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Policy Study No. 6

# THE CONTRACT RESEARCH BUSINESS IN THE UK

SCIENCE AND ENGINEERING POLICY STUDIES UNIT

THE ROYAL SOCIETY THE FELLOWSHIP OF ENGINEERING

Box 1991

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# THE CONTRACT RESEARCH BUSINESS IN THE UK

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**SCIENCE AND ENGINEERING POLICY STUDIES UNIT**

of

The Royal Society and The Fellowship of Engineering

## FOREWORD

This report into the dynamics of the contract R&D marketplace will be of interest to three particular groups of practitioners and policymakers: those that undertake contract R&D; current (or potential) customers of contract R&D; and the policy makers influencing the contract R&D marketplace.

The study identifies important changes taking place within the UK contract R&D marketplace. It highlights the role of UK Government policies and their effects on the R&D network (including the move away from funding of near-market research contracts, the consequences of the needs-driven shift of many HEIs from traditional research to consultative development and the ability of the Government to ensure an open 'level playing field'). Such issues are of great significance, both to the players within the contract R&D marketplace and the overall effectiveness of 'UK Limited'.

Other important factors include the considerable broadening of the technical scope of the performers of contract R&D, the novel alliances now being developed, the major push towards collaborative research on the part of the UK Government and the CEC, the increasing number of organizations taking the opportunity to offer out their facilities and the rise in trans-national activity.

A clear conclusion of the report is that the UK is well served by its domestic contract R&D industry. However, growth of this domestic engine of wealth creation is being stimulated by international rather than UK based industry and the implications are that 1992 will increase this trend. Unless UK industry similarly takes proper advantage of the R&D services available this could lead to deterioration of Uk industry's technological capabilities. The report offers perspectives which appropriate Goverment and industrial strategists may wish to incorporate into future thinking.

Dr Ian Nussey F.Eng.
Chairman, SEPSU Management Board

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A study of this sort would be impossible without the willing cooperation of many people: those who completed questionnaires, those who set aside time to be interviewed and to show us round their organizations, those who gave us expert advice. I am most grateful to all concerned.

The Confederation of British Industry much facilitated our enquiries among the industrial customers for contract research by conducting a questionnaire survey of a sample of its members.

The study was financed mainly by SEPSU itself from core funding received from The Royal Society, The Fellowship of Engineering and industrial and commercial sponsors. In addition, a grant was received from the European Commission under the MONITOR/SPEAR programme to cover analysis of the extent to which the market for contract research is becoming Europeanized.

Finally, I should like to thank all my colleagues in SEPSU for their support during the study.

## CONTENTS

Tables and Figures

## SUMMARY


*The study*

This study was undertaken to highlight a sector of research and development (R&D) capability within the UK that has remained rather in the background. As our report shows, the UK has a large body of organizations able and willing to undertake contract research. These organizations are, in general, well established and technically sophisticated with close links with UK (and overseas) industry. They are well placed to disseminate new technologies rapidly and effectively to a wide industrial base.

The study set out to examine the market for contract research—both the organizations that provide such services and their customers. We did not include Ministry of Defence (MOD) procurement spend, nor did we include the large amount of contract work undertaken by industry for industry, although this is touched on in chapter 4. We concentrated on the major contract research organizations (CROs) in the UK, such as the member organizations of the Association of Independent Research and Technology Organizations (AIRTO) and similar bodies.

*Size of the market*

Contract R&D activity in the UK, as undertaken by the major R&D contract organizations, was estimated to be worth about £670M in 1988/89. This excluded contract R&D performed by industrial companies for the MOD and other government departments and for other industrial companies. Indications are that the market is expanding, and will continue to do so over the coming years.

*CROs*

UK CROs believe they are world experts in particular fields, and undertake a significant amount of overseas work. Most CROs expect to increase such work as the Single European Market (SEM) develops.

There has been a distinct move from the 'master—servant' type of contract R&D (where the customer told the CRO exactly what work was required) towards a more equal partnership between the CRO and customer. Because of their broad and intimate industrial contact base, many CROs now act as technological management consultants rather than 'simple' technical problem solvers, and have developed a range of services to make optimum use of such skills.

*HEIs*

UK Higher Education Institutions (HEIs) are becoming increasingly involved in the contract R&D market. Some are developing full-time commercial activities, while others are 'testing the water' and have yet to decide how far to engage in competitive contract R&D.

While welcoming HEI interest in industry, many industrial R&D managers are concerned that the HEIs are moving too far towards industry at the cost of diminishing their effectiveness as truly innovative basic research centres and possibly leaving a 'research gap' in future years. CROs, and many industrial companies, have close links with HEIs, which they see as essential for bringing technological innovation into industry. The CROs in particular see part of their role as ensuring that the technology flow from academia to industry is enhanced where possible—in their view for the benefit of the academic institutions, industry and themselves.

*Government laboratories*

In a similar way, Government R&D laboratories are looking to contract R&D as a method of increasing revenue. At present contract revenue from industry is, in general, not large, but there is evidence that it is increasing.

The effects of the Next Steps Initiative on Government laboratories is an issue that is attracting considerable attention. At present some 50 agencies have been set up (with another 18 under consideration). This includes most, if not all, of the Government's R&D laboratories. The Initiative aims to increase the effectiveness and efficiency of the Civil Service, and to provide a better service to the public. There is some evidence that in this strive for efficiency R&D facilities/services are being offered on a more commercial basis. In time will government agencies be competing against established CROs?

*Customers*

Industrial companies appear to be making increasing use of the various performers of contract R&D as a way of deploying their R&D resources more efficiently. There are several reasons for this. A major reason is the high cost of developing the wide spectrum of technology an individual company requires to compete in today's global markets. Many companies now concentrate their in-house effort on their main technological area, and buy in additional expertise as and when necessary. In the pre-competitive stages companies often look to club-type research projects where costs are shared.

Some industrial companies now offer out their own R&D expertise on a contract basis. This helps to increase revenue from an expensive piece of otherwise under-used equipment, and often acts as an additional service for their main customers. Specialized development work for such customers, on a contract or collaborative basis, may allow products to be developed jointly, which the first company is then ideally placed to produce.

Many industrial companies note that with the development of the Single European Market they will be looking further afield for expertise to contract, and that they will require 'on the spot' facilities in new export markets.

*Single Market issues*

UK CROs are already active in European (and global) markets, and they see the Single European Market as facilitating access. In general they do not expect significant increased competition from other Member States. However, some CROs are concerned that there will not be a 'level pitch' on which to compete. In many of the EC States considerable government money is directed at industrial innovation and technology transfer and UK CROs are worried about unfair competition.

Staff mobility and retention are an increasing concern for the CROs. High quality technical staff appear to be in short supply, and some CROs report difficulties in recruiting staff. A number believe such difficulties will increase if the standard of living for scientists and technologists became noticeably better in other Member States. At present only small numbers of non-UK EC technical staff are employed in UK CROs; numbers are expected to increase slowly after 1992.

Many CROs believe there will be an overall increase in the need for standards and quality assurance, as companies enter new markets. Some CROs are active in developing higher standards for the future.

Many CROs see a large new market if public procurement in the EC opens up to the extent it is expected.

Both CROs and industrial companies are involved in EC R&D programmes. Some point to examples of economic benefit from this involvement, either directly from the technology developed, or from further work or ventures with partners. Virtually all those involved report that they have gained enhanced contact with the partner organization. In the majority of cases there has been continued informal liaison with partners, but there is also evidence of continuing collaborative ventures.

There are, however, problems with being involved in these programmes. It takes considerable time and effort to set up a project with partners in different countries, with no guarantees that the projects will eventually qualify for EC funding. Bureaucratic procedures are regarded as unnecessarily cumbersome. However, most managers regard themselves as being on a learning curve, and most agree they are likely to become involved in future programmes.

*Highlights*

The UK contract research market is a well established, and apparently healthy market. However, it is continually evolving, and those closely involved draw attention to a number of concerns:

- the European Community needs to ensure a fair, open and level 'playing field' for R&D services;
- HEIs need to decide how best to increase industrial revenue, and assess precisely how this will affect their role;
- the effects of the Next Steps Initiative on government laboratories;
- recruitment of qualified scientists and engineers is a problem that is expected to increase rather than ease.

## CHAPTER I: INTRODUCTION

### (i) Outline

In chapter I we introduce the contract research and development (R&D) market in the UK and define the boundaries of the study. Brief comments on previous studies of this market are included.

### (ii) Background

*Historical setting*

The UK has a long tradition of collaborative or cooperative research organizations focused on industrial needs. Some have been geared to particular industrial sectors, others to a particular technological base. Research Associations (RAs), with a membership format, have been in existence since the 1920s, and a number of independent organizations since before then. These organizations have flourished, and withered, along with the fortunes of British industry during the century, and have evolved greatly from their original forms.

*Technological innovation*

Industrial need for technological innovation is increasing, as competition from all sources increases. Over the last decade British Industry has undergone, and continues to undergo, considerable upheavals, spurred in no small part by technological innovation (be it by U.K. industry or overseas competitors). Throughout this period there has been, both in U.K. industry and government, an emphasis on increased efficiency and profitability. This ethos has swept across the whole industrial spectrum, and its effects can be clearly seen in the contract research market.

*Organizations willing to undertake contract research*

This striving for efficiency has led to many changes. In the contract research organizations (CROs) themselves the number of services offered and the quality of the services have, according to many CRO managers, noticeably increased, partly also driven by increased competition and higher customer expectations. Universities and other higher education institutions (HEIs) have been under considerable financial constraints and are looking to making the best use of their expertise. One method is to offer such expertise, on a commercial basis, to paying customers. Government laboratories, under similar pressures, are looking (to varying extents) to paying customers to ensure efficient use of facilities, and increased revenue, without losing their main aims of providing Government with national expertise. With the privatization of many state industries a number of well-founded laboratories now operate on cost centre lines, and within truly commercial organizations. One method of retaining such facilities is to ensure that, when appropriate, they carry out profitable work for external customers. In addition, some private industrial concerns, which require well-founded R&D laboratories in-house, have looked to contracting out such facilities as a method of helping retain them.

This is not to suggest that such activity did not go on before, or that all examples of the above organizations are undertaking contract research (indeed much collaborative/joint work takes place with partner companies in similar fields), but the overall trend is towards many more organizations now able, and actively seeking, to undertake contract R&D of some form.

*The study*

Our study therefore set out to look at the changing dynamics of the contract R&D business in the UK, from the perspective of both the performers of, and the customers for, contract R&D. Why do industrial companies contract out R&D, rather than undertake work in-house, or collaborate with CROs or other industrial or governmental bodies? Who undertakes this contract R&D, and what sort of work is undertaken? How has the UK contract R&D business changed and where is it headed?

**(iii) Definitions**

*Contract R&D*

We have defined the term 'contract research and development', for the purposes of this report, as work of an innovatory nature undertaken by one party on behalf of another under conditions laid out in a contract agreed formally beforehand. We have used this very broad statement to include work undertaken by government laboratories. Core funding from a government department to a laboratory within the department's own sphere has not been included (i.e. Department of Trade and Industry funding to the National Technology Centre (formerly the National Engineering Laboratory) or the National Physical Laboratory). However, government funding for specific projects is included as contract R&D when there is in principle a choice as to where the project is carried out. We have tried to include only those contracts that are open to competition.

However, we excluded the Ministry of Defence (MOD) spend on procurement, and made no attempt systematically to include the large amount of contract work undertaken in industry for industry, although where we came across examples of such activity it was noted (chapter 4). We therefore concentrated on those established CROs which derive a significant amount of their turnover undertaking contract research.

We specifically excluded organizations often referred to as 'testing houses', which undertake independent testing and accreditation services. Testing houses (of which there are some 10 000 in the European Community) may undertake applied development work, but few have the depth and breadth of the major CROs.

*CRO*

The acronym CRO covers a great variety of organizations in terms of turnover, staff employed, equipment, services offered, range of technology covered, customer base and organizational history. In the UK CROs can broadly be divided into two main types—those that are membership organizations of a non-profit making kind and those that are public limited companies.

We have concentrated on organizations that undertake R&D contracts, often as part of a wider technology based service. Much of the work undertaken by CROs in the UK is of a developmental, innovative, applied nature, although this is backed up by strategic research and is usually based on a long-standing relationship with the broad industrial base, or with particular industrial sectors.

### (iv) Previous studies

*Research Associations*

In the early 1970s two comprehensive studies of Research Associations in the UK were undertaken, namely *Research Associations: the Changing Pattern*, by the Centre for the Study of Industrial Innovation (1972) and *Industrial Research and Development*, the Report of the Committee of Enquiry into the Research Associations 1972/3 (known as The Bessborough Report). Together these two studies produced a picture of the overall RA scene in the UK at this time.

*The Rothschild Report*

The studies are useful because they followed on the heels of the Rothschild Report (1971) which was to have profound effects on the way Government R&D was funded, and subsequently on the way CROs operated. The Rothschild Report introduced the customer/contractor principle, and Government departments became paying customers rather than providers of grants.

The effects of the Rothschild Report were highlighted in Kennedy et al. (1985) *Changes in the Research Associations over the decade 1972-1982.* This followed up the research undertaken for the Bessborough report and was a comparative study of 37 RAs. The results showed that RAs had, on the whole, moved towards rather than away from government funded projects and that most RAs had moved towards a broader technological base with wider industrial applications.

*The European Community dimension*

In 1989 the European Commission (DGXIII) published a report by a French group (Bossard Consultants) entitled *Contract Research Organizations in the EEC.* The report consists of two sections: the first describes the overall contract research market in 10 Member States and highlights the major differences between them (such as government support for such activities and CRO working practices); while the second part is a directory of some 130 CROs and includes considerable data on the amount and funding of contract R&D undertaken in each organization. The report provides a useful snapshot of the CROs and highlights the usefulness of such organizations within the European Community (EC). The report reveals a number of points, the most important being that 97% of contract R&D undertaken covered in the survey is carried out in only 5 States: France, Germany, Holland, Italy and UK. It is also clear that the level of governmental financial assistance given to individual CROs varies significantly between Member States. For example in the UK CROs receive no direct grant/subsidy, and only partial funding on projects deemed by the Government to be of a pre-competitive nature, whereas in Germany and Holland some CROs receive direct subsidies and, with support for particular projects, may receive over 50% funding from their respective Governments. In the light of the opening Single European Market this has considerable implications for competition policy, and is a problem that UK CROs wish to see addressed. This is highlighted in our own report.

*European Association of Contract Research Organizations (EACRO)*

The European Association of Contract Research Organizations (EACRO), recently set up with the encouragement of the European Commission, includes CROs from France, Germany, Italy, the Netherlands and the UK. It aims to raise the profile of European CROs and increase technology transfer through the Community. Membership is extended to organizations which are 'commercially independent of any industrial group or Government institution', and one of its aims is to 'defend the profession against unfair competition from establishments which practise contract research on a non-economic basis'.

*The Association of Independent Research and Technology Organizations (AIRTO)*

The Association of Independent Research and Technology Organizations (AIRTO) has in recent years become a voice for UK CROs, both in the UK and overseas. It produces a newsletter and an annual Technology Review, and undertakes annual data collection of its member organizations and is thus building up a useful bank of statistics.

*Federation of European Industrial Cooperative Research Organizations (FEICRO)*

AIRTO is the UK representative in the Federation of European Industrial Cooperative Research Organizations (FEICRO). This is a federation of national associations of technical centres and similar bodies engaged in cooperative research in Europe. One of its prime aims is the furtherance of R&D for industry, especially small and medium-sized enterprises. It also acts as a non-Governmental forum for communication with the European Commission and other European bodies on policy and technical issues.

*Confederation of British Industry*

Another source of information in the UK is the Confederation of British Industry (CBI); similar organizations in other Member States can provide data on their respective industrial bases for approximate comparisons. The CBI undertakes a number of studies, many on a regular basis, which enable trends to be defined over time. In particular *Innovation Trends 1990* (1991) is the second annual survey looking at the way British industry undertakes industrial innovation. The survey asks industrial companies (over 300) how and why innovation takes place, both for the current year and the expected effort for the following 12 months. It asks companies, for example, for the trend in their current and expected expenditure on the use of individual consultants, Government research organizations and cooperation with academics. A number of findings from the survey are of interest to this report, particularly a slight trend towards industrial collaboration rather than contracting of R&D. The results also showed encouraging signs that companies valued innovation and were continuing, on the whole, to invest despite the recent recession.

*Future studies*

Such studies give an interesting perspective to our report. In particular the CBI's Innovation Survey should give a valuable perspective with time of UK industry's views on innovation and the use of CROs and consultants within this. In addition further studies of the contract research business within individual Member States of the EC would highlight the commonality, and the differences, between States.

## CHAPTER II: METHODOLOGY

### (i) Outline

*General approach*

A questionnaire approach followed by interviews (in person, though sometimes by telephone) was the main method of collecting information. Data from annual reports and other, mostly published sources were used to substantiate questionnaire data. In addition, informal discussions at various meetings, seminars and similar events proved useful.

### (ii) The contract research organizations (CROs)

*The CROs*

Our selection of CROs was based on the membership of the Association of Independent Research and Technology Organizations (AIRTO), though the sample also included organizations that were not AIRTO members, some government laboratories and a small number of Higher Education Institutions (HEIs).

*Responses*

Questionnaires were sent to 65 CROs within the UK. 9 explicitly declined to participate, 11 failed to reply, 8 replied partially, and 37 replied in full. The usable response rate was therefore 69% (45 of the 65 sent). The questionnaire is given in Annex B.

*Interviews*

Interviews were undertaken with 21 CROs during 1989/90, many of them being conducted with the Managing Director or Chief Executive. With the majority of CROs being (relatively) small organizations (rarely more than 200-300 staff) these executives have the ability to discuss both the technical laboratory projects and the changing market conditions.

A number of visits were made to HEIs and interviews were mainly conducted with the industrial liaison officer or the managers/directors of the university/polytechnic companies. Data on the amounts of contract R&D undertaken in this sector were obtained from various published sources.

### (iii) The industrial customers

*Customers' response*

In spring 1989 1000 questionnaires were sent on our behalf by the CBI to a non-targeted selection of British industry (based on the Standard Industrial Classification List (SIC)). We received 138 replies, a response rate about normal for this type of such surveys. The responses covered 43 classes from the SIC. 10 classes had 5 or more respondents: the water supply industry, metal manufacturing, chemical industry, metal goods, mechanical engineering, electronics and electronic engineering, motor vehicles, food/drink/tobacco, footwear & clothing and other manufacturing.

*Interviews*

Interviews were conducted with 18 industrial companies, selected from those who responded to the CBI questionnaire. Interviews were mostly held at the company's premises, usually with the R&D manager.

Table 3.1 University research income from sources other than UGC/UFC (£K, cash terms)

| | 1982/83 | 1983/84 | 1984/85 | 1985/86 | 1986/87 | 1987/88 | 1988/89 |
|---|---|---|---|---|---|---|---|
| Research Councils | 119168 | 135479 | 147453 | 162194 | 183976 | 187857 | 215516 |
| *1990 pounds (GDP deflator)* | *171960* | *186868* | *193508* | *201985* | *221391* | *214449* | *229272* |
| UK Government | 51523 | 58329 | 64301 | 75951 | 86329 | 93355 | 105372 |
| *1990 pounds (GDP deflator)* | *74348* | *80454* | *84385* | *94584* | *103886* | *106570* | *112098* |
| UK Charities | n/a | n/a | 57230 | 72757 | 93121 | 110009 | 132558 |
| *1990 pounds (GDP deflator)* | | | *75105* | *90606* | *112059* | *125581* | *141019* |
| UK industry | 27031 | 32664 | 47688 | 59315 | 68556 | 78632 | 93111 |
| *1990 pounds (GDP deflator)* | *39006* | *45054* | *62583* | *73867* | *82498* | *89763* | *99054* |
| Other | 65097 | 79409 | 36877 | 45803 | 56176 | 68444 | 92124 |
| *1990 pounds (GDP deflator)* | *93935* | *109530* | *48395* | *57040* | *67600* | *78132* | *98004* |
| Total research grants and contracts * | 262819 | 305880 | 353549 | 416020 | 488156 | 538296 | 638681 |
| *1990 pounds (GDP deflator)* | *21* | *421903* | *463975* | *518082* | *587432* | *614493* | *679448* |

Source: USR University Statisitics, vol 3
Notes: Complete breakdown of income not available before 1984/85.
* All disciplines combined: income figures for science and engineering only are not readily available.

