely to be available for and willing to accept part-time employment. Furthermore, female workers are generally less unionised (and less loyal to their unions), particularly in the traditional craft unions that have proved so resistant to the changing practices required by the adoption of new technology.

Information technology was also cited as contributing to the employment of part-time labour because it is able to absorb much of the routine work that keeps full-time workers in useful employment during the normal working troughs that occur between peaks. As a result, the tendency is towards the employment of part-time workers to meet peak loads.

We believe that the United Kingdom occupational trends are likely to apply in other countries, though with local variations. For example:

— In West Germany we would expect a less marked trend towards female employment because of stronger social pressures on women to remain at home.

— In the Netherlands and Scandinavia the shift from full-time to part-time employment could well be less obvious than in the United Kingdom because of the efforts under way to reduce the working hours of full-time workers.

— In France and Italy there may be greater full-time youth employment, and less of a trend towards part-time female employment because of government efforts to reduce youth unemployment, and because of social pressures on women.

— In countries such as West Germany where craft unions are less powerful than in the United Kingdom, where flexible working practices are part of the work culture, and where there is a tradition of continual worker training, the contraction in the employment of single-skilled craftsmen and operatives is likely to be much less evident.

Figure 1.6 Expanding and contracting occupations in service and production industries

Occupations	*Service industries*	*Production industries*
Expanding occupations	All professionals	Engineers, scientists
	Support services (part-time)	Technologists
	Personal services (part-time)	Technicians
		Multiple-skills craftsmen
Contracting occupations	Managers and adminstrators	Single-skilled craftsmen
	Technicians, craftsmen	Operatives
	Operatives	Clerical and other nontechnical support services
	Support services (full-time)	
	Personal services (full-time)	Personal services

(Source: IMS Study "UK occupation and employment trends to 1990")

OTHER IMPACTS RELATED TO INFORMATION TECHNOLOGY

We now consider the other organisational trends on which information technology has had, and is continuing to have, an impact. They are:

— The declining importance of geographical location.

— The growth of matrix management.

— The involvement of external parties in the business activities of the organisation.

THE DECLINING IMPORTANCE OF GEOGRAPHICAL LOCATION

The influence of geographical location on organisational structure is related to the ease or difficulty of communication, information flow, and control. Every improvement in the ease, speed, and cost of communication weakens the influence of geography. Every improvement in management-control techniques or practices reduces the need for a manager to be 'on the spot' to supervise the work of subordinates. Clearly, information technology is playing an important role in improving communications and management-control systems. In this section we focus on two facets of this issue: telecommuting (or home working), and distributed departments.

Telecommuting

Telecommuting, the term used to describe the growing practice of working from home supported by information technology, has begun to be important for some industries, particularly:

- Journalism, where freelancers or employees are increasingly working from home (or hotels), typing up their articles on portable personal computers before transmitting them direct, or via a store-and-forward electronic mail service, to their editors or to automated typesetting systems.
- Software development, where employers (such as F International and ICL) are employing a largely female, home-bound workforce for the online development and testing of software. These employers have found it less costly and more productive (as well as personally satisfying for their employees) to provide a terminal for a skilled programmer who resigns to have children, than to hire a trained replacement or to make extensive use of contract programmers.
- Insurance, where home-based salesmen and independent brokers are increasingly being equipped with online terminals or personal computers to improve their productivity and/or to 'lock' them more firmly into the organisation.
- Other industries where home-based salesmen are used, such as the food and drinks industry, where there are examples of the successful use of videotex terminals, data-capture devices, and personal computers to improve communications with a central sales office and to shorten the elapsed time between receipt of order and invoicing.

Rank Xerox's much-publicised experiment to equip some of its skilled staff with appropriate training and information-technology tools, and then establish them as independent home-based workers, employed only part-time by Rank Xerox, has met with only qualified success. A totally cynical interpretation of what Rank Xerox has done is that it has saved the cost of firing, or retiring early, redundant professional workers, and has instead left them to sink or swim as freelancers. A more generous interpretation would suggest that a humane and caring employer has sought, with some, if not total, success, to give a few of its older professional workers a new lease of working life. The truth probably lies between these two extremes. (Peter Drucker has argued persuasively that it will become a common, indeed essential, feature of the 'knowledge economy' for 'burned-out' middle-aged knowledge workers to be given the opportunity to develop a second career, thereby extending their productive life by 10 or 20 years.)

We believe that the use of subcontract professionals, whether or not based on telecommuting, will become an important feature of office work in the future because:

- Employers have access to a larger skilled workforce, and the risks are less than those of employing full-time workers.
- Freelance or home-based employees tend to work longer and more variable hours than office workers because they are freed from the rigidity, strain, and lost time of commuting.
- Costs for employers need not be higher, because home workers have negligible overheads to support, and they are paid only when their services are used.

Our research indicates that one of the main hurdles to be overcome before telecommuting can become more widely established is the scepticism of employers who feel that it is harder, if not impossible, to control the work of a telecommuter. While this may be true in some situations, those organisations that have learned to use telecommuters effectively feel the benefits outweigh the problems and risks.

Distributed departments

By 'distributed department' we mean an organisational situation where a manager and all or some of his subordinates are at different physical locations. This is not a new organisational form. Most senior line managers in large organisations manage subordinate managers who are geographically distributed. No technology beyond a telephone, a typewriter, and a telex or a facsimile device (and easy access to effective transportation) is needed to make a distributed department manageable.

Maintaining organisational cohesion and managerial authority is much harder in a distributed department, however. The manager will usually need a larger support staff, increasingly equipped with effective systems technology, to monitor and probe more deeply into the activities of distant subordinates and to advise on remedial action. (Whether the action is called for may not be the point at issue: the manager of a distributed department needs to assert his authority from time to time.)

Examples of information technology that make the management of distributed departments easier and more effective include:

- Store-and-forward electronic mail systems, which are overcoming time barriers.
- Facsimile, which is facilitating the control of activities where accurate and timely document communication is required.
- Linked systems, used to provide access to a common database of information for the department, or to link independent processors

(for example CAD/CAM devices in a distributed research and development environment), which are increasing the effectiveness and cohesion of departments.

New technologies, such as videoconferencing, whether slow-scan or full video, will further reduce the impact of geography on organisational structures. But the real barrier to their further adoption is the same one that is slowing the acceptance of telecommuting. Managers are understandably reluctant to accept unfamiliar and less convenient forms of working.

THE GROWTH OF MATRIX MANAGEMENT

Matrix management is an effective and, indeed, an essential aid to the direction, coordination, and control of complex operations. Yet it is a management style that is manifestly inefficient, and it has a tendency to generate real or electronic paperwork. In a large, complex, and matrix-structured organisation, it would not be unusual for 10 or more individuals or departments to be involved in the decision-making process affecting a single product in a local geographic market. Any relevant document generated in any of these 10 or more departments would need to be distributed (probably with multiple copies) to all other interested departments.

Efficient office systems, fast interdepartmental communications, and effective management information systems to analyse and report on events from many different angles have played an important role in the success of matrix management in organisations where it is an essential form of management, and have made it popular in other organisational environments where it is not essential.

Some industries (such as government, aerospace, pharmaceuticals, and computers) need matrix management, as do some departments in other industries — planning and coordination departments, for example. Some activities, such as a major new product launch, also need matrix management. But for the majority of industries, departments, and activities, matrix management can create organisational paralysis, inefficiency, and ineffectiveness — aided and abetted by information technology.

