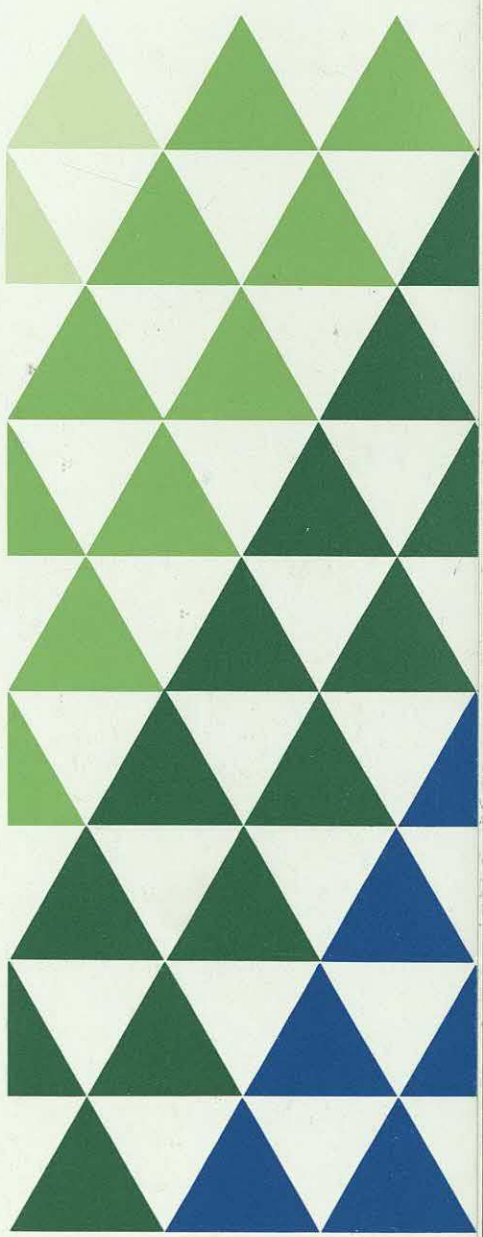
BUTLER COX FOUNDATION

Visual Information Technology



Management Summary

February 1992

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Management Summary

Visual Information Technology

Foundation Report 85, Visual Information Technology, was published in February 1992. This document summarises the main business messages arising from our research. The report is our 1992 Technology Review, and in it we describe the principal technologies used to capture, create, manipulate, manage and communicate visual materials. We analyse their potential applications, and identify the business implications for Foundation members. The full report is available only to members of the Butler Cox Foundation.

Vision is the most important of the human senses – more of the brain is devoted to processing visual information than to all of the other senses combined. Early in life, we develop the skills to analyse visual images, picking out complete shapes, and imposing order and structure on a complex and chaotic visual environment. These skills remain fundamental to the way that we live our lives. Even when dealing with complex abstractions, such as engineering problems or financial data, most people find that a visual representation helps substantially. This is reflected in our language for problem solving. We talk of 'looking at the whole picture' and 'seeing the solution'.

In business, visual information can play a prominent role – in the design of products and corporate logos, and whenever a diagram or a chart is used to communicate an idea. People also depend on visual information in more subtle ways – for example, in seeing the expression on a colleague's face during a discussion, in the layout of words on a page, and in the aesthetics of our working environments.

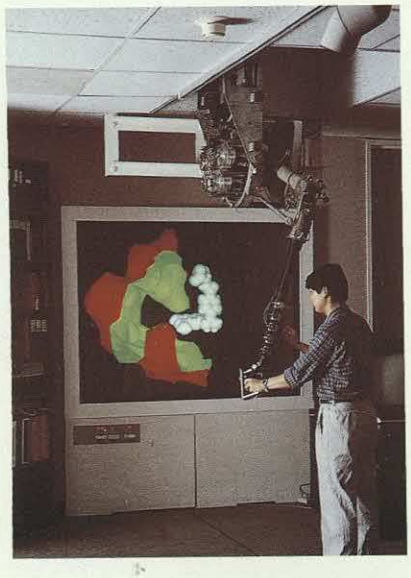
To date, information technology has not been well suited to handling visual information. Computers have simply not been powerful enough to cope with the vast quantity of data needed to represent a visual image, and have lacked the techniques for managing the complexity of visual images. Information systems have effectively been restricted to handling information that is well structured and relatively concise, such as financial figures, stock codes or simple text. Important as such information is, it represents only a small proportion of the total information on which a business depends – typically about 6 per cent. In addition, the high cost of entering information generated outside the organisation (rekeying incoming correspondence, for example) has meant that much of this information has been excluded from computer systems.