Universities Funding Council, UFC) over recent years.

In 'real' terms as measured by the GDP deflator, total income from research grants and contracts increased by 10.2% p.a. between 1982/83 and 1988/89. From 1984/5 to 1988/89 income has risen particularly rapidly from UK charities (by 17.1% p.a.) and from UK industry (by 16.8% p.a. (1982/83 – 87/88)).

As one would expect, much of the university income is in the form of research grants from the Research Councils and charities that are outside our terms of reference. Of total external income approximately £200 M is attributable to science and technology in 1988/89. Part of this £200M will have been in the form of grants rather than contracts as defined in this study, and part of the contract income will have been for fairly routine work rather than innovatory R&D. Just how large a part is not known. *A reasonable estimate would put the income received by UK universities in 1988/89 for contract R&D in science and technology disciplines, as defined in this study, at around £140M—£150M.*

Universities also organized £71M worth of special short courses in 1988/89, some related to industrial training. Although this is not contract R&D it is a measure of the saleability of university equipment and personnel. Experts used for training purposes may also be used for contract research.

The above figures refer only to the university sector in the UK. They do not reflect the substantial industrial connections of polytechnics and colleges. The Polytechnics and Colleges Funding Council (PCFC) has recently carried out a review of research in the PCFC sector. This found that *PCFC institutions carried out a total of £80M of research in 1988/89, of which about £30M was contract research for industry within the meaning of this study.*

**(v) Research Councils**

UK Research Councils run a number of specialist laboratories, which, like the universities, have found themselves under pressure to increase revenue from external sources where possible. Again a variety of services are being developed—the hiring of technical equipment, licensing/patenting of research ideas, and consultancy and commercial contract R&D. The proportion of income generated by the Research Councils' institutes from such external sources is growing, and the growth looks set to continue in future years.

Table 3.2 analyses Research Council income by source. Core funding for the Research Councils is ultimately from the DES, but they also attract a considerable amount of additional earned income, both from other Government departments and industry. Much, though not all, of this will be earned from contract research within the meaning of this study.

For all five Research Councils combined, 'earned' income in cash terms was £130M in 1988/89. As with the HEIs, it is difficult to estimate just what portion of external research income should be counted as contract research. *It would seem reasonable to give figures of £100M in 1987/88, and over £100M in 1988/89, for the income received by research councils from external sources for contract R&D.*

### (vi) Government research laboratories

*Department of Trade and Industry*

The DTI runs five main laboratories, with a combined turnover in 1988/89 of £90M:

| | *Staff* | *Budget* |
|---|---|---|
| Lab. of the Government Chemist | 340 | £11M |
| National Engineering Laboratory (now National Technology Centre) | 580 | £23M |
| Warren Spring Laboratory | 300 | £12M |
| National Physical Laboratory | 800 | £42M |
| National Weights + Measures Laboratory | 50 | £ 2M |
| Total | 2070 | £90M |

The role of all DTI laboratories was reviewed in the light of the 1988 Enterprise Initiative. This Initiative led to a move away from government funding of near market research (seen as the role of industry) towards funding of only pre-competitive, collaborative research. The NEL was at this time undertaking considerable amounts of industrial-led research, with support mainly from direct government funds plus other government sources, even though as noted, much of the work was of direct relevance to industry. It was therefore decided such work should be financed wholly by industry. After unsuccessfully attempting to sell NEL to the private sector, the DTI decided instead to convert it to 'agency' status, as defined under the Next Steps Initiative.

Government Agencies are run by a Chief Executive, who works to agreed set targets and limits imposed by the relevant Government department. However, the day to day running, and how these targets are achieved, are in the hands of the Chief Executive. One of the guidelines is the amount of income derived from external contracts—apparently set at a general level of 10% of turnover, although this can vary.

Many of the Government laboratories now have, or are moving towards, agency status. On the whole these laboratories are undertaking government-funded work for the public benefit. However, it is also true that some are under the same pressures as HEIs, looking to increase revenue from wherever it can be generated. In future such agencies may be given more freedom.

At present the limit of 10% would imply that the DTI laboratories carry out not more than £9M of contract work per year. Less than half of this—say £4M—would be contract R&D within the terms of this study.

*Ministry of Defence*

In recent years there has been a considerable opening up of MOD R&D resources for civil industrial use. In February 1988 the Civil Industrial Access Scheme was launched to publicize MOD facilities and arrange for industrial contracts and collaborations to be set up with MOD laboratories. In addition, Defence Technology Enterprises (DTE) was set up, with the aim of disseminating appropriate scientific and technical advances made in MOD establishments to industry. This, however, has failed to meet expectations.

Following the Next Steps Initiative the five non-nuclear research establishments (Admiralty Research Establishment, Chemical

Table 3.2 Research Council income by source (£K, cash terms)

| | 1980/81 | 1981/82 | 1982/83 | 1983/84 | 1984/85 | 1985/86 | 1986/87 | 1987/88 | 1988/89 |
|---|---|---|---|---|---|---|---|---|---|
| AFRC | | | | | | | | | |
| Total commissions/contributions | 41096 | 48387 | 53166 | 56268 | 58013 | 60984 | 58860 | 57810 | 52991 |
| Total receipts | 78573 | 90321 | 96790 | 102108 | 104693 | 113709 | 116009 | 112706 | 114103 |
| *1990 pounds (GDP deflator)* | *141719* | *148376* | *148296* | *149469* | *146001* | *150508* | *148509* | *136939* | *129418* |
| ESRC | | | | | | | | | |
| Total commissions/contributions | 367 | 299 | 254 | 292 | 473 | 339 | 425 | 823 | 1324 |
| Total receipts | 20586 | 20955 | 20905 | 22732 | 22452 | 23926 | 24245 | 25686 | 28338 |
| *1990 pounds (GDP deflator)* | *37130* | *34424* | *32029* | *33276* | *31311* | *31669* | *31037* | *31209* | *32142* |
| MRC | | | | | | | | | |
| Total commissions/contributions | 20197 | 5047 | 5491 | 6061 | 6575 | 6855 | 7556 | 8408 | 12315 |
| Total receipts | 92934 | 106571 | 112993 | 119770 | 123727 | 129165 | 137597 | 149967 | 164238 |
| *1990 pounds (GDP deflator)* | *167621* | *175070* | *173121* | *175323* | *172545* | *170966* | *176144* | *182211* | *186283* |
| NERC | | | | | | | | | |
| Total commissions/contributions | 24778 | 27564 | 24200 | 21732 | 21574 | 22967 | 30779 | 28428 | 31479 |
| Total receipts | 74859 | 86598 | 87819 | 89825 | 93132 | 99924 | 105498 | 106444 | 127901 |
| *1990 pounds (GDP deflator)* | *135020* | *142260* | *134551* | *131488* | *129879* | *132262* | *135053* | *129330* | *145068* |
| SERC | | | | | | | | | |
| Total commissions/contributions | 6461 | 7916 | 9332 | 9993 | 12343 | 18012 | 19957 | 28718 | 31625 |
| Total receipts | 208245 | 225079 | 244177 | 264527 | 291426 | 317617 | 337215 | 386703 | 397139 |
| *1990 pounds (GDP deflator)* | *375602* | *369752* | *374114* | *387222* | *406412* | *420406* | *431685* | *469847* | *450445* |

Source: Research Council annual reports
Notes: Government commissions, main sources
MRC - DHSS until 1980/81, then Health and Saftey Executive: NERC - Dept. of Environment, Dept. of Energy, SERC - DTI and MOD
Other commissions/contributions, main sources:
AFRC - sale of produce; ESRC - sales and publications
MRC - Area Health Authorities, WHO, private donations
NERC - European Community; SERC - NATO, canteen, hostel receipts
Total receipts includes additional miscellaneous receipts

Defence Establishment, Royal Aircraft Establishment, Royal Armament and Development Establishment, Royal Signals and Radar Establishment) are to become part of one 'agency' in 1991. It is expected that over time these will increase the amount of contract work undertaken.

In 1988 the defence establishments carried out £51M of work for other Government departments, and a further £22M for other customers. Of this, some 75%—£55M in 1988—may be regarded as contract research.

*Other Government departments/labs*

A number of other Government departments also run R&D laboratories, such as the Transport and Road Research Laboratory funded mainly by the Department of Transport, and the Building Research Establishment funded by the Department of the Environment. These establishments also generate some 5-10% of income from contract work of a variety of different services. It is estimated that in 1988/9 the amount generated from contract work as included in this study is in the region of £4-5M.

One of the largest R&D organizations in the UK is AEA Technology, which now operates as a Trading Fund. AEA Technology has recently been reorganized into 9 main business areas, all of which are actively seeking to increase revenue from appropriate sources, particularly industry. The subsequent reorganization has given an added impetus to the role of contract work within AEA Technology as a whole. An approximate figure of £75 M for contract R&D undertaken in 1988 will now be considerably underestimated for AEA Technology as a whole.

**(vii) Summary**

Total income for contract research received by the various performers of contract R&D in 1988/89 is, approximately, as follows:

| | |
|---|---|
| CROs | |
| – AIRTO members | £190 M |
| – Others | £ 60 M |
| – **TOTAL** | **£250 M** |
| HEIs | |
| – Universities | £150 M |
| – Polytechnics and colleges | £ 30 M |
| – **TOTAL** | **£180 M** |
| Research Council Institutes | |
| – **TOTAL** | **£100 M** |
| Government Laboratories | |
| – DTI | £4/5 M |
| – MOD | £ 55 M |
| – Others (including AEA Technology as Trading Fund) | £ 80 M |
| – **TOTAL** | **£140 M** |
| **GRAND TOTAL** | **£670 M** |

It should be noted that this does not include contract R&D carried out in industry, for which figures are not readily available. The largest single source of funding for this is the MOD, which in 1988/89 spent £1202 M in industry on R&D. Other Government departments also spent significant sums on R&D in industry, as highlighted below.

Extramural R&D expenditure by departments in private industry, 1988/89

| | |
|---|---|
| MOD | £1202.0 M |
| DTI | £183.5 M |
| (including c. £20 M spent in RAs) | |
| Energy | £ 10.3 M |
| Environment | £ 12.2 M |
| Others | £ 22.0 M |

(Data from *1990 Annual Review of Government funded R&D*)

*Our total of £670 M for the volume of contract R&D performed in the UK thus excludes an unknown but very considerable amount performed in industry, funded by both industry and Government.*

## CHAPTER IV: THE PERFORMERS OF CONTRACT R & D

### (i) Outline

In chapter III we presented an estimate of the volume of contract R&D performed in the UK. In this chapter we assess the contract R&D business from the point of view of the performers. In chapter V we examine the customers' perspective.

### (ii) Contract research organizations (CROs)

#### *(a) Function and structure*

*The changing role of CROs*

The nature and role of CROs in the contract R&D market place has changed greatly in the last 25 years. Up to, and during, the 1960s the relationship between a CRO and its customer was, in many cases, a 'master—servant' relationship. The paying customer was the 'master', dictating how, why and when work was undertaken. Often interaction between a CRO and a customer was restricted to that necessary to solve an immediate problem. The majority of CROs were run as membership based research associations (RAs), generally working for the betterment of an industrial sector as much as for individual members.

During the 1960s, with new technologies emerging, a different form of CRO came to prominence. The focus of these organizations was the use of new technology and developing expertise in technology rather than particular industrial sectors. They marketed themselves as technology driven organizations able to improve customer's productivity through the introduction of new and appropriate technology, and also through reviewing, assessing and updating a customer's product design, marketing, processing and overall business planning. These organizations worked very much as equals to their customers—a customer brought in the CRO not to solve a particular problem in a prescribed way (although this was, and still is, one of the introductions a customer may have of a CRO), but to secure an informed analysis of the problem and to exploit the expertise and experience of the CRO in finding solutions, possibly in unexpected ways or areas.

This move towards technology consultancy is now common and most CROs, including the membership based RAs, have gone some way along this path. CROs are, in many cases, in an good position to assess a customer's technological capabilities in the light both of emerging technologies and of his general position within the marketplace in relation to competitors and the general industrial market, and to then follow up such assessments by introducing/developing any required technology.

*Reorganization of CROs*

Some RAs have found their membership structure, and the Council and statutes to which they have to adhere, to be a constraint on corporate development. Because of this a small number have undergone management buyouts of their facilities, with the agreement of the members. In such cases the RAs (now with money from the buyout but no facilities) are tied to the new company by agreement. The RA agrees to commission work for its members only from the new

company, and not to set up new facilities in competition. The new company, with shareholders, is free to evolve however it sees fit, to invest where necessary and, of course, to make a profit. Other RAs are trying in less drastic ways to alter their constitutions to allow greater management flexibility. It was generally agreed that more management buyouts or similar quite drastic reorganization of a number of CROs could be expected in the medium term.

A few CROs have been the subject of takeover bids by larger companies. Being relatively small, generally successful and technically advanced, UK CROs in particular are an attractive target, for incorporation as the technical arm of a large company or simply to be taken over as successful businesses.

CROs with membership schemes use them in a variety of ways. Some undertake very little work for non-members, whilst for others non-membership is little or no barrier for placing a contract (though rates charged may be different). All the public limited companies are open to any paying customers.

### *(b) Customers*

*The customer base*

The customer base of CROs varies widely—from 10 to over 2500, reflecting the industrial sector in which the CRO works—from low-tech, small-medium enterprises (SMEs) such as in the furniture industry, to large, high-tech enterprises in aerospace or nuclear fields. AIRTO figures for 1988 indicate that its 45 members had a client/member base of some 20 000 organizations. Of that total some 12 800 (64%) were companies of fewer than 200 employees and a further 3200 (16%) had 200-500 employees. This suggests that some 80% of the AIRTO client base consists of SMEs. The remaining 20% includes 93 of the UK's top 100 companies. However, it is thought that of the total AIRTO turnover some 80% is derived from the 20% of large enterprises, and 20% from the 80% of SMEs.

*Type of customer*

In the questionnaire; we asked what percentage of CROs' customers were industrial companies, government bodies or other types of organization. Of the 30 replies to this question, 24 (80%) noted that 70% or more of their customers were industrial companies. For only three organizations were industrial companies less than half of their customer base, and two of these three reported that the bulk of their work was testing, quality and legal evidence work. Six organizations noted that 20%-35% of their customers were governmental, and two organizations noted that over 70% of their customers were central or local government. Other customers, in general less than 10% of total customers, included academic organizations, charities, 'information' groups and similar.

*Geographical distribution of customers*

We asked about the geographical location of the CROs' customers for the last financial year. 18 (60%) of the CROs reported that at least 90% of their customers were based in the UK, and a further 8 (27%) that UK organizations accounted for 70%-90% of their customers. 5 (16%) organizations reported that overseas customers constituted over 30% of their total customers, and 3 (10%) that over 70% of their customers were based overseas. However, a number of organizations commented that although numbers of overseas customers were

small, the amount of revenue they brought in was often significantly higher, and growing.

*Single-client vs multi-client R&D projects*

31 CROs replied to this section, of which 15 reported that over 90% of their contracted R&D projects were funded by a single client, and an additional 8 reported that 50%-90% of their contract R&D projects were single-client funded. Only 4 of the CROs reported that 90% or more of their R&D projects were multi-client funded, and a further 4 reported that 50%-90% of their work was multi-client funded.

Most contract R&D projects undertaken by the CROs in our sample were thus for single clients rather than groups of clients. This may reflect the extent to which work is sufficiently near market to be commercially confidential. It may also reflect a certain amount of technology consultancy activity, related to specific technical problems experienced by individual clients. However, some CRO managers described difficulties organizing multi-client projects and a few gave the impression in interviews that multi-client projects were avoided where possible. One manager commented, after noting the hassles caused by multi-client projects, 'maybe we do them badly'.

However, some organizations undertook considerable amounts of multi-client work—often on strategic, timely projects of relevance to industry. Often these were organized on an open club basis, while others were arranged with the CRO acting as the link between 3 or 4 interested companies on a more confidential basis. Work could be undertaken at the CRO, or it could act as the central coordinator, providing the common ground where companies met to discuss results from each in-house project.

It should also be noted that most DTI funding for R&D projects is available only for multi-client rather than single-client projects. Some RAs organize at least part of their core programme of research around such multi-client projects, thus both bringing together member organizations to undertake or at least be involved with advancing new technologies, and also allowing the RA to be involved in new technology cheaply, or even at a profit. Most DTI project funding is directed at pre-competitive projects involving emerging technology, which is often the research required for a core programme of R&D. From the DTI's perspective the use of CROs (particularly RAs) to undertake such projects (or at least play a central role in them) helps ensure results are (usually) quickly available to a wide industrial base.

*Attracting customers*

Contract research is a business, and the same marketing ploys are used to attract customers as in any other business. Mailshots, attendance at trade fairs, publishing of news-sheets and direct advertising were standard practice. Some organizations had overseas agents, and a small number of CROs had daughter organizations based overseas. These were sometimes the result of takeovers, or occasionally they were set up with the host government's financial support.

Most CROs had at least one employee in charge of publicity/customer relations, in one case the managing director was himself responsible, in the first instance, for 66 client companies, and many had small dedicated teams. Some teams coordinated and had at least a working

knowledge of all contracts. Such teams had a greater role than simply advertising the CRO: some acted as the first line of customer contact, and might remain the CRO's 'overseeing' arm, ensuring that while the customer was being dealt with by the technical experts everything ran smoothly and to plan.

A number of CROs believed they had developed a high tech image that actually scared off smaller customers, and were concerned to counteract this ('we're not as expensive as you may think'). One CRO manager noted he tried to encourage the high tech smaller companies, for the reason that 'next year a few will be very successful'.

All CRO managers agreed that the personal touch with clients was vital. Considerable time was spent in building up a stable working relationship with a customer, with the aim of ensuring repeat work in the future (which is often the case in practice)—CROs aimed to be the customers' 'friends'. One CRO manager reported they were particularly attentive if the customer was new, or the CRO was moving in an area in which it may actually not know much more than the customer.

The marketing approach, with dedicated staff, was more prevalent in the 'technology consultants' type of CRO. As one manager put it, 'we train our scientists to act as businessmen', and on the rare occasion that a scientific staff member just could not act in this manner he was kept back from the business aspects of the work, entering only technical discussion.

However, no matter how hard a CRO sold itself and got in front of the industrial 'eye', no contracts could be signed until technologists from the customer had talked with technologists from the CRO, and agreed a work programme.

The reputation and professional integrity of any CRO were of paramount importance. Great efforts were made to ensure nothing was allowed to blemish their record or associate the CRO with 'dubious' dealings. All CROs realised their reputation for quality, confidentiality and general professional standing had taken a long time to build but took very little to erode. Protecting a reputation had, on occasion, led to court action.

