Management Summary

BUTLER COX FOUNDATION

Communications Infrastructure for Buildings

BUTLER COX FOUNDATION

Communications Infrastructure for Buildings

Management Summary
Report 62, February 1988

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

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.

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

Communications Infrastructure for Buildings

Management Summary

This document summarises the main management messages from Foundation Report 62, published in February 1988. The full report is available to members of the Butler Cox Foundation.

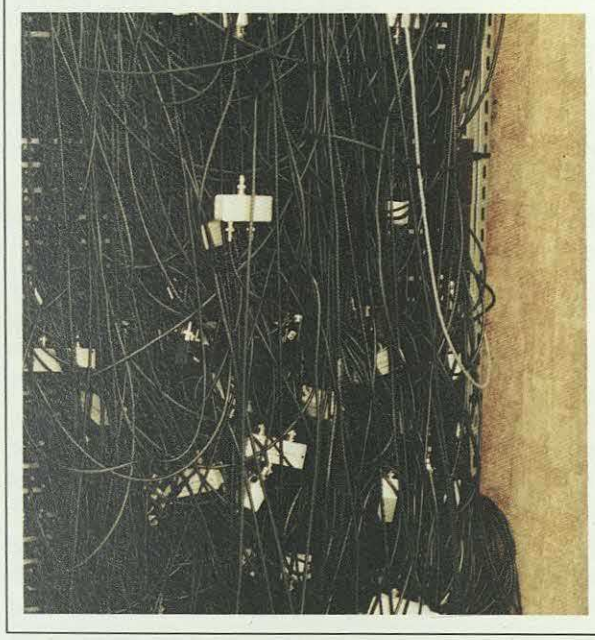
Hitherto, building wiring has often been perceived as unworthy of management attention. However, many organisations are now faced with the situation where the wiring installed in their buildings will increasingly become a constraint on the way in which computer technology can be deployed. The situation can be improved considerably, either by making better use of existing wiring or by prewiring with a structured wiring scheme.

Wiring can be a serious constraint on information systems

In many of the organisations we studied for this report it was clear that the wiring resources installed in buildings were not under effective management control. There has been no master plan for the growth in wiring that has resulted from the proliferation of computer-based systems. As a consequence, new cables have been installed in an ad hoc way to meet specific needs as they arise. The result is a jumble of cables and full wiring ducts — Figure 1 shows the typical problem that many organisations now face.

Wiring problems may cause severe difficulties because they may delay or, in extreme cases, prohibit the introduction or expansion of computer systems. Without a proper wiring infrastructure it may take several weeks, or even months, to install or move a terminal because a new cable has to be installed as well (with all of the attendant disruption that this brings). Wiring constraints can also make it difficult to reorganise office layouts to meet changing business requirements, and in some cases can prevent the ideal layout being achieved.

Figure 1 **A typical wiring problem**



Many organisations rely on the PTT (or other external contractors) to install and maintain not just the telephone wiring but all other communications wiring in their buildings. This, too, can cause problems because, left to itself, the PTT or contractor will schedule work for its own convenience rather than for that of the organisation.

Wiring problems can be overcome

The root cause of many of the problems is that wiring is often perceived as not demanding management attention. Cables are regarded as low-cost items using 'low technology', and are often left to the site-services department. However, our research has shown that wiring *does* require very careful and close technical management, and that the true costs are often much higher than is believed.

In the past, the lack of management attention was understandable, because the wiring installed in buildings did not need to change very often. Today, though, the situation is different. Our research confirmed that most organisations will increasingly be unable to predict where computer terminals and workstations will need to be installed. The conclusion is that organisations must have the flexibility to install and move terminals at will. In turn, this implies that the planning of building wiring needs to be done differently, focusing on the need to prewire rather than responding to ad hoc requests.

Our research has identified certain key actions that can be taken to overcome (or at least reduce) the wiring problems faced by many organisations. The specific actions will depend on individual circumstances, in particular on whether the need is to improve the wiring in an existing building or to start afresh either by prewiring a new building or by rewiring an existing building.

In an existing building, the problems can be avoided by:

- Managing the wiring resources, particularly the ducts and other spaces used for cables. Many organisations have incomplete records of their wiring resources and the costs of those resources.
- Making better use of the existing wiring, either by using multiplexing techniques or by using the wiring to support a local area network.