THE INVOLVEMENT OF EXTERNAL PARTIES IN BUSINESS ACTIVITIES OF THE ORGANISATION

Most organisations exclude external parties (customers, suppliers, contractors, and the like) from their corporate organigrams for the obvious reason that they are not employed or controlled by the organisation. Increasingly, however, information technology is bringing external parties 'into' the organisation. They will need to be treated as an extension of the organisation because they will, with the assistance of information technology, be able to undertake activities previously undertaken by the organisation. Examples include:

- Airlines and tour operators that have 'subcontracted' to travel agents the work of establishing the availability of a seat or bed, of making and cancelling reservations, and of issuing tickets via online terminal networks.
- Petroleum companies that have sold their filling stations to former employees, while keeping in place the existing sales and stock replenishment data-capture systems.
- Banks that have installed EFT/EPOS systems in shops and garage forecourts and that offer telebanking and cash-management systems, in effect putting an electronic bank teller in the shop and garage, and potentially in every office and home.
- Insurance companies that have hived off their direct sales force, establishing them as independent brokers, and provided them with information-technology support in an attempt to 'lock them in' as loyal customers.
- Motor manufacturers that have provided dealers with vehicle-locator systems to minimise lost sales opportunities and to reduce unnecessary stockholding.
- Pharmaceuticals distributors that have provided pharmacists with online access to their ordering systems, thereby improving customer service and reducing order-taking costs.
- Manufacturers that are increasingly specifying the type of CAD/CAM systems their subcontractors or partners must use before they will do business with them.
- Freight hauliers that are beginning to use value-added network services to locate loads and empty vehicles.
- Banks and airlines that are strategically dependent on third-party value-added networks (such as SITA, SWIFT, and centralised bank-clearing services) for communications within their respective industries.

Every year the list of third-party information-technology dependencies grows longer. As information technology spreads outside the organisation, it brings external parties into the organisation. New activities, skills, and departments need to be created to manage and support these new external 'employees'. And because these new employees are often clients as well, the marketing department should have a key role to play, along with the systems department. More than any of the other impacts of information technology identified in this chapter, the increasing involvement of third parties in the business activities of the organisation will require a review of where the systems department should report in the organisation.

Chapter 2

Future impacts

In Chapter 1 we established that information technology has had a significant impact on the organisation structures of most major organisations. In many organisations, however, managers are unlikely to recognise the role that information technology has played in producing organisational change. This is because the changes have been initiated by management, with information technology playing an enabling role. Information technology has provided management with opportunities to make incremental changes in organisational structures in ways that would otherwise have been impossible. Over a long period, the sum of the incremental changes has, in many organisations, been considerable, and it is only with the benefit of hindsight that the impact of information technology on organisational structures can be determined.

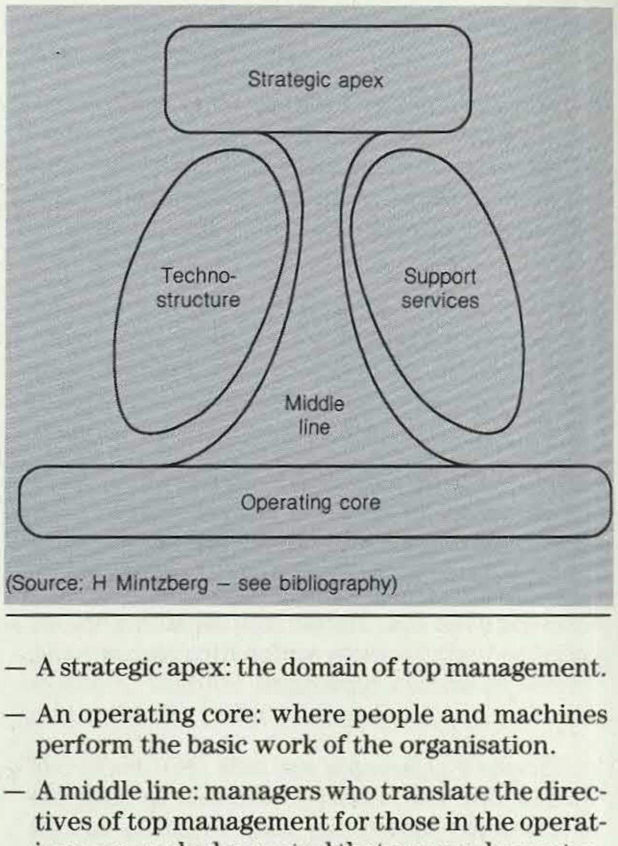
Given the increasing rate of technological change, we can see no valid reason for thinking that the impact of information technology on corporate organisation structure will be any less over the next 25 years. Indeed the changes are likely to be even more profound. In this chapter we provide some pointers as to what those changes may be.

We made no attempt in Chapter 1 to distinguish between the different types of organisation structure that exist. Now it is appropriate to do so, because the impact of information technology is likely to vary between types of structure. We begin this chapter by describing the classification of organisation structures proposed in the early 1980s by Henry Mintzberg of Harvard University. We then explore the possible long-term impact of information technology on each type of structure and describe a hypothetical new structure that might emerge in the 21st century, and which could function effectively only with the support of information technology.

MINTZBERG'S CLASSIFICATION OF ORGANISATION STRUCTURES

Professor Mintzberg proposed that all organisations — however large or small, and in all sectors — could be broken down into five elements (see Figure 2.1):

Figure 2.1 The five basic elements of the organisation



(Source: H Mintzberg – see bibliography)

— A strategic apex: the domain of top management.

— An operating core: where people and machines perform the basic work of the organisation.

— A middle line: managers who translate the directives of top management for those in the operating core, and who control that core and report on performance to those at the strategic apex.

— A technostructure: professionals, analysts, and planners who are concerned with the formal planning and control of work, and who devise the operational systems that ensure the efficient functioning of the operating core and middle line.

— Support services: internal services (ranging from the mail room to the legal department) for the rest of the organisation.

With these five basic elements, Mintzberg constructed five standard organisation types:

— Simple structures.

— Machine bureaucracies.

— Professional bureaucracies.

– Conglomerates.
– 'Adhocracies', which he further subdivided into operating adhocracies and administrative adhocracies.

We now describe each of these in greater detail, to enable the reader to classify his or her own company's organisation type.

SIMPLE STRUCTURES

Simple structures (illustrated in Figure 2.2) were prevalent in the pre- and early-industrial era and consist only of the strategic apex and an operating core.

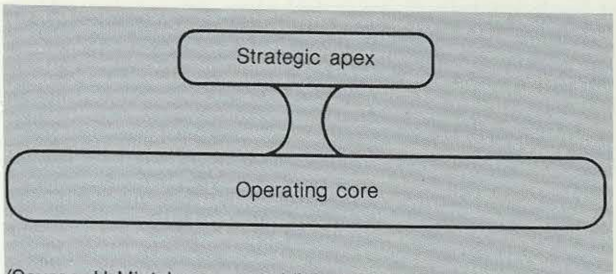
The strategic apex may consist of a single entrepreneurial manager or family, or a small closely knit management team. The role of the strategic apex is to direct: the employees do the work. Simple structures have no formal management systems and rely on personal supervision by the director(s) for direction and control. They are highly innovative, flexible, and fast-footed. They thrive by seeking out niche markets and growing rapidly to exploit them. Most forms of information technology — other than basic facilities such as the telephone, telex, and word processors — and inflexible computer systems have little place in simple structures.

Many simple structures grow rapidly and then collapse, usually for one or more of three reasons:

— They suffer cash-flow crises because they lack the systems and the professional management to cope with rapid growth.
— They outgrow their niche markets and, rather than seek out new niches, run into fierce competition from larger organisations that have the advantage of economy of scale and the staying power to withstand market fluctuations.
— They fail to make the organisational transition from a simple to a more complex structure, often because their founders are unable to relinquish personal control.

Of those that do not fail at an early stage, a few will make the successful transition to a different structure, while others, often on the point of failure, will be taken over by larger companies. The new owners will then try to impose their own management style on the simple structure. Often this will cause the original directors to resign rather than accept the 'bureaucratic' controls being forced on them. With no internal systems in place, and a manager from the parent company put in charge, these organisations will languish and flounder until they are 'turned round' by a major injection of management attention and cash or they are sold off to another entrepreneur. Mintzberg's insight is that simple structures need simple-structure managers to run them successfully.

