THE CHANGING CHARACTER OF RESEARCH ASSOCIATIONS IN THE UNITED KINGDOM FROM 1970 TO 1989 AND BEYOND.

by

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PARENTS

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Preface

The main purpose of this study has been to establish the changing character of the RAs (Research Associations) in the UK from 1970 to 1989 and beyond. The last major piece of research carried out on the RAs was the Bessborough Report which was undertaken in 1972.

One of the main problems encountered was the availability of secondary data on the RAs. Most of the data, especially statistical ones, had to be generated from primary sources e.g. Annual Reports of RAs, internal papers of RAs and interviews. Consequently, a great amount of time and effort went into the accumulation of data.

The thesis is divided into five parts. Part 1 consists of the research methodology. Part 2 and 3 provide the necessary background information in order to map out the changes in the RAs over the two decades. Part 4 forms the core of the thesis and it presents the results of the research model used. Part 5 presents the conclusions and recommendations of the study.

Part 1

This part consists of one chapter. Chapter 1 provides a literature review of past studies, explains the objectives of the research, describes the research methodology and outlines the sources of data. It also provides a brief introduction on the RAs.

Part 2

This part consists of Chapter 2 to 6 which provide the background, in particular, governmental policy which triggered major changes in the RAs. Chapter 2 discusses the economics of technology policy and highlights the different policy instruments available. Chapter 3 describes the S&T (Science and Technology) policy in the OECD member countries over the last two decades while Chapter 4 focuses on the changes in the S&T policy in the UK during the same period. Chapter 5 analyses the R&D funding in the UK and Chapter 6 looks into the Department of Trade and Industry which is closely linked with the RAs.

Part 3

This part consists of Chapter 7 and 8. Chapter 7 describes the background to the RAs and Chapter 8 provides a statistical analysis of the RAs. Chapter 7 also provides the history of the development of the RAs and their features.

Part 4

This part which consists of five chapters i.e. Chapters 9 to 13, present the results of the research model used. Chapter 9 and 10 show the results of the environment analysis and the internal audit of the RAs respectively. Chapter 11 shows the strategic choices available to the RAs generated from a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis using the results from Chapter 9 and 10. Chapter 12 analyses the RAs' response and highlights the major changes in the RAs over the last two decades.

It would be ideal to examine each RA as an individual entity in order to make sensible comment at the level of operational policy but the task would be too great. Therefore only four case studies have been chosen and presented in Chapter 13.

Part 5

This part consists of Chapter 14. It presents the conclusions and the recommendations of this research.

CONTENTS

Part 4

Abbreviations

ABRC	Advisory Board for the Research Councils
ACARD	Advisory Council for Applied Research and Development
ACOST	Advisory Council On Science and Technology
ACSP	Advisory Counci for Scientific Policy
AICRO	Association of Independent Contract Research Organisation
AIRTO	Association of Independent Research and Technology Organisations
AMTRI	Advanced Manufacturing Technology Research Institute (Machnine Tool Industry Research Association)
App	Appendix
ARC	Agriculture Research Council
ARRL	Advanced Robotics Research Ltd.
BCIRA	British Cast Iron Research Association
BCR	British Ceramic Research Association
BGI	British Glass Industry Research Association
BHRA	British Hydromechanics Research Association
BLC	British Leather Confederation (British Leather Manufacturers Research Association)
BMT	British Maritime Research Association (a merger of British Shipping Research Association and the National Maritime Institute)
BNF	British Non-Ferrous Metals Research Association
BNF-FULMER	a merger of BNF-FULMER
BRA	Building Services Research Information Association (Heating and Ventilating Research Association
BSRA	British Shipping Research Association
BTTG	British Textile Technology Group (merger of SI and WIRA)
CAMP	Campden Food Preservation Research Association
CAT	Cutlery and Allied Trades Research Association
CDRA	Council of Directors of RAs

CEC	Commission of the European Communities
CEST	Centre for the Exploitation of Science and Technology
CIRIA	Construction Industry Research and Information Association
CORA	Contract Research Association
CPRS	Central Policy Review Staff
CROs	Contract Research Organisations
CSII	Centre for the Study of Industrial Innovation
DES	Department of Education and Science
DPRC	Defence Research Policy
DSIR	The Department of Scientific and Industrial Research
DTI	Department of Trade and Industry
DTp	Department of Transport
EACRO	European Association of Contract Research Organizations
EC	European Communities
EEC	European Economic Community
ERA	Electrical Research Research Association
ESPRIT	European Strategic Programme For Research And Development In Information Technology
EUREKA	European Research and Coordination Agency
FCR	Fabric Care Research Association
FhG	Fraunhoffer Gesselschaft
FIRA	Furniture Industry Research Association
FMBRA	Flour Milling and Baking Research Association
GERD	Gross Domestic Expenditure on R&D
GIREs	Government Industrial Research Establishments
HATRA	Hosiery and Allied Trade Research Association
HAZ	Hazleton UK
HEIs	Higher Education Institutions

HR	Hydraulics Research Limited
HRS	Hydraulics Research Station
IAB	Innovation Advisory Board
IPC	Innovation Programme Committee
IPCS	Institution of Professional Civil Servants
JUTERA	Jute Research Association
LAM	Lamberg Industrial Research Association
LEA	Leatherhead Food Research Association (British Food Manufacturing Industries Research Association
LGC	Laboratory of Government Chemists
MAFF	Ministry of Agriculture, Fisheries and Food
MIRA	Motor Industry Research Association
MoD	Ministry of Defence
MRC	Medical Research Council
NEL	National Engineering Laboratory
NERC	Natural Environment Research Council
NMI	National Maritime Institute
NPL	National Physical Laboratory
OECD	Organisation of Economic Cooperation and Development
PERA	Production Engineering Research Association
PIRA	Paper and Board, Printing and Packaging Industries Research Association
PR	Paint Research Association
PREST	Policy Research in Science and Technology
R&D	Research and Development
RAPRA	Ruber and Plastics Research Association
RAs	Research Associations
RB	Requirement Board
RIC	Ricardo
RTP	Research and Technology Policy

S&T	Science and Technology
SATRA	Shoes and Allied Trade Research Association
SCRATA	Steel Castings Research and Trade Associations
SEPSU	Science and Engineering Policy Study Unit
SERC	Science and Engineering Research Council
SFI	Support for Innovation
SI	Shirley Institute (Cotton, Silk, Man-made Fibres Research Association)
SINTEF	Foundation For Scientific And Industrial Research AT The Norwegian Institute Of Technology
SIRA	Scientific Instruments Research Association
SMF	Small And Medium Firm
SRA	Spring Research Association
SSRC	Social Science Research Council
SWOT	Strengths, Weaknesses, Opportunities and Threats
TCC	Technical Change Centre
TCC	Technical Change Centre
TNO	Netherlands organization for applied scientific research
TRADA	Timber Research and Development Association
TRB	Technology Requirement Board
TRRL	Transport and Road Research Laboratory
UGC	University Grant Committees
WI	Welding Institute
WIRA	Wool Industry Research Association
WRC	Water Research Centre (Water Research Association)
WSL	Warren Springs Laboratory

List of Appendices

CHAPTER 1: BACKGROUND TO THE STUDY AND RESEARCH METHODOLOGY

1.1 Introduction

1.1.1 RAs - From 1917 to the mid 1970's

Research Associations (RAs) are a group of organisations which carry out R&D or provide related services (testing, accreditation, training, consultancy) for industry and government departments. The RAs have been subject to many studies since the first were created at the end of the first World War.

Their diversity increased with time, some being created around an area of technology rather than a sector of industry, with considerable differences in size and in structure, but all subject to the privileges which the Research Association status endowed upon them. An important benefit was derived from government support (Grant-in-Aid) which was calculated according to their membership income, but at a ratio set individually for each RA. Some had no such support and were wholly financed by their membership (Appendix 1.1 shows the list of non-grant-aided RAs). These non-grant-aided RAs were few and their role was less significant in comparison to the grant-aided RAs. They are not dealt with in this research.

When RAs were first established in 1917, it had been intended that government grant-in-aid should be used only to help establish them over the first five years. At the end of that period the industries concerned were expected to provide total financial support. In the event, government support continued, subject to an annual Parliamentary Vote. By the end of 1945, the

Government decided once more to extend the Grant-in-Aid though various stiffening measures which came into effect from 1951 onwards. Although no time limits were set, the RAs were expected to derive an increasing income from industry and, at each grant renegotiation, the Government was free to reduce its contribution accordingly.

The period between 1945 and the early 1960's was one of growth for the RAs, by which time about fifty were in existence. By the 1960's stronger differences had developed between them: some had extended their membership to companies overseas, some had given greater emphasis to technical service work in their field, some had gone towards contract research. A good picture of the situation as it was around 1970 is given by two comprehensive studies of the time: Research Associations: the changing pattern by the Centre for the Study of Industrial Innovation (1972)[1] and Industrial Research and Development, the Report of the Committee of Enquiry into the Research Associations (known as the Bessborough Report) (1973)[2]. These studies were made at the time of publication of the Rothschild Report of 1971[3], a report which was to exert a major influence on the Government's support for R&D in RAs, in government research establishments, and in industry over the following years.