Any opportunity should be taken to prewire a new building or to completely rewire an existing building. The benefits of prewiring are substantial, and the initial investment required can usually be repaid in a few years. Prewiring or rewiring should be based on one of the structured wiring schemes (for example, AT&T's Premises Distribution System, which uses telephone wiring techniques and practices, or IBM's Cabling System).

Irrespective of whether existing wiring is being improved or new wiring is being installed, problems can be avoided by:

- Not attempting to integrate voice and data wiring. In some cases, local regulations will not permit integrated wiring, and even if they did, there will still be technical difficulties until all voice communications are based on digital transmission. Wiring for security-control and environmental-control systems should also be kept separate.
- Ensuring that staff with the appropriate technical expertise are involved in all aspects of building wiring, particularly at the stage when wiring is being installed and commissioned.
- Preparing for the time when optical fibres will become more cost-efficient than the copper cables used by today's wiring schemes.

Wiring resources need to be managed

Few organisations know precisely what cables are installed in their buildings and what they are used for. The first steps in managing wiring are to establish the inventory of wiring resources and create proper records (software packages now exist to help in this task), and to identify the total wiring costs. It is clear from our research that many organisations are paying too much for wiring — the highest reported cost of moving a computer terminal was 25-times higher than the lowest, for example. This means that in some cases the wiring for a terminal costs as much as, or even more than, the terminal itself. It is also clear that many organisations are unaware that they are paying too much because they do not know what the total costs are for moving or installing a computer terminal. When the total cost is calculated, it is often surprisingly high.

The spaces in a building available for cables are a scarce and valuable resource. They are limited in size and are used for a variety of services such as power cables, water, heating, ventilation, and sanitation, as well as for several different types of communications cables. In the past, different parts of the organisation have laid claim to this space for cables — the systems department for data communications, the site-services department for environmental-services wiring, the security department for video cameras, and the communications department for telephone wiring. The activities of all of these departments need to be coordinated by one person responsible for managing the spaces and routes in the building that could be used for cables.

Existing wiring can often be improved

In many organisations, it is not possible to overcome the existing wiring problems by completely rewiring because this would be impractical or too expensive to contemplate. However, there are a wide variety of possible techniques and products that can be used to improve existing wiring and to reduce the problems. This means that it is not possible to specify a universal solution and we therefore recommend a three-stage procedure for dealing with the problems once the existing cabling position has been established:

- Identify the approaches to upgrading wiring.
- Match the approach to the wiring problem.
- Implement the changes.

It is also necessary to take account of other building services, particularly power supply and air conditioning. The advantages of an improved wiring system would be negated if the existing power supply and air conditioning could not cope with the resulting larger number of workstations and other equipment.

The main technical options for improving existing wiring are to:

- Make better use of existing cable capacity. Multiplexing techniques can often provide extra capacity without the need for rewiring. And there is often spare telephone cable already installed in a building that can be used for a variety of purposes.
- Install a new communications infrastructure element such as a local area network. Such a network can meet a variety of needs and is not dedicated to a single application or type of device. With this approach, additional communications capacity is installed in anticipation of future developments.

The cause of wiring problems can usually be traced to one of the following:

- Insufficient space in the 'risers' — the shafts connecting the floors of a multistorey building through which building services are run.
- No cables of the required kind in the office areas.
- Insufficient sockets.

The main report provides detailed advice on matching the technical option to the wiring problem that is to be solved. One option that is not used as often as it could be is flat undercarpet cables. Such cables are now available for electrical power, telephony, and a variety of data communications applications, although specialist skills and considerable care are required to install them properly.

Prewiring a building has substantial advantages

The best way of avoiding the wiring problems now faced by many organisations is to prewire (or rewire) a building whenever it is possible to do so — in other words, to install a communications infrastructure that can both cope with today's needs and can provide the flexibility to cater for a growing and changing population of terminals and workstations.

Substantial cost benefits can be obtained from prewiring. Although prewiring requires a considerable initial investment, it is likely to be less expensive than ad hoc wiring over a period of no more than five years. (Figure 2 and Figure 3 overleaf show two examples where prewiring will be cheaper over periods of three years and five years respectively.)