Figure 2.2 Simple structures



(Source: H Mintzberg – see bibliography)

Many large corporations contain managers who are frustrated simple-structure managers, who feel their potential is wasted, and whose performance and 'attitude' may be considered to be below standard. Large corporations also contain many operational and support departments whose performance would be greatly improved if they were managed as simple-structure enterprises. These departments range from the typing pool to the delivery-vehicle fleet.

MACHINE BUREAUCRACIES

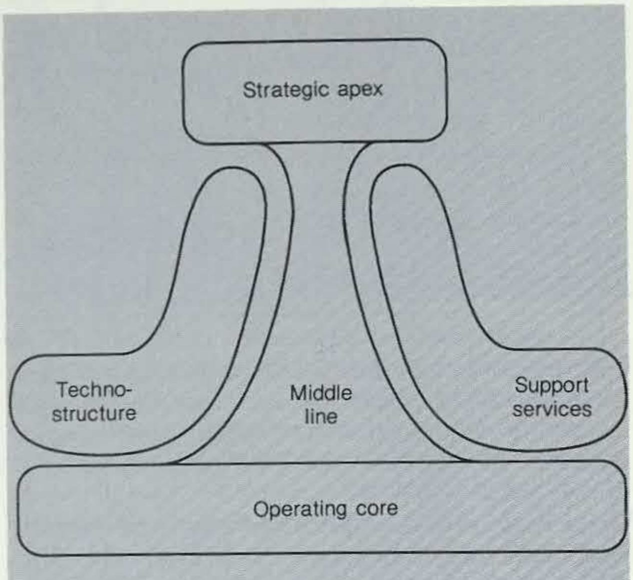
Machine bureaucracies are the product of industrialisation, and they consist of:

— A strategic apex.
— A strong middle line.
— A large operating core.
— Very substantial technostructure and support-service elements.

Figure 2.3 overleaf illustrates the structure of a machine bureaucracy. Such organisations are ideally organised to turn out consistently high-quality, mass-produced goods and services. Government public-service departments, banks, insurance companies, multiple retail organisations, airlines, telephone companies, postal services, mass-production manufacturing companies, petroleum distribution, mining, and power and water utilities are all, or should all be, managed and structured as machine bureaucracies.

Machine bureaucracies are highly centralised, and the well-developed technostructure and disciplined (even regimented — in Japan *par excellence*) middle line ensures that the corporate machines operate as efficiently as is possible, given their size. The large support-service structure insulates the production powerhouse from the outside world.

Figure 2.3 Machine bureaucracies



(Source: H Mintzberg – see bibliography)

Typically, though not universally, machine bureaucracies are highly integrated, providing virtually all services, and, as far as is possible, all the product, from within.

Machine bureaucracies are inherently monolithic, bureaucratic, and stable, and will change direction only under extreme pressure, and even then with great difficulty. They need large and, ideally, mature markets to operate in, and a key corporate goal is often domination of the market, in order to damp down external and competitor-driven instability. For the same reason, machine bureaucracies also tend towards vertical integration. These characteristics mean that the successful machine bureaucracies become very large. This drives them to bureaucratise, which makes them still larger.

The problems inherent in many organisations structured as machine bureaucracies are well known: massive size, inability to adapt, obsession with control, and alienated, frustrated, and demoralised employees. Yet they are efficient machines for producing goods and services, and there is probably no structure better suited to meet the needs of a consumer society that demands high quality at minimum cost.

The managers who thrive best in machine bureaucracies are the archetypal tough disciplinarians. They take instructions from above and see that they are carried out precisely by subordinates. They are essentially system-oriented and will generally suppress creative ideas and individual initiative. They have little time, and even less respect, for the staff professionals who thrive around the strategic apex and who from time to time descend to interfere with their line-management duties.

Traditional computer systems have a crucial and indispensable role to play in the smooth operation of machine bureaucracies. The relative inflexibility of such systems and the inflexibility of the organisation go hand in hand and are mutually reinforcing.

PROFESSIONAL BUREAUCRACIES

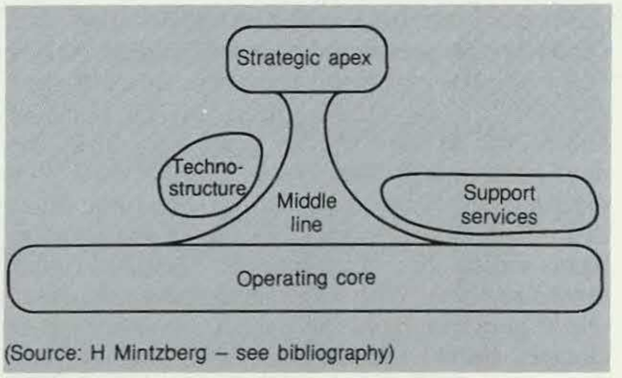
Whereas machine bureaucracies are optimised to standardise production processes, professional bureaucracies are ideally suited to standardise professional skills. They are the preferred organisation form for such institutions as hospitals, universities, large accounting firms, government agencies, and other 'professional' government departments.

Professional bureaucracies tend to be very decentralised. They rely on the work of highly trained professionals in the operating core who have a high degree of control over their work. The professionals exercise considerable power over many key decisions.

Figure 2.4 illustrates the structure of a professional bureaucracy. Only a small middle line and virtually no technostructure is required because the highly trained professionals work independently on largely standardised tasks. Middle-line management's main task — depending on the type of organisation — is protecting the organisation from external interference and generating funding or winning new client accounts.

Large numbers of support-service staff (librarians, nurses, research assistants, secretaries, and so on) are required to undertake the tasks that the professionals regard as being a poor use of their time and skills. Often, the support services are autocratically and systematically managed and con-

Figure 2.4 Professional bureaucracies



(Source: H Mintzberg – see bibliography)

trolled, and much of the work of those in the small technostructure is concerned with achieving high levels of efficiency, standardisation, and quality from the support services.

A professional bureaucracy is well suited to undertake tasks that match its specialist skills. However, a weakness of this type of organisation is that tasks that do not fit these skills cannot be handled, or are handled ineffectively by the application of standardised skills and techniques. (Many of the larger consultancy firms have become professional bureaucracies, performing their assignments well and efficiently using standard methodologies. But if their clients' problems do not 'fit' the methodologies being applied, the results are worthless.) Another weakness is that it is difficult for a professional bureaucracy to change direction, or even to introduce internal change — a bottom-up democratic process operates, and change can take place only with the agreement of the professionals.

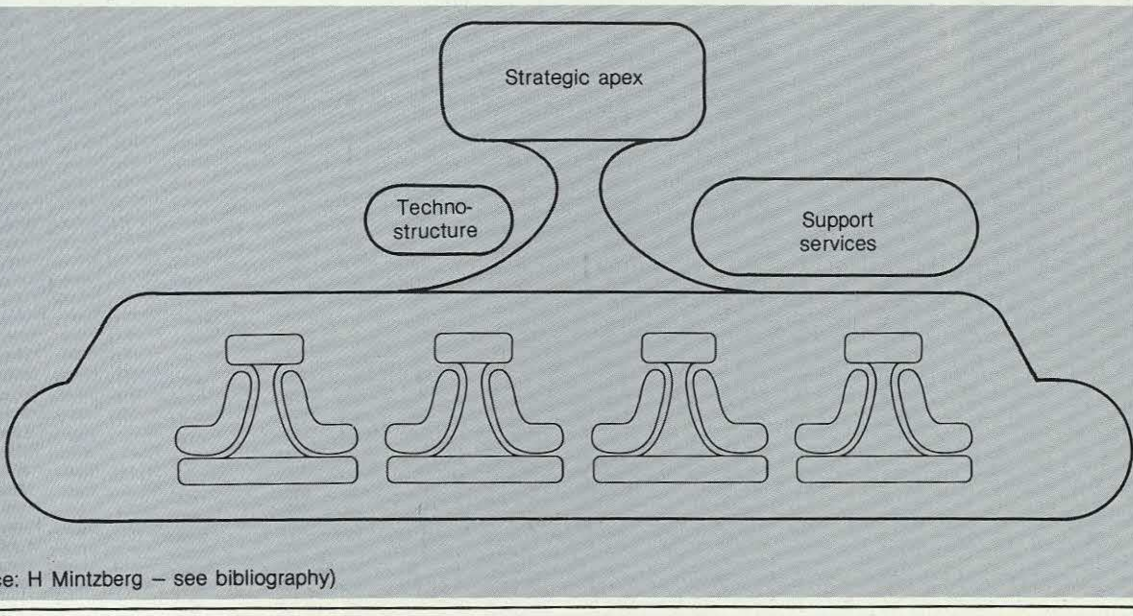
Senior and middle managers in professional bureaucracies are likely to be professionals themselves, but with a keen political instinct and considerable sales skills. Their main contribution to managing the professionals is to leave them alone to get on with the job, while oiling the political wheels of the democratic decision-making process. They will generally have a low regard for the managers and staff who provide the vital support services and will allocate as much of the available resources as they can to their professional colleagues.