New developments in information technology are beginning to provide the tools to make substantial inroads into the residual 94 per cent of an organisation's information. Faster processing, higher-density storage media, and higher-capacity communications links are enabling information systems to handle ever-larger

volumes of data. These developments underlie the new technologies that are becoming available for capturing existing visual images in electronic form, for modifying and manipulating them, and for displaying them on a screen. We call these new technologies, collectively, visual information technology.

Visual information technology extends the scope of information systems by enabling them to handle visual materials, such as drawings, photographic and document images, and video in the same way as text and data, and is opening up new ways to harness the power of visual images. One example is shown in the picture. As a consequence, it is enabling major improvements to be made in business processes, by allowing them to become more independent of the location of paper, people and other physical objects.

It is for these reasons that visual information technology represents a radical improvement in the capability of information systems. In terms of its potential to change the way that business is conducted, visual information technology is at least as significant as the introduction of data- and text-based information processing. In this management summary, we expand on these conclusions, drawing examples from our research. Foundation members requiring further evidence, or a review of the principal developments in the technologies, their applications and their systems implications, should read the main report.



Visual modelling of molecular structures is improving productivity in pharmaceutical research. GROPE, an experimental workstation developed at the University of North Carolina, models the forces between molecules. Tests showed that providing the operator with force feedback via the mechanical arm doubled productivity.

Visual information technology provides new ways of harnessing the power of visual images

Visual information technology enables visual images to be generated, stored, retrieved, manipulated and communicated in electronic form. This opens up new opportunities to harness the power of visual images for communication and for the organisation of information. At the simplest level, visual information technology can enhance or extend existing uses of visual images. However, in our research, we also found organisations using the technology in ways that have a substantial impact on their business. The benefits gained from these more ambitious applications include bringing products to market faster, and managing geographically dispersed assets more effectively.

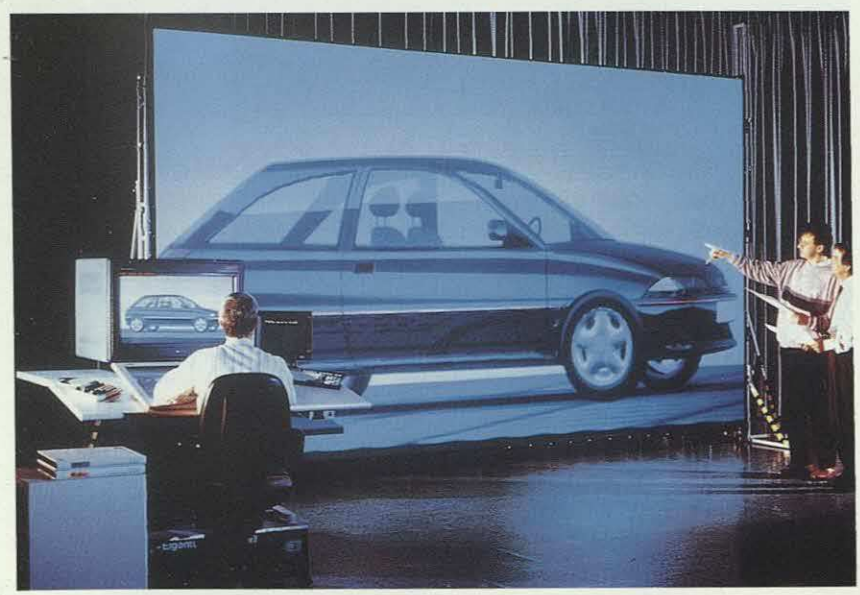
Visual modelling can help bring new products to market faster