Figure 2 Prewiring costs can be recovered within three years

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Wiring changes						
Number of additions	10	10	10	10	10	50
Number of relocations	18	22	24	30	32	126
Ad hoc wiring costs ($000)						
Extra connections	3.0	3.0	3.0	3.0	3.0	15.0
Relocations	2.7	3.3	3.6	4.5	4.8	18.9
Total costs	5.7	6.3	6.6	7.5	7.8	33.9
Cumulative cost	5.7	12.0	**18.6**	26.1	33.9	33.9
Prewiring costs ($000)	15.0	0	0	0	0	15.0

This example is for an office building housing 100 staff. At the start of year 1 there are 50 workstations. The assumptions are:

- Ten new workstations will be installed for each of the next five years, so that at the end of five years there is one workstation per person.
- One-third of the average number of workstations installed will need to be relocated each year.
- With ad hoc wiring, each new workstation will need a new cable, and half the relocations will need a new cable to be installed.
- With prewiring, 150 sockets are installed initially, and subsequent new connections and relocations do not need new cables to be installed.
- Cables cost $100 to install if the building is prewired and $300 each if the work is done on an ad hoc basis.
- All devices installed can use the same cables.

Figure 3 Using different assumptions, the cost of prewiring can be recovered in less than five years

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Wiring changes						
Extra dumb terminals	5	5	0	0	0	10
Dumb terminals replaced by PCs	0	0	17	17	16	50
Additional PCs installed	5	5	10	10	10	40
Terminals relocated	14	16	12	8	3	53
PCs relocated	4	9	16	25	29	83
Ad hoc wiring costs ($000)						
Cost of extra connections	2.0	2.0	5.4	5.4	5.2	20.0
Cost of relocations	1.8	2.5	2.8	3.3	3.2	13.6
Total cost	3.8	4.5	8.2	8.7	8.4	33.6
Cumulative cost	3.8	8.3	16.5	25.2	**33.6**	33.6
Prewiring costs ($000)	30.0	0	0	0	0	30.0

This example is for an office building housing 100 staff. At the start of year 1 there are 40 dumb terminals and 10 PCs. The assumptions are:

- The total workstation population increases by 10 a year, growing to 100.
- After small increases in the first two years, the dumb terminals are replaced progressively by PCs. After five years all workstations are PCs.
- A new cable needs to be installed when a terminal is replaced by a PC.
- Approximately one-third of the installed base of workstations is relocated each year.
- Where wiring is ad hoc, a new cable has to be installed for each new connection and for half of the workstations that are relocated.
- Following prewiring with 150 sockets, neither new connections nor relocations need new cables to be installed.
- Cables cost $200 to install whether they are prewired or installed in an ad hoc basis.

Prewiring may entail major building works and can usually be done only in a new building or during a major refurbishment. However, the benefits are so substantial that any opportunity to prewire a building should be eagerly sought. In summary, the benefits are:

- Improved response to subsequent requests to relocate or install equipment.
- Easier moves into new accommodation.
- Reductions in wiring faults.
- Improved management control of the wiring system.

The aim of prewiring is to ensure that there is a conveniently located socket whenever a new workstation or PC has to be installed or an existing workstation needs to be moved to a different part of the office. Prewiring therefore requires careful thought to be given to the number of sockets installed and their location.

The temptation is to base the wiring scheme layout on the existing population of workstations and staff. Experience has shown that this inevitably leads to problems. We know of many cases where management decisions or changing business requirements have increased substantially the number of staff housed in a building. Thus, the number of sockets installed should be based on the maximum number of staff that could possibly be housed in the office space. In some office areas, the number of sockets will need to be even higher. Examples include typing pools, telesales areas, and financial dealing rooms.

The two approaches that have proved successful in providing the required flexibility are to use special system furniture with built-in facilities for cables or to install floor sockets that can be easily moved. With system furniture, there is a socket at every possible desk location and these are decided when the spine of the system is laid out. Figure 4 shows an office layout based on a commercially available furniture system.

Movable sockets are provided by floor traps connected to underfloor access boxes by flexible conduit. Alternatively, if the fire regulations permit, cables may be run direct from the underfloor boxes through holes in the floor to the devices. (The floor tiles with holes should be movable and the holes should be closed up when they are not in use.)

Wiring schemes based on telephone technology will cater for most needs

During the past three years, several major suppliers have announced products designed to address the wiring problems that many organisations have. The most notable products are AT&T's Premises Distribution System (PDS) and IBM's Cabling System. These products are examples of structured (or universal) wiring schemes. We recommend that a structured wiring scheme should be installed whenever an opportunity arises to prewire a new building or to rewire an existing building.