Information technology has an important role to play in professional bureaucracies by providing the tools and systematic controls necessary for the support services to function efficiently and, where appropriate, by providing an analytical tool to support the professionals. Many professionals, especially the older ones, will be reluctant to use information technology to support their work. Their professional status is based on the expert use of the tools they were trained to use, and they have a deeply rooted resistance to change.

CONGLOMERATES

Conglomerates are, like professional bureaucracies, loose structures (see Figure 2.5) held together by an overlay of administrative and support services and a technostructure. The units in the operating core are semi-autonomous product or market divisions. Unlike professional bureaucracies, power in conglomerates is highly centralised; the power structure is maintained partly through the imposition and detailed monitoring of quantified goals and performance standards that eventually filter down to the lowest layers of the organisation, and partly through the use of central staff professionals and 'troubleshooters' to probe the performance of divisions. These control mechanisms tend to make the divisions organise themselves as machine bureaucracies as a means of achieving performance standards. The centralisation of power also serves to inhibit divisional risk taking: it is a brave manager who will take an unauthorised gamble when he is subject to a monthly performance scrutiny. These factors act together to make conglomerates slow-moving and conservative. They are, however, well adapted to support the size of organisation required to dominate world markets whilst allowing top management to retain control.

Figure 2.5 Conglomerates



(Source: H Mintzberg – see bibliography)

(Some readers will realise that Mintzberg's 'conglomerates' correspond with what many people describe as divisionalised companies.)

ADHOCRACIES

Adhocracies are organisational structures that have become important only since the Second World War. They are the favoured structures for high-technology industries such as aerospace, pharmaceuticals, and electronics. Many systems departments are structured as adhocracies.

As Figure 2.6 shows, adhocracies consist of a strategic apex and a bloated middle line that has absorbed the technostructure and support services. They abound with experts and professionals, whizz kids and 'little professors'. They are project-oriented, task-force-oriented and matrix-management-oriented. They are superbly adapted for innovation, problem solving, and for operating in very volatile environments, but they are hopelessly inefficient at anything else. Some adhocracies, recognising this weakness, have no operating core.

Adhocracies use information technology to support their innovative activity but, except in the operating core, are loath to accept the standardisation that accompanies the implementation of formal management systems. Standardisation of information technology is treated as an afterthought, and control over the information-technology purchasing process is virtually nonexistent.

Mintzberg has identified two types of adhocracy: operating and administrative adhocracies. We describe these organisation forms in greater detail before examining how they match the style of a typical computer department.

Operating adhocracies

Operating adhocracies undertake innovative problem-solving assignments for their clients for a fee. Examples include independent development laboratories and innovative and problem-solving consultancies. By comparison with the professional bureaucracies against which they may compete, operational adhocracies can produce brilliantly innovative results, but they are unlikely to compete with them on price.

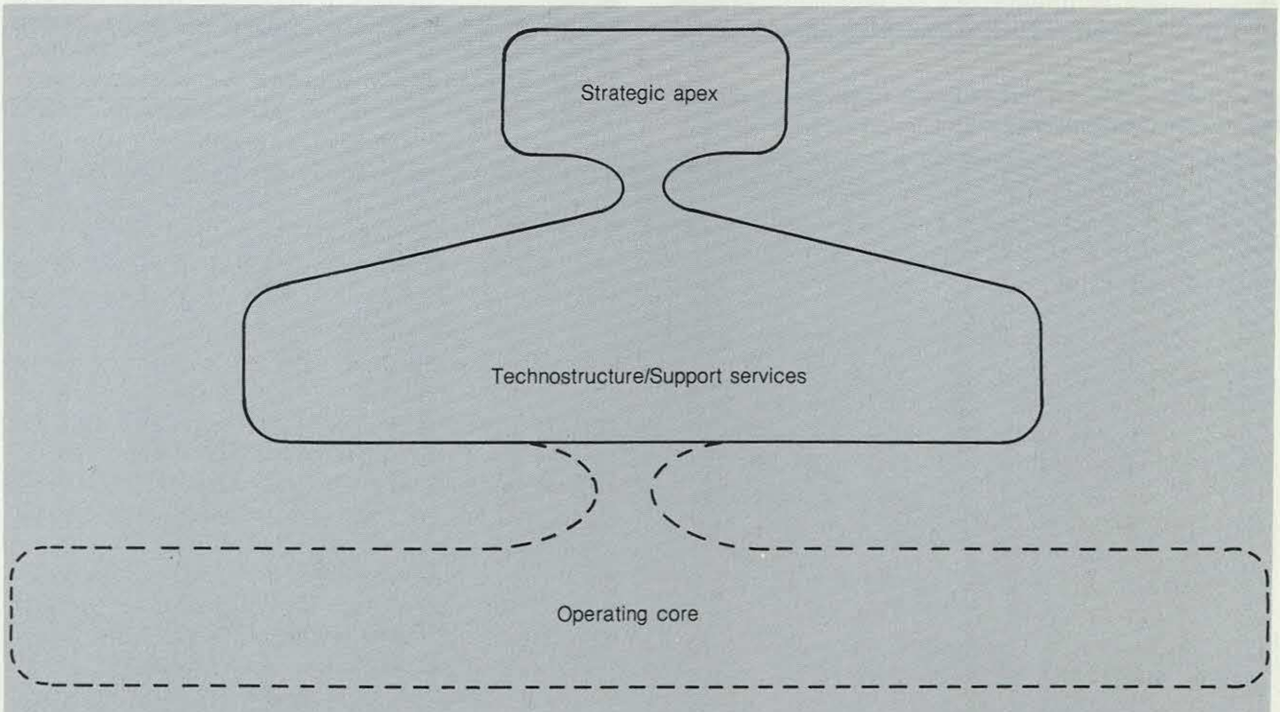
Administrative adhocracies

Administrative adhocracies differ from operational adhocracies in two important aspects:

- The innovative projects they undertake are done on their own behalf to achieve corporate goals.
- They perform operating-core activities, though these may be carried out by subcontractors outside the organisation.

Examples of administrative adhocracies include NASA, computer vendors, system houses, and many of the more successful organisations serving the volatile fashion markets — from haute couture and sportswear to toys.

Figure 2.6 Adhocracies



(Source: H Mintzberg – see bibliography)

The greatest danger that an administrative adhocracy can face is to fail to adopt a totally different management style for its operating core, which should ideally operate as a simple structure or as a machine or professional bureaucracy. This requires great agility and unique skills from top management. (NASA's Space Shuttle disaster has been attributed in part to a failure to meet this requirement.)

A large systems department is an example of an administrative adhocracy. The systems-development function requires all the innovative characteristics and project orientation of the adhocracy, while the operations and user-support activities, which form the operating core of the systems department, must operate as ruthlessly efficient, high-quality, standardised machine bureaucracies.