### *(c) Competitors*

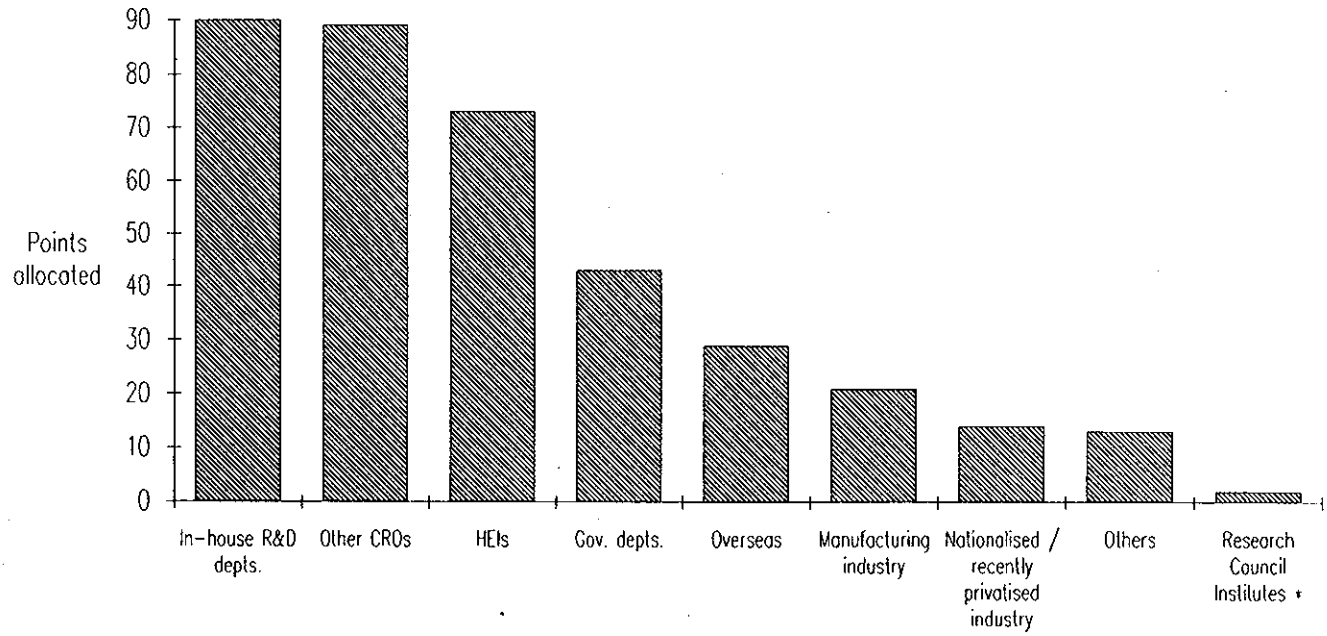
We asked CROs to identify their five main competitors from a list, and to prioritize their answers on a scale of 1 to 5. We analysed the replies by allocating five points for the most important answer, down to one point for the 5th placed competitor. 27 companies prioritized their answers, with an additional three noting 'all are competitors'.

The results are given in figure 4.1.

*In-house R&D departments*

The customer's in-house R&D departments were always mentioned as a major competitor—it is this department the CRO has to beat to win a contract. A number of the business consultancies noted that much of their work came from contact with the business manager rather than the R&D manager of a company. Such consultancy CROs often concentrated on selling a technological business package rather than

Figure 4.1 Perceived competitors to the UK CROs




individual technical solutions.

*'Other CROs'*

'Other CROs' also featured high on the list of competitors. This usually referred to one or two CROs in similar specialist technological areas. Generally though CROs, because of their specializations, were not in competition with each other.

*HEIs*

Most CROs thought that HEIs, in general, were of little threat to their mainstream activities (based on specialized experience of the industrial market). They believed few HEIs had the overall experience to compete for the bulk of a CRO's work. However, most CROs did note that for testing/using sophisticated equipment and some consultancy work HEIs had entered the market and were in competition. This was felt most in those CROs that undertook a considerable amount of testing, and specially in the smaller CROs, where any threat to turnover was serious. In addition, a number of CROs noted a few specialist HEI spin-off companies that were forces to be reckoned with in their fields; these were being closely watched.

*Industrial companies*

A number of engineering based CROs noted that there had been a distinct move by engineering companies to offer their own specialized facilities on a contract and/or collaborative basis. This was perceived as an economic necessity for a few companies, but more usually as a result of the general increased 'business' awareness leading to pressure to provide additional services for a company's main customers. Some companies were undertaking considerable amounts of this contract/collaborative work and were affecting at least one CRO's market.

*Government laboratories*

As with the universities, Government laboratories were not, in general, thought to be seriously challenging the CROs' industrial base, although

in particular areas the CROs were watching and attempting to become partners with such organizations rather than competitors. However, where such laboratories were strongly moving into the independent contract R&D business (such as AEA Technology and NEL) they were seen by CRO managers as having a distinct competitive advantage. This was particularly so for AEA Technology, which as part of the former UKAEA has entered the CRO market in a major way with laboratories and staff built upon government funds. However, others noted that, at least in the recent past, AEA Technology had been quite expensive, and that much contract work was placed there because of the unique facilities offered, rather than for the industrially relevant expertise of the staff. Many CRO managers expressed some concern that organizations such as AEA Technology and NEL would still receive forms of government aid, if not directly then indirectly through funding for projects that, although probably not directly applicable to the industrial market, would provide the base on which industrially relevant work could be developed. It was felt that this, at least in the short term, would give such organizations an unfair advantage in the highly competitive market.

### *(d) Income of CROs and services offered*

*Turnover*

The turnover of the 37 CROs in our sample varied considerably, from £0.75 M to £112 M. Only four organizations had turnovers in excess of £20 M; the majority had turnovers of between £2.5M and £10M. Many of the UK CROs were relatively small organizations. As such they were prone to changes in their particular markets and in the economy in general.

*Sources of income by activity*

We collected data on total income and on the services that brought this in. Responses varied tremendously and only a brief overview is given below.

CROs offered a wide range of services, with managers noting they were constantly looking for new areas, services and approaches to increase revenue, although they were conscious that they must not lose established custom by changing too drastically.

*Major R&D contracts*

Income from major R&D contracts ranged from 5% to 98% of total income, with 7 companies reporting over 80% of their income was earned by such contracts, 13 reporting 50%—80%, 10 reporting 35%—50% and the remainder reporting less than 35%.

Such R&D contracts formed the bulk of CROs' workload, whether applied or strategic research or single or multi-client funded, and were based on experience of the industrial market place. The CROs, by working for a wide range of customers, built up, and continually developed, a breadth of industrially relevant technical expertise.

*Testing and short term consultancy*

Income from short-term contracts/consultancy ranged from 2% to 65% of total income, although the majority fell between 20% and 35%. This included routine testing and short-term technical assistance, often trouble-shooting, which formed a core of work that CROs could generally rely on, and often led to further work.

*Application of appropriate technology*

All CROs applied 'appropriate' technology—not necessarily the *latest* technology but that which was appropriate for the industrial need. This often entailed transferring technology from one industrial sector, with adaptations, to another, rather than developing new technology. Some CROs actively sought, often successfully, industrial sectors where such innovative applications of technology could be introduced. This seemed particularly true in the older, established industries, and where there were considerable numbers of small/medium sized, low/medium tech companies.

*Research clubs*

Only 10 CROs reported that the running of research clubs brought in income (however, two CROs who did not reply to this question but were subsequently interviewed, did bring in income by running such clubs in their core research programme, but allocated the money as research funds not as income). The amount of income generated by this service ranged from 4% to 49% of total income.

*Manufacturing*

'Manufacturing' included the sale of finished (usually specialized) products, and the manufacture/hire of specialist equipment. Of 15 CROs that gave data, only 4 reported this accounted for more than 10% of total income, 2 reported that it generated 7%-10% of total income and the rest that it generated less than 7%.

Such CROs had a small but steady market for precision testing equipment, generating up to 10% of income. In addition a few CROs manufactured finished products, having developed an idea to the product stage, rather than sell it to a manufacturer to exploit. In some cases spin-off companies had been set up to manufacture the product, leaving the CRO free to continue as a CRO and not diversify.

An obvious motive for manufacturing was to exploit ideas to the best commercial advantage (more profit). However, another reason put forward by some CRO managers was that CROs were increasingly being asked to go to industry with proven, profitable ideas (for which industry would pay well) rather than 'possible' ideas, which were cheaper but needed to be developed before a product/process was, potentially, profitable. Because CROs themselves were developing ideas nearer to the market, some had taken this to the logical conclusion and licensed or produced/marketed the finished products themselves.

*Patents and licences*

Only 2 organizations reported that patenting, and subsequent licensing, generated more than 5% of their total income; for most it generated less than 1%. Many organizations did not respond to this question.

*Information/computer services*

15 CROs reported that information/computing services generated income, ranging from 0.5% to 38% of their total income (including sales of computer software). All bar 3, however, reported that income generated by these services totalled less than 10% of their total income.

Many RAs used information/library services as a benefit of membership, with one RA allowing members up to two hours' free use of library facilities/personnel as required, whenever required. Others used technical computing software in a similar manner as the selling of sophisticated equipment. Some CADCAM services were offered as an

extension of the technical facilities, whilst software packages had been designed specifically for particular markets, e.g. the USA or Germany. Some CROs saw this internationalization of services as very important for the future.

*Membership fees*

For the 18 organizations that reported income from membership fees, the range was from 2% to 42%, with the majority between 20% and 30% of income.

*Training courses*

15 organizations reported income from organizing courses, ranging from 2% to 15% of total income. Of these 9 noted that less than 7% of their turnover originated from courses.

Some courses were highly specialized, others more 'general business' orientated. A few CROs were used as head offices of professional bodies and ran conferences/courses for them. Such activities were deemed worthwhile, both for the income generated and for enhancing reputations and maintaining contact with customers.

*Expert legal advice*

Most CROs offered specialist expert legal advice and were often involved where unbiased, factual evidence was required. Many saw this as an extension of their 'expert' standing, and one CRO manager pointed out that his staff had never been proved wrong in court. Some CROs undertook considerable amounts of such work and, like testing services, it brought in a steady income over time.

*Other services*

A few CROs had acted as project managers to sizeable industrial projects, overseeing development of new plant, with technical input where appropriate. Some offered business consultancy, marketing advice and economic planning. Such skills were being utilized as part of the Government's Enterprise Initiative, with the CROs called in to advise companies on specific business areas, both generating income and enhancing their customer base.

Some CROs offered unique testing and pilot plant facilities (where new products/processes could be tested on a commercial scale), which were highly regarded by a number of industrial R&D managers.

*Sources of income by sector*

32 CROs gave data enabling a good breakdown of the sources of income (other replies were incomplete). In summary, the amounts of income generated from the UK Government, UK commercial organizations and overseas in 1988 were as follows.

- Income from the UK Government ranged from 0% to 89% of total income. 8 CROs earned more than 30% of their total income from government, 11 earned 20%-30% and 11 earned less than 20%.
- Income from UK industry: 15 CROs earned more than 60% of their total income from UK industry, 8 earned 30%-60% and 9 earned less than 30%.
- Income from overseas contracts: 4 CROs earned more than 60% of their total income from overseas customers, 4 earned 30%-60%, 5 earned 20%-30% and 19 earned less than 20%.

We also asked for analogous data for 1983. 32 CROs were able to provide data for both years, allowing a basic comparison to be drawn. Of those 32, one organization did not undertake work for Government in either year, 29 showed a total percentage cutback in the amount of

government income and two showed increases in the amount of government income (of 1% and 18%). The most dramatic cutback was of 70% (from 50% of total funding in 1983 to 15% in 1988). In addition, one organization noted a 90% cutback in its turnover derived from government sources, from 10% in 1983 to less than 1% in 1988. On average, there was a reduction of 11 percentage points between 1983 and 1988 in the proportion of total income derived from government sources.

Of the 29 CROs that gave data on the proportion of their total income that was earned from UK industry for both 1983 and 1988, 25 reported an increase, 2 reported no change and 2 reported a slight decline in percentage terms.

Only 18 CROs gave data for both years on turnover originating from the EC (although, of course, in some cases this reflected no turnover originating from the EC in 1983). Of the 18 respondents, 11 reported an increase in the percentage of turnover from EC sources, 6 reported the same percentage and 1 reported that the % of turnover from EC sources was less than five years ago.

Nearly all CROs now had a more diverse customer base than five years ago. A small number of CROs had closed and others had merged in order to strengthen the combined organizations. A number of CROs managers reported that the period of change had been very difficult, but that their organizations were now 'leaner and fitter' than they were before.

In virtually all CROs, overseas work brought in a significant amount of income. All but one visited reported that the amount of overseas work being undertaken was increasing, although they had always undertaken a significant amount of overseas work. Individual CROs reported they had particular growth areas, such as the USA, Japan and south east Asia. Many reported that income directly from the European Community programmes had increased in the last five years (partly because it is only in that time they had become actively involved in such schemes). All commented that, despite the problems associated with these schemes, they would continue to be a small but distinct part of their overseas contracts. Some, but by no means all, reported they were now undertaking more work for European countries in general (2 reported that they seemed to be moving away from the USA to Europe), but this included all countries of Europe, including Eastern Europe, and not just members of the European Community. Indeed some reported they had long worked for and with EC countries and as such did not expect major increases in the amount of this work in the short term.

### *(e) Core research*

*Core research – keeping up to date*

The RAs with membership schemes all ran some form of core programme of research, to help keep the RA, and its members, up to date with emerging technology. These were usually run on a club-type basis.

For any RA/CRO the running of research clubs for interested parties, (rather than just for interested, or all, members) was a similar method of keeping up to date at a small cost or even at a profit to any RA/CRO.

The non-RA CROs spent varying amounts of turnover on a core programme of R&D not under direct contract to a customer. Some reported that 8%-10% of turnover was spent in developing ideas which in the short term cost money, but in general proved cost effective when translated into technical know-how in customer contracts. However, many CRO managers reported that it was difficult to put a figure to this in-house R&D. Most contracts involved the CRO investigating an area for a customer, in the process of which the CRO built up knowledge useful somewhere along the way.

A number of CRO managers ensured team leaders had a budget element that they could assign to promising areas of research, regardless of direct profitability. This allowed staff to follow up ideas, which could, and had, led to unexpected, profitable developments.

Some of the 'technical consultancy' CROs reported they did little innovative in-house research—they were more concerned with bringing a customer company up to date by introducing appropriate technology rather than pioneering technical breakthroughs.

All CRO managers stressed their relationships with individual academics in HEIs as a method of keeping in touch with research developments. This was both via an informal network of acquaintances, attendance at meetings, seminars etc, and by contracting, sponsoring or co-working in areas of mutual interest.

### *(f) Membership*

*Membership*

Some RAs were seeking to increase membership numbers, seeing this as a method to increase total custom. One organization would only test to standards for non-members, and only then give a pass or fail verdict. If the customer wanted to know why failure occurred, and how to improve performance, they had to become members. However, other RAs played membership down and would work for any customer.

Although membership was being pushed by some RAs there was a general view that over a 10-15 year period membership was going to become less significant. The level of fees contributed by this route (20%-25% of total income in some RAs) was thought likely to diminish (in percentage terms) over the period.

### *(g) Staff*

*Number of QSEs*

Numbers of qualified scientists and engineers (QSEs) varied significantly: the smallest RA had a scientific complement of only 14 and the largest organization had some 3800 qualified staff. AIRTO members (45 CROs) noted a total staff of 9800 (of whom approximately 50% were QSEs). A rough estimate of QSEs in CRO type organizations, including those who were not members of AIRTO, must be in the region of 10 000—a significant manpower resource.

Of the 33 respondents giving data on staff numbers, 23 (70%) had QSEs making up 30%-60% of their total workforce. The range, as a percentage of total workforce, was from 23% to 91%, with an average near 50%.

The allocation of QSEs between activities varied considerably between

organizations. In some, major R&D projects employed the vast majority, whilst in others there was a more even division between scientists working on major R&D projects and those employed on consulting and testing services. A few organizations had a significant number of QSEs working on library/information database systems.

*Non-UK EC scientists and engineers*

Few CROs employed significant numbers of non-UK EC nationals. One organization reported it employed 30 non-UK EC staff, but the majority of these were employed in an offshoot in another EC country. Most CROs had fewer than 5 non-UK EC staff.

The questionnaire asked whether the number of non-UK EC national staff had increased, decreased or remained the same in the last five years. Of the 38 CROs replying to this question, 14 (37%) reported that there had been an increase in non-UK EC staff and 24 (63%) reported that numbers had remained the same (very low or zero).

*Recruitment*

CROs were asked whether they had problems recruiting QSEs. 35 (94%) answered 'Yes'. Of these, 26 indicated that the problem had increased in the last five years, and 8 that it had remained the same. Nearly all were prepared to recruit staff of virtually any nationality. Many commented that they had difficulty attracting staff because of prevailing salary levels, house prices etc. This was especially so for attracting overseas staff.

*Isolation*

Many CRO managers stressed the technical expertise of their workforces and the strong links with both the industrial base, where the technology was applied, and the academic environment, from which technical breakthroughs often emerged. CRO scientists (often working on several projects at once) therefore, over time, liaised with a wide spectrum of technologists through the natural course of contracts. In addition many CRO managers stressed the efforts made to maintain and enhance these contacts, particularly in academia. It would appear therefore, that, far from being isolated, CRO scientists/engineers had well established links with both academic and industrial scientists. It was clear from interviews that CRO managers valued such contacts and many agreed that they would like to do more to enhance them further, but, they noted, they had businesses to run.

### *(h) Government policy*

*DTI Enterprise Initiative*

Most CRO managers noted that the DTI Enterprise Initiative was a well thought out set of initiatives, relevant to industry.

Particularly highlighted was the fact that the various schemes were organized under one umbrella scheme, which allowed easy 'entry' to a variety of sub-schemes. There was, however, an element of bias in the CRO managers' comments. Many CROs were involved (some heavily) as consultants to the various schemes, which brought in a significant amount of additional income. Some of the more traditional CROs worked mainly under the R&D and Process/Plant initiatives, but the 'technology consultants' often undertook work for marketing, design, business plans and general market activity initiatives. Managers looked favourably on the schemes for two reasons, the direct economic benefit of the consultancy work and the increased customer contact base that the CRO could subsequently interest in further work.

However, there was also a view expressed that the 'first line' counsellors, who initially assessed a company and decided what help was required, were not particularly competent, and were seen as the failing point of the Initiative. It was said that over half of the money was directed to the marketing initiative, and it was suggested that, rather than trying to sell a second-rate product, companies would be helped better by a design or technology input.

*The General Industrial Collaborative Projects (GICPs)*

The research clubs supported by the DTI (with funding of up to 50% of costs under the General Industrial Collaborative Projects scheme) were highly regarded, and there were suggestions that the scheme should be extended. Clubs were set up at CROs (and universities and government laboratories) with a number of companies paying relatively small amounts of money to be involved in research projects of a usually strategic nature. These appeared to be very successful, and were praised by both the CROs and the industrial customers (barring the odd comment of incompetence of particular staff, firms or clubs).The partners themselves appeared to have a considerable say as to what the club should be looking into, with the red tape at the DTI kept to a minimum. Clubs could be highly technical, and hence usually only attracted a small number of interested companies; they could be more strategically aimed, and would attract a larger number; or they could be organized mainly as information clubs, attracting a large number of companies (paying relatively cheap contributions) using the club as an information/watching brief service, on which to build if and when deemed necessary.