The Rothschild Report recommended that applied research and development commissioned by the Government should be controlled in accordance with a "customer/contractor" principle (which at once creates problems in the funding of basic research). It was for the customer to decide whether an R&D programme was necessary and how much should be spent upon it. The Government, as a customer, used the Chief Scientists in an advisory role to

evaluate the contractor's work. The recommendations were adopted by the Government and the Grant-in-Aid was gradually replaced by research contracts for specific projects assessed according to the Rothschild philosophy.

The Bessborough Report resulted from an enquiry set up by the Conference of Industrial Research Associations and made recommendations aimed at increasing their industrial effectiveness. The report concluded that contract schemes were indeed more healthy than general grants. However, one important proviso was that the Government should continue to contribute monies other than for contract work to RAs in order to help support specified programmes which were in the national or industrial interest. A further important recommendation was that the RAs should develop a policy for overseas activities.

Rothschild and Bessborough together, therefore influenced four key areas: the basis of RA funding, the relationship with the Government, the benefits which the members derive, and the membership composition.

1.1.2 RAs - From the mid 1970's to the 1980's

The RAs had to cope with the recessions which hit the UK in the mid 1970's and early 1980's on top of the changes brought about by the Rothschild Principle. When the Conservative Government came into power in 1979, the pressure to change was even greater with the tight squeeze in the Government's R&D budget, which was intended to restore competitiveness in economy. Higher Education Institutions (HEIs) like universities were forced to get closer to industry to obtain financial support for their research. Some Government Industrial Research Estabishments

(GIREs) like the Hydraulic Research Station (HRS) and the National Maritime Institute (NMI) were privatised and others were forced to carry out repayment work for industry to gain income e.g. Harwell. Consequently, the competition in the R&D market intensified and RAs found themselves in direct competition with HEIs and GIREs.

Until the mid 1980's, British industry did not see the importance of investment in R&D brought about by international competition and the need to exploit new opportunities arising from developments in science and technology. Between 1969 and 1983, the industrially funded R&D in the UK increased by around 20%, whereas that in Germany doubled. Furthermore, the City had set too high a priority for short-term profits and dividends at the expense of R&D and other innovative work. The RAs found themselves in a slow-growth market where there was increased competition.

In January 1988, the DTI published its White Paper on Enterprise[4], by means of which, the Government emphasized that industry itself was best able to assess its own markets and to balance the commercial risks of financing R&D and innovation. The Government believed that it should not take on the responsibilities which were primarily those of industry - whether directly through research subsidies, or indirectly, through new tax concessions. Consequently, the Government was increasingly withdrawing from near-market research. A continuing preoccupation of government policy was the management of the resources for research.

The DTI has had no clear role since it was formed in

1970. In the last eight years alone, there have been seven Secretaries of State. Without a clear role, the DTI has been at the mercy of a ministerial whim. The RAs in turn have had problems in trying to adapt to the changing policy of the DTI towards R&D. For example, when the DTI's Enterprise Initiative was launched in 1988, the RAs had to adapt to this new environment with considerable personnel changes in the Marketing Divisions of DTI. There were many changes going on and the RAs felt that there ought to be greater stability since R&D should be a long-term business.

1.1.3 Summary

Despite the adverse conditions the RAs were operating in during the last two decades, the majority had adapted to the environment but there were also those which had to liquidate, some had fallen below a critical mass and some had to merge. By 1988, the number of RAs had dropped to 32 in comparison to 42 in 1970 (App. 1.2 shows the list of grant-aided-RAs in 1970 and 1988). But the combined turnover of the RAs increased from £94 million in 1970 (1988 prices) to over £167 million in 1988. In 1988, their total staff number amounted to over 5700 and they served an estimated 20,000 companies, including 93 of the top 100 companies in the UK.

The main objective of this study is to investigate the changing characters of the RAs in the last two decades (i.e. 1970 to 1990) and beyond. A strategic planning model is used to achieve this purpose. The model highlights the RAs' environment, conducts internal audits and identifies the strategies available and the strategies adopted.

The RAs have changed dramatically in the last two decades;

each of them have responded differently and even their Memorandum and Articles of Association can differ from each another. The quantifiable characteristics do not pose a problem, but the philosophies, structures and technical quality of the RAs vary so greatly that it is difficult, if not impossible to produce a sample of RAs which is in a statistical sense representative of them all.

Factors like global competition, the Single Market, deregulation and rapid technological change will continue to force the RAs to be alert and adapt to the changing environment. Although the past twenty years have seen dramatic changes compared with the previous fifty years, the next decade is likely to bring about even greater change.

1.2 Literature Review

The following is a list of studies or surveys that were carried out in the last two decades i.e. from 1970 to 1990. They are listed in chronological order.

(a) Research Associations: the changing pattern by the Centre for the Study of Industrial Innovation (CSII)(1972)

The objective of this study was to gather and present some up-to-date information on the scale and nature of the RAs' activities in order to inform public discussion[5]. It also had the aim of presenting some conclusion, based upon the evidence gathered, as to the kinds of considerations which should be borne in mind by industry, the Government and the RAs themselves if the technical resources which they represent were to be employed as effectively as possible.

A questionnaire survey was carried out and several RAs were

interviewed. The study showed that[6]:-

- the notion of co-operative research of the old style had lost its supremacy to be replaced by that of directly commissioned work in its various forms.
- the RAs were far from being dying institutions.
- the RAs ought to increase their technical activities on the basis of direct commissioning by members. The importance of a general programme determined by the intermediary of an elected Council or a research committee should diminish.
- the idea of membership should cease to involve programme control as its central benefits.
- at the centre of the association affairs should be a core programme of non-mission oriented work to serve as a source of technical stimulation.
- the Government's policy towards RAs lacked definition.

(b) Bessborough Report (1973)

The objective of the report was to examine the scope, organisation, functions and methods of operation of the research associations, including the relationship and interaction between them and with Government, industry, universities and other bodies, with the object of making suggestions to increase their effectiveness[7].

The study could be divided into two parts. Part one presented a thematic approach to RAs, looking into, for example, the RA's objectives, the size of company RAs served and new fields of RA activity. Part two of the study presented profiles of all the 45 RAs, each of which was divided into three sections. Section 1 was a brief summary, covering such factors as date of

establishment, size in terms of income and employment, and the main emphasis of work. Section 2 gave a brief summary of some of the technical achievements for the last 20 years and section 3 was a comment on the RA.

The study concluded that:-

- the government support to RAs had produced handsome benefits for industry and the economy.
- the RA general grants should be replaced by money given for specified purposes i.e. it approved the principles expounded by Lord Rothschild.
- each RA should be the concern of the Minister responsible for the industry this RA mostly dealt with.
- the RAs by their long and intimate contact with industry were better equipped to undertake work of industrial importance than most of the Government Industrial Research Establishments (GIRES).

(c) Survey conducted by the Technical Change Centre (TCC) (1985): Changes in the Research Associations Over The Decade 1972 - 1982[8]

The purpose of the survey was to establish the nature and scale of the changes which had taken place in the RAs in the decade following the application of the recommendation in the Rothschild Report.

The survey provided a brief analysis of the RAs' membership, staffing, organisation, finance, activities and collaboration over that period. Around 30% of the sample size was taken from non-grant-aided RAs and therefore it did not wholly reflect the changes in the grant-aided RAs.

The survey concluded the following[9]:-

- the withdrawal of Grant-in-Aid made it difficult for the RAs to undertake exploratory work unless they had reserve funds.
- the income from government sources increased over that period by 30% in real terms; in terms of proportion of RA income, it increased from 30% to 36%. Paradoxically the RAs became more dependent on government money following Rothschild than they had been before.
- there were increased opportunities for industrial contract research over that period but the competition was becoming increasingly tougher especially from universities.
- the total income of the group of RAs studied rose by 11% in real terms over that period.
- the support from industry in no way matched what was needed to keep such institutions up-to-date technologically.

(d) **Commission of the European Communities (CEC): Contract Research Organisations in the EEC (1989)**[10]

This was a survey carried out by the CEC to list the contract research organisations in the EEC and identify their structure and the nature of their activities[11]. The contract research organisations surveyed in the UK were members of the Association of Independent Research and Technology Organisations (AIRTO) of which most of the RAs are members.

The results of the survey basically provided a directory of Contract Research Organisations (CROs) in the EEC. The study also concluded that[12]:-

- subsidy was a barrier to the general development of European contract research.
- there was a lack of awareness of CROs in Europe.

- the CROs would need to update their technological base constantly.
- greater coordination of research was needed among CROs in Europe.

(e) Other Prior Research

The Research and Technology Policy (RTP) division of the DTI carried out feasibility studies on randomly selected RAs but the findings were not made public.

A report on the contract research market in the UK is currently being carried out by the Science and Engineering Policy Study Unit (SEPSU). The study focuses on the contract research market in the UK and it touches indirectly on RAs as R&D contractors.

1.3 Research Objectives

The objective of this study is to investigate the changing character of the RAs over the last two decades (from 1970 to 1989) and beyond. This is achieved through the investigations of the following points:-

1.3.1 The RAs' Environment

- to identify the variables that triggered or continue to trigger changes in the RAs and their activities.
- to provide a better understanding of the environment's effects on the RAs' business.
- to identify the past and present opportunities and threats arising from the environment variables.