This conflict of styles gives the systems director a particularly difficult set of problems that may leave him not a little perplexed. Depending on his background, the systems director will tackle the problems in a different way, and with different effects:

- If he has a systems-development background, he is likely to allow the operations department to degenerate into well-meaning, but frantic chaos, and it will soon begin to establish its own advanced-technology experimentation unit. Meanwhile, the system-development activity will thrive and will pour forth creative ideas that will baffle and perplex end-user management, who "only asked for a patch to the sales-ledger system".
- If the systems director has an operations background, as a good machine bureaucrat he will ensure that the operations department is delivering 99.5 per cent uptime for 60 per cent of the budget his predecessor required. But he will find his systems-development schedule is in tatters because his best analysts and programmers have all resigned — to his utter bafflement.
- If he joined the organisation from a sales-management position in a successful small computer bureau, he will in next to no time have persuaded his superior that he should be running an independent business unit with any surplus 'profit' being reinvested in the department. He will let the internal management controls slide; the operations department will tend to grind on, but at an ever slower pace; and the systems-development staff will be grumbling about having to build systems that have been hopelessly underpriced by their manager.
- If he joins from a university, as a professional bureaucrat he will start by recruiting top-notch experts with whom he feels he can work to head up the main departments while he goes out selling new work and raising the status of the department in the organisational hierarchy. He will be amazed on his return one day to find that edicts have been issued by his subordinates requiring that, from now on, all systems will be developed in APL, while the operations department is in the process of converting from IBM to DEC. The debate he initiated on how best to decentralise computing to the line units continues, to his private satisfaction, but to his superior's growing irritation.

This intentionally light-hearted review of the plight of four fictitious systems directors underscores a serious point. Not only does the systems director need to adapt his behaviour to the different styles of his own department — and there will be relatively few other departments in the organisation that face this dilemma — but he will also need to insulate his department, as far as he can, from the possibly harmful pressures resulting from the management style of the organisation of which it is a part.

EVOLUTION OF ORGANISATIONAL TYPES

In the rest of this chapter we explore the ways in which Mintzberg's five organisational types may change over the next 25 years, and we examine the role of information technology in causing and supporting these changes.

We need to make two things clear at the outset, however. First, we believe that apart from macro-economic changes in market size and structure, information technology will, either directly through the automation of tasks previously performed by people or indirectly because of new pressures arising from the impacts of automation, be the most important factor in promoting organisational change. (We also suspect that management will be no more conscious of this than it is today.)

Second, we believe that the organisation structures that exist today will continue in all areas of organisational activity. None will disappear, although there may be a shift in emphasis towards simple structures and adhocracies because these are the structural types that are best adapted to innovation and to rapid response to change. They are also the most prevalent organisation types in the new non-institutional 'knowledge' businesses and the fast-growing technology-oriented industries. We believe, however, that all five organisation types will undergo substantial evolutionary change, and we postulate the emergence of a structurally new type of conglomerate, which we have termed a 'confederation'.

IMPACT ON SIMPLE STRUCTURES

The adoption of information technology by simple-structure organisations has been relatively low because the high costs, systematisation, and inflexibility of traditional data processing have clashed with their financial resources and management style. Personal computers at affordable prices, and the availability of better package software have now started to change this situation. Small businesses can now afford to automate their accounting and can gain benefits at affordable prices from word processing. This trend will clearly continue, with accounting systems and word processing (and, later, stock- and production-control systems and networked office systems) producing the same kinds of changes in simple organisation structures that we have observed in larger organisations today. These changes will play an important role in ensuring the survival of some small companies because the use of information technology will indirectly impose some of the controls required to allow a small business to grow and evolve into a machine bureaucracy.

In addition, we envisage four other important information-technology-related organisational changes for small organisations:

— They will increasingly be drawn under the 'umbrella' of large organisations.

— Cooperation with other small businesses in the same industry will increase.

— New small businesses based on the use of information technology will spring up.

— Large organisations increasingly will create in-house simple-structure organisations.

Online links between large suppliers and small companies, such as independent retailers and insurance brokers, will be exploited increasingly by the large companies to draw their customers into their organisations. Although they will retain their independence, the small companies will become increasingly dependent for their survival on the 'lock-in' information-technology services provided by their main suppliers. In some cases, they may become so dependent on these services that, in effect, they lose their independence and become *de facto* extensions of the supplier organisation.

Partly to counter this threat, we envisage greater cooperation between small businesses in the same industry, with the cooperation being coordinated by a trade association. For example, if independent insurance brokers feel they are being drawn too closely into the sphere of influence of a particular group of insurance companies, they may decide to cooperate in the establishment of an industry value-added network service that provides them with equal access to all insurance companies. They may even be willing to form a cooperating group — a loose form of professional bureaucracy — in order to counter the lock-in effects of information technology.

Simple-structure organisations that act as suppliers to large organisations such as major retailers and assembly manufacturers will also be subjected to lock-in pressures created by the systems of their customers. These large organisations will use information technology to increase their control over their suppliers by using value-added network services to automate the ordering and stock-replenishment procedures. They will use these procedures to offload much of their stockholding to suppliers, who will be responsible for ensuring that the goods they supply can be delivered at short notice. This trend is likely to have two impacts on smaller suppliers:

— It will force them to systematise and automate their own production and delivery processes in order to increase their responsiveness and to cut costs.

— It will oblige them to invest more heavily in stocks and finished goods.

Both these impacts will tend to force closer cooperation between small suppliers and their large customers, particularly in the area of systems so that system modifications made by the large customers can be reflected in their suppliers' systems. The large organisations will also need to adopt a caring and commercially responsible attitude to their small suppliers, even to the extent of funding some of the investment in stock and the automation of production processes. In the end, moves such as these will be less costly (and less risky) than buying out the small supplier to ensure continued supply when it runs into financial difficulty.

Given the enormous advances in information technology that we envisage over the next 25 years, we would expect many new companies to spring up to exploit the new business opportunities that these advances present. (An exact parallel occurred in the early days of the Industrial Revolution, when many small companies began with an entrepreneur buying a machine, while his competitors were still using craft skills.) We expect many entrepreneurs to buy a computer, perhaps with a packaged expert system and an online link to a database, and to set up in business advising on, say, gardening, or on employment opportunities, or on horserace betting, or on marketing. Such a business, if successful, might grow and spread geographically as a franchise, or it might use telecommunications to service a wider area, perhaps even a world market. Given sufficient advances in technology, it is not beyond the realm of possibility that one could find million-dollar one-man businesses based on information technology.

Finally, we expect more simple-structure businesses to emerge within large organisations. Depending on the function of the department, such 'internal' small businesses might either be located in the business or be telecommuting-based. Already, some large organisations have inhouse travel offices or canteens that are independent, or they have independent service shops (bank branches, hairdressers, etc.) in their main offices. We believe that this trend will become increasingly prevalent, with internal service departments (such as printing, artwork, building cleaning and maintenance, security, stationery supply, and programming) hived off to entrepreneurs. In parallel, more managers and professional staff will, in middle age, be encouraged to become independent telecommuters. The parent organisation will still be able to benefit from their services and skills, but at lower cost and without incurring such high overheads. Such professionals could include programmers, designers, graphic artists, market researchers, exhibition organisers, project managers, and many others.

IMPACT ON MACHINE BUREAUCRACIES

Despite their inherent stability, machine bureaucracies may be changed most by information technology over the next 25 years because they are:

- More systematised and standardised than most other organisations, so it is easier to apply information technology.
- Strongly motivated to increase efficiency and product quality, areas where automation can bring significant benefits.
- Accustomed to making large capital investments to produce productivity benefits.
- Highly bureaucratic, and therefore able to benefit considerably from office automation.
- In need of becoming more innovative and more responsive to change as competition increases and as markets become more volatile — changes that may be assisted by information technology such as CAD/CAM and improved system-building tools.

We envisage four main types of organisational change for machine bureaucracies:

- Massive automation of offices and factories.
- Flattening of organigrams and the growth of central staff functions, accompanied by a shift in influence from line management to technostructure managers and professionals.
- Greater use of subcontractors.
- A tendency to evolve towards a conglomerate structure that incorporates adhocracies.