Some CRO managers noted that considerable effort was initially required to attract potential collaborators to a new club. There were a number of examples quoted where there was simply not enough interest in particular club projects, which, after sometimes considerable effort from the CRO, had to be dropped. However, many CROs noted that a well run collaborative club type project, where all or the bulk of the work was undertaken by the CRO, could be fruitful, both for the CRO and the partner organizations.

*LINK*

The LINK scheme attracted considerable hostility. Although the idea behind the scheme was praised, the red tape and time required before decisions were forthcoming (up to and over a year) were unacceptable. Perseverance was needed to get through the system, and a number of CROs, and in particular industrial companies, reported that if the work was of any importance it would have been done, in-house or collaboratively, before the application had been processed.

The rules for LINK have now been revised to allow 'one-on-one' collaborations to take place (the DTI contributing to the industrial company and SERC the HEI). There was also some pressure to change LINK rules to become more like those governing the EC Framework programmes.

*The move from near-market research*

Since the introduction of the DTI's Enterprise Initiative in 1988 there has been a distinct move away from government funding of near-market research to funding of pre-competitive, generally collaborative research. CRO managers had directly felt the effects of this change, on both their own organizations and industry in general. Many felt that much of the work that the Government used to pay for as near-market

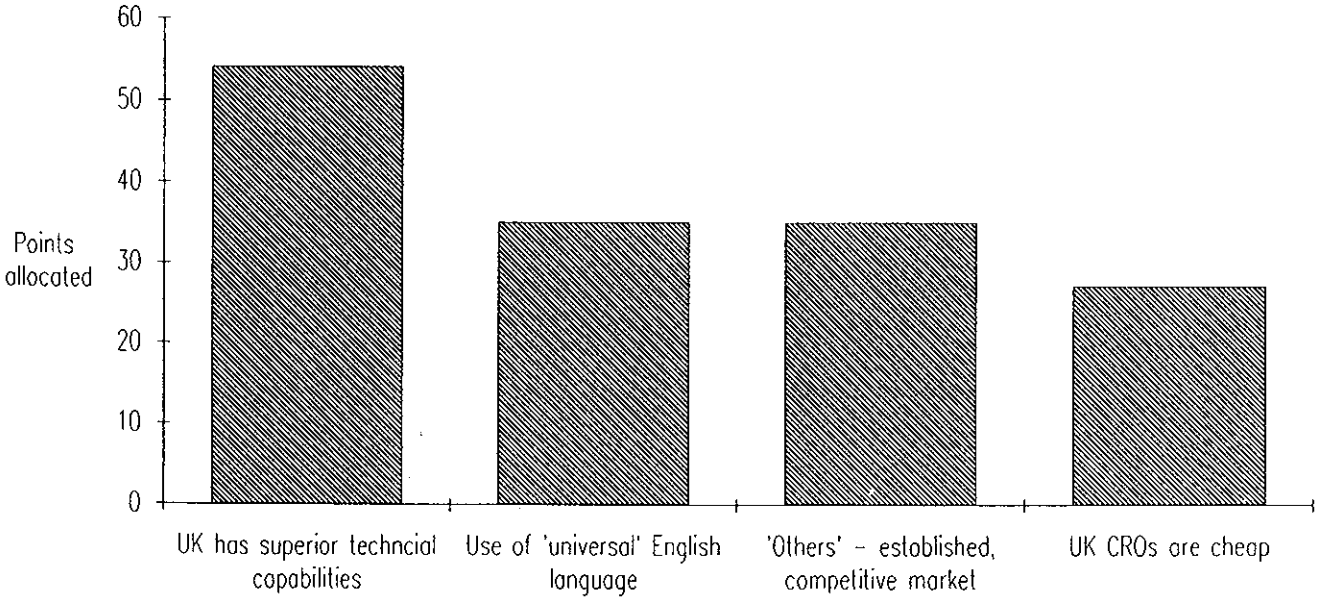
joint projects was highly beneficial to the industrial base as a whole. From the CROs' viewpoint such near-market projects, on a joint basis, meant that the technology was quickly distributed, to the benefit of industry in general. This itself produced a return for the Government in more profitable industry, and subsequently tax income. As a result of the Government funding only pre-competitive research, near-market research was now being funded mainly by individual companies (and only those that could afford to) which, because they were paying full costs, wanted to keep any advantage for as long as possible. This, according to the CRO managers, meant that UK industry as a whole was being held back, particularly the smaller companies.

In addition a number of managers reported that although they could not get government funds because much work was deemed too near-market (and so they were undertaking more strategic work), HEIs were being encouraged to undertake more work for industry on a contract basis. There seemed to some CRO managers an illogicality somewhere.

This cutback also had an international aspect—the UK Government was seen to be one of the few not giving direct support to industry, to ensure it remained generally competitive, particularly in the run-up to the Single European Market. Whatever the merits of this policy, many CRO managers felt that UK industry was going to find it difficult to compete in overseas countries where considerable 'aid' was available to companies, if not in subsidies then in government support for high quality industrial infrastructure, publicly funded S&T and so on.

Many CRO managers were aware that the EC had a policy of controlling state aids, but were also aware of the complexity of the problem, particularly as to where R&D services fitted with this, and where state aids for R&D merged with aid for regional development. The CRO managers were sceptical that the Single European Market was going to open up on a 'level playing field'.

Figure 4.2 Perceived reasons why UK CROs undertake transnational contract research



### *(i) Transnational work*

*Reasons for UK success*

We asked CROs what they felt were the reasons for the UK CROs undertaking a considerable amount of overseas contract R&D. We suggested three possible reasons, plus 'others', and again asked respondents to prioritize their answers. With 3 points allocated to the primary reason, and 2 points to the second and so on, the points allocation was as in Figure 4.2

In the eyes of the CRO managers the major reason for attracting transnational work was the UK's superior technical capability, although the open, competitive market and the relative cheapness of UK research were also important.

These points were reiterated in interviews—the breadth of competence in a single organization in a particular industrial sector was often quoted as, if not unique, then at least rare in Europe. Many managers believed the closeness of the CRO to industrial companies, both in personal links and through general working with industry, was a major factor. The open competitive market was mentioned, not so much because a customer had a large choice of CROs in a particular field, but because the general market conditions had honed the CROs to industry-led businesses, which again appeared to be rare in the rest of Europe. Most UK CROs looked upon themselves as world class experts, and many had a world-wide customer base to back the claim.

Although the CRO managers were aware that an international client base showed their expert standing, they were also aware that this actually meant that their expertise was being exported, relatively cheaply, and often to the detriment of 'UK Limited'. If overseas companies saw the potential of emerging technologies, then why not more UK companies ?

CRO managers saw few overseas organizations capable of undertaking the same type of industrial R&D found in the UK. Many believed this reflected the fact that in many countries most industrial research centres were funded largely by governments, and run along the lines of government/university laboratories. Good work was being produced from these organizations, but they did not have the commercial knowledge or attitudes found in UK CROs. For this reason CROs felt that transnational work would become even more important as they fully exploited the Single European Market.

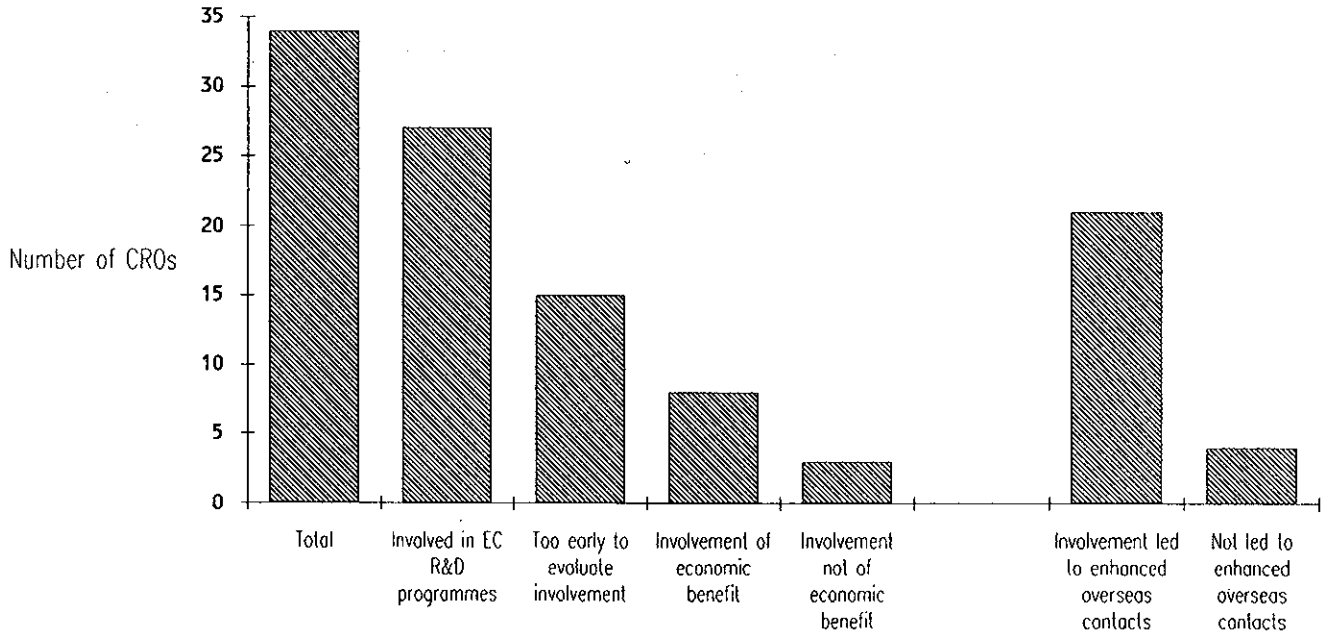
### *(j) European Community R&D Programmes*

*Participation in EC programmes*

We asked a series of questions about participation in European Community (EC) R&D programmes. Of the 34 respondents who replied to some or all of these questions, 27 (80%) indicated that they had been involved in such programmes in the last year (1988/89). Results are shown in Figure 4.3.

Of these 27, 8 (30%) reported that involvement had been of economic benefit to the CRO or to industry in general, 15 (56%) commented that it was too soon to evaluate the projects and 3 (11%) reported that involvement had not led to economic benefit. (1 CRO gave no answer.)

Figure 4.3 UK CRO involvement in EC R&D programmes




Of the 27 CROs involved, 21 (78%) reported that involvement had led to enhanced contact with overseas organizations (the partners in the projects), 4 reported that involvement had not led to enhanced contact and 2 did not reply.

5 CROs reported that they had been involved in work that, although it did not receive EC funding, still went ahead with some form of collaboration with other partners. 23 CROs noted they had not followed up any rejected proposals.

6 CROs reported that they had been, or were about to become, involved with follow-up projects related to EC programmes. 5 gave an indication of the scale of this follow-up work: for 2 the follow-up project was worth more than 300% of the original contract, for 1 it was worth 100%-300% of the original contract, for 1 it was worth 10%-50% of the original work, and for the last it was worth under 10% of the original contract.

The responses showed that while many CROs had been involved in EC R&D programmes, few had been involved as project leaders, and many had only limited knowledge based on one or two contracts. Despite the various grievances noted below, there was overall enthusiasm for the programmes and what they were trying to achieve, and many managers were looking at a learning curve (which they were slowing moving up) of involvement with the EC and overseas partners. Many saw the eventual benefits of involvement in the programmes as outweighing the problems initially faced in setting them up.

***Difficulties with EC programmes***

The task of 'Project leader' was often regarded as a merciless task—'having to go through a phenomenal amount of red tape, not once but four, five or many more times for each partner', and the lead organizations 'almost certainly lost money' because of the amount of effort needed to set up the projects. A typical comment was: 'If they're

foolish enough to do it (the leaders) then let them get on with it, we will benefit in the short term, and learn lessons on how to act as leaders in the future'.

Many CRO managers had similar attitudes of becoming involved in the programmes in the easiest way possible, before fully committing themselves on a major contract of their own. Many CROs were, apparently, initially involved in EC programmes 'on the back' of a larger industrial partner, sometimes as a full partner or sometimes as a sub-contractor.

Problems highlighted by CRO managers included the following:

- finding and communicating with potential overseas partners (although this was already reported as not as big a problem as 3-4 years ago);
- ensuring the project specification agreed by the partners met the requirements of the EC, and having to change project details at short notice to accommodate divergent views;
- difficulties in finding out how contracts were allocated, when, who assessed projects and how, to what criteria. Some CROs noted they found out about tenders too late, although this was also said to be less of a problem now;
- the time taken by the Commission to decide on contract tenders;
- paper work seemed to be required 'yesterday' by the Commission, and then sat on for 6 months;
- very large amounts of time and effort had to be expended on setting up a contract, with no guarantee of anything at the end (many thought this was particularly off-putting for the smaller CROs and companies who could not afford such 'lotteries');
- EC bureaucrats were the subject of many comments such as 'often totally the wrong sort of people, with little experience or expertise of a sector', 'more concerned with making sure the money when finally distributed is allocated with a distinct bias to the poorer countries, regardless of whether the project will actually be undertaken satisfactorily'.

However, in opposition to some of the above comments, it was also noted that 'Eurocrats' were often more knowledgable than national bureaucrats. There was also, in some minds, an understanding that 'Eurocrats' were trying to achieve (at least) two targets—one of a purely technical nature, and the of increasing cohesion through the Community. Linked to this was the fact that the EC technical contracts were (usually) quite specific—if the tender was at variance to this (i.e. the tendering organizations wanted EC funding for their own purposes rather than for the particular programme) there could be a problem in coordinating the call for tender and the tender proposal itself.

Despite the problems, CRO managers in general agreed that they would continue to become involved in the programmes, and could see such involvement becoming easier. They believed that such contracts were a useful way of becoming involved in emerging technologies (eventually cheaply), making overseas contacts and eventually

developing new markets/collaborative projects. In addition involvement was looked on as enhancing their business reputations, and great play was made of such work in annual reports, newsletters and journals.

*Funding of EC contracts*

The part funding of EC contracts was not a major problem (once contracts were finalized), although costs were very carefully controlled. The fact that the CRO had to pay partial costs of the project was occasionally put forward as a stumbling block, particularly for the smaller CROs. A number of CRO managers reported that costs sometimes did not fully cover the expected programme, and all noted that they kept tight control on financial input, both during the contract, and by careful and detailed planning before the contract was agreed, to ensure the contract was economically viable. Some CROs funded such work from in-house funds, others used membership fees and incorporated such projects into their core research programme. One was looking at a club type funding scheme whereby members or customers paid to become associate members of the contract, although this was not yet in operation.

***(k) The Single European Market (SEM)***

*The Single European Market*

Most, if not all, CROs saw the opening of the SEM as making their path into Europe easier. Most were already active in other EC countries; the SEM would allow them to compete even more favourably. One RA manager did note that his constitution was worded to allow work only for the betterment of British industry, and by undertaking overseas work he was in breach of the letter, if not the meaning, of the wording. Hence he was using the 1992 banner to bring about these (and other) changes.

*Movement of scientists*

Most CROs, on the look-out for good scientists, thought there would be a natural increase of non-UK EC nationals on their payrolls, both based in the UK and as agents, sub-units and such like based overseas. This was seen as a natural progression of the Europeanization, and indeed globalization, of R&D and of industrial activities more generally. Some managers did express fears that the UK could have difficulties in attracting and keeping the best scientists and engineers as more became aware of the better standards of living available to their professions elsewhere.

*Industrial standards*

Many CROs were involved in the formulation/harmonization of standards for the EC. Some were putting considerable effort into this, in their own right, via trade associations or the British Standards Institution, in the knowledge that their expertise would be required by industry when new standards came into force. Many CROs also saw an increasing need for overall quality control (i.e. a BS 5750 quality assurance gave a company more leverage in the export market) and they were gearing services to meet this need, from both UK and overseas companies.

*Public procurement*

Many CRO managers saw the possibility of increased EC public sector work as the market for public procurement opened up, although only in the medium term. If this market did become fully open the CROs saw that they were favourably poised to undertake work for the various local and national governments which would be forced to put such

contracts out to tender.

### *(l) Other issues for CROs*

*Intellectual Property Rights*

Few CRO managers reported problems with Intellectual Property Rights (IPR)—contracts were invariably detailed on these points and problems seldom arose on either side. This was attributable to the contracts being properly drawn up and to both sides being fully aware of the possible outcomes of the contract, before it was undertaken.

*Patents and licences*

Virtually all CRO managers thought they did not make the best of their patents and licences. Many commented that they were trying to improve their returns from them, but could not afford to employ a full-time member of staff (or a small team) to handle this aspect of their work. It seems paradoxical that such organizations, dealing continually with technology transfer, had not done more to exploit patents and licences. Indeed our interviews suggested there may be a case for organizations like British Technology Group to become more involved with CROs (this is happening to a certain extent), which could be beneficial to both CROs and the transfer organizations. Some CROs employed agents to deal with patents and licences, but none were happy that their organization was getting all it could out of its intellectual property, and indeed a number could point to quite major technological advances that had been developed by the CRO but had not led to income for it from royalties or licence fees. One did comment that the copyright law on diagrams was very useful.

*Links with HEIs*

Links between HEIs and CROs were generally noted as good and, on the whole, well maintained through a variety of mechanisms. Most CROs were aware that HEIs were where many of their exploitable ideas initially come to light, and hence spent considerable time and money nurturing links. Contact included visiting scholars, research studentships, contracted work, consultancies, joint projects and so on. Many CRO managers held positions on local HEI faculty boards, committees and similar bodies and CRO staff gave occasional course lectures, and some CROs opened their doors to classes, both as a public relations exercise and as a method of staff recruitment.

Many CROs used specialist academics as consultants on particular projects. Academics were used particularly when the CRO entered a new technology—it might set up its own in-house unit, with input from academics, or it might put its own staff into an academic laboratory for a month to learn as much as possible, including the network of experts in that field.

Most CROs, as noted, did not see HEIs as real competition, although the smaller ones were keeping a close watch, especially on the testing/assessment services that some HEIs now provided (still, on the whole, cheaply).

Virtually all CROs voiced concern about the balance of teaching, research and industrial contract work that HEIs were undertaking, and many stressed the need for the basic research to be kept strong for the sake of 'UK Limited'. Managers were worried that the balance might be tipping too far towards industry, and that this was changing the basis of academic life, possibly to the long-term detriment of the

country as a whole.

### (iii) Industrial companies as performers of contract R&D

*Contract R&D as a source of additional income*

In a drive towards more efficient use of resources, some companies had reorganized their R&D facilities to concentrate solely on their core businesses. In some instances this had involved closure of parts of their facilities. Other companies however, had decided to retain a range of R&D facilities in-house and, to help fund them, contract them out (when available) to outside organizations on a commercial basis. There was a range of working practices going on under this heading, both in the type of work undertaken and for whom it was undertaken. From our survey of companies 16 reported that they did contract out their facilities on a truly commercial basis, and of those 9 reported that it was a recent development.

Contract research along these lines usually brought in only a very small amount of total company turnover. However, the profits could be used within the R&D division to enable additional exploratory research to be undertaken. The income could thus make an appreciable difference to the R&D division itself.

One of the major nationalized industries, now being run as an independent business, had opened up one of its research centres to contract research. It was thought that, in the event of the company being privatized, the research centre was highly likely to be sold off as a contract research laboratory. It was therefore moving towards working on commercial projects for outside (and internal) customers wherever possible.

*Inter-company relationships*

Some industrial companies, especially the larger ones, undertook contract research as a method of enhancing their relationships with similar companies in the same field. A number of companies commented they would undertake such work only for companies within their own industrial sector, and with which they had had prior dealings. Much 'contract' research seemed to be aimed at developing mutual advantages, helping general company relationships to grow. A number of organizations interviewed noted this relationship was extremely valuable—almost an old boys' network.