1.3.2 Internal Audit of the RAs

- to pinpoint the RAs' strengths and weaknesses.
- to analyse the exploitation of the RAs' resources and the extent to which these resources have been controlled.
- to examine the role of the stakeholder groups (e.g. the Council, the Government, the Research Director, the Board of Management and the staff)

1.3.3 RAs' Strategic Choices

- to generate the strategic options available to RAs.
- to evaluate the strategic options open to RAs.
- to identify the strategies adopted by the RAs.

1.3.4 Implementation - Changes in the RAs

- to analyse the changes in their resources e.g. physical resources, funding level and human resources.
- to examine the changes at the operational level.
- to study the variation in their organisation structures.
- to look at the cultural change.
- to provide a background against which the future development of RAs may be assessed.

1.4 Research Methodology

1.4.1 Introduction

The past studies carried out on RAs (covered general areas like finance) as well as the Case Studies Approach. These approaches were simple and provided a clear background to RAs and the changes they underwent. The general approach, however, did not draw out fully the answers to questions underlying the

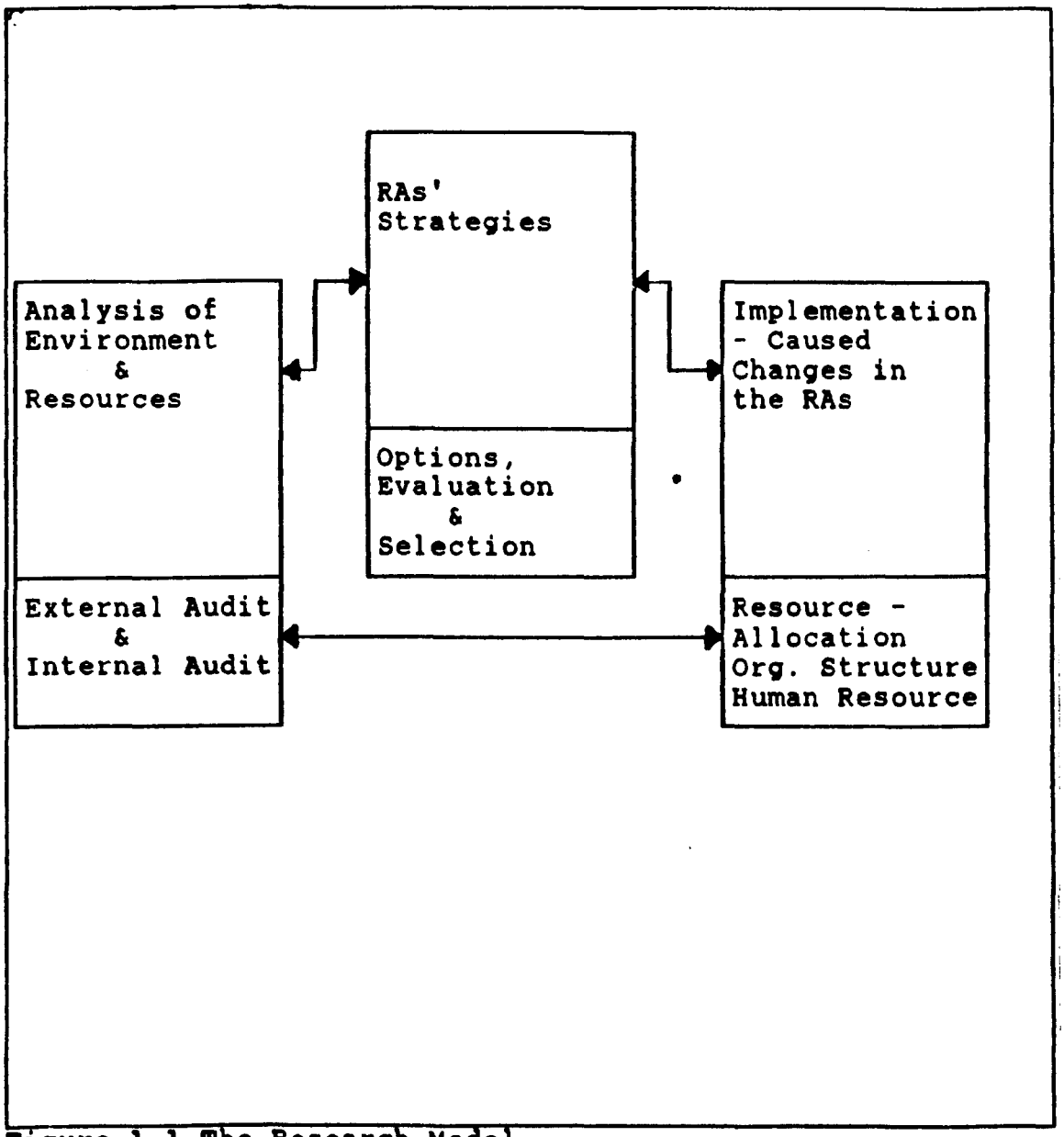

Figure 1.1 The Research Model

changes. To overcome these shortcomings, an adapted strategic planning model is used for this study. The model enables a more detailed "post-mortem" on RAs, using contemporary methods of analysis. It is important to emphasize that the study does not attempt to carry out strategic planning for RAs but uses the model to map out the changes.

1.4.2 The Research Model

The model is illustrated in figure 1.1. It can be divided into three sections which are dependent on one another.

(i) Section 1 - Analysis of RAs' Environment and Resources

The events that triggered a strategic review are analysed. The RAs have to match their activities to that of their environment. One can also identify the major factors that affected the RAs, some of which gave rise to opportunities of some sort and many of which exerted threats upon the RAs. Since the continually changing environment influences the RAs internally, it seems sensible to study this environment first in order to understand the changes the RAs undergo.

The internal audit identifies the RAs' strengths and weaknesses. Their strengths are 'what they are good at' or where their resources are superior to those of their competitors thus providing them with a leading edge. Their weaknesses are where they are at a competitive disadvantage. The aim in this analysis is to identify the internal influences, constraints and whether or not the RAs could overcome them. An internal audit cannot overlook the value systems of those involved in the RAs. Given the same environment and resources, the response would have differed according to the value systems of the people involved (e.g. the Council or the Board of Management) and their expectations.

(ii) Section 2 - RAs' Strategies

This section looks at the many possible courses of action generated and open to RAs. Once the options are generated, a matching or the evaluation process is carried out. One of the tools used will be a Strengths, Weaknesses, Opportunities, Threats (SWOT) Analysis. The feasibility of the implementation of the options will be examined.

The final part in this section looks at the strategies that were adopted by RAs. The advantages and the disadvantages of the options are highlighted. There are no clear-cut options because the choice of any option must inevitably be a matter of management judgement. An attempt will be made to focus on the subjective or irrational factors involved e.g. the values of the Council and the role of the Research Director.

(iii) Section 3 - Implementation Stage

This section looks at how the RAs translated the general directions of strategy into actions. The problems in doing so are highlighted. This section looks into the resource planning of the RAs, identifies the key tasks to be carried out, analyses the matching of the organisational structure with the strategy adopted and looks at the management systems they adopted.

1.5 Sources of Data and its Collection

1.5.1 Sources of Data

The following is a list of the sources of data:-

- Annual Reports of the RAs from 1970 to 1989.
- past studies on RAs.
- journals and periodicals.

- visits to 16 RAs and 3 CROs. During these visits, the Research Directors were interviewed.
- consultants e.g. Prof Charles Suckling.
- interviews with the President of AIRTO and the Honorary Secretary. The complete list of interviews carried out is shown in App. 1.3.
- the Department of Trade and Industry (DTI). During the course of the research, a month was spent in RTP where it was possible to experience the working environment in the DTI and to carry out a number of interviews. Among those interviewed were the Head of RTP and his staff (particularly those responsible for RAs, industrialists seconded to the DTI, the Secretary to the LINK Programme, the Secretary to the Chief Scientists and Engineers, Heads of Marketing Divisions of the DTI, the Secretary to the Innovation Programmes Committee (IPC), Secretaries to the Requirements Boards and Central Unit members).
- visits to GIREs i.e. the Warren Springs Laboratory (WSL) and the National Engineering Laboratory (NEL).
- members of the Advisory Committee on Science and Technolgy (ACARD) i.e. Prof. Robin Williams (who is also an advisor to the House of Lords Select Committee on Science and Technology), Prof. Stan Metcalf and Dr. Brian Lindley.
- the Institution of Professional Civil Servants (IPCS).
- the Policy Research in Science and Technology Centre, Manchester University (PREST).
- the Science and Engineering Policy Study Unit (SEPSU), Royal Society.
- attended the first conference of the European Association of Contract Research Organisation (EACRO) in Amsterdam.

- interviews with Research Directors of CROs in the EEC e.g. Dr. A. Imbush of Frauenhofer Gesellschaft, Germany.
- correspondences e.g. with Mr. Eiliv Sodahl, Director of SINTEF, Norway.

1.5.2 Data Collection

Data collection using a questionnaire survey was considered but eliminated since advice indicated that the response rate would be low. Furthermore, depending on the respondent, the degree of accuracy of response would be questionable. Another major reason against this form of data collection is that over the last two decades, the RAs have changed so much that an across-the-board questionnaire survey on RAs would not have had much significance.

The data collection method adopted involves interviewing selected RAs, interviewing organisations that interact with RAs and collecting of statistical data on RAs. This form of data collection is known as triangulation, which is defined as "the combination of methodologies in the study of the same phenomenon"[13]. This method helps to cross-validate the data collected from the different methods used. Triangulation helps to capture a more complete, holistic, and contextual portrayal of the RAs under study.