Structured wiring schemes have two main advantages compared with conventional (ad hoc) data wiring. A wide variety of devices can be connected to the wiring, and it can be used as the basis for different types of local area network. Moreover, each outlet (socket) can easily be reconfigured to provide a different type of communications service.

Structured wiring schemes are based on the long-established block wiring principle used for telephone wiring. Each outlet is individually wired to a patch panel, where the wires are connected (patched) to cables installed in the risers. The patch panels are usually installed on each floor, typically serving between 100 and 200 outlets. Figure 5 shows the patch panel used with AT&T's PDS.

Some structured wiring schemes, most notably AT&T's PDS, use unshielded telephone-type cable. However, the cables are manufactured to tight specifications, and older-style telephone wire installed in many buildings is not always suitable for a universal wiring scheme. Other schemes, particularly the IBM Cabling System, use shielded cables. In general, the IBM scheme is more expensive to install than schemes based on telephone-type cable, but it provides advantages not available with unshielded cable — such as reduced electromagnetic radiation, decreased sensitivity to interference, higher signalling speeds, and greater cable lengths. However, these features are not particularly necessary in most office environments, and in many situations it may therefore be difficult to justify the additional cost of the IBM product. In our view, the schemes based on unshielded cables will be more than adequate for most office requirements for the next 10 years. (The main report contains a detailed comparison of proprietary structured wiring schemes.)

Figure 4 **Office layout using the Sunar Race furniture system, showing the beams that carry the cables**

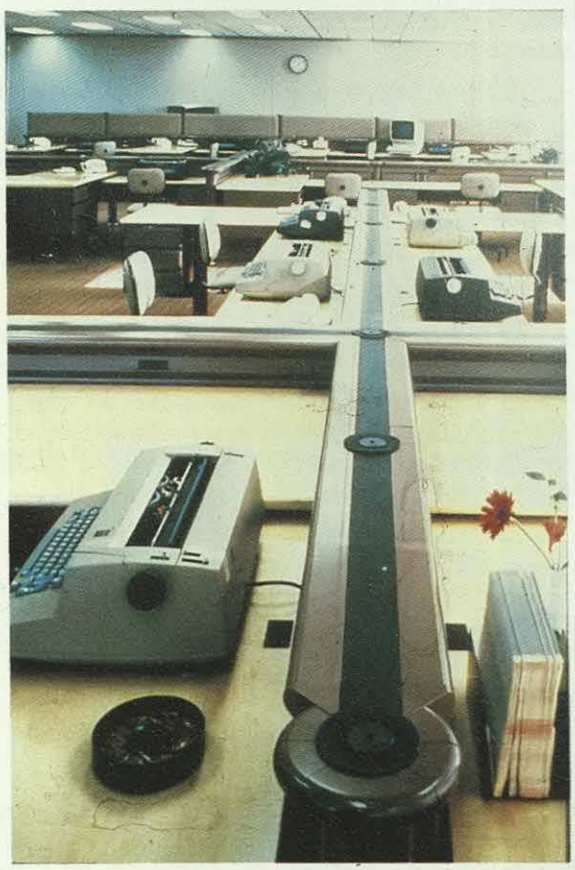
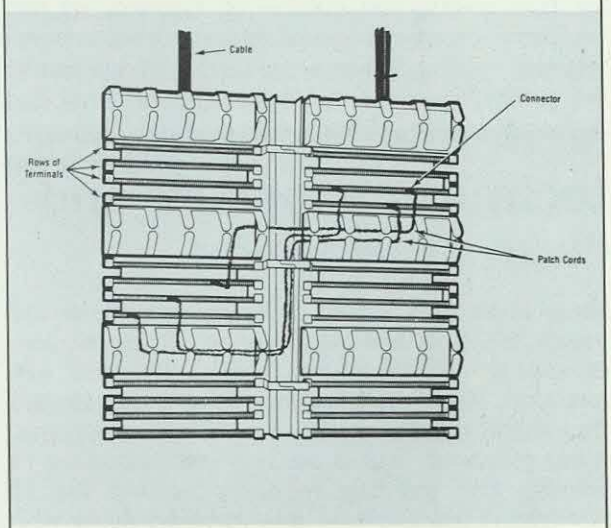


Figure 5 **AT&T's Premises Distribution System patch panel**



The above illustration is reproduced with AT&T's permission and shows an AT&T type 110 cross connect.