The machine bureaucracies will go as far and as fast towards the automation of offices and factories as their centralist and bureaucratic management styles permit. The more ruthless will shed labour as quickly as automation allows. Where they have paternalistic attitudes to employees, they may be forced, in order to provide employment, to move into labour-intensive 'service' activities, to buy market share through acquisition, or to encourage staff to move to telecommuting independence.

Automation will continue to flatten their organigrams and to increase managers' span of control, as it has done in the past — except that much of the flattening will be 'virtual' — more machines will replace fewer people at the base of the organigram. For example, one bank teller or supermarket checkout person may be replaced by three ATMs or automatic POS checkout stations. (As the cost of technology falls, organisations will be able to afford more machines to improve customer service — for example to reduce queues at supermarket checkouts).

Accompanying the flattening of structures will be a growth in skilled and professional staff functions, to service and support both automation and management. Managers of technostructure departments will increase in influence at the expense of line managers as the businesses become increasingly dependent on information as a key resource. The old-style line managers will give way to others better able to cope with knowledge workers and the logistical issues associated with highly automated environments. In order to increase organisational flexibility, machine bureaucracies will make greater use of subcontractors. This will enable them to sell off or close down internal facilities such as specialist component-manufacturing facilities, 'metal-bashing' workshops, canteens, and print works. Another advantage of switching from inhouse facilities to subcontractors is that organisations increase their ability to adapt quickly to new product or market pressures, and they reduce their exposure in the event of their businesses contracting.

In an attempt to increase responsiveness to market forces, and to prepare for the shedding of parts of their activities, machine bureaucracies will be forced to divisionalise faster than they would otherwise. (It is virtually impossible to sell off a department such as a metal-bashing workshop if it is fully integrated into a larger factory; but if it is established as an internal business with its own independent management and systems and is encouraged to seek work outside the parent organisation, the chances of finding a buyer, should a sell-off be required, are greatly increased.)

To increase their innovative capabilities, machine bureaucracies will find it necessary to acquire, or create, adhocracies. These adhocracies will need to be managed as separate divisions if they are not to be stifled by the tight management controls that are essential for machine bureaucracies. The challenge for top management will be to refrain from smothering these new activities with their 'natural' (and successful) machine-bureaucratic management style.

IMPACT ON PROFESSIONAL BUREAUCRACIES

To date, information technology has been used mainly to support the service activities that themselves support professional staff in their work. The administrative, accounting, and research services in hospitals and universities use computers. But, with some exceptions, such as large accountancy companies, information technology has not been used extensively by the professionals themselves. Few hospital specialists use computers to assist in diagnosing their patients' diseases, for example, and few university lecturers use computers as teaching aids.

Clearly, and despite resistance from the professional staff, computers will be used increasingly to enhance the productivity of professionals. Expert systems are likely to have a fundamental role to play. One of the organisational impacts of the adoption of expert systems will be the distribution of expertise, which will undermine the influence and importance of professional staff.

In hospitals, expert systems will be used by paramedics to provide an early diagnosis when patients are admitted. The specialist will be required only to confirm the diagnosis or to check factors the expert system is unable to interpret. The next stage in the dispersal of medical expertise is likely to be to general practitioners, who will be able to consult expert systems — first from remote terminals but later from computers in their surgeries, and later still from portable computers in patients' homes. In the long term, the role of general practitioners may even be changed when (and if) individuals can buy off-the-shelf medical expert systems for self-diagnosis and prescription, just as today they can buy medical dictionaries. How far these changes will have progressed in 25 years we can only guess at. The real unknown is not so much the rate of technological development, but how effectively medical professionals will resist the changes.

In education, the rate of dispersal may be faster because education is not a life-or-death issue. Moreover, education is a huge public financial burden in all European countries. As more politicians become aware that knowledge skills are the key to economic success in the knowledge economy, and that computer-assisted or fully automated teaching is cheaper and (arguably) better than human teaching, they will press for the change. The probability that parents will be able to buy packaged expert-system teaching courses for use at home, at a fraction of the cost of full-time private education, may bring further pressure on governments to encourage the widespread adoption of information technology as a replacement for human teachers. However, such a change would have significant effects on society in general, because schools serve more than just educational purposes. Many parents would find it difficult to work if schools no longer took responsibility for their children for 6 or 7 hours a day.

If these technological developments take place and are adopted, the organisational impacts on professional bureaucracies may be very significant. 'Universities of the airwaves' may replace today's educational institutions. The large hospitals that today provide the economies of scale necessary for the practice of modern medicine may be replaced, or complemented, by many neighbourhood healthcare centres capable of coping with the bulk of today's hospital intake. It may be that by the year 2010 the main role of medical specialists and university professors will be to feed their knowledge and understanding into ever more expert systems.

IMPACT ON CONGLOMERATES

Most conglomerates currently consist of divisionalised machine bureaucracies; thus, most of the likely impacts of information technology on conglomerates have already been described (see page 21). However, many conglomerates will continue to depend on efficient intercompany trading, probably in a largely free-market manner. Information technology will therefore play an important role in holding them together and moving them forward in a coordinated way, by providing effective and extensive group-wide communications and control systems. For this reason, we focus on the kinds of changes that could occur at the strategic apex of conglomerates.

Earlier, we expressed the view that conglomerates would be likely to consist not only of divisions made up of machine bureaucracies, but that they would increasingly need to absorb and effectively manage simple structures (small businesses) and adhocracies. Professional bureaucracies may also need to be incorporated, for example if the conglomerate wishes to demonstrate its social responsibility by running schools and health-care facilities for its employees and local communities (as already happens in Japan). This will present managers at the strategic apex of a conglomerate with a problem, because their centralist and bureaucratic management style is likely to stifle the new types of organisation that are absorbed into the conglomerate.

One solution is to seek out a new breed of top executive who has learned the art of successfully managing all the organisation types. It is possible that there will be enough individuals with the necessary skills to allow the existing conglomerate structure to continue to operate effectively. Another possibility is that a new layer of management may emerge just below the strategic apex, and that divisions will be grouped for reporting purposes according to their organisational type. This structure, which we have termed a confederation, is shown schematically in Figure 2.7.

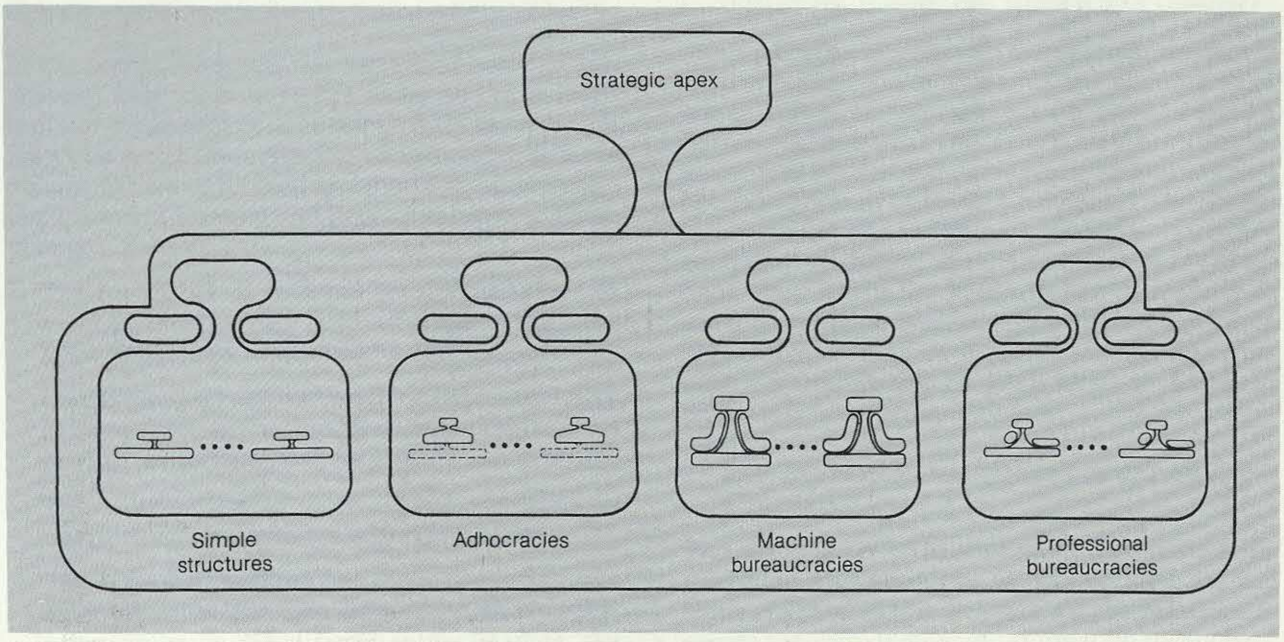
The strategic apex of a confederation would need to delegate many of its powers to the top confederate managers, but would retain control of overall corporate finance, organisation, strategy, and shareholder relations. The four confederacies would have direct responsibility for their own operations, including their own technostructures and support services (or those not yet hived off to the simple-structure confederacy). Each company within each confederacy would focus on doing what it could do best, be it research and development, manufacturing vehicles, running management-training institutes, exploiting niche markets, or something else.