(i) Designing of Interview Questionnaires

The designing of the interview questioning regime was done with the help of the comments given by RTP. It was further improved after being tested on the first few RAs visited. The final questionnaire set used is shown in appendix 1.4.

The difficulties of designing the questioning regime lay in the nature of the subject area and the required data. It had to be designed to give the flexibility needed for the individuality of each RA. The confidence and cooperation of the interviewee had to be won before any sensitive or probing questions could be asked and this had to be done in a limited amount of time.

But the interview had the advantage that greater returns could be expected than if forms were simply distributed to the RAs to read, complete and return on their own. Even though fewer RAs would be reached, results could be guaranteed.

The questions asked were of a considerable length and, if presented as a formal questionnaire, might not have attracted a very charitable response. The presence and attention of an interviewer, however, helped to generate interest and hold attention. The respondent could ask questions about the information demanded before giving his reactions and responses. Also many of the questions had to be very subjective in nature and might have been difficult to understand without an explanation. All interviews were conducted by the same person so that consistent information could be supplied.

It was felt that results would be more accurate because respondents would not only get a better understanding of the questions asked but also because the interviewer would more easily be able to understand the responses given and the true opinions of the respondents. It was possible to question participants more fully and gain a clearer insight into their answers. The interpretation of written answers would be more difficult and would result in biases of interpretation.

(ii) Sample of RAs Interviewed

The sample of RAs chosen was chosen to reflect the following criteria:-

- the size of the RA in terms of turnover and staff number e.g. Water Research Centre (WRC) and Shoes and Allied Trade Research Association (SATRA).
- the RAs' sources of income.
- the RAs' profitability in terms of their net profit and turnover to staff ratio.
- the organisational structure adopted.
- former GIRES which were privatised e.g. British Maritime Technology (BMT) and Hydraulic Research (HR) Ltd.
- the corporate status of the RAs e.g. British Hydraulics Research Association (BHRA).
- newly merged RAs e.g. British Textile Technology Group (BTTG) and BNF-FULMER.
- where the majority of their members are SMEs e.g. SATRA.
- liquidated RAs e.g. Jute RA.
- whether the RA is a technology based or particular industry based RA.

The characteristics of the RAs chosen are given in appendix 1.5 and an individual summary on each of the RAs interviewed is given in appendix 1.6.

(iii) Sample of Organisations Dealing with RAs and Contract Research Organisations Interviewed

The complete list of organisations interviewed and are shown in appendix 1.3. Among them were:

- the DTI, which includes the RTP, RBs, Marketing Divisions and Central Unit.
- CROs in the UK.
- CROs in the EEC.
- Consultants
- AIRTO.

(iv) Statistical Data

The primary source of statistical data is from the RAs' Annual Reports and Accounts. Some RAs were reluctant to disclose their Annual Reports and Accounts since they are only meant for members. There were difficulties in obtaining the annual reports from 1970 to 1979 as most RAs do not have any copies or records left. The information from past studies is used as secondary data to fill the gap of the missing period. The other sources of secondary data were:

- Annual Reports of government-funded R&D.
- reports from the DTI and RBs.
- Annual Abstracts of Statistics.
- Reports on the House of Lords Select Committee on Science and Technology.
- AIRTO and EACRO newsletters.

The statistical analysis of the RAs is presented in Chapter 8 and in some of the appendices.

(v) Problems of Data Collection

In any phase of data collection there are potential sources of bias or error which can make the data less than 100% reliable. From the initial stages of designing sensible and meaningful

questions, to the presentation of these questions and their understanding, and in the accurate recording and interpretation of responses, there is always the danger that errors will arise. Each stage in the above sequence is filtered through the conditional perception of the human mind. An interview style should help to minimise certain sources of potential bias: both the understanding of questions by participants and the interpretation of responses should be more accurate. Obviously the reliability of the data depends on the honesty and reliability of the participant.

The following were other areas of difficulty encountered:

- obtaining the cooperation of the people within the RAs who were in a position to discuss the issues.
- soliciting accurate, unambiguous and sincere responses.
- gaining the confidence of the RAs.
- finding common criteria or variables which could be used to measure the performance of the RAs.
- obtaining a common level of detailed information from the RAs.
- differing characteristics of RAs.
- selecting the key questions when a time limit was imposed.

1.6 Summary

It is difficult to carry out a research in an area which has not been looked into comprehensively for the last two decades. The character of the RAs and their activities have changed so much during this period that it is quite a task to study these changes without having many past studies to refer to.

The study did not attempt to answer the question whether RAs in general (or specific ones) give great or small value relative

to the money they spend. This kind of evaluation of costs and benefits is important but can only effectively be carried out in the detailed context of an individual association. The full cooperation of the association concerned would be essential.

The RAs could have been viewed as a group of institutions connected by common or similar Articles of Association, with privileges in respect of taxation and the like, and enjoying government grant support. It could have been justifiable to seek to establish whether or not the RAs were good value to the UK in terms of the money the taxpayers provided. However, with the end of Grant-in-Aid, and with individual institutions following a way-of-life which best exploits their assets and their potential markets, across-the-board assessments of their role and value have lost much of their old significance.

It took more than a year to focus on the chosen area of research because of the complications brought about by the privatisation of NEL, which sponsored the research. In retrospect, this difficult year provided a first-hand experience of the impact of changes in government policy towards a research establishment which forced it to change and adapt to the changing environment. This was what the RAs went through in the early 1970's when grant-in-aid was phased out.

The RAs are rarely in the news nowadays. Hopefully this study will help to stimulate more public discussion on the RAs and to encourage industry, the Government and RAs themselves to focus on the kind of considerations which should be borne in mind if the technical resources which the RAs represent are to be employed as effectively as possible.

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CHAPTER 2: THE ECONOMICS OF TECHNOLOGY POLICY

2.1 Introduction

The long-run performance of any economy depends upon its success in innovating new products and processes. Few would doubt that the spectacular post-war economic record of Japan, as compared to that of the USA or the UK, has had much to do with its superior achievements in developing and applying new technologies. The aim of the following paragraphs' is to clarify theoretically a number of economic issues in technology policy.

One can define technological change, following Schumpeter, as changes in products, processes of production, raw materials, and management methods[1]. A classic trilogy that has informed and conditioned many debates on technology and technology policy, again attributed to Schumpeter, is that which characterizes three stages in the process of technological change: invention - the generation of new ideas; innovation - the transformation of those ideas into, for example, new marketable products and processes; and diffusion - the spread of use of ownership of new technology[2]. Implicit in this trilogy is the knowledge base which underlies technological change and which is itself continually changing and evolving. It should be realized that a country's technology does not always have to be produced at home; new technology can be and often is imported from overseas. It is also worth noting that it is only at the diffusion stage that the economy obtains benefit from and is affected by new technology.

A distinction often made is that between Science and Technology. At a general level it is common to associate science with the knowledge base and technology with invention, innovation and diffusion. For the former, knowledge is a public good, and scientists compete to be first to publish new ideas. For technologists, however, the value of being first to innovate leads not to public esteem but in private return. The distinction is not hard and fast and it would be a serious mistake to think that science policy and technology policy can be considered in isolation from one another.

2.2 Technology Policy

What does technology policy mean? In the present context, technology policy is defined as a set of policies involving government intervention in the economy with the intent of affecting the process of technological change. However, even using this definition, the economics of technology policy is a complex subject. Some of the reasons for this are:

(1) The incentives that firms have to invest in new technology are influenced by such diverse factors as the nature of product, market competition, the availability of skilled personnel, the extent of public subsidy (direct or via procurement policy), and the availability of finance for technological change.

(2) Technological change and thus technology policy proceed in an environment of uncertainty and often very incomplete information. Attitudes to risk and uncertainty greatly influence the funding of technological activity and thus bring issues of finance to the forefront of technology policy discussions.

(3) Several government policy instruments have interacting effects on incentives to advance technology. As well as direct instruments of technology policy, enforcement of property rights over information, subsidies, public R&D etc., it is essential to consider the impact of other microeconomics policies, notably competition policy, trade policy, and education and training policies.

(4) The severe difficulties of measurement. Neither input measures (e.g. R&D expenditure) nor output measures (e.g. patents filed) are perfect indicators of innovative activity.

(5) Problems of evaluation. It is hard enough for firms themselves to make sensible assessments of the private return to technological activity, and it is harder still to assess social returns. Quite apart from difficulties in gauging the (probabilities of) future returns, there is the question of what discount rate to apply to them, and in particular how to take risk into account.

(6) The assessment of the national return from technology policy is complicated by international rivalry. For example, there may be the danger of countries attempting to free-ride on each others' R&D efforts, or on the other hand, governments might compete in a zero sum game to support their national champions in the hope of gaining strategic advantages over their competitors in international markets.

2.3 Why Have Technology Policies?

There would be little point in having technology policies if unassisted market forces could be expected to lead to the efficient allocation of resources to technological activity.