Using conventional computer-aided-design (CAD) systems, it has long been possible to build electronic models of complex three-dimensional objects on a computer workstation. This has improved the productivity of engineers and draftsmen. Recent advances in 'rendering' technology, such as those illustrated at the top of page 3, now make it possible to create photorealistic images of those electronic models that, in some cases, are virtually indistinguishable from photographs of the physical object. As well as bringing the traditional benefits of CAD to new areas such as the design of clothes and product packaging, photorealistic modelling is changing the way that products are brought to market.

Advances in 'rendering' technology facilitate the generation of more realistic three-dimensional models. The simple shading of the smaller image has been enhanced in the larger image with 'texture mapping' to produce surface patterns, 'radiosity' to model diffuse lighting, and 'reflection mapping' on the shiny surfaces. Developers are employing such technology to pre-sell new buildings. (Courtesy of Pixar.)

At Ford of Europe, visual modelling is playing a crucial role in reducing the lead time on new cars (see photograph below). Instead of building large numbers of full-size clay models, new designs are now created on workstations, and projected full-size on a high-definition television display for management to view. This has speeded up the styling process – the first stage in a new car design – and it has allowed the stylists to explore more design options. In future, the same technology will improve the effectiveness and reduce the costs of market research and testing. Moreover, since the styling system can now be fully integrated with the engineering and production systems, what were previously sequential stages in the development are starting to be performed concurrently. Ford of Europe is a pioneer user of several visual information technologies. More details about its experiences can be found in the main report.

The design of a new car typically entails building several full-size clay models. Ford of Europe has eliminated much of this effort by coupling a state-of-the-art three-dimensional visual modelling system to a high-definition television display. Management is now able to review more design variants in a shorter time and at lower cost.



Visual interfaces facilitate the management of information

A visual representation of the spatial relationship between physical objects can help in information retrieval and presentation. Geographical information systems, of the type illustrated in the photograph opposite, are the most familiar example of this approach. The user interface takes the form of a map on which geographical information – for example, the location of equipment such as pipes or pumping stations – is displayed. Selecting a location or an item on the map initiates the retrieval of information about it. Where appropriate, the information retrieved may also be displayed in graphic form. This approach to the user interface can be applied in many other application areas – for example, exploded diagrams of machinery can be used as the interface for retrieving information about individual components.

As well as providing a more convenient and intuitive user interface, and thereby improving the efficiency of the underlying process, a geographical information system can deliver other benefits. By enabling the user to view the interrelationship between several sets of data, important new patterns and relationships may emerge. For example, several police forces are experimenting with the use of geographical information systems to detect patterns in crime. The photograph opposite illustrates how new developments in visual interfaces may help to manage large amounts of information.