Contract research could constitute an additional 'service' for a company's main industrial customers. Occasionally this was 'master-servant' contract work but more often there was an element of mutual advantage. The industrial company could undertake development work for one of its customers, either collaboratively or cheaply under contract, in the knowledge that if the project was successful it could lead to the customer ordering new plant or processes which the company was in an ideal position to produce. A number of companies, especially in the more 'high tech' fields, had acted in this manner.

*Motivation of staff*

An additional reason for contracting out services was the motivation of the company's in-house staff. It allowed staff to work on different projects and liaise with staff from other organizations which was seen, in general, as a good thing (contacts were highly important in all aspects of industry). It was also a method of ensuring in-house staff were up with the leading technology of the sector, and could be looked

on as part of a company's technology watching brief.

*Type of work undertaken*

There were some types of work that a contracting company would not place at a commercial rival's laboratory, particularly near-market product development, or sensitive research that the company felt was too confidential to place anywhere other than, perhaps, a trusted CRO. Larger companies, with many links across a technical subject, also linked up in joint, collaborative R&D, particularly if this was useful in other aspects of company work as well. The most common form of truly commercial 'master-servant' type contract work was simple testing/facility hire whereby equipment and expertise were contracted on relatively simple terms, where (usually) few areas of contention were likely to arise.

*Extent of contract R&D done by industry*

It was difficult to be sure how widespread such contracting out of company R&D facilities had become, although our interviews suggested that it may be becoming more prevalent. However, our interviews also suggested that the majority of industrial companies did not contract out their own R&D facilities (expect in joint/collaborative ventures). One particular reason given by a number of industrial R&D managers concerned opportunity cost. Some R&D departments operated on the basis that every project should have a clear profit-increasing/cost-decreasing value to the company, worked out on the basis of, in one case, 5:1. This meant that if an R&D project undertaken in-house cost £100 000, then the company should be able to see a return for that investment of £500 000 within a specified period. If, however, that R&D laboratory were to undertake outside contract work it would only produce the slight profit element built into the contract. Therefore it was far more profitable for the company to have the R&D department working full-time on company problems than on contract work.

**(iv) Other performers of contract R&D**

***(a) The Higher Education Institutions***

*Higher Education Institutions*

As already noted Higher Education Institutions (HEIs) are now undertaking a sizeable, and growing, amount of contract research for both UK and overseas industry. The fact that contract research is being undertaken by academia is not new and indeed such contract work on a relatively small scale has been a feature of academic life in certain subjects for many years. However, over the last decade or so HEIs have been under growing financial pressures to find extra sources of funding to meet increasing costs, and an obvious one is industry. Hence what was once a minor 'distraction' is now becoming a part of academic life.

*University sector*

During the last decade, especially the early 1980s, the supply of Government monies directed towards the university sector has been tightened and a number of the newer universities (Salford, Aston and others) had funding cut severely. However, virtually all universities were affected to some extent, and from this time all have felt the need to search out new sources of funding.

Some technical universities (Salford and Aston in particular) went through major upheavals of staff cuts and reorganization. These universities turned back to their industrial past and concentrated on

producing graduates that industry required (i.e. engineering, computer technology and so on) and seeking industrial involvement in many, if not all, aspects of their research. By concentrating on this technical expertise these universities have developed as centres of excellence in technical fields of direct relevance to industry and as a result are able to offer technical services on a commercial basis.

These universities had a strong history of industrially relevant research. The majority of UK universities did not. However, they too had to look elsewhere for additional funding and hence towards industry. Most universities now have at least one university company offering out its expertise. There have been success stories amongst these companies, but there have certainly been others that may not have lived up to expectation. Our limited study of this area suggests universities 'jumped on the bandwagon' and set up companies because it appeared to be an obvious way of increasing funds. However, it was suggested that it was only those based on particular skills/departments and which already had a history of industrial involvement and relevance that were making a real contribution to university funds.

*Polytechnic sector*

Polytechnics and colleges of higher education have long had close contacts with local, and increasingly national, industry, partly as providers of technically qualified staff but also in many cases as providers of expert knowledge and facilities. They have recently entered a new phase with the setting up of the Polytechnics and Colleges Funding Council (PCFC). In many polytechnics this has allowed them to set up offshoot and subsidiary companies to exploit commercial opportunities. In the last year or so the number of such companies has increased tremendously, with many variations of company style. Some formed totally separate companies, others are linked to the polytechnics and put profits/surpluses back into central funds, some are highly specialized, based on a particular department, others are broad based, providing technical and business expertise, and yet others are information/library/ computer based services.

The PCFC has recently published a report on research in the PCFC sector which highlighted a number of polytechnics and departments that are having considerable success in attracting industrial funding. It would appear, from our limited study into this area, that the most successful polytechnics/departments, like the technical universities, are those that have built up close links, and good reputations, with industry over time. These are now in the position of being able to capitalize on these links in a more commercial manner.

*Costing of contracts*

The costing of R&D contracts undertaken in HEIs (and particularly in the universities) is highly contentious, and one which cannot be entered into in detail in this report. However, universities in particular have in the past been looked on as being cheap sources of strategic, if not applied, research. The need to increase revenue from industrial contracts has meant that the HEI sector is having to attempt to work out the full costs of a contract (including full overheads), to ensure profitability. A recent report by SEPSU (*The Structure of Research Expenditure*) highlighted the difficulties involved in this exercise and suggested that the overhead element of many research contracts (be

they industrial, EEC, or governmental contracts) were not being fully met in the university sector. HEIs have in recent years raised charges for contracted work but, apparently, still not to the true costs (which a CRO would have to meet). HEIs have a choice whether to undertake work as a contract or collaboration, whether to charge at cost price, make a profit or even a loss depending on the work undertaken. Some universities have strict budgetary guidelines and standard contracts which take note of IPR rights, royalties and so on. There is no doubt that many universities are waking up to the complexities of entering into industrial contracts and some are well up the learning curve. However, as CRO managers point out, if HEIs are seriously entering the contract research business they have to learn to act as businesses, work to full costs, be prepared to fail in the face of competition, and should not be kept going in the face of bankruptcy.

*Science and business parks*

Following the success of the Cambridge Science Park a great many HEIs have developed science and business parks in close proximity to their campuses. These are often high quality, with pleasant surroundings and good facilities. The parks undoubtedly bring in revenue—they are good property development deals for the HEI (and the developer), but how much additional revenue, and enhancement of reputation, they generate, above basic rents, is difficult to quantify. Some of the companies sited on the parks, however, do have strong links with the parent HEIs, with some being started by entrepreneurial academics.

*Competition*

As more HEIs move into commercial R&D contracting, there will inevitably be increased competition. However, as many CRO managers pointed out, the HEI sector simply does not have the industrial experience or expertise to challenge the main work of a CRO. However, the smaller CROs in particular did show signs of keeping a watchful eye on HEI companies, particularly those offering technical facilities rather than industrial R&D development. Any threat to a small turnover is serious and, if an HEI offers a similar service, and possibly cheaper if full costs are not being charged, then cries of unfair competition are likely to be heard. In addition, some HEIs are already in competition with the established CRO where there may only be a few organizations/departments with the relevant expertise or equipment to undertake particular types of work. Over time, as HEIs develop industrial expertise, then competition in these areas is likely to increase also.

*The future of HEIs as CROs*

There is no doubt that all HEIs will continue to look towards industry for revenue, and after the experience of the 1980s HEIs have the ability to look at individual successes and failures and decide on a more targetted approach related to the expertise of particular institutions. There will no doubt be some institutions with industrial expertise that will flourish, but some may consider that the teaching/training role may be more suited to their expertise. The successful HEIs in this respect have been those that have developed a commercial slant to an area that they have been good at, have a reputation for and for which there is a market.

As already noted many of the R&D managers interviewed expressed worries that the move towards industry for (in the main) solutions to

short-term financial problems could lead to a shift in the HEI sector away from the academic towards the industrial. There were fears that the emphasis of HEIs was moving now too far towards industry and that many were in danger of suppressing the fundamental basics of curiosity driven research in the desire to increase revenue. Just how far this was happening (if at all) was not known.

### (b) *Research Council Institutes*

As noted in Chapter 3, the UK Research Councils earn in the order of £100 M p.a. from external research contracts. Along with the universities and polytechnics, these institutes have been under pressure to increase revenue from external sources, such as industry and government departments. Some of the research council institutes have had considerable success in both attracting contracts from industry and reaping profit from their own work. Part of this is the industrial use of unique facilities found nowhere else in the UK, but much else is of a research and development nature using the expertise of the particular institutes and units. These trends are expected to continue.

### (c) *Government laboratories*

As noted in chapter 3 Government laboratories undertook some £60 M of industrial contract work in 1988, the vast majority being undertaken in MOD laboratories.

The UK Government's strive for efficiency and profitability has altered the way many of the government laboratories now work, particularly with the introduction of the agency status (see also chapter III, section vi). While all still dominantly work on topics that are deemed useful for the UK as a whole and are funded by public funds, these organizations, like the HEIs and Research Council institutes, have come under considerable financial pressures. They too have therefore been looking at ways of increasing industrial involvement, under contract and collaboratively, and the introduction of agency status has allowed them some manoeuvrability to provide research services. It will be interesting to watch the future development of R&D related agencies—is agency status, at least for some, the first step to privatization?

It is not suggested that these laboratories are, as yet, making major inroads into the contract research market, but they are undoubtedly testing the market and assessing ways to increase industrial funding in the future.

## CHAPTER V: THE INDUSTRIAL CUSTOMERS FOR CONTRACT R&D

### (i) Outline

In chapter IV we discussed the main performers of contract R&D in the UK. In this chapter we take a look at the customers for such R&D—why contract, when and to where?

### (ii) Survey

*Types of customers*

In the UK contract research market there are three broad categories of customer. These are UK industry (including those multinational organizations that have a substantial presence, including R&D facilities, in the UK); the UK Government, both in the guise of direct contracts and in the 'support of UK R&D contracts' specially organized by the DTI in an attempt to stimulate cooperation and investment by industry; and overseas organizations, both governmental and industrial.

*Questionnaire survey*

The data presented in this chapter are derived from the questionnaire survey carried out on our behalf by the CBI (see chapter II). They therefore concern only the first of the above categories of customer for contract R&D—UK industry.

### (iii) Company profiles

*Turnover*

Of the companies responding to our questionnaire, 55% had UK turnovers of less than £25 M, and 46% had world turnovers of less than £25 M. The sample thus included a sizeable proportion of small companies, many of which had a turnover of less than £10 M. 15% of the respondents had UK turnovers of between £25 M and £100 M, 17% had UK turnovers of £100 M—£500 M and 12% had UK turnovers of in excess of £500 M. 16% of the respondents had world turnovers of more than £1 billion.

*R&D facilities*

The questionnaire asked how many companies had access to company R&D facilities in the UK or overseas (Figure 5.1). Of the 138 respondents, 97 (70%) had access to some sort of facilities in the UK, and of these 33 also had access to overseas facilities. Of the remaining 41 that had no UK facilities 7 had access to overseas company R&D facilities.

Of the 97 companies with UK R&D facilities, 78 (80%) were members of Research Association (RA) or other research/information clubs. Of the 41 organizations without UK based R&D facilities, 20 (49%) were members of Research Associations or other information/research clubs. In total 98 (71%) of all respondents were members of at least one RA or information/research club.

The majority of companies which replied thus had some form of R&D laboratory available for company development. The in-house company R&D facilities varied from simple quality assurance testing of production lines to fully dedicated laboratories. In addition, half of those that did not have R&D facilities were involved in some form of research association or club.

Figure 5.1 Access to company R&D facilities

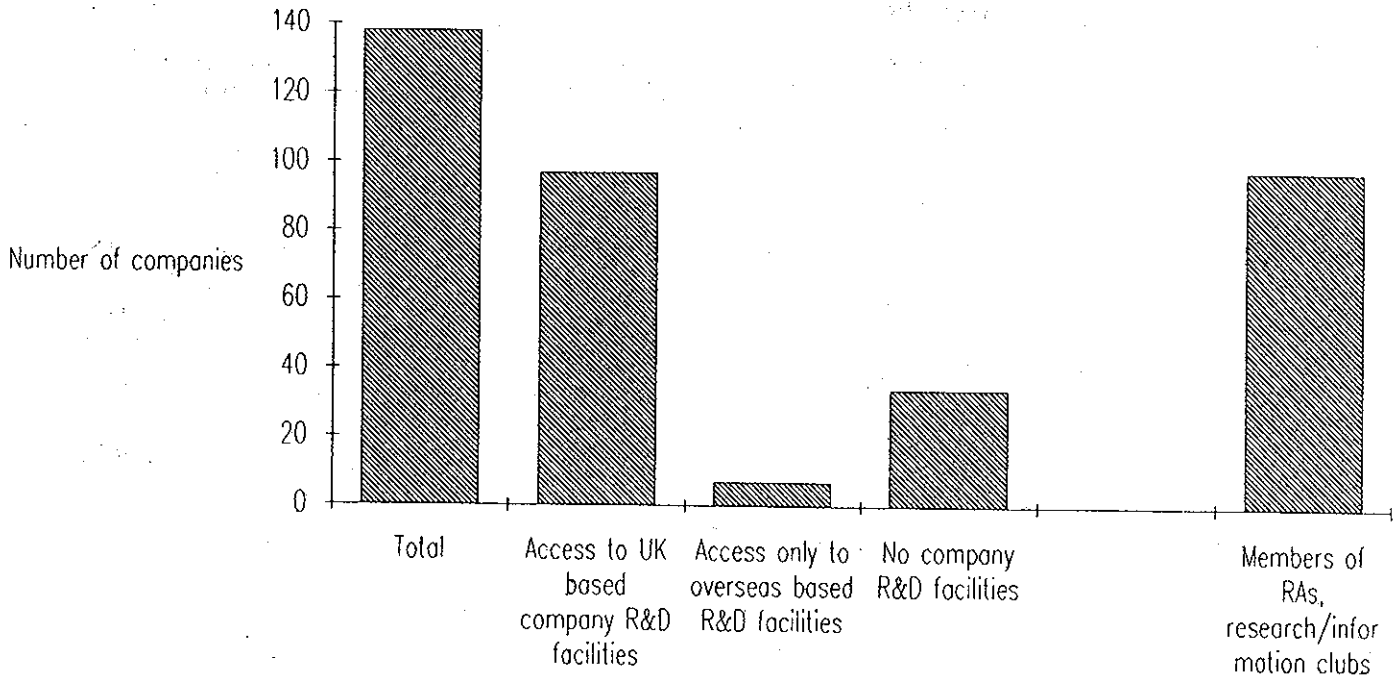
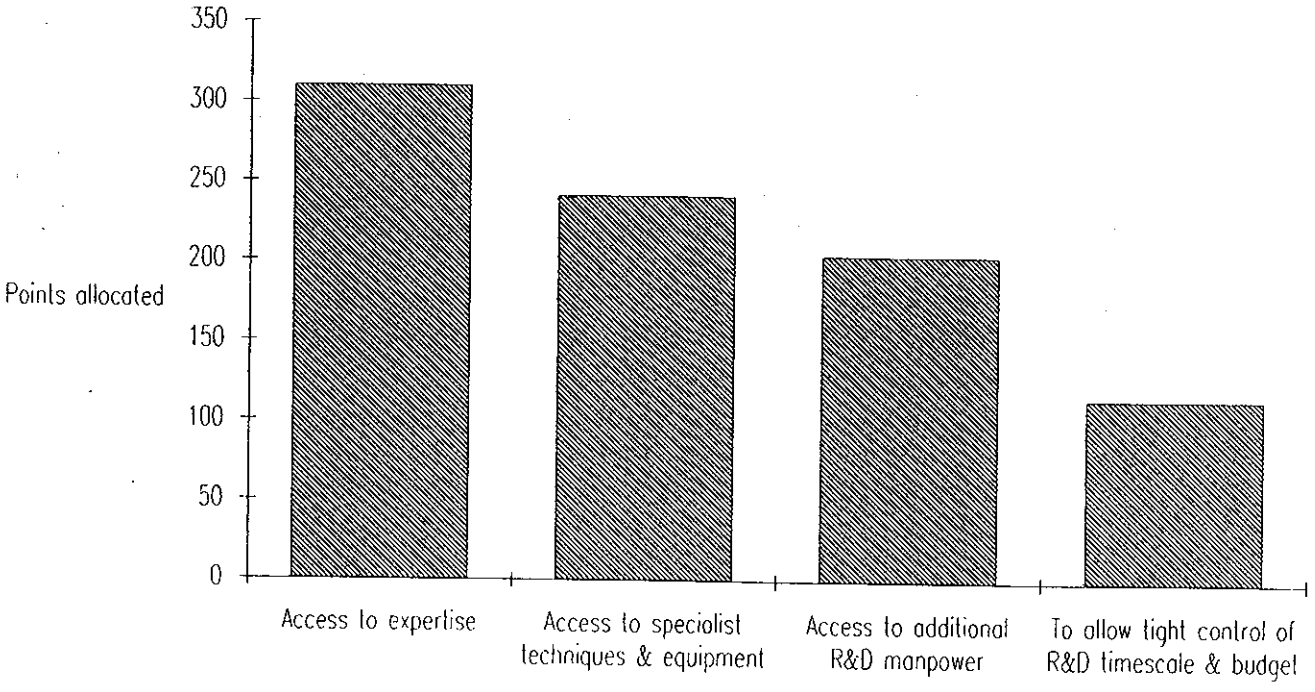



Figure 5.2 Reasons for contracting out R&D



*External R&D*

63 (53%) of companies spent less than 10% of their total R&D budgets on contracted and collaborative research combined; 16 (13%) spent 10%-20%, and 11 (9%) spent 20%-30%. Companies spending more than 30% on contracted or collaborative R&D tended to be those that had no direct access to company-owned R&D facilities.

**(iv) Why contract out R&D?**

*Questionnaire survey*

Our questionnaire suggested four broad reasons why an industrial company might contract out R&D work. By using a points system (1st place 4 points, 2nd 3, 3rd 2, 4th 1 we ranked the replies as shown in Figure 5.2.

*Expertise/ equipment*

By far the most frequently stated motive for contracting out R&D was to gain access to specialist expertise. This usually went hand in hand with the second motive, access to specialist techniques/equipment. For occasional or exploratory work requiring sophisticated, expensive equipment, companies found it more economical to go to the specialized CROs or HEI departments in possession of the equipment than to acquire it themselves. In addition some companies required routine testing on a weekly or monthly basis. If the volume of testing did not justify the purchase of equipment (or there was a commercial need for 'independent testing'), the companies would contract it out, to a testing house or a CRO. Some companies were pleased with the service they received but a number of others grumbled at the time taken, quality and cost, and were considering investing in equipment and supplying testing services themselves, both to fulfil their own needs and possibly on a contract basis for other companies.

*Manpower*

The motive of gaining additional R&D manpower, although less significant than access to expertise or equipment, was important for some respondents. This was especially true in two types of companies. In smaller companies there was occasionally a need for additional personnel, laboratory space and equipment to develop or test a product. Often companies needed to be able to increase their workforce, to meet a customer's deadline or rapidly develop a product. Work was contracted for reasons of speed and efficiency—'to get the job done'. This applied to all sizes of company but was particularly important in the smaller ones. Other companies required a large amount of long-term testing/trials. Some companies were geared to undertaking this type of work in-house, but in many organizations (because of the amount of such work) it was contracted out, to UK CROs but also overseas. Such long-term projects required a dedicated laboratory and personnel, which might not be the type of laboratory or scientists the company required in-house to develop its products. Some companies deliberately cut back on this type of laboratory in the early 1980s (deciding to put all long-term testing out to testing houses) and concentrated their R&D resources on developing new products. Partly as a result of this, there had been a marked increase in the price of long-term testing, both in the UK and overseas, especially in toxicology and clinical trials. Often it was the ability to undertake work immediately that industry found most useful, especially as product life in many sectors was steadily falling. Speed and time were more important than cost.