IMPACT ON ADHOCRACIES

Operational adhocracies are already well adapted to the new environment likely to prevail in the future. They are dynamic and innovative. They are heavy adopters of new technology and this will help them to remain competitive despite their inherent inefficiency and internal confusion. Information technology will help them in making their necessary matrix-management and project-management structures work. Moreover, the increasing flexibility and versatility of the emerging forms of information technology will assist them in reshaping and re-forming organisationally, as they must to retain their unique value.

Administrative adhocracies will tend, we suggest, to move either towards a confederation structure, so keeping the managerial chaos of the adhocracy activity away from their machine-bureaucracy operating cores, or towards subcontracting their operational and production requirements. Information technology, and especially improvements in telecommunications, will play an important role in maintaining control of multimillion-dollar, highly dynamic and diverse organisations that will depend on thousands of subcontractors for all but the

Figure 2.7 Confederations



innovative aspects of their business activity. In many respects this is the way that large successful Japanese trading organisations operate, albeit without using particularly sophisticated information technology to manage their operations. Large organisations in other parts of the world have the opportunity to emulate the Japanese model and use information technology (much of the hardware for which might be supplied by the Japanese) to make it even more effective.

Chapter 3
Management implications

In the first chapter of this report we described how information technology had been a major contributor to change in organisational structures over the past 25 years. The changes have included:

— A flattening or broadening of organigrams.

— A distribution of some central functions to lower levels in the organisation, and the creation of new central functions.

— A greater centralisation of authority in both top management and central staff functions.

— A tighter control of operations and of routine decision making.

— A reduction in staffing levels in most organisations, although in a few organisations the early and extensive adoption of information technology can be a strategy for employment growth, as well as for continued profit.

Yet despite the strategic nature of these changes, many senior business and systems managers do not immediately appreciate the role that information technology has played in producing them — perhaps because they are the result of incremental changes, each initiated separately by management.

In the second chapter, we described some of the changes that we believe are likely to occur in all types of organisation over the next 25 years, some resulting from the adoption of information technology, others supported and made possible by the application of existing and new technologies. These changes include:

— The hiving-off of internal service activities to external third parties, or to entrepreneurial managers previously employed by the organisation.

— Continuing high levels of personnel redundancy at many levels in the organisation, unless business growth can compensate for improved efficiency.

— The distribution of professional expertise in institutional, knowledge-based industries.

— The accelerating tendency for fragmentation of large organisations into semi-autonomous operating divisions. This trend might lead to the emergence of a new organisational structure (a confederation), which would require major organisational change at the top-management level.

— The growing importance of certain types of organisation, particularly simple structures and adhocracies, and the need for other organisational types to absorb and manage these types of organisation successfully.

Thus, in our view, information technology will continue to have a significant impact on organisational structures in the future. Clearly, it is important that senior managers at the highest level are aware of the potential changes and can prepare for them.

THE MAIN EFFECTS AND THE PROBLEMS THEY CREATE

We have identified eight main ways in which information technology will affect organisational structure. These, together with the problems and challenges they pose, are described below.

1. IMPACT ON JUNIOR AND MIDDLE MANAGEMENT

Information technology can increase management's span of control and may permit the elimination of whole layers of management (in other words, a flatter organigram). The effect may be to make junior and middle managers resist its introduction because they may be made redundant. These are the same people who in the past helped to introduce computer systems that made clerical staff redundant. They will be less helpful when their own jobs are threatened. It is asking for trouble to appoint a user manager to an implementation steering committee if that manager's job is likely to disappear once the system is implemented.

2. REDUCTION IN MANAGEMENT DISCRETION AND AUTHORITY

The automation of routine tasks will reduce the discretion and authority of some managers, and those affected in this way will also be reluctant to accept the introduction of information technology.

3. DISTRIBUTION OF PREVIOUSLY CENTRALISED FUNCTIONS

Information technology can enable previously centralised functions to be distributed. Central departmental managers will naturally oppose such a move, not just because they fear losing their jobs, but because they fear they will not be able to cope with the remaining higher-level central role. For example, we know of a chief accountant who ran a head-office accounting function with 100 staff. A new accounting system distributed much of the work to the divisions and reduced the staff complement of the head-office function to 25. However, the chief accountant was assured that his role would be upgraded to that of financial advisor to the group. His fear was that he did not have the experience or capability to do the new job. Unfortunately, he was the project manager for the new system. Not surprisingly, the system was delayed, and it was not until he had moved on to another company that it was eventually installed.

4. CENTRALISATION OF PREVIOUSLY DISTRIBUTED FUNCTIONS

In some organisations, information technology can be used to centralise functions that were previously distributed. The managers of the distributed departments will, of course, resist the introduction of information technology because they will see it as a threat to their jobs.

5. REDUCTIONS IN STAFF

The productivity improvements resulting from information technology will lead in many cases to staff surpluses. Plans will need to be made for shedding the surplus staff or retraining them so they can be deployed elsewhere.

6. REQUIREMENTS FOR NEW SKILLS

Adoption of information technology will remove the need for some well-established traditional skills and will introduce the need for new skills. The future skills mix required should be identified, and appropriate recruitment and training policies formulated. Without the relevant human skills, it will not be possible to gain the full benefits of adopting information technology.

7. REORGANISATION MAY BE REQUIRED TO ACHIEVE FULL BENEFITS

The full benefits of a new system may be realisable only after a considerable reorganisation has taken place. Systems that do not 'fit' the existing organisational structure are unlikely to work well until either the system or the organisational structure is changed. For example, many organisations have found that electronic messaging services fundamentally change the way in which people work. In particular, they cut across existing organisational boundaries and hierarchies. Senior management needs to be aware of the major organisational implications of apparently straightforward applications of information technology.

8. ORGANISATIONAL RESPONSIBILITY FOR INFORMATION SYSTEMS

The implementation of front-office systems can diminish the power and responsibilities of front-office directors. In this situation, the front-office directors are likely to react in one of two ways: either they will demand that the front-office departments control their own systems, or they will demand that the systems director report to a front-office director, or even to the chief executive, rather than to a back-office director.

PREPARING FOR THE CHANGES

We believe it is important for an organisation's senior management to understand the potential changes and the effects they may have in the future. One way of achieving this is to carry out a review of long-term systems plans and of the effects of emerging technologies, looking specifically at organisational issues. This review can be carried out by considering the eight areas of impact described above.

Such a review could be initiated by senior general management or by the personnel (or human-resources) department. Failing that, the systems director should prepare his or her own analysis of the situation and seek opportunities to ensure that its findings are understood at the highest level in the organisation.

It is also most important for the systems director to think through the possible effects of new systems, particularly on the jobs of departmental managers. This should be done before the allocation of specific responsibilities for user involvement in system development activities. Systems directors should use their influence to ensure that user managers whose roles might change as a result of new systems are not in a position to block or delay the implementation of the systems.