Technological change is concerned with the production of new information. Information is unlike ordinary commodities[3]. Once discovered, a piece of information can usually be made widely available at a very little (social) cost. It costs virtually no more to produce a given piece of information many times over once the first unit has been produced. It is generally beneficial from the social point of view for information to be widely disseminated. For example, in commercial situations it allows firms to compete more intensively and resulting benefits are passed on to the consuming public. From the private viewpoint of the innovating firm, however, dissemination of that information is likely to be very costly. Indeed, the private value of information tends to diminish the more widely it is known. The more other firms benefit from and free-ride on the R&D efforts of the first firm, the less incentive is there to engage in R&D activity in the first place. The conflict between the public interest in dissemination and the private interest in exercising exclusive property rights over information is known as the appropriability problem.

Even where there is perfect appropriability, e.g. watertight and long-lived patents, there are often reasons to expect the private reward from technological activity to be less than the social benefit. Successful R&D is generally of net benefit to consumers over and above the gain in profits to the innovator.

Externalities between firms must also be considered. If there are spillovers, so that firm B benefits from the technological activities undertaken by firm A (e.g. because it learns or imitates) then each firm will hold back its

technological efforts to some extent, and hope to benefit from the efforts of others.

On the other extreme, it is possible that there will be too many firms engaging in technological activity. This is the potential problem of duplication of, for example, research efforts. It is possible to show analytically[4] that industry R&D expenditure might exceed the socially desirably level of R&D, with too many firms each individually doing too little. In that case there is too much R&D input and too little R&D output, a double inefficiency. Similarly, in some cases there may be a common pool problem in which the first-past-the-post-takes-all nature of the race to invent induces excessive speed in the process. It is natural to think of policies to promote cooperative R&D in these contexts. On the other hand, rivalry R&D can have advantages. First, it is desirable when independent, as opposed to completely parallel, research strategies are being pursued. Then there is the advantage in diversity. Competition between researchers, whether they are in an academic or commercial environment, allows reward to be used on priority of discovery. With research inputs and outputs being hard to observe, and the relation between them being unknown, it is difficult to provide incentives for effort in the absence of rivalry.

As discussed above, technological activity is taking place in an environment of incomplete information and uncertainty. In view of the difficulties of measuring R&D inputs and prospective returns, R&D funding is beset with acute problems of asymmetric information, and the market for R&D finance is likely to be highly imperfect. The problems include ones of adverse selection

and performance monitoring. The nature of financial institutions can influence how well such problems are overcome, and it has been argued that financing via long-term relationships with banks may be more effective than stock market financing due to closer monitoring arrangements and better information flows[5]. Moreover, given asymmetric information, managers anxious to satisfy the stock market opinion may divert resources towards visible signals of corporate health (e.g. high dividends) and away from less tangible activities (e.g. R&D). Such imperfections in the capital market reduce opportunities for risk-shifting, and risk aversion may become a dominant influence in R&D investment decisions. Problems of this kind are part of what is described as excessive short-termism in financial markets. It is worth noting that it is becoming a convention in the UK for publicly quoted companies to detail their R&D spending in annual reports. Without such information it is difficult to see how capital markets could optimally allocate resources for technological activity across alternative uses.

Thus there are several reasons, including externalities, scale economies, market power, the attitude to risks, to expect that market forces will not result in desirable levels of technological activity and dynamic efficiency if left to themselves. Policy intervention is likely to be necessary to remedy some of these defects. Moreover, there may be other reasons that motivate technology policies by national governments in the context of international competition[6]. Competition in the civil aircraft industry between the European Airbus, Boeing and McDonnell/Douglas is an example of this. Thus, not only are unassisted market forces unlikely to lead to levels and

directions of innovative activity that are in the general interest, but governments may also seek to influence the position of their national firms in world markets.

2.4 Policy Instruments

The following are some of the government policies that can have influence on R&D activity. There are four general approaches to externality problems in economics: private property rights, public provision, subsidies/taxes and cooperation. They are briefly discussed here.

2.4.1 The Patent System

The patent system and related laws are designed to give discoverers property rights over their new information, at least for a period of years. The advantages of such systems are obvious, they promote dynamic efficiency by providing incentives for R&D effort. The disadvantages are twofold. First, patents do not always succeed in ensuring appropriability of rewards. In addition, there are considerable enforcement costs.

2.4.2 Public Provision

At the other extreme from private property rights lies the public provision of R&D through institutions such as government research laboratories, research councils and universities. Public provision overcomes free rider problems in R&D, avoids competitive duplication of effort, and allows researchers to be motivated other than by the prospective market power conveyed by patents. The disadvantage is the relative lack of commercial information and incentive that firms in industry are more likely

to possess. For these reasons, public R&D activity is more appropriate to basic research than to near-market research.

2.4.3 R&D Subsidies

Subsidies to R&D are a way of attempting to improve the terms of the trade-off between static and dynamic efficiency that is at the heart of the appropriability problem. In principle a combination of R&D subsidies and relatively high spillovers between firms could promote both kinds of efficiency[7]. Innovative efforts could be encouraged by the subsidies and spillovers would allow the competitive and widespread application of improved technology. The main problem however is knowing the appropriate rate and direction of subsidy.

2.4.4 Cooperative R&D

Like all the other policies considered here, cooperative R&D in the form of joint ventures or mergers in high technology industries has pros and cons. It internalizes the externalities between firms, and can in principle overcome both free-rider problems and duplication problems in R&D, while also being consistent with product market competition in the case of research joint ventures. However, in practice there is the obvious danger that collaboration in R&D will lead to anticompetitive collaboration in the product market.

2.4.5 Other Policy Instruments

(i) Risk Sharing

In the absence of perfect markets for shifting risks the government may intervene as a risk bearer. Since the government

is less risk-averse than the private sector, the carrying of risks by the government is an appropriate policy.

(ii) Diffusion Policies

The diffusion stage is the stage when new technology affects economic activity and when the benefits arise. It is clear, however, that diffusion policy is the poor relation in technology policy. Two main types of diffusion policies are information provision and subsidy policies (designed to extend the use of a particular technology e.g. computers).

(iii) Competition Policy

Mergers in high technology industries may permit the realization of scale economies and the pooling of incentives in R&D, and avoid the duplication of efforts. But this should not lead to product market competition being undermined, and should not blunt the incentive to innovate.

(iv) Trade Policy

We discussed above how R&D policies, e.g. subsidies to R&D, can be used to affect the positions of domestic firms in markets, including markets with international rivals. Conversely, trade policies can be used as instruments of technology policy.

(v) Education and Training Policy

Perhaps the most important input to technological activity is trained personnel. An adequate resource of appropriately trained human capital is therefore a prerequisite for successful technology policies.

(v) Procurement Policies

These can be oriented towards technological objectives as ways of hidden protectionism, R&D finance etc. However, the costs of deflecting procurement policy from the straightforward objective of cost minimization may be high.

(vi) Defence Policy

Although the technological spin-offs from military projects can be considerable, there is a danger that they will be exaggerated, especially, given the large vested interests typically involved. Moreover, the nature of military projects is sometimes such that the technological information gained cannot be made generally available.

(vii) Policy on Standards and Compatibility

The issue of standards and compatibility arises in many high technology industries. Standardization, for example can help break down market segmentation and enhances competition. It can also allow full exploitation of scale economies. On the other hand, standardization can be costly.

The list of policies could easily be extended. The four direct approaches to externality problems in R&D are shown above. All have advantages and disadvantages. We now turn to consider some of the trends on how and to what extent the instrument of technology policy was used in the OECD countries for the last two decades.

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CHAPTER 3: SCIENCE AND TECHNOLOGY POLICY IN THE OECD COUNTRIES From 1970 to 1985

3.1 Introduction

The economic issues of this chapter has been discussed in Chapter 2. During this period, Science and technology policy was focused on the rapid development of new technologies and their application in economy[1].

Government priorities for science and technology changed markedly during this period. Support shifted towards industrial innovation. Long-term research was steered to areas that may contribute best to advancing the new technologies, and university-industry cooperation was fostered for the same purpose.

The emphasis on technological innovation increased the need for long-term research of both a basic and strategic nature. However, government support for long-term research, remained at an essentially static level in most OECD countries.

While financial support was of considerable concern, the aging of the cadre of researchers and the obsolescence of their research equipment posed the greatest threat. It was clear that government action was required to arrest and reverse the aging of the research system.

In most OECD countries, industry increased its spending for R&D, continuing the trend started in the late 1970's and maintained throughout the recession years.

Government measures for promoting innovation expanded, and created an elaborate structure of aids and incentives in most OECD countries. These structures grew in a piecemeal fashion with measures being added by various ministries from time to time, the result in many cases was an assortment of policies which lacked cohesion and proven effectiveness. New policies and programmes were being developed at a rapid rate in a variety of directions. Governments in general were broadening their policy portfolios to include more indirect assistance to industry, primarily in the forms of tax credits and incentives. A second direction was greater aid for innovation activities downstream from R&D, particularly for applications of the new technologies in manufacturing. In addition to these, intensive and growing efforts were directed to regional development and small high technology firms.

Although OECD governments in general increased their efforts to promote innovation and technological advancement, there were still large differences among them in the degree and kind of goverment support.

3.1.1 Strategic Issues in the Planning of Public Sector R&D

The planning of public sector R&D was focused on the rapid development of new technologies and their application in the economy. The focus on these technologies derived primarily from[2]:-

(1) The extraordinary pace of advances in these technologies and in the science which underlies them.

(2) The wide applicability of the new technologies, not only in manufacturing, but also in communication, banking and insurance.
(3) The growing strategic role of technology in international competition and trade.
(4) Deregulation.
(5) Hostile takeover.