Visual information technology extends the scope of information systems

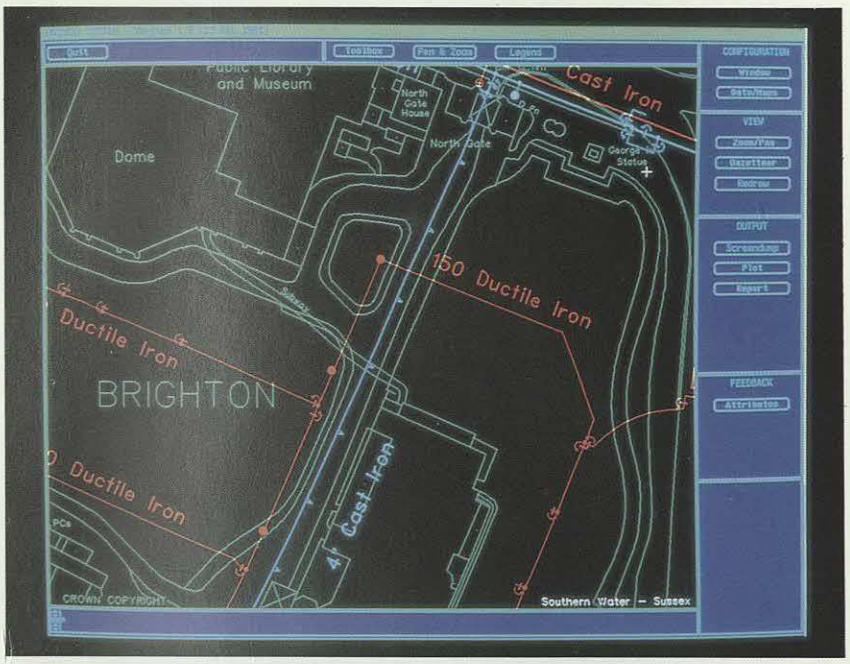
Visual information technology enables computer systems to handle a greater proportion of the information on which an organisation depends. In addition to extending the capabilities of information systems to inherently visual materials, such as colour photographs, it also increases the range of text and data materials that can be accessed electronically, and enables meaning to be extracted from documents, and from three-dimensional images of products and scenes.

EDM enables computer systems to deal with existing documents

The ability of an electronic image to appear in multiple locations without any real cost of movement or duplication is critical for one of the fastest growing applications of visual information technology – electronic document management, or EDM. This technology, which is now being widely taken up within paper-intensive sectors, such as insurance, allows information contained in paper documents to be electronically scanned, stored, retrieved and processed.

In its early days, EDM was seen as a successor to microfiche for document archives because it offered faster retrieval times and more flexibility in terms of document types and methods of retrieval. Today, EDM is beginning to be used as a tool for re-engineering whole administrative business processes, offering dramatic improvements in operating efficiency, as well as flexibility for future changes.

Geographical information systems can provide a powerful visual interface to complex databases. Applications range from precision marketing to environmental monitoring. This system is in use by Southern Water, a UK water service company, for managing and maintaining its infrastructure.



Visual metaphors may hold the key to managing very large amounts of information. 'Rooms' is one of several such metaphors being researched at Xerox Parc (Palo Alto Research Center) in California. The user navigates through the information base by moving from room to room.

In part, this change has been brought about by changes in the technology. EDM systems can now be built from standard components such as PCs for the users' desks, and shared image servers (usually based on optical-disc technology) for the actual storage. EDM can now be integrated better with other information systems – for example, with word processing, electronic mail and customer databases. 'Workflow' software, which controls the way in which an electronic document, such as a purchase order, moves around the organisation, and the processes that must be applied to it at each stage, has become much more powerful and flexible. Early workflow software was cumbersome to set up; modern systems enable workflow to be redesigned and respecified quickly in response to changing requirements.

These technologies are collectively facilitating the emergence of new administrative and business structures. One example is case-based processing, in which a single person manages the whole cycle of, say, a customer order, rather than referring it through a series of sequential stages.

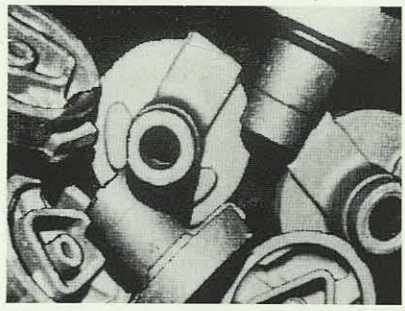
Image interpretation extends the range of materials that can be captured on computer systems

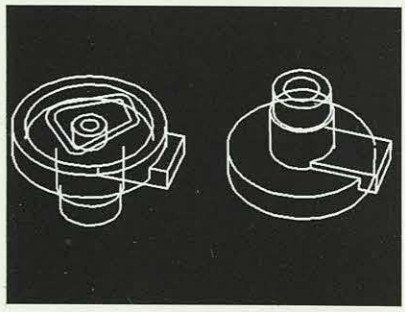
Most EDM systems handle an image of a paper document as a large collection of bits to be stored, retrieved, displayed and moved around; they do not extract meaning from those bits. Increasingly, however, computer systems are able to interpret images to extract meaning or structure from them, and this is further widening the application of visual information technology.