Furthermore, the transmission rate available over unshielded cables is being increased all the time — at present 10M bit/s is possible, compared with 16M bit/s soon to be available with the IBM Cabling System. By the time there is a widespread need for local transmission rates in excess of 10M bit/s, optical fibres will be a better medium than the copper cables used today.

Avoid integrated voice and data wiring

For the time being, most organisations should not attempt to combine voice and data services in a common cable network. Instead, they should install separate wiring for data networks, for telephony, for security purposes, and for environmental-control purposes. In most countries, an integrated wiring scheme would be subject to PTT control. The most immediate disadvantage of this is that often only PTT (or PTT-approved) tradesmen can install or modify the wiring. There is also a technical reason (concerned with crosstalk) for physically separating the analogue telephone signals and digital signals used for data transmission. Experience shows that the signalling used for analogue telephony can interfere with adjacent digital data transmission.

Separate wiring for security systems is desirable because it allows the security function to control its own resources and prevents users of other systems from gaining access (accidentally or otherwise) to the security systems. In addition, the wiring for security systems often runs to places not included on the telephone and data networks — rooftops (for cameras), car parks, plant rooms, and so on.

Modern wiring requires technical expertise and close supervision

Many of today's wiring problems stem from the unsuitability of the buildings in which modern computer and communications systems are installed. Many organisations take it for granted that building professionals — architects, engineers, space planners, and so forth — are competent to provide the building facilities needed for IT systems. Although some can, there are many who lack the necessary knowledge, foresight, and understanding. It is therefore necessary to ensure that people with systems and communications skills and experience are involved at the earliest possible stage in planning a new building (or a major refurbishment of an existing building). Questions that systems and communications experts can provide answers to include:

- Building design or selection: Will the building have enough power, enough cooling, and enough space for cables?
- Space planning: Will the building have space for wiring closets, for departmental computer rooms, for central computer rooms, and for desktop workstations?
- Furniture selection: Does the furniture have built-in space for cables? Will they connect with the cable trunking between the desks and the wiring closet?
- Cable routes: The routes used for cables, and the method used to install them, largely determine the cost of installing a wiring scheme. Should cables be led under false floors, on trays in the ceiling voids, or in a variety of other ways?

The work carried out by the wiring contractor also needs to be supervised closely by people with appropriate technical expertise. Commissioning an ordinary wiring contractor, whose main work concerns the installation of power cables, to install a communications wiring scheme can be a recipe for disaster. We have been amazed at the mistakes made during the installation of wiring schemes. For example:

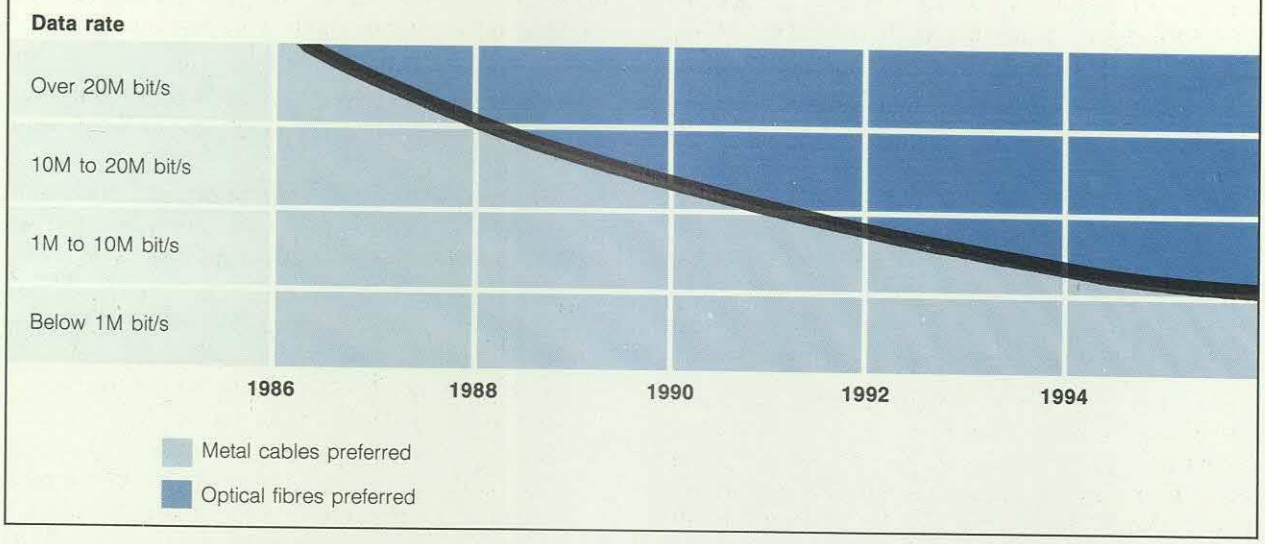
- A floor trap that was too small to take the required plug.
- Plastic conduit used instead of metal, and which therefore did not provide electrical shielding.
- Telephone wire that was not earthed according to the relevant national standard.
- Telephone wire in which spare wires had been cut back so they could never be used.