The many benefits from the exploitation of the technologies and the penalties for not doing so motivated the intense national efforts in these areas. The benefits and penalties involved ensure a high rank for the planning of public sector R&D on the political and economic agenda of most countries.

3.1.2 Dimensions of the Planning of Public Sector R&D

The strategic dimension of contemporary planning of public sector R&D policy centres around:-
(1) The role of government vis-a-vis industry in industrial R&D and innovation.
(2) Policies for promoting technologies and industries.
(3) Planning and coordination of R&D policy.
(4) Funding of R&D under budgetary constraints.
(5) Policy for long-term research and scientific personnel.
(6) Integration of R&D policy with industrial, economic and social policies.

Countries differ considerably in their stance on these dimensions. To illustrate the range of differences, the strategic policy stances of France and USA over the period are compared and contrasted.

USA	France
-The government took a less active and more indirect role in R&D policy, leaving most of the initiative to the private sector.	The government assumed an active and direct role in planning, coordinating, supporting and guiding its R&D policy.
-The government did not have an explicit industrial or high technology policy. However its national programmes for defence and space provided industry with important contracts and a market for high technology products and opportunities for spin-offs to the civil sector. Regulations were also been relaxed in order to allow industrial firms to cooperate in research within certain guidelines.	France's long-term economic strategy is focused on policy for promoting the key high technology sector. The government initiated large national programmes in each sector to provide financial support not only for R&D but also for "downstream" activities such as application and diffusion of technologies.
-Avoided centralised planning by government,relying instead on market forces to allocate resources and set priorities except in areas where the government was the prime user of the results[3].	Planning and coordination of R&D policy were centralised.

-Emphasis on national defence with large growth in military R&D and reduction in civil areas.	Emphasis on civil R&D and innovation for revitalising mature industries and creating new ones for the future.
-Did not set targets and research personnel matters. They were not regarded as the responsibility of government.	Set targets for high annual increases of funding and the expanded the number of posts for researchers, especially young scientists.
Technology and industrial matters were left largely to the private sector, while government was concerned with science and economic policies.	Attempted to integrate R&D policy with its industrial and broader economic policies.

3.2 Government Spending and Priorities

3.2.1 R&D Spending

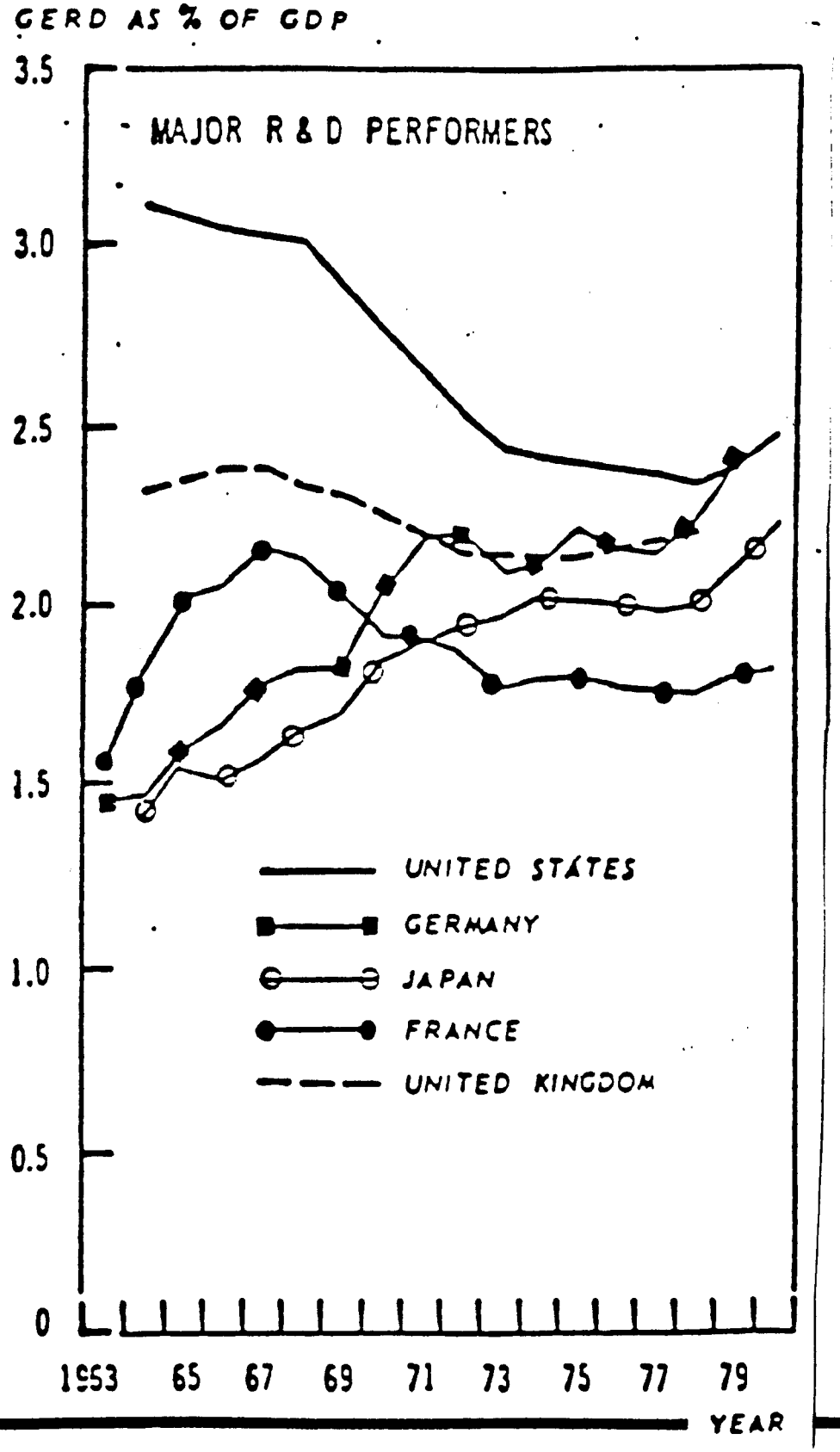
The trend of total spending on R&D in advanced economies fell into three distinct phases[4]. They were:-

(i) Phase 1

From the post-war period until the end of the 1960's. Trends in GERD as a percentage of GDP were increasing rapidly towards a figure in the 1.5% to 2.5% region. In the case of the USA and the UK, the percentage fell but stayed within that region. This is shown in figure 3.1[5].

Figure 3.1 Trends in GERD as a Percentage of GDP in the 1960's and 1970's.

Source: OECD (1985)



Source: OECD (1986)

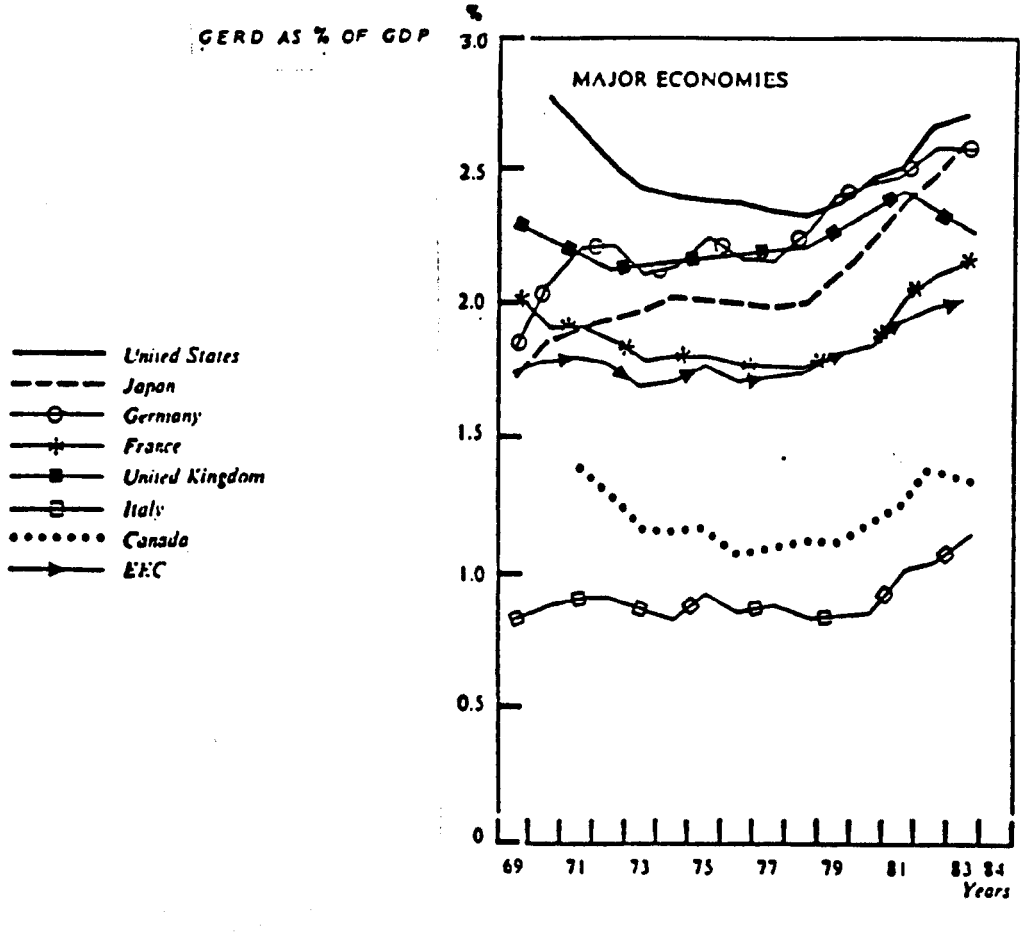


Figure 3.2 Total expenditure (all fields of sciences) as a percentage of GDP.