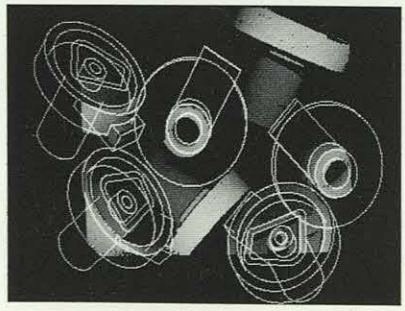
At the simplest level, optical character recognition (OCR) is a form of image interpretation. With OCR, the text from a printed or typed page can be input to a word processor or desktop publishing package for editing or reformatting, eliminating the need to rekey the text. In the engineering world, image-interpretation techniques are being used to scan archive engineering drawings and decompose them into their basic elements of lines and symbols for editing on a computer-aided-design package.

Software to interpret handwritten characters is now available (although the robust recognition of joined-up writing is still some years off), allowing forms and questionnaires to be scanned automatically. Realtime versions of the same software form the basis of a new range of 'notepad' computers that replace the keyboard with an electronic stylus. By allowing information to be captured at source – during a visit to a customer, for example – several steps in conventional business processes can be eliminated.

The interpretation of images of three-dimensional scenes is more difficult than the interpretation of paper-based images. However, the technology of 'scene analysis' is just starting to be applied commercially (see photographs). On a production line, vision systems allow robots to cope with more complexity and flexibility than the simple 'blind' manipulator robots. In security and surveillance applications, scene-analysis technology is able to identify potentially hazardous events, such as a car stalled on a railway crossing. In these cases, tedious manual processes can be fully automated. In other cases, visual information technology complements human experts, improving their productivity and reliability – a good example being an initial assessment of radiographic images in medicine.







Scene-analysis technology will extend information systems to real-world monitoring and control. This system, developed at SRI International in California, enables a robotic manipulator to recognise jumbled machine parts (top). The software rotates three-dimensional wireframed models of known objects (centre) to find the best fit with the scanned image (bottom).

Visual information technology enables business processes to be decoupled from physical entities

Visual information technology can enable existing business processes to be transformed, by allowing those processes to be decoupled from the physical entities on which they currently depend. For example:

- Image manipulation and three-dimensional visual modelling on a computer workstation can reduce or remove the need for physical objects to be present for inspection.

- EDM enables clerical processes to be decoupled from the paper documents that initiate them.

- Image transmission and videoconferencing enable people to cooperate on a task, independently of their physical location.

Such transformations can substantially reduce costs, shorten the time-to-market for new products, improve customer service and result in more responsive operations. They can even generate new ways of competing in the marketplace. As a consequence, organisations should be alert to the opportunities generated by visual information technologies.

Image manipulation is the key to a new concept in retailing

Images that exist in electronic form, including paper images that have been scanned electronically, or scenes captured by a video camera, can be readily manipulated to alter their size, shape, composition or other visual parameters. This technology is now starting to be applied to the selling of fashions and furnishings, enabling customers to view potential purchases without the physical objects themselves being present, and redefining some of the fundamental retailing processes.

The British furniture retailer, Allied Maples, has experimented with the use of image manipulation to enable customers to view the effect of combining different fabrics in a model room. There are two motivations for this. First, it offers a potential solution to the conflicting pressures to increase product ranges and to reduce retail floor space – hence, reducing the amount of stock that can be displayed. Second, providing customers with an opportunity to experiment with different combinations of fabrics encourages them to be more adventurous, leading to greater satisfaction with their final choice.

Clothing manufacturers are experimenting with the same technology (see photograph overleaf). Some can already foresee the day when a substantial proportion of retail fashion sales will move from off-the-peg stock to made-to-order. Image manipulation and visual modelling in the stores will enable customers to view themselves wearing any combination of garments, in any combination of fabrics.