*Relationships with CROs*

In interviews, respondents stressed the importance of establishing and nurturing good relationships between themselves and CROs. The industrial customers needed to be able to get their work done, and if an organization had worked well for/with them and provided a generally satisfactory service they were inclined to repeat their business. On its part, the CRO was keen to build such relationships, partly simply to gain business, but also because, by building up a relationship, it could serve the customer better and hence gain more work. Both organizations therefore had incentives to build such relationships, to their mutual benefit.

*Budgetary control*

Budgetary control was not seen as a significant motive for contracting out R&D: where control was important, the work was more likely to be carried out in-house.

*Contracting out vs collaboration*

119 respondents gave data on the percentage of their overall R&D budgets spent on contracted and collaborative R&D projects. 53 (45%) spent a higher percentage of their budgets on contracted work than on collaborative work, 30 (25%) spent about equal amounts and 36 (30%) spent more on collaborative than contracted work.

In interviews we asked the question why contract, collaborate or undertake R&D in-house? Although this is expanded in the next section, there were a number of views which should be noted here. A few large organizations had a policy of not contracting R&D out at all (although they did undertake considerable strategic collaborative R&D with HEIs and similar organizations). Such organizations had major R&D facilities of their own, often with a core R&D centre undertaking research which was subsequently developed in company divisions. Other organizations, at the other end of the scale, contracted out all their R&D requirements. The predominant reason for this was the companies were invariably too small to run an R&D facility, and most could not justify the expenditure. However, this was also the case where a company was a member of a relevant Research Association/ CRO which undertook both core research and contract work of relevance. In such cases even though a company could see a justification for having an R&D facility they were content to use the experience and facilities of the CRO as and when, and under contract or collaboratively depending on the work required. It also meant that they, of course, did not need to run a laboratory which they might not use to the full.

The main difference noted between the type of work contracted and that which was collaborated on was the potential commercial value of the work, and, to a lesser extent the cost of the project. Most companies noted that work of a strategic nature, of relevance but possibly in the mid rather than short term, was often worked on collaboratively, either with a small number of interested partners or as part of an organized club. At this stage the work, although promising, might or might not be profitable, and such collaborations were a method of being involved in emerging technologies and keeping a watching brief on rival companies without risking considerable finance.

However, if a company required a particular product to be developed quickly and could see commercial gain, then it was often noted that this work would be undertaken in-house in the first instance, and if that was

not possible, work would be contracted to a trusted CRO. In such circumstance there was a need for commercial confidentiality and speed.

However, there were a few examples where large scale R&D projects had been undertaken collaboratively, although here the aim of the project was to produce results of direct commercial value for the partners. In such cases it was usually the case that the R&D effort was too large for one company, so the only way to achieve such gains was by collaboration. There could be considerable problems ensuring all partners were happy with the financial outcome of the project, IPR, who did what part of the work, and who decided on the detailed agenda, but these problems could be overcome with patience.

*Use of the results*

How the results of contract research were used depended on their nature. Much of the product and process development performed under contract was of direct relevance to companies' production processes and would be incorporated accordingly. Work of a more strategic nature was usually fed into on-going in-house projects, whether it be testing of a potential new product/material or something of a broader nature. In these circumstances close liaison between the technical experts of the CRO and the customer was required if both teams were actively to work towards a desired goal. Without close cooperation and understanding of the nature of the project/problem being tackled, there was a risk of wasted effort and misunderstanding. Both the CRO and the industrial R&D managers stressed that considerable effort was put in to attending meetings, reading reports and so on, to ensure there were minimal misunderstandings.

Truly strategic work, undertaken in HEIs, CROs etc is a way for a company to keep a watching brief over potentially promising areas relatively cheaply. This might entail sponsoring research students (often collaboratively) to look into emerging or novel areas of science, which could be followed up as appropriate. This may mean additional sponsored work within an HEI or investigating further in-house. If an area looked promising, a company might follow up with work in-house and also contract/collaborate with other bodies to assess different approaches.

**(v) What is contracted out, and to whom?**

*Trouble shooting*

Industrial customers often used CROs for trouble shooting, for example when they had problems with their basic process/production plant. If production was down, or not to standard, the company was losing money and hence any faults needed to be rectified quickly and efficiently. A number of companies reported they had built up a close working relationship with particular CROs over a number of years, who, because of their customer knowledge, were able to trouble shoot very effectively. This quick response mode of CROs was often mentioned as one of their attributes, and it was also one of the failures of a particular CRO in the eyes of dissatisfied customer who did not get the service he required.

*Production processes*

Related to this quick response mode was the on-line development of production processes. Again, as the CRO often knew the customer's processes and products, it was well suited to refining processes to

increase production or the quality of products. This work was often on a small scale, but helped maintain the relationship. This type of 'process refining' might be initiated by the CRO or by the customer.

CROs were also used to assess, and suggest, potential new developments or innovations, which might be introduced from other industrial sectors. Such work was often in conjunction with the customer's in-house R&D department. Sometimes this was of a technical nature, or it might involve assessing the cost-benefit of a particular technology for a company or its market impact.

*Product design*

Industrial customers increasingly used CROs for product design/development. This often related to the expertise in the CRO, such as CADCAM design, or new materials. Again work might be of a purely technical nature or it might involve more process/general company related consultancy.

*Strategic work*

Strategic work, either under contract or on a collaborative basis, usually related to work going on in-house. Such work was usually not so sensitive as to be commercially vulnerable and hence could be undertaken on a collaborative basis. In many cases companies were members of 'clubs', often organized by CROs, both to undertake research in conjunction with their in-house departments, and to make contacts and keep a watching brief on developments in fields possibly not directly related to their own. This often included contact with experts in HEIs.

Strategic work central to a company's main business was coordinated in-house. Often researchers undertook work in-house and placed work outside to gain new slants to problems. Some work was placed purely for the use of technical equipment, the results of which were fed into the in-house projects. Some companies drew up specifications for particular projects and circulated them on a tender basis to a number of CROs or similar bodies. This both got work done cost effectively and gave the customer a certain amount of 'free' ideas about how the required results could be achieved that it might not have thought of previously.

*Basic research*

Truly basic research is rarely undertaken by industrial companies. Certainly all but the very largest companies reported that all their research activities had some long-term strategic potential. Even those large organizations who could point to some research projects with no obvious benefits reported these were only a very small portion of their total effort and any true blue sky research was the domain of a few researchers who had proved their inventiveness in their fields. In addition these researchers generally had close links with HEIs and their research was often linked with outside research projects.

*Management consultancy*

Some industrial companies actively sought CROs who had both a technical or a management consultancy service. They believed such CROs were well placed to be informed of developing technology and particular market niches.

*Types of body to which R&D is contracted out*

We asked about the distribution of contract expenditure between universities, CROs, government laboratories and other manufacturing industries. 74 respondents provided data for both 1983 and 1988, allowing an assessment of changes between these two dates. Of

these 74 respondents, 15 reported that in 1988 they were spending a bigger percentage of their total expenditure on contract R&D with universities than in 1983, while an equal number reported that they were using universities less. 12 companies reported that they were using CROs less than five years ago, while 16 reported that they were using these organizations more. Only 1 company reported that it was using government laboratories more, while 7 reported that they were using them less. 2 companies reported they were using other companies' facilities less than they were in 1983, and 5 reported they were using them more.

*Research Associations*

In some sectors there were strong research associations to which most, if not all, the sector companies belonged. Typically a relatively small number of companies paid a large percentage of the total membership fees, and therefore had considerable say in the type of work undertaken. Although these organizations were collaborating by pooling monetary sources, they suggested they used the CRO almost as a joint R&D unit. There was an element of 'since we pay so much each year we get what we can and want out of the organization'. Therefore work that potentially could be done in-house, or contracted out, was automatically placed to the RA. The companies, of course, still had their own R&D labs in which confidential research could be undertaken if commercially vulnerable. However, the close association of the companies brought about under this arrangement was, on the whole, viewed positively.

However, at least some of the companies involved were aware of how 'incestuous' the relationship could become and were looking for other organizations to work with to broaden their outlook.

**(vi) Links with HEIs**

Virtually all the industrial customers interviewed had some form of link with HEIs in the UK. These links served a variety of purposes.

*Providers of qualified manpower*

A number of companies held strong views on the role of universities (and HEIs in general) in providing educated, trained manpower. One view, strongly expressed, was that there was a divergence between what universities thought industry wanted (if universities addressed such a question at all) and what industry thought universities should be providing. Some universities were now tailoring courses to produce a particular style of graduate for a particular industrial sector. The universities and companies involved seemed happy with this arrangement, with the university gaining financially as well as developing close contacts with industrial partners. The companies often encouraged graduates to join them (sometimes by direct sponsorship), in the full knowledge of what the graduate had learnt, and what training was subsequently needed in-house.

However, this was countered by a number of managers (not involved in such course design) who expressed the opinion that these graduates, once outside their particular specialization, needed considerable retraining (occasionally including the basics) in general science and engineering. Indeed this was at the heart of a great many comments of the industrial customers—in many interviews it was stated that HEIs should be teaching students the basics of particular

science or engineering disciplines, plus the ability to apply scientific methodology to a problem. If there was a need for industry to train the graduates into particular specializations, industry on the whole appeared to be happy to do this—what it did not want to do was retrain graduates in the basics of a scientific discipline. This was spelt out by one industrialist who reported that some HEIs tried to incorporate the latest industrial techniques into courses to give them an industrial slant. Unfortunately by the time the graduate actually got into industry these latest concepts had been superseded, leaving the graduate out of date and occasionally without the basic background knowledge to be able to understand the new emerging technology.

A number of companies also reported a need for HEIs to gear themselves more to the retraining needs of industry. Technological innovation was expanding, and often companies were diversifying a such a rate that there was the real possibility that a manager might be out of touch with the concepts his department was working on. Some companies were holding talks with various HEIs to produce training/updating courses for these types of employees (say 30-40 age group). Individual managers noted, however, they were having difficulty in finding the right academics in the right environment able and willing to help them.

*Providers of sophisticated equipment/ techniques*

HEIs have always been used to a certain extent by industry as providers of sophisticated equipment and techniques. Often, because of costs, HEIs, along with the government laboratories, were the only place where such equipment was located in the UK. This was usually because industry could not justify the costs involved. This also meant that the HEI staff were among the few experts in the UK who could fully utilize such equipment and interpret the data produced. Hence, along with their technical expertise, industry also contracted HEI experts to incorporate the data they produced into the ongoing project. Often such work was of a strategic nature, and such contract/collaborative approaches appeared to work well.

Many HEIs now offered expertise on a contract basis, in competition with the testing houses and CROs. Most industrial customers who had had dealings with HEIs reported that most of their dealings had been with individual academics with whom they had worked before and trusted, or with individuals recommended by them. The work placed was not (usually) commercially vulnerable, nor urgently required. Most R&D managers were of the impression that the HEIs were good for the strategic, new ideas/suggestions work, but not for commercially sensitive material. If such work was required and could not be undertaken in-house, then virtually all managers reported they would place the work at an established CRO rather than an HEI.

*Providers of a network of experts*

The academic network of experts was seen to be of great potential benefit both to individual companies and to the country as a whole. Every R&D manager interviewed reported that the universities were where much of the truly innovative research was undertaken and that it was their job as R&D managers to tap into this (cf the CRO managers). All spent considerable amounts of time and effort forging links with universities and HEIs in general, through a variety of methods. However, most also reported that they spent nowhere near

as much time as they would like developing these links, since they had businesses to run.

*Threat to basic research in HEIs*

As noted above (page 34, 39) many managers (both industrial customers and CRO managers) expressed concern that the network of experts was changing, because of the need for HEIs (particularly in the university sector) to earn additional income. They believed there was a need for an industrial input into the HEI sector, but there was a fear that the balance had moved too far in industry's direction. In addition to the possibility that this could lead to a curtailing of blue sky research, some expressed concern that the way scientific methodology was applied to problems in the academic sector was also changing. An academic's approach to problem solving was different to industry's often short-term solution-seeking approach, and R&D managers would not like to see this difference eroded—they wanted academics to maintain the academic approach. Diminution of basic research in HEIs would reduce the flow of original ideas that could in time lead to industrial exploitation. Managers were concerned to see where the balance would be struck.

**(vii) Trends in volume of work contracted out**

*Increase in contracted R&D*

Industrial customers were asked whether they were commissioning 'more', 'less' or 'about the same amount' of contract research as 5 years ago. Of the 121 responses, 49 (40%) stated they were commissioning more contract research than 5 years ago, 65 (54%) were commissioning the same amount, and only seven (6%) were commissioning less, as shown in Figure 5.3. These results imply that the contract research market is growing in the UK.

Some of the reasons for this apparent increase in the use of contract research emerged during our interviews.

*Rationalization of in-house R&D facilities*

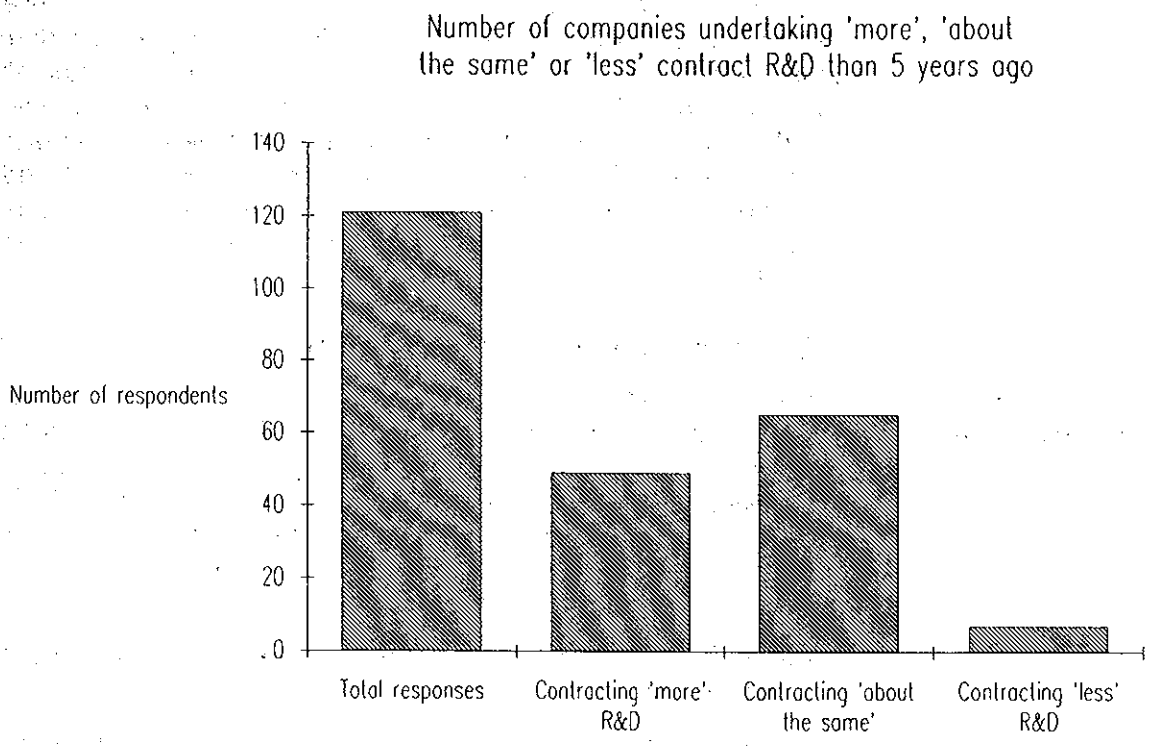
Many companies during the late 1970s and early 1980s reorganized their R&D facilities in a drive for greater economy and efficiency. Some laboratories were shut, others were rationalized. Some companies curtailed particular areas of R&D, while retaining the basic R&D function central to company business, with additional work being undertaken outside on a contract basis when required. This did not necessarily mean a reduction in total R&D expenditure, but it did mean curtailing the breadth of in-house R&D. This line of reasoning was still prevalent. Many companies could not afford to be in-house experts in all the areas of technology they required to develop their business fully. They had therefore been defining the areas of R&D essential for in-house development, and shedding other areas where they did not need equipment/facilities on a full-time basis, on the understanding that where necessary work could be contracted out. This was particularly the case when there was a need for considerable amounts of long-term testing, such as in the pharmaceutical industry. Some companies deliberately closed their own, often large-scale testing facilities and decided that they would contract out work when required. This meant that the company could concentrate its R&D resources on developing new products, and contract out other work to the most effective and efficient contract organization.

*New technologies*

In recent years there has been a vast increase in new technologies

affecting industrial companies. How does a company cope with being master of all these new technologies, which it may need for production, but could not afford to develop on its own? Many companies had identified particular speciality areas and contracted in experts (or bought in to clubs and other collaborative ventures) to help develop such areas. This was particularly true when a company involved itself in a new area outside its traditional technical capabilities.

Figure 5.3




R&D clubs and joint ventures provided a cost-effective way of exploring a new area, without major long-term investment, before the technology and its applications to the core business had been proven. Once the company had built up a knowledge base, it could decide whether to move into the area by setting up its own in-house facilities, or to continue on a collaborative basis, or to pull out of the area entirely if it became clear that the new area was not as useful as it initially looked.

In addition to the increasing numbers of new technologies, a number of R&D managers reported that as their companies had expanded in recent years they had come into contact with areas of existing technology that previously the company would not have been involved in. A good example of this was a food and drink conglomerate that had diversified into high street restaurants. The R&D manager realized that his company was responsible for £2 billion of buildings, and that no one in the company was expert in the technology of the construction industry. Initially he called in a small university-based building consultancy, which showed considerable savings could be made. Following from this he set up his own small construction R&D team,

which was said to be saving the company considerable sums of money.

*Demand for higher quality*

Another reason for the increasing amount of contract work was reported both by CROs and by a number of their industrial customers. As the UK economy had developed there had been demand for higher quality goods and services. To meet this demand companies had been designing products to higher standards, with better materials, and had required rigorous testing of them along the way. Therefore the use of CROs had increased both because of the general increase in higher quality products and the technology required to develop them, and also from the testing/quality control aspects of their work. The increase in quality, particularly of services, had also affected the CROs, prompting them to offer more professional services.

*Overseas markets*

More recently the move towards a Single European Market had opened the eyes of many industrial managers to wider markets and how to get into them. One essential aspect was to ensure that the standards required by the target countries for the products were at least met if not exceeded. Industrial R&D managers saw that this required testing to high the standards required for the product development in the UK, but also reported that the easiest way of getting around any local restriction was to have their products, where possible, tested in the local test centres, thus generating an increase in overseas work. Although R&D managers recognized that the Single European Market should enable the product to be tested in one Member State only and then sold throughout the Community, they did not believe that this would actually happen (at least on an industrial time scale required to ensure profitability) for a considerable time to come. Therefore, if by having the product tested in the local country it enabled a product to be quickly launched, they would continue to send products for testing.

**(viii) Transnational contracting of R&D**

*Geographical distribution of contracted R&D*

We asked industrial customers where contracted work was carried out, i.e. in the UK or overseas. Of the 112 responses to the question, 87 (78%) reported that over 90% of their expenditure on contracted work was spent in the UK (75 (66%) gave the figure of 100% spent in the UK). A further 21 (19%) reported they spent 70%-90% of their contracted expenditure in the UK.

24 (21%) of the companies placed some work in the EC countries, ranging widely from 1% to 75% of total contracted work. Only two companies in our sample placed work in non-EC European countries. 15 (13%) of the companies placed work in the USA, again amounts varying widely, and only 7 (6%) placed work elsewhere in the world.

It is clear from our survey that the majority of contracted R&D was placed at UK-based CROs. UK companies were more likely to place work at a UK CRO because they were, in general, perceived to be of a high standard of technical competence. In addition it was easier to build up a close working relationship with a company within easy reach rather than a considerable distance away. However, there would appear to be some movement away from automatically placing work in the UK, without looking further afield. This appears to have been

brought about partly as a result of improved communications in recent years, and partly from a greater awareness of overseas markets and facilities, stimulated by the moves towards the Single European Market. Company R&D managers reported that they would be open to overseas CROs that could technically and economically compete with the UK CROs, and would also be actively seeking them for certain amounts of 'in-country' expertise that would enable a company to achieve greater penetration into a new export market.

*Involvement in European initiatives*

Of the 138 respondents to our questionnaire, 20 had been involved in one or more EC R&D initiatives in the last five years (Figure 5.4). 6 reported that involvement in the schemes had led to a noticeable economic benefit to their organizations or industry in general, and 13 that it was too soon to evaluate the schemes. Only one organization stated that involvement in a particular scheme had not led to economic benefit. Furthermore, of the 20, 19 stated that involvement in the schemes had led to enhanced contact with their European partners, and only one stated it had not.

Six of the organizations involved in EC schemes also had some involvement with pan-European R&D initiatives, such as EUREKA or COST. A further three organizations had involvement with the pan-European schemes but not the EC ones. Of the nine organizations involved in the pan-European schemes, eight stated it was too soon to evaluate potential economic benefit from the involvement and one organization, involved in more than one project, reported both yes and no to this question. In addition seven reported that involvement had led to enhanced contact with their European partners (the other two gave no answer to the question).

Industrial R&D managers drew attention to 'red tape' involved in EC schemes, and to the time taken to organize projects. All who had been involved commented that the projects had taken considerable effort to set up, and had suffered long delays whilst the partners were organized and consulted, and then further delays while the project was assessed by the Commission. It was felt that in general only the larger companies could stand such delays and additional costs.

However, once involved, most companies had gained enhanced contact with the partner organizations within the Community, and, as seen from the questionnaires, a number thought that involvement had led to economic benefit either for themselves or for industry in general.

Many of the companies we visited had no central method of collecting information concerning EC schemes and projects, and information was often gained from the DTI, from journal articles or similar. However, a number of organizations (particularly the larger ones) reported they had personnel dedicated to collecting and assessing information from the EC, covering all aspects of the Single European Market, EC schemes, policy and monetary data.

*Non-UK EC nationals employed on R&D staff*

We asked what proportion of a company's R&D staff were non-UK EC nationals, and how this had changed over the last five years (Figure 5.5). Of 102 companies that gave some answer (either numbers or 'same', 'increased' or 'decreased'), the vast majority had few non-UK EC staff. 80 (78%) companies reported they had no non-UK EC nationals. Of the

Figure 5.4

UK industrial involvement in EC R&D programmes
(total respondent number 138)

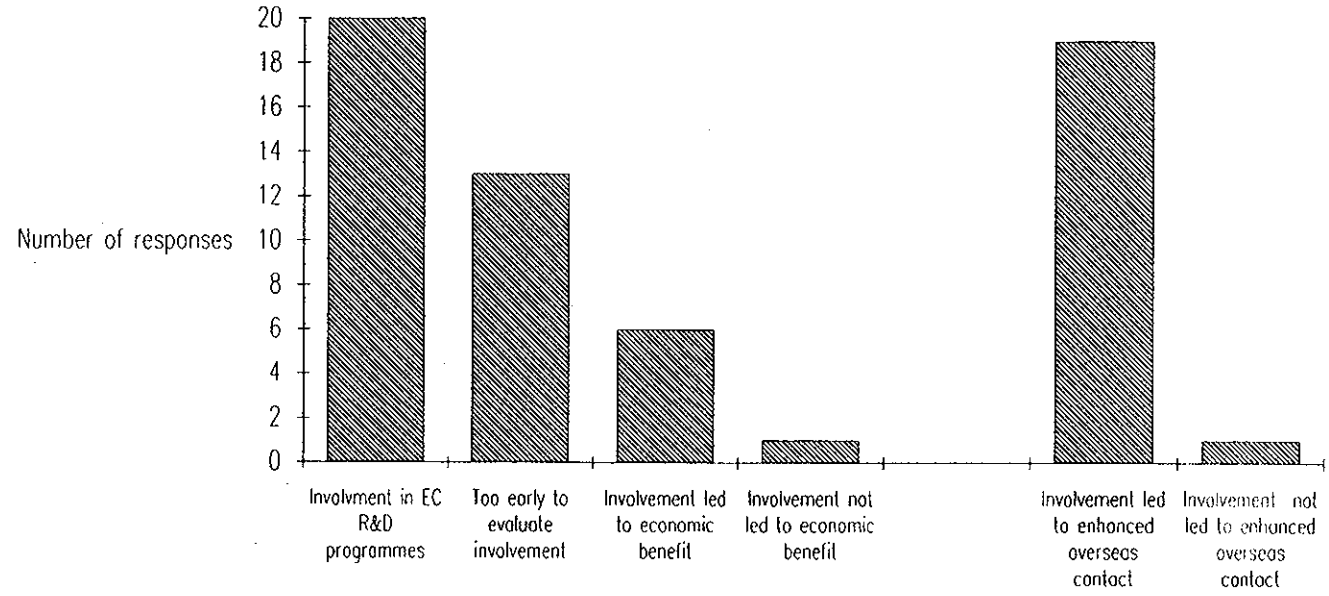
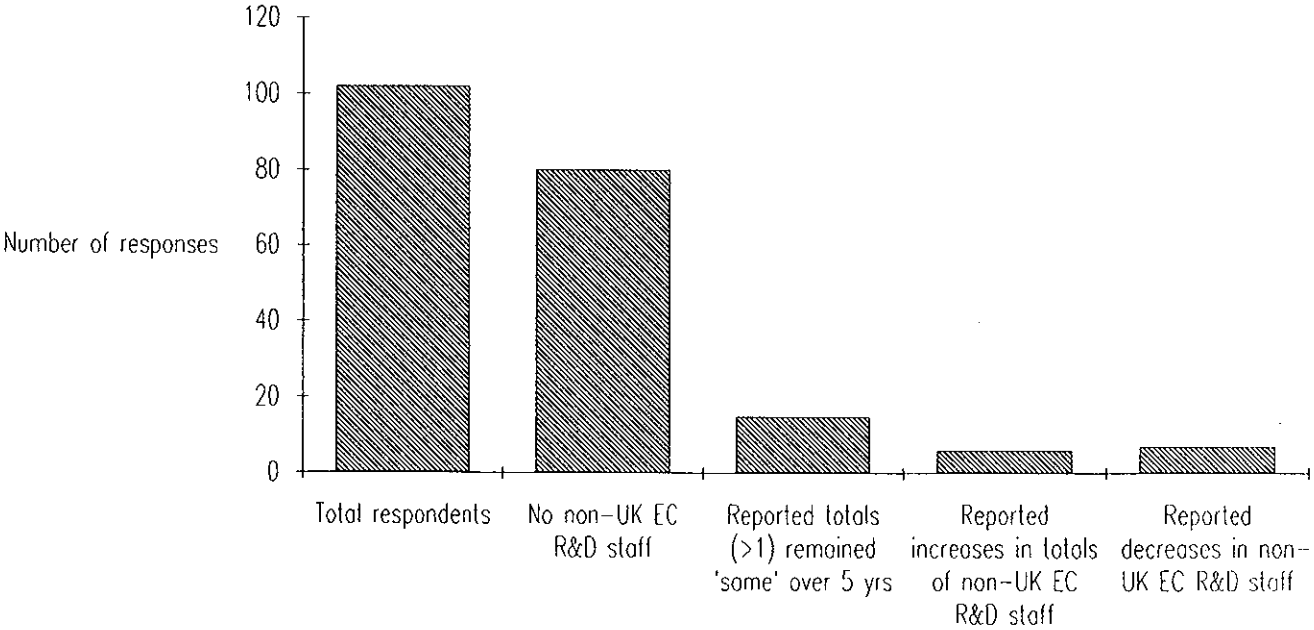



Figure 5.5

Non-UK EC R&D staff employed by industry



60 (59%) respondents that employed the 'same' number of non-UK EC nationals in 1988 as in 1983, 45 employed none in either year. In addition to these 60 companies, a further six reported an increase in the number of non-UK EC staff, and seven reported a decrease. There were 13 companies that gave percentage numbers of staff other than zero: one company reported that 15% of its R&D staff were non-UK EC nationals, while the other twelve reported up to 5% each.

It is clear that there are few non-UK EC nationals on the R&D staffs of industrial companies in the UK at present. However in interviews, the majority of companies (both customers and CROs) expressed the expectation that as the whole process of Europeanization developed in the coming years there would be an increase in the number of non-UK EC staff employed in all aspects of company life. To some extent such staff were currently concentrated in the areas where profits were to be made, e.g. the sales force, as agents who knew and understood the foreign markets. Some of the major companies, faced with a shortage of graduate recruitment in the UK, were actively recruiting in continental universities and colleges of higher education. This would enhance integration of the European workforce.

*1992 and contract research*

Most organizations did not see their attitude to contract research changing because of the Single European Market—they would still go to the organizations they believed could do the work. A few noted that in particular fields this already meant going overseas, and such a policy would be continued. However, similarly to European staff, most R&D managers did see there was a distinct possibility that as their organizations became more international/European there would be a general move to use overseas organizations, including overseas CROs.

Some managers thought that the SEM might lead to increased use of CROs particularly in the standards and quality assurance fields, both in the UK, but also overseas if it were more prudent to comply with the local standards in addition to any UK or more general standards. Some R&D managers were also conscious of the increasing importance of EC-wide standards, and were actively involved in the setting of these standards, either through CROs, some of which were acting as UK representatives, or more generally through trade representations to the British Standards Institution.

Many R&D managers felt that the UK Government was not giving as much support to industry as other European Community governments were, particularly in support of industrial technology.

## CHAPTER VI: INTERNATIONAL COMPARISONS

### (i) Outline

In this chapter we briefly examine the standing of UK CROs within the European Community. We attempted no data collection of our own outside the UK, but frequently discussed the European Community dimension in interviews. Data given below are from the Bossard Report (1989).

### (ii) The Bossard Report

*Contract R&D in the Community*

The Bossard report (1989) on the contract R&D market in the European Community found that 863 MECU of contract R&D was performed in 1987/8. 97% of this total was divided between five countries—France, Germany, Italy, the Netherlands and the UK. The UK share of the total was 28% (approximately £160M).

*Basic data*

Table 6.1 shows the basic Bossard data. Care must be taken when using these data (there are internal inconsistencies in the report) and one requires some background information before drawing any conclusions. For example, the table shows Germany and the UK having approximately equal numbers of CROs (39 & 38 respectively). However, AIRTO itself has 45 members, and there are a number of other UK CROs that are not members of AIRTO. Hence the Bossard data do not include all CROs in the UK, nor probably other Member States.

Moreover, of the 38 German CROs, 20 are institutes of the Fraunhofer Gessellschaft. Of the 3 CRO organizations reported in the Netherlands (total contracts 140.1 MECU) TNO dominates (total contracts 125 MECU) the other two. This is similar to the Fraunhofer Gessellschaft. Both these large organizations receive considerable amounts of public funding for technology innovation, far more than their UK counterpart CROs. The only organization of similar scale in the UK is AEA Technology, which was not included in the Bossard study.

*Public vs private funding of contract R&D*

Table 6.1 also shows the proportion of income derived from the public and private sectors in each country. In Germany the CROs identified by Bossard derived 60% of their revenue from public funds, while the Netherlands was even higher at 76%, with Italy at 41%. France and the UK were funded 27% and 25% respectively by the public purse. This reflects the differing types of organizational funding between the countries and the wide range of organizational structure represented in the table. It also represents the degree of interventionism practised by the respective Governments—with the UK Government playing a relatively non-interventionist role.

*Sources of contract R&D funding*

Figure 6.2 shows the proportion of R&D contract income derived from domestic, EC and non-EC sources. Of the big 5 countries the UK was the only country to derive over 20% of funding from non-domestic sources (in fact, it received 38.5% from non-domestic sources). This confirms the international standing of UK CROs, and illustrates well the level of contracts UK CROs undertake for overseas organizations.

*UK fears*

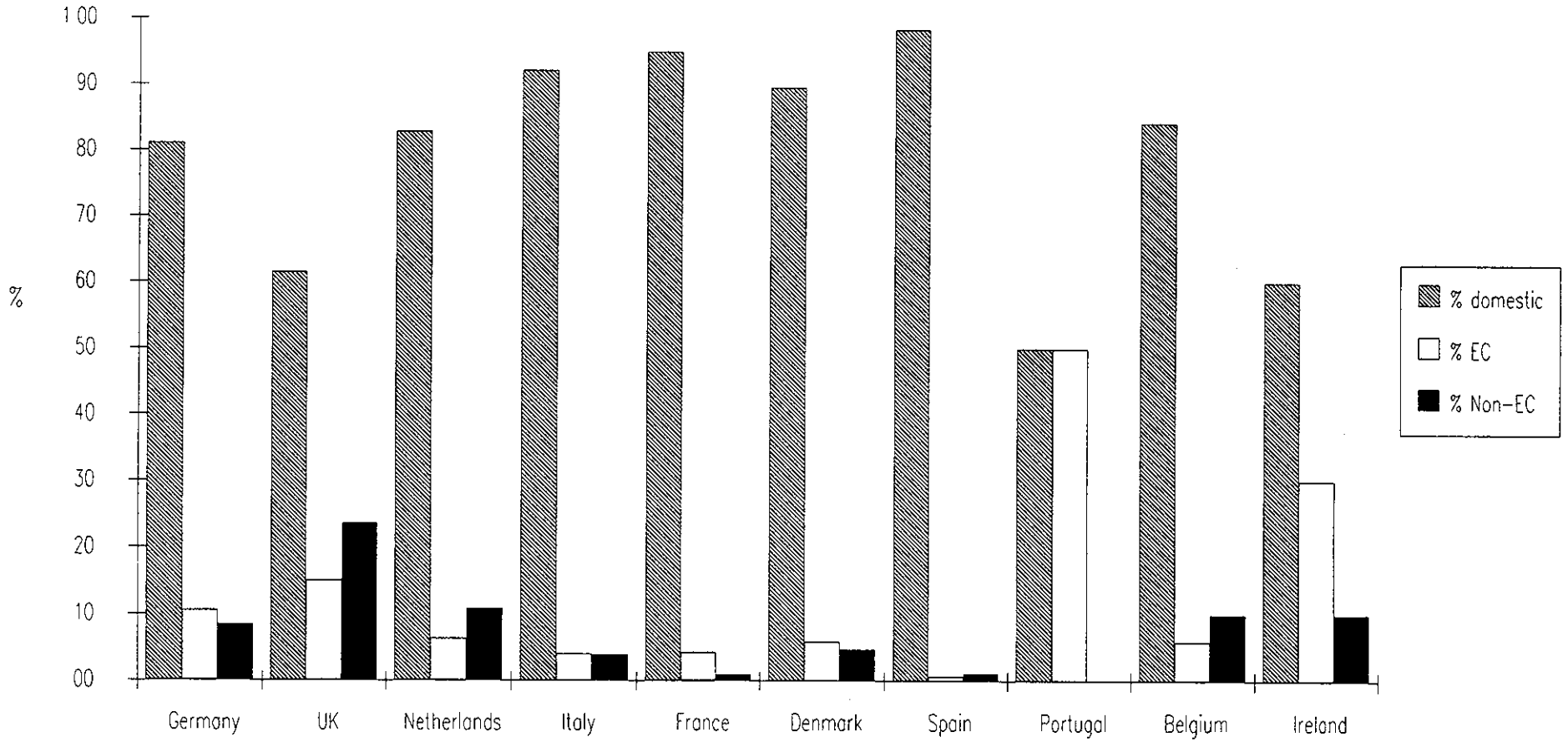
The private vs public funding data from the Bossard report help explain why UK CROs are worried about unfair competition in the SEM. When

Table 6.1 Bossard Report Contract Research Statistics

| | Number of CROs | Value of contract research MEcu | % domestic | % EC | % non-EC | % private sector | % public sector | value domestic MEcu | value EC MEcu | value non-EC MEcu | value private sector MEcu | value public sector MEcu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Germany | 39 | 322.1 | 81.0% | 10.5% | 8.5% | 39.0% | 61.0% | 261.0 | 33.9 | 27.2 | 125.7 | 196.4 |
| UK | 38 | 242.5 | 61.4% | 15.0% | 23.6% | 74.6% | 25.4% | 149.0 | 36.3 | 57.2 | 180.9 | 61.6 |
| Netherlands | 3 | 140.1 | 82.8% | 6.3% | 10.9% | 23.7% | 76.3% | 116.0 | 8.9 | 15.2 | 33.2 | 106.9 |
| Italy | 11 | 87.7 | 92.1% | 4.0% | 3.9% | 58.3% | 41.7% | 80.7 | 3.5 | 3.4 | 51.2 | 36.5 |
| France | 25 | 73.7 | 94.9% | 4.2% | 0.9% | 72.8% | 27.2% | 69.9 | 3.1 | 0.6 | 53.6 | 20.1 |
| Denmark | 7 | 12.3 | 89.5% | 5.8% | 4.7% | 41.0% | 59.0% | 11.0 | 0.7 | 0.6 | 5.0 | 7.3 |
| Spain | 6 | 7.5 | 98.3% | 0.6% | 1.1% | 43.0% | 57.0% | 7.4 | 0.0 | 0.1 | 3.2 | 4.3 |
| Portugal | 1 | 7.3 | 50.0% | 50.0% | 0.0% | 35.0% | 65.0% | 3.7 | 3.7 | 0.0 | 2.6 | 4.7 |
| Belgium | 2 | 0.6 | 84.2% | 5.8% | 10.0% | 16.7% | 83.3% | 0.5 | 0.0 | 0.1 | 0.1 | 0.5 |
| Ireland | 1 | 0.1 | 60.0% | 30.0% | 10.0% | 97.0% | 3.0% | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 |
| TOTAL | 133 | 893.9 | 78.2% | 10.1% | 11.7% | 51.0% | 49.0% | 699.2 | 90.2 | 104.4 | 455.6 | 438.3 |
| "Big 5" | 116 | 866.1 | 78.1% | 9.9% | 12.0% | 51.3% | 48.7% | 676.7 | 85.7 | 103.7 | 444.6 | 421.5 |

Figure 6.1

Sources of funding contract research: domestic, from the EC countries and from non EC countries



organizations such as TNO receive such large public subsidies (16% of TNO's turnover is subsidy to renew the technological base) and earmarked funds, they can build up a firm base from which to undertake contract R&D. Some of these organizations are also large (TNO is reported to have a staff of 5200), with correspondingly broad expertise. In comparison UK CROs (with the possible exception of AEA Technology) are relatively small organizations and importantly receive no state subsidies.

Although UK CROs believed they were world experts, competitively priced and working directly to the requirements of industry (claimed as major advantages over many CROs in other EC countries), they did not believe that they should be made to compete on such unequal terms. Of course, they were already competing in this market (and apparently successfully), but with the freedoms of the SEM, and the stimulus to the 12 economies, competition from all quarters was expected to increase. UK CROs believed this would leave them at a distinct disadvantage.