(ii) Phase 2

From the late 1960's through to the late 1970's (see figure 3.1). The growth curve flattened or even declined in some instances. The growth in phase 1 could be interpreted as a unique historical learning period, in which the institutionalisation of industrial R&D was completed. The level of investment in R&D in phase 2 was considered to be appropriate for the maintenance of equilibrium growth, whereas there were those who voiced concern

Source: Cabinet Office (1987)

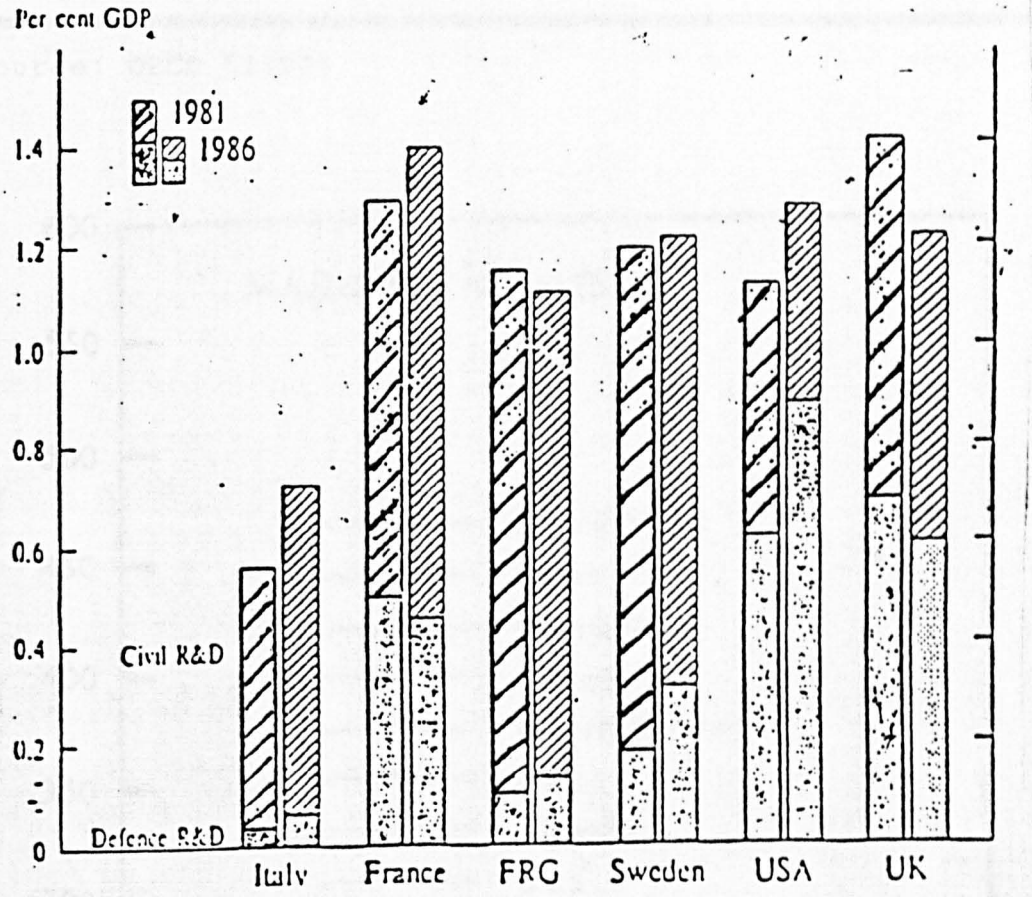


Figure 3.3 International comparison of government funded R&D.

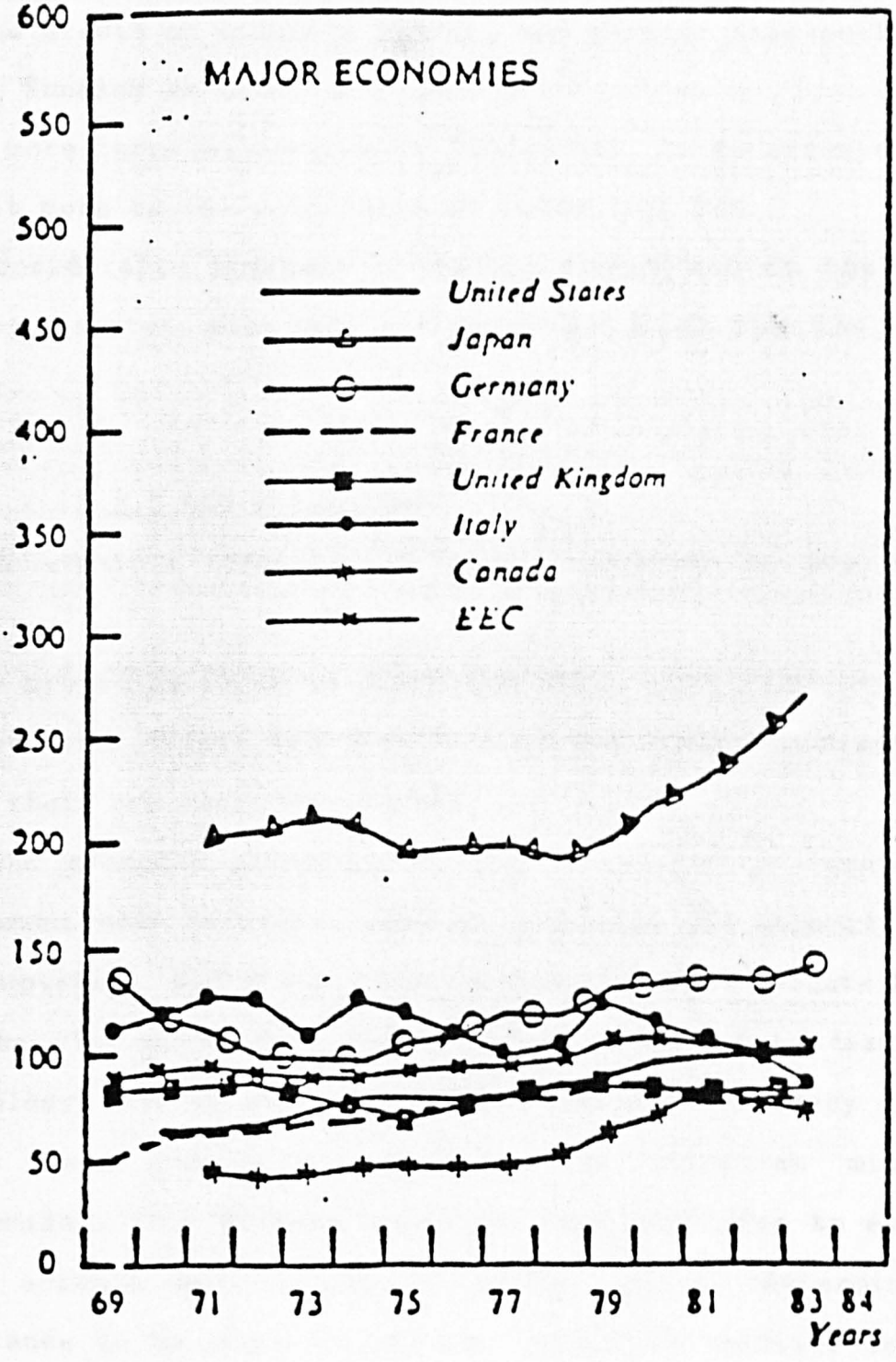
that the slowdown in R&D caused a negative effect in the long-term growth of the economic system. The debate over the balance between the public and private sectors and their respective responsibilities began to intensify in this context.

(iii) Phase 3

It began in the late 70's and continued as shown in figure 3.2[6]. There was a modest growth in R&D spending in most countries. Government funds for R&D increased in real terms (after accounting for inflation) in most countries in the early 1980's. The growth was particularly large in the USA (primarily

Figure 3.4 Ratio of business to public GERD funding when GERD funding = 100 from 1969 to 1984.

Source: OECD (1985)



for defence) as shown in figure 3.3[7]. Several countries on the other hand, grew little, including Canada and the UK.

Among the trends in phase 3 were:-

(1) The growth was strong in the USA and Japan as compared to European countries (see fig. 3.2).

(2) The growth of industry funding was greater than public sector funding as shown in figure 3.4[8].

(3) A more targeted government-funded R&D, in an attempt to link it more to the priorities of industrial R&D.

(4) Considerable pressure on public funded R&D in the higher education sector. HIEs were anxious to get funds from the private sector.

3.2.2 R&D Priorities

Governments supported R&D and innovation in two general ways:

(1) By providing funds to carry out R&D.

(2) Through indirect measures such as tax credit to firms which their own resources in R&D.

The economic situation during the period confronted the government with difficult choices regarding the support of R&D and innovation. Efforts to constrain governmental budgets for R&D ran the risk of denying the resources needed for science and technology; but without the latter, economic recovery and the longer term competitive positions of countries might be compromised. This dilemma compelled many countries to evaluate their science and technology policy and to determine the importance to be given to R&D and innovation relative to other national goals involving government spending.