Technical EDM facilitates concurrent engineering

EDM enables the processing of the content of a document to be separated from physical paper management, so that business processes can be conducted more efficiently and effectively. For example, the electronic management and distribution of technical engineering drawings facilitates 'concurrent engineering' – that is, it enables design activities that were previously sequential to be

With advanced image manipulation, a fabric pattern can be mapped onto a digitised photograph of garments made from white material. This system, developed by Computer Design Inc, is already in use by clothing designers; in the near future, it could become the basis of a new concept in fashion retailing.

conducted concurrently. By involving more relevant sources of expertise, such as production or maintenance engineers, the need for subsequent revisions can be reduced, the quality of the final product can be improved and timescales can be shortened.

Visual communication can open up new markets

The telephone enables people at different locations to communicate. Not all business, however, can be conducted effectively on audio media alone. In some cases, visual materials have to be exchanged or discussed; in others, participants need to be able to see each other. Image transmission, and videoconferencing, extend the power of telecommunications to enable people to work together regardless of location.

Budget Rent-A-Car, a car-rental company, has installed unmanned remote-transaction booths (see photograph on page 9) at 40 locations in the United States. The booths enable customers to complete car-rental transactions, without a Budget sales agent present. The booths provide voice and image communications with a sales office at a remote location. The image link enables the customer to see a still picture of the sales agent on a video screen,

Budget Rent-A-Car has developed remote-transaction booths to provide car rental at locations that cannot justify full-time staff. Transmitted images of faces keep the transaction more personal, and the same technology permits the remote operator to check the customer's driving licence and signature on the contract.

and transmits pictures of the customer, his or her driving licence, and the signed rental agreement to the agent to enable the identity of the customer to be verified and the transaction confirmed. When all the formalities are complete, an envelope with a set of keys drops through the slot, and the customer collects the car from a nearby car park. The booths enable Budget to do business at locations – for example, small airports, hotels and outer suburban areas – that do not generate a sufficient volume of rentals to justify a full-time member of staff, and have enabled Budget to open up a new market segment previously inaccessible to them.

Organisations should anticipate visual information technology

We believe that, in five to ten years, visual information technology will become as pervasive and critical to most organisations as electronic data and text is now. Those organisations that anticipate the trend will be the ones that will exploit visual information technology most effectively and most efficiently. Early adoption of new visual technologies can bring strategic benefits. To take full advantage of these opportunities, organisations will need to escape from their text-dominated culture and promote the use of visual approaches. The full benefits will, however, be obtained only from a coherent overall approach to visual information technology.

Organisations should be prepared to adopt emerging visual technologies

Applications of visual information technology can generate many intangible benefits, such as improved corporate image. It is important to realise, however, that such applications can also generate many tangible, quantifiable benefits.

Many visual technologies are already sufficiently well established to be justified by conventional cost/benefit analysis, like conventional information technologies. They can reduce costs – for example, administration costs can be reduced by centralising document storage or by offering wide-area access via high-bandwidth networks. Electronic picture libraries with dial-up access can deliver images in seconds rather than hours, potentially increasing revenues. In both cases, tangible benefits outweigh the costs.

Other visual technologies are only just beginning to appear in commercial form, however, and their application will be riskier and will cost more than established technologies. Nevertheless, such 'emerging' technologies can bring substantial benefits to those organisations prepared to plan for the risks. They provide the opportunity to be first in the market with a new service, to help shape the technology and the supply industry to the organisation's own requirements, and in a few cases, to lock out the competition.

New visual technologies are emerging from the laboratory faster than most other information technologies. Because of this, we recommend that Foundation members should track those visual

technologies still at the research stage where such technologies could lead to strategic opportunities.

Organisations need to encourage the use of visual approaches

In today's business environment, the use of visual approaches is rare – most communications and personal work practices are dominated by text and numbers. This situation has been maintained by the high perceived cost of visual approaches, but many of the costs are now being reduced by advances in visual information technology. If an organisation is to take advantage of the new possibilities for visual communication, managers will need to encourage the use of visual approaches. They will also need to ensure adequate quality standards, and provide access to sources of visual skills.