Finally, Foundation members should consider initiating experiments to assess the use of information technology to support new forms of organisational structures — particularly telecommuting and home working. These working methods are well established in some organisations for some types of staff (salesmen, for example). We believe that information technology now makes it possible to consider extending these working practices to many other types of staff. However, many organisations are reluctant to take this step because they lack knowledge and experience both of the technologies and of the methods for motivating and controlling staff working in this way.

Systems directors should therefore seek opportunities to initiate trial projects in order to assess:

- The types of jobs and staff that are candidates for home working or telecommuting.
- The attributes required for a successful home worker or telecommuter.
- The problems associated with managing, controlling, and motivating home workers or telecommuters.

The results of such a practical experiment could lead to a better understanding of the impact of information technology on working practices and organisational structure. This, in turn, could lead to a wider realisation of the benefits that can accrue from adopting information technology and could open the door to its wider application throughout the organisation.

Bibliography

Bailey, N E. Why the computer is altering decentralised management. International Management, June 1986.

Bjorn-Andersen, N and Hedberg, B L T. Designing information systems in an organisational perspective. Prescriptive models of organisations, North-Holland, 1977.

Bjorn-Andersen, N and Pedersen, P H. Computer-facilitated changes in the management power structure. Accounting, Organisations and Society, Volume 5, Number 2, 1980.

Buchanan, J R and Linowes, R G. Understanding distributed data processing. Harvard Business Review, Volume 58, Number 4, July-August 1980.

Cash, J I jr and Konsynski, B R. IS redraws competitive boundaries. Harvard Business Review, Volume 64, Number 2, March-April 1985.

Cash, J I jr and McLeod, P L. Managing the introduction of information systems technology in strategically dependent companies. Journal of Management Information Systems, Volume 1, Number 4, Spring 1985.

Cooper, B. A sideways look at productivity. Guardian, 24 July 1986.

Drucker, P F. The age of discontinuity. Pan Books, 1971.

Gerwin, D. Relationships between structure and technology. In Nystrom, P C and Starbuck, W A (editors), Handbook of Organizational Design. Oxford University Press, 1981.

Gobel, R. and Meers, A. The impact of two successive mechanisation projects on motivation and work organisation in a bank. Work, organisations, and technological change. Plenum Press, 1982.

Hedberg, B L T *et al.* Designing organisations to match tomorrow. Prescriptive models of organisations. North-Holland, 1977.

Huber, G P. The nature and design of post-industrial organisations. The Institute of Management Sciences, Volume 30, Number 8, August 1984.

Kajan, A and Kearson, R. UK occupational and employment trends to 1990. Butterworths, 1986.

Keen, P G W. Information systems and organisational change. Center for Information Systems Research, May 1980.

Khandwalla, P N. Design of organisations. Harcourt Brace Jovanovich, 1977.

Kilman, R H *et al.* MAPS as a design technology to effectively mobilise resources for social and organisational problem solving. The management of organisation design. North-Holland, 1976.

Mackenzie, D H, Martel, A and Price, W L. Human resource planning and organisation change. Work, organisations, and technological change. Plenum Press, 1982.

Melita, A. ITG sweeps in with Wall Street shuffle. Computer Weekly, 26 June 1986.

Mensch, G O. The co-evolution of technology and work-organisation. Work, organisations, and technological change. Plenum Press, 1982.

Mintzberg, H. Organisation design; fashion or fit? Harvard Business Review, Volume 59, Number 1, January-February 1981.

Miret, P. The modernisation of a refinery: its influence on men, their work and structures. Work, organisations, and technological change. Plenum Press, 1982.

Robey, D. Computer information systems and organisation structure. Communications of the ACM, Volume 24, Number 10, October 1981.

Rockart, J F and Scott Morton M S. Implications of changes in information technology for corporate strategy. Interfaces, Number 14, January-February 1984.

Simon, H A. Applying information technology to organisation design. Public Administration Review, May/June 1973.

Simon, H A. Designing organisations for an information-rich world. Computers, communications and the public interest. Johns Hopkins Press, 1971.

Staehle, W H. Technological and organisational change in office work: the case of the visual display units. Work, organisations and technological change. Plenum Press, 1982.

Summer, C E. Strategies for organisation design. In Kilman, R H, The management of organisation design. North-Holland, 1976.

Sumner, S. A workstation case study. Datamation, February 1986.

Wanders, H J D. Production control, participative management and action research: A case history. Work, organisations, and technological change. Plenum Press, 1982.

Wilson, J W and Dobrzynski, J H. And now, the post-industrial corporation. Business Week, 3 March 1986.

BUTLER COX FOUNDATION

Butler Cox

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

Objectives of the Foundation

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

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

Membership of the Foundation

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

The Foundation research programme

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

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

The report series

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

Selected reports

5 The Convergence of Technologies
8 Project Management
11 Improving Systems' Productivity
15 Management Services and the Microprocessor
17 Electronic Mail
18 Distributed Processing: Management Issues
19 Office Systems Strategy
20 The Interface Between People and Equipment
21 Corporate Communications Networks
22 Applications Packages
23 Communicating Terminals
24 Investment in Systems
25 System Development Methods
26 Trends in Voice Communication Systems
27 Developments in Videotex
28 User Experience with Data Networks
29 Implementing Office Systems
30 End-User Computing
31 A Director's Guide to Information Technology
32 Data Management
33 Managing Operational Computer Services
34 Strategic Systems Planning
35 Multifunction Equipment
36 Cost-effective Systems Development and Maintenance
37 Expert Systems
38 Selecting Local Network Facilities
39 Trends in Information Technology
40 Presenting Information to Managers
41 Managing the Human Aspects of Change
42 Value Added Network Services
43 Managing the Microcomputer in Business
44 Office Systems: Applications and Organisational Impact
45 Building Quality Systems
46 Network Architectures for Interconnecting Systems
47 The Effective Use of System Building Tools
48 Measuring the Performance of the Information Systems Function
49 Developing and Implementing a Systems Strategy
50 Unlocking the Corporate Data Resource
51 Threats to Computer Systems
52 Organising the Systems Department
53 Using Information Technology to Improve Decision Making
54 Integrated Networks

Forthcoming reports

Planning the Future Corporate Data Centre
Choosing System Development Methods
Educating the Organisation to Exploit IT
Electronic Data Interchange
Expert Systems in Business
Competitive-Edge Applications: Myth or Reality?
Communications Infrastructure for Buildings

Availability of reports

Members of the Butler Cox Foundation receive three copies of each report upon publication; additional copies and copies of earlier reports may be purchased by members from Butler Cox. Reprints of the summary of research findings for each report are available free of charge.

BUTLER COX FOUNDATION

Butler Cox & Partners Limited
Butler Cox House, 12 Bloomsbury Square,
London WC1A 2LL, England
☎ (01) 831 0101, Telex 8813717 BUTCOX G
Fax (01) 831 6250

Benelux
Butler Cox BV
Burg Hogguerstraat 791
1064 EB Amsterdam
☎ (020) 139955, Telex 12289 BUCOX NL
Fax (020) 131157

France
Butler Cox SARL
Tour Akzo, 164 Rue Ambroise Croizat,
93204 St Denis-Cedex 1, France
☎ (161) 48.20.61.64, Fax (161) 48.20.72.58

Germany (FR)
Butler Cox Deutschland Ltd.
Richard-Wagner-Str. 13
8000 München 2
☎ (089) 5 23 40 01

United States of America
Butler Cox Inc.
150 East 58th Street, New York, NY 10155, USA
☎ (212) 486 1760 Fax (212) 319 6368

Australia
Mr John Cooper
Consultants (Computer and Financial) PLC
Level 7, 20 Bond Street, Sydney, NSW 2000
☎ (02) 237 3232, Telex 1 22246 MACBNK
Fax (02) 237 3350

Italy
SISDO
20123 Milano – Via Caradosso 7 – Italy
☎ (02) 498 4651, Telex 350309 SISBDA I

The Nordic Region
Statskonsult AB
Stortorget 9, S-21122 Malmo, Sweden
☎ (040) 1030 40, Telex 12754 SINTABS