These constraints, combined with new opportunities in science and technology, led some countries to change their allocation of funds among R&D objectives. Such changes reflected shifts in R&D priorities but many also arose from changes in the nature of government measures.

Given the crucial role of technological innovation, it was understandable that "economic development" R&D was given increased priority. Less understandable was the continuing decline of support for basic research. Such research was needed for innovation. Moreover, it was the source of fundamental information needed for the pursuit of all other R&D objectives. But beyond this, such knowledge was required to create opportunities for the future and to cope with the unforseeable challenges ahead.

The R&D priorities for most countries were strongly focused on advancing and applying new technologies (e.g. Germany)[9], usually in some form of relationship with industry, and often directed to specific industrial sectors. This provided yet another illustration of the growing integration of science, technology and industrial policies. The priority R&D areas, especially those centering on industrial technologies, were remarkably similar for many countries. Furthermore, cooperative efforts among countries emerged in some areas, particularly in those where there was a complementarity of interests and capabilities and where R&D costs and risks may be too large for individual countries to assume[10].

3.3 The General Response to Strategic Issues in the Formulation of S&T Policy

3.3.1 Project funding rather than institutional funding

Governments took the opportunity to restructure the roles, procedures and responsibilities of the institutions they fund. The autonomy of government research laboratories was diminished in order to ensure greater responsiveness to changing R&D requirements and a more effective transfer of knowledge. Project funding increased in size and influence and was used more as a policy tool of governments to direct research not only in government research establishments but also in university research.

However, the administrative procedures devised by funding bodies to ensure accountability of the project money were often cumbersome and time-consuming. Furthermore, short periods of support can lead to piecemeal research and an inability to finance large or expensive instrumentation and equipment. Efforts were needed by researchers to find the funds to pursue their work and younger researchers found it difficult to obtain funds for project funding.

3.3.2 Increasing Control and Direction

A dilemma governments faced, whatever the level of available resources, was to ensure that research simultaneously addressed problems of national importance and of scientific significance.

The problem faced by many countries was how the executive departments of government could influence laboratories to address issues of present national concern and to respond more quickly and effectively to changing needs.

The UK government tried to gain greater control and direction of R&D through a radical reallocation of research funding. This approach was on the Rothschild Report which recommended the comprehensive use of the customer-contractor principle; a principle which was adopted and continues to be applied by government departments.

That principle did not prove as effective as hoped during that period partly because as from 1977, the economic situation placed restrictions on departmental budgets and required ministers to re-examine their priorities. In addition, the original proposals were never fully implemented with regard to the Research Councils.

3.3.3 Concentration of Research Efforts

The concentration of research in a limited number of institutions was not a new phenomenon, but appeared to be increasing in some countries, particularly in the university sector. It would be prohibitively expensive to develop and maintain the potential research capabilities of all of a nation's research institutes at a uniformly high standard.

3.3.4 Summary

New efforts to strengthen, direct, control and concentrate the research effort can bear fruit if they are allowed to develop over a period of time. Thus, research policy makers can make plans only insofar as forecasts can be made regarding resources which will be available in the future. On the whole, and in most OECD member countries, the future levels of support for long-term research remain uncertain.

3.4 Networking

Despite some significant exceptions, the three sectors (higher education-government-industry) developed their long-term research programmes in relative isolation from each other. Governments attempted to encourage the development of links and relations between various performers of basic research. In many countries, the development of new systems of networks was apparent. Most significant were arrangements made to bring and foster collaborative research between firms, governments and universities.

3.4.1 New Industrial Networks

The industry adopted new strategies for developing and exploiting technologies of interest to a broad range of firms and of a sufficiently long-term nature to be labelled as "generic" technologies. These included cooperation between firms, consisting of approaches such as the pooling of resources from a number of companies to support research carried out by universities and other research institutes, as well as collaboration between institutes in conducting research themselves. The cooperation included companies from the same country as well as from different countries.

3.4.2 Relations between Research Institutions and Industry

Efforts were made to develop and strengthen relations between universities and industry[11]. These were because:-

(1) The governments attempted to marshall resources of their countries to promote economic development.

(2) The governments encouraged universities and other research institutions to contribute their capabilities (e.g. in Germany)[12].

(3) On the industry side, fundamental research in numerous areas was needed to develop and exploit important new technologies. The interest on the part of industry in strengthening relations with universities often centred on education and training.

It is difficult to identify the main line of development or to see the likely course the relationships will take in the future. The principle efforts appear to include:-

(1) Efforts by universities to interact with industry and develop links with firms.

(2) The development of research links in new areas or the experimentation with new types of longer-term contractual arrangements.

(3) The setting up of new bodies within universities or related to universities in order to respond to industrial demands for certain scientific and technological services.

(4) The development of international industry-university research links.

(5) A growing industrial interest in influencing educational curricula and programmes.

Although these developments did not generate resistance, they were not greeted with universal enthusiasm. Some academics feared that closer relations may jeopardize traditional academic freedom and values. University research, it was feared, may be

compromised and its "natural" directions could be distorted by close collaboration with industry.

Despite these concerns, however, interest in strengthening present ties and developing new ones grew. Governments provided stimulus and support for these developments.

3.5 Obsolete research equipment

Much of the laboratory equipment in universities and government research institutes was obsolete in many countries, with consequent effects on research. The funding allocated for equipment did not match the requirements of research. During this period a vast array of powerful techniques and instruments became available which allowed the measurement and manipulation of entities and phenomena which were previously inaccessible. As these tools became more sophisticated, their cost increased substantially.

The cost of re-equipping a laboratory was estimated to grow at an average annual rate of 4% above inflation during that period[13]. Coupled with inadequate past spending, the modernisation of equipment became a formidable problem[14].

Because equipment was expensive to replace, institutions kept what they had for a longer time. Much of the older equipment was frequently in need of repair.Governments and other responsible bodies were slow to respond, and when they did, the response was not commensurate with the magnitude of the problem.

The scientific community can be expected to continue to find ways of adapting, at least partially, to the situations through the pooling and sharing of the available modern instrumentation. The development of regional and national facilities is likely to

be a major direction favored by governments. This may well be complemented by increased efforts to create "centres of

Table 3.1 Business enterprise R&D expenditure (BERD): national trends.

Source: OECD/STHU data bank - December 1985

	1981		Compound real growth rates (%)					
	Millions	Percentage of total[b]	1969-81	1969-75	1975-81	1979-81	1981-83	Millions
United States	51 810.0	50.2	1.9	-1.6	5.4	6.5	4.4	62 816.0
Japan	15 517.3	15.0	8.4	7.6	9.2	13.6	10.7	21 270.0
Germany	10 686.3	10.4	5.9	5.6	6.2	2.0	2.9	12 649.0
France	6 304.4	6.1	4.2	3.9	4.4	5.7	2.9	7 461.1
United Kingdom (nse)	7 029.7	6.8	2.0	-0.1	4.1	2.2	-1.3	7 662.9
Italy	2 563.1	2.5	5.6	6.3	4.8	9.5	5.5	3 179.0
Canada	1 902.9	1.8	5.9	1.9	10.1	16.9	1.3	2 168.0
Spain	442.7	0.4	10.9	21.9	0.9	2.5		
Australia	344.4	0.3			1.6	1.4		
Netherlands	1 336.0	1.3	1.7	2.7	0.8	1.7	3.9	1 607.2
Turkey								
Sweden (nse)	1 442.1	1.4	6.8	8.5	5.1	7.5	7.9	1 874.6
Belgium	950.1	0.9	7.0	8.5	5.4	3.6	4.1	1 148.7
Switzerland	1 324.8	1.3	0.5	0.7	0.3	-0.1	-0.4	1 471.0
Austria	427.4	0.4	11.0	13.4	8.6	5.9		
Yugoslavia	294.4	0.3						
Denmark	273.8	0.3	3.7	1.9	5.5	5.2	10.7	372.3
Norway	309.1	0.3	7.3	10.0	4.7	2.4	9.0	414.2
Greece	22.9	0.0						
Finland	272.9	0.3	9.2	9.9	8.6	10.4	10.6	372.3
Portugal[c]	48.3	0.0	5.6	-0.8	12.5	31.7		
New Zealand[a]	52.0	0.1	7.2	12.2	2.5			
Ireland	67.7	0.1	7.2	5.5	9.0	14.9		
Iceland	1.7	0.0	46.4	73.8	23.2	5.8		
Total OECD[a]	103 120	100	3½	1	5½	6½		
of which								
EEC[a]	29 230	28½	4	3½	5	3½		

[a] OECD estimates.
[b] Secretariate estimates are provided where 1981 figures are not available.
[c] 1982.

excellence" to specialise in selected fields of research, with a substantial portion of any new funds for equipment being channelled to them. Centralisation and specialisation may appear

to be the major directions countries will take in responding to the instrumentation problem.

3.6 Industrial Strategies for Innovation

3.6.1 Industrial R&D Spending in the early 1980's

Industrial expenditures for R&D continued to increase during this period. In general, R&D fared better than other areas of corporate spending. There were several possible explanations for the continuing growth of R&D spending. It could be due to:
(1) Industry which regarded R&D as a high yield investment particularly under the circumstances of rapid technological innovation and promising prospects for advances and application.
(2) The recession caused by the Oil Crisis itself