Few managers or staff outside specialist departments have the drawing, design or video-editing skills required to produce visual materials that put their message across clearly and attractively, and that meet the standards of quality that most organisations wish to display in all their activities. In the early days of desktop publishing, many companies sent out material that was poorly designed, unattractive and difficult to read. Companies need to avoid making the same mistake with the new visual technologies – no-one wants his corporate communications to look like home movies.

Systems directors should adopt a coherent overall approach

Planning to adopt individual visual information technologies will not be sufficient. Many applications combine several of the technologies, and others require the integration of visual systems with conventional data processing applications. Systems directors must adopt a coherent overall approach to obtain the full benefits.

Such an approach requires action in five areas. The adoption of a client-server architecture will facilitate the sharing of costly peripherals, and also permit the development of more visual user interfaces. Individual applications should be implemented in such a way that they can be integrated in future, both with mainstream information systems and with each other. Systems directors should provide for expansion in storage and network capacity to cope with the requirements of visual applications. Workstation architectures should be selected to permit portability of visual applications. Finally, systems directors should ensure that their departments have access to the appropriate skills to implement visual systems. We provide guidelines for each of these areas in greater detail in the main report.

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The Butler Cox Foundation

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

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

Membership of the Foundation

The Foundation is the world's leading programme of its type. The majority of subscribers are large organisations seeking to exploit to the full the most recent developments in information technology. The membership is international, with more than 450 organisations from over 20 countries, drawn from all sectors of commerce, industry and government. This gives the Foundation a unique capability to identify and communicate 'best practice' between industry sectors, between countries, and between information technology suppliers and users.

Benefits of membership

The list of members establishes the Foundation as the largest and most prestigious 'club' for systems managers anywhere in the world. Members have commented on the following benefits:

— The publications are terse, thought-provoking, informative and easy to read. They deliver a lot of messages in a minimum of precious reading time.

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

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

Combined with the manager's own creativity and business knowledge, membership of the Foundation contributes to managerial success.

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A company of Computer Sciences Corporation

United Kingdom
Butler Cox House
12 Bloomsbury Square
London WC1A 2LL
☎ 44 (0)71 831 0101
Fax 44 (0)71 831 6250

8 Clifford Street
Mayfair
London W1X 1RB
☎ 44 (0)71 434 2512
Fax 44 (0)71 439 7357

Cranfield IT Institute Limited
Fairways, Pitfield
Kiln Farm
Milton Keynes MK11 3LG
☎ 44 (0)908 569333
Fax 44 (0)908 569807

Australia, New Zealand and South-east Asia
Mr J Cooper
Butler Cox Foundation
Level 10, 70 Pitt Street
Sydney, NSW 2000
Australia
☎ 61 (0)2 223 6922
Fax 61 (0)2 223 6997

Belgium and the Netherlands
Prins Hendriklaan 52
1075 BE Amsterdam
The Netherlands
☎ 31 (0)20 6 75 51 11
Fax 31 (0)20 6 75 53 31

France
Tour Akzo, 164 Rue Ambroise Croizat
93204 St Denis-Cédex 1
☎ 331.48.20.61.64
Télécopieur 331.48.20.72.58

Germany, Austria and Switzerland
Butler Cox GmbH
Bavariaring 24
8000 München 2, Germany
☎ 49 (0)89 5 32 93 90
Fax 49 (0)89 5 32 93 999

Ireland
SD Consulting
8 Clanwilliam Square, Dublin 2
☎ 00 (0)1 764701
Fax 00 (0)1 767945

The Nordic region
Mr R Bydler
Box 160, Borganäsvägen 44
S-781 22 Borlänge, Sweden
☎ 46 (0)243 886 60
Fax 46 (0)243 124 50

Spain and Portugal
T Network SA
Núñez Morgado 3-6°b
28036 Madrid, Spain
☎ 34 (9)1 733 9910
Fax 34 (9)1 314 3198

United States of America

Headquarters in Boston, and offices in Chicago and San Francisco