## CHAPTER VII: BUSINESS ISSUES

*The contract market and the level playing field*

Both the size of the market and the number of organizations offering R&D services on a contract basis in the UK have increased over the last decade, and the market has become highly competitive. Within the UK independent CROs receive no direct government support. However, they are increasingly facing competition from public sector and quasi-government bodies that are beginning to act as CROs from publicly funded bases. Similarly on a European Community (and wider) scale CROs are increasingly facing competition from organizations that receive considerable financial assistance from their respective governments (by a variety of means). Not surprisingly UK CROs expressed concern as to the unfairness of the situation and were keen to see the European Community ensure a 'level playing field' as the Single European Market develops. Future competition policy, within both the UK and the EC, will have considerable impacts on the contract market—such impacts need to be fully investigated before implementation.

*Mergers and reorganization*

As the contract R&D market becomes more competitive, a number of organizations have taken steps to strengthen their positions. This has resulted in mergers of CROs and the changing of status from a Research Association to a private limited company (along the lines of management buyout). A number of CROs have also been threatened with takeover by larger consortia and some CRO managers see such bids becoming more prevalent in the future, particularly as most UK CROs are relatively small, well-run technological organizations that could be incorporated into a consortium, both to work on particular projects and to remain as a profitable technological arm.

*Overseas contracts*

UK CROs undertake an increasing amount of contract work for overseas organizations. In the short term this shows the excellence of UK innovation and technical development. However, (linked with the comment below on patents and licensing) many managers also feel disquiet about the situation. They see such contracts as part of the technology 'drain' from the UK—UK CROs develop new technology only for it to be used overseas to produce products in direct competition to, and to the detriment of, UK industry. CRO managers believe that there is a need for UK industry to become more aware of CROs' capabilities in order to serve UK industry rather than its competitors.

*Staff and mobility*

The major UK CROs employ a force of some 10 000 qualified scientists and engineers with considerable industrial experience and expertise—a valuable national asset. The nature of contract R&D means that this expertise permeates a considerable part of the UK industrial base. One of the effects of the Single European Market (and general Europeanization and globalization) is to increase movement of qualified personnel. QSEs have been relatively mobile throughout recent years and it is debateable whether there will be a 'sudden' flourish of mobile technologists in the near future. However, some R&D managers think that in the medium term there may be a gradual loss of the best UK contract QSEs, due to the ability to command a higher standard of living in other Member States, and staff recruitment is expected to become harder than at present.

**6. How many of these customers were:**

a) Industrial companies [ ]
b) Government bodies [ ]
c) Other—please specify [ ]

.....

**7. How many of the customers you have worked for in the last financial year were based overseas, and how has this geographical distribution changed over the last 5 years?**

Customers based in UK [ %] Customers based overseas [ %]

Of the overseas customers, what percentage were based in:

| | 1983 | 1988 |
|---|---|---|
| a) Countries of the European Community (excluding UK) | [ ] | [ ] |
| b) Non-EC European countries | [ ] | [ ] |
| c) USA | [ ] | [ ] |
| d) Rest of the world | [ ] | [ ] |

**If data are not available, please state any perceived changes in your overseas customer base that you think are notable:**

.....

**8. If possible, please divide your *industrial* customers between:**

| | UK based organizations | Overseas organizations |
|---|---|---|
| a) Small (‹50 employees) | [ ] | [ ] |
| b) Medium (›50-‹500 employees) | [ ] | [ ] |
| c) Large (›500 employees) organizations | [ ] | [ ] |

**If you have a membership scheme:**

**9. How many members do you have?** [ ]

What types of membership schemes do you run, and how many members of each type do you have?

| | Type of Membership | Number of Members |
|---|---|---|
| a) Industrial/company | [ ] | [ ] |
| b) Government | [ ] | [ ] |
| c) Academic | [ ] | [ ] |
| d) Individual | [ ] | [ ] |
| e) Other—please specify | [ ] | [ ] |

.....

**10.* How many of your total membership in the last financial year were overseas-based organizations and how has this geographic distribution changed over the last 5 years?**

**1988** Members based in UK [ ] Members based overseas [ ]
**1983** Members based in UK [ ] Members based overseas [ ]

| | | 1983 | 1988 |
|---|---|---|---|
| a) | Number of members from EC (excluding UK) | [ ] | [ ] |
| b) | Number of members from non-EC European countries | [ ] | [ ] |
| c) | Number of members from the USA | [ ] | [ ] |
| d) | Number of members from the rest of the world | [ ] | [ ] |

**If data are not available, please state any perceived changes in your overseas customer base that you think are notable:**

.....

**11. If possible, please divide your *industrial* membership into numbers of:**

| | | UK based organizations | Overseas organizations |
|---|---|---|---|
| a) | Small (‹50 employees) | [ ] | [ ] |
| b) | Medium (›50-‹500 employees) | [ ] | [ ] |
| c) | Large (›500 employees) organizations | [ ] | [ ] |

**12. What is the approximate range of costs of membership for a UK and an overseas based organization?**

| | | **UK-based costs** | | | **Overseas-based costs** | | |
|---|---|---|---|---|---|---|---|
| | | *Lower* | *Average* | *Upper* | *Lower* | *Average* | *Upper* |
| a) | Industrial | £ | £ | £ | £ | £ | £ |
| b) | Academic | £ | £ | £ | £ | £ | £ |
| c) | Government | £ | £ | £ | £ | £ | £ |
| d) | Individual | £ | £ | £ | £ | £ | £ |
| e) | Other | £ | £ | £ | £ | £ | £ |

**If industrial company membership is related to the size of member company, please give an approximate membership fee for UK-based organizations and overseas-based organizations.**

| | | **UK-based costs** | | | Overseas-based costs | | |
|---|---|---|---|---|---|---|---|
| | | *Lower* | *Average* | *Upper* | *Lower* | *Average* | *Upper* |
| a) | Small | £ | £ | £ | £ | £ | £ |
| b) | Medium | £ | £ | £ | £ | £ | £ |
| c) | Large organizations | £ | £ | £ | £ | £ | £ |

## III FINANCE

**13. Please state total turnover in 1987-88, or the latest year for which figures are available.**

| **YEAR** | **TURNOVER** |
|---|---|
| 1987–88 | £ _____ |
| 19– | £ _____ |

**14. Please indicate the proportion of turnover derived from:**

| | | % |
|---|---|---|
| a) | R&D contracts | [ ] |
| b) | Short-term technical assistance / consultancy | [ ] |
| c) | Patents and licences | [ ] |

d) Membership fees [ ]
e) Training courses [ ]
f) Manufacturing of products [ ]
g) Running of research and information "clubs" [ ]
h) Information / library services [ ]
i) Other—please specify [ ]

.....

**15.* What percentage of your company's turnover originates from the following sources and how has this changed over the last 5 years?**

| | % turnover 1983 | % turnover 1988 |
|---|---|---|
| a) UK Government sources | [ ] | [ ] |
| b) UK commercial organizations | [ ] | [ ] |
| c) EC sources | [ ] | [ ] |
| d) EC-based commercial organizations (excluding UK organizations) | [ ] | [ ] |
| e) Non-EC European countries | [ ] | [ ] |
| f) USA | [ ] | [ ] |
| g) Rest of the world | [ ] | [ ] |
| | 100% | 100% |

**16. Of the R&D contracts, what % by value (£) is:**

a) Single client funded [ ]
b) Multi client funded [ ]

**Of the single client funded projects, what % by value (£) are funded by:**

a) UK Government departments [ ]
b) Industry [ ]

**Of the multi-client funded projects, what % were funded by:**

| | % |
|---|---|
| a) Wholly UK industry | [ ] |
| b) UK industry plus UK Government funds | [ ] |
| c) UK industry plus overseas industrial partners | [ ] |
| d) UK industry, European industry and EC funds | [ ] |
| e) UK industry, European industry and UK Govt. funds | [ ] |
| f) UK industry, European industry plus non-EC funds (*i.e.* EUREKA) | [ ] |
| g) Wholly non-UK | [ ] |
| h) Other—please specify | [ ] |

.....

## IV. STAFF

**17. How many staff do you employ?** [ ]
**How many of these are qualified scientists and engineers?** [ ]

**Of the scientific personnel, please give approximate numbers involved in:**

a) Large scale R&D projects [ ]
b) Testing/consultancy [ ]
c) Library/information [ ]

d) Administration/clerical [ ]
e) Other—please specify [ ]

.....

**18.* How many European Community nationals (excluding British) do you employ on your staff?**

Total European staff [ ]

**Of this total, how many are:**

a) Qualified scientists and engineers? [ ]
b) Scientific (technical) support staff? [ ]
c) Administration/clerical staff? [ ]

**In the last 5 years, has the total of European staff (excluding British nationals) changed in a significant manner?**

Increased [ ] Decreased [ ] Remained the same [ ]

**19. Do you have problems in recruiting qualified scientific staff to your organization?**

Yes [ ] No [ ]

**If Yes, has the problem increased, decreased or remained the same over the last 5 years?**

Increased [ ] Decreased [ ] Remained the same [ ]

## V. COMPETITION

**20. Who are your main competitors?**
*(Please prioritize your answers using the numbers 1 to 5 with 1 being your major competitor.)*

a) Your customers' own in-house R&D facilities [ ]
b) Independent contract organizations [ ]
c) Government run laboratories [ ]
d) University departments and related companies [ ]
e) Research Council Institutes [ ]
f) Large manufacturing industries [ ]
g) Nationalized (and recently privatized) industries [ ]
h) Overseas organizations [ ]
i) Other—please specify [ ]

.....

**21. What methods do you use in the UK, Europe and worldwide to attract your customers?**

| | UK | Europe | World |
|---|---|---|---|
| a) Advertisement/mailshots | [ ] | [ ] | [ ] |
| b) Word of mouth | [ ] | [ ] | [ ] |
| c) Attendance at trade fairs, exhibitions, seminars, *etc.* | [ ] | [ ] | [ ] |
| d) Publishing in learned journals, general articles | [ ] | [ ] | [ ] |
| e) Publishing of trade journals, newsletters | [ ] | [ ] | [ ] |
| f) Overseas offices/agents | [ ] | [ ] | [ ] |
| g) Collaboration with overseas organizations under EC or UK Government initiatives | [ ] | [ ] | [ ] |

h) Other—please specify [ ] [ ] [ ]

.....

**Which of these methods do you think are the most effective?**

.....

**22.* We are aware that UK contract organizations attract a higher amount of transnational work than do their European counterparts. Why do you think this is?** (*Please prioritize your answers using the numbers 1 to 3 with 1 being the most important reason.*)

a) Superior technical competence [ ]
b) Relatively lower manpower costs [ ]
c) Use of English as a "universal" language [ ]
d) Other—please specify [ ]

.....

## VI EUROPE

**23.* Have you undertaken contracts for, or as part of, EC funded schemes?**

Yes [ ] No [ ]

**If Yes, please specify the initiatives:**

.....

.....

**Has participation in these schemes led to a noticeable benefit for your organization in the longer term** (*i.e.* has the technology developed in these projects been of actual use in application to the industrial base?)

Yes [ ] No [ ]

**Have you been part of an unsuccessful bid for EC funds for a particular project where that project has, nevertheless, gone ahead without these additional funds?**

Yes [ ] No [ ]

**Have you been involved in follow-up projects to EC funded contracts?**

Yes [ ] No [ ]

**If Yes, what was the approximate value of the follow-up work in relation to the initial project you were involved in?**

£ _____

**Again, if Yes, what was the value of this work in relation to the initial project?**

0–10% of initial project costs [ ]
10–50% [ ]
50–100% [ ]
100–300% [ ]
Over 300% [ ]

**24.* Have you undertaken contracts for, or as part of, Europewide initiatives, *e.g.* EUREKA?**

Yes [ ] No [ ]

**If Yes, please specify the initiatives:**

.....

.....

**Has participation in the schemes led to a noticeable economic benefit for your organization in the longer term** (*i.e.* has the technology developed in these projects been of actual use in application to the industrial base?)

Yes [ ] No [ ]

**Has the involvement in such schemes led to continued or enhanced contacts with the European partners?**

Yes [ ] No [ ]

.....

.....

*Thank you for your cooperation in filling in this questionnaire. We would be grateful if you would indicate your willingness to allow a follow-up interview to discuss in greater detail some of the issues raised above and more broader issues relating to the changing market for contract research.*

The company **IS / IS NOT** willing to allow a follow-up interview.

## B THE INDUSTRIAL CUSTOMERS

*Please pass this questionnaire to your Technical Director or the appropriate member of your staff best qualified to answer.*

### I YOUR COMPANY

**1. Does your company have its own R&D facilities in the UK?**

Yes [ ] No [ ]

**Do you have access to company R&D facilities overseas?**

Yes [ ] No [ ]

**2. If your company has no access to company R&D facilities either in the UK or overseas, please give brief reasons why** (*e.g.* no perceived need for R&D, a perceived need but your company cannot justify or afford an R&D department, all your R&D requirements can be (and are) met by outside contractors, *etc.*)

.....

**3. Is your company a member of a research association(s), information or research club(s), or similar?**

Yes [ ] No [ ]

**If Yes, please give details.**

| | |
|---|---|
| a) Member of a research association | [ ] |
| b) Member of an information or research club | [ ] |
| c) Other—please specify | [ ] |

.....

### II YOUR COMPANY'S RELATIONS WITH OUTSIDE ORGANIZATIONS

**4. What percentage of your total R&D expenditure is spent with outside organizations, either under direct contract or in a collaborative effort?**

| | % |
|---|---|
| Direct, explicit contract | [ ] |
| Collaborative efforts | [ ] |

**Is your company now undertaking more, less or about the same amount of contract research than it was 5 years ago?**

More [ ] Less [ ] About the same [ ]

**How much of your contracted R&D budget is spent in the UK or overseas?**

| | % spent in |
|---|---|
| a) UK | [ ] |
| b) European Commission countries (excluding UK) | [ ] |
| c) Non-EC European countries | [ ] |
| d) USA | [ ] |
| e) Rest of the world | [ ] |

**5. What percentage of the R&D you contract out to UK organizations is contracted to the organizations below, and how has this changed in the past 5 years?**

| | 1988 % | 1983 % |
|---|---|---|
| a) Universities | [ ] | [ ] |
| b) Independent contract research organizations | [ ] | [ ] |
| c) Government laboratories | [ ] | [ ] |
| d) Other manufacturing companies | [ ] | [ ] |
| e) Other—please specify | [ ] | [ ] |

.....

**6. What type of organization would you use to undertake basic, strategic and applied research?**

| | (a) Basic | (b) Strategic | (c) Applied |
|---|---|---|---|
| a) University (departments or related companies) | [ ] | [ ] | [ ] |
| b) Independent contract organizations | [ ] | [ ] | [ ] |
| c) Government laboratories | [ ] | [ ] | [ ] |
| d) Other manufacturing organizations | [ ] | [ ] | [ ] |
| e) In-house | [ ] | [ ] | [ ] |
| f) Other—please specify | [ ] | [ [ | [ ] |

.....

**7. What are your reasons for contracting out R&D?**
*(Please prioritize your answers using the numbers 1 to 5 with 1 being the most important reason.)*

| | |
|---|---|
| a) To gain access to specialist techniques/equipment | [ ] |
| b) To gain access to specialist expertise | [ ] |
| c) To gain access to additional R&D manpower | [ ] |
| d) To allow tight control over the timescale and budget of the project | [ ] |
| e) Other—please specify | [ ] |

.....

## III CONTRACTS FROM OUTSIDE ORGANIZATIONS

**8. Does your company contract out any of its R&D services/facilities to other organizations?**

Yes [ ] No [ ]

**If Yes, approximately what percentage of your total company turnover does this contracting bring in?**

[ %]

***If your answer to Question 8 is Yes, please go on to Question 9. If No, please go on to Question 11.***

**9. Have you always contracted out your R&D facilities where appropriate, or is this a recent development for your company?**

Always [ ] Recently [ ]

**10. What are the main reasons for contracting out your R&D facilities?**

a) To make more efficient use of your existing facilities [ ]
b) To ensure that your own facilities and R&D are up to date with the latest technology? (maintain contact with outside organizations?) [ ]
c) Other—please specify [ ]

.....

## IV EUROPEAN ASPECTS OF YOUR R&D WORK

**11. Has the R&D department of your company undertaken contracts as part of any of the EC research initiatives in the last 5 years?**

Yes [ ] No [ ]

**If Yes, please specify the initiatives.**

.....

**Has participation in these schemes led to a noticeable economic benefit for your organization in the longer term** (*i.e.* has the technology developed in these projects been of actual use in application to your industrial base)?

Yes [ ] No [ ] Too soon to evaluate [ ]

**Has involvement in such schemes led to continued or enhanced contact with the European partners?**

Yes [ ] No [ ]

**12. Has your R&D department undertaken contracts as part of non-EC European R&D initiatives, such as EUREKA?**

Yes [ ] No [ ]

**If Yes, please specify the initiatives.**

.....

**Has the participation in these schemes led to a noticeable economic benefit for your organization in the longer term** (*i.e.* has the technology developed in these projects been of actual use in application to the industrial base)?

Yes [ ] No [ ] Too soon to evaluate [ ]

**Has involvement in these schemes led to continued or enhanced contact with the European partners?**

Yes [ ] No [ ]

**13. What percentage of your R&D staff in the UK are EC nationals (excluding British personnel)? Has the number increased, decreased or remained the same over the last 5 years?**

% of EC nationals on your R&D staff [ ]

Increased [ ] Decreased [ ] Remained the same [ ]

**14. What do you think the main effects of the completion of the Single European market in 1992 will have on your policy towards use of contract research?**

.....

## BACKGROUND DATA ABOUT YOUR COMPANY

**15. What is the total size, in terms of staff and turnover, of your operation in 1987–88?**

| | Worldwide | UK |
|---|---|---|
| Staff numbers | [ ] | [ ] |
| Turnover | [£ ] | [£ ] |

**16. Please indicate your main operational activity/activities using the attached Standard Industrial Classification Codes.**

.....

.....

## ANNEX B: ABBREVIATIONS

| | |
|---|---|
| AFRC | Agricultural and Food Research Council |
| AIRTO | Association of Independent Research and Technology Organizations |
| CAD | Computer-aided design |
| CBI | Confederation of British Industry |
| COST | European Cooperation in the Field of Scientific and Technical Research |
| CRO | Contract research organization |
| DES | Department of Education and Science |
| DTE | Defence Technology Enterprises |
| DTI | Department of Trade and Industry |
| EACRO | European Association of Contract Research Organizations |
| EC | European Community |
| ESRC | Economic and Social Research Council |
| EUREKA | European high technology programme |
| FEICRO | Federation of European Industrial Cooperative Research Organizations |
| GDP | Gross domestic product |
| HEI | Higher education institution |
| IPR | Intellectual property rights |
| MECU | Million European Currency Units |
| MOD | Ministry of Defence |
| MRC | Medical Research Council |
| NDL | National Physical Laboratory |
| NEL | National Engineering Laboratory |
| NERC | Natural Environment Research Council |
| PCFC | Polytechnics and Colleges Funding Council |
| PGA | Parliamentary Grant-in-Aid |
| QSE | Qualified scientists and engineers |
| RA | Research association |
| R&D | Research & development |
| SEM | Single European Market |
| SERC | Science and Engineering Research Council |
| SIC | Standard Industrial Classification |
| SME | Small and medium sized enterprise |
| UGC | University Grants Committee |
| UFC | Universities Funding Council |
| WS | Warren Springs Laboratory |

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