Wiring contractors must therefore be chosen carefully, the work to be done must be specified in the minutest detail, and the work must be closely supervised and inspected.

Ultimately optical fibres will be used for building wiring

In time, the present debate about the technical merits of shielded and unshielded copper cables will become irrelevant as optical fibres are used for building wiring schemes. Optical fibres have many

Figure 6 **Optical fibres will be the preferred technology for progressively lower transmission rates**



advantages over copper cables: they provide almost unlimited communications capacity, high security, immunity to electromagnetic interference, and they do not emit electromagnetic radiation. Fibre is already the preferred technology for the PTTs' own national networks and for the inter-building and backbone elements of on-site wiring. We believe that by the middle of the 1990s, optical fibres will be the preferred cable medium for most digital business communications, with individual desks being provided with direct connections to optical-fibre wiring schemes.

Unfortunately, optical-fibre technology is not yet developed sufficiently to allow it to be used economically for prewiring buildings. The electronics required to connect a fibre to a computer terminal are expensive, and specialist skills are required to splice and terminate fibres. Nevertheless, we believe that fibre will become the preferred transmission medium at progressively lower transmission rates (see Figure 6).

In preparation for optical fibres, for example, empty tubes could be installed when any wiring work is carried out today. Optical fibres can then either be drawn through the tubes or, by using a recently developed technology, be blown through them.

Conclusion

During the next five years or less, most Foundation members will install as many terminals and workstations as they have in the last 20 years. If systematic solutions to the resulting wiring problems are not found quickly, ad hoc solutions will be used instead, leading to further problems and making it even more difficult to adopt systematic solutions later. Many of the problems can be avoided by seizing the opportunity to prewire (or rewire) buildings whenever it occurs. Others can be solved and avoided only by detailed technical management of wiring systems by personnel with systems and communications expertise.

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 one of the services provided by Butler Cox. It provides the executives responsible for information systems in large organisations with a continuous analysis of major developments in the technology and its application.

The Foundation publishes six Research Reports each year together with a series of special Position Papers. The programme of activities includes a wide range of meetings that provide Foundation members with a regular opportunity to exchange experiences and views with their counterparts in other large organisations.

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

Belgium and the Netherlands
Butler Cox BV
Burg Hogguerstraat 791
1064 EB Amsterdam
☎ (020) 139955, Fax (020) 131157

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

Germany (FR)
Butler Cox GmbH
Richard-Wagner-Str. 13
8000 München 2
☎ (089) 5 23 40 01, Fax (089) 5 23 35 15

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

Australia/New Zealand
Mr J Cooper
Butler Cox Foundation
3rd Floor, 275 George Street, Sydney 2000, Australia
☎ (02) 236 6161, Fax (02) 236 6999

Ireland
SD Consulting
72 Merrion Square, Dublin 2, Ireland
☎ (01) 766088/762501, Telex 31077 EI,
Fax (01) 767945

Italy
SISDO
20123 Milano, Via Caradosso 7, Italy
☎ (02) 498 4651, Telex 350309, Fax (02) 481 8842

The Nordic Region
Statskonsult AB
Stora Varvsgatan 1, 21120 Malmo, Sweden
☎ (040) 1030 40, Telex 12754 SINTABS

Spain
Associated Management Consultants Spain SA
Rosalía de Castro, 84-2°D, 28035 Madrid, Spain
☎ (91) 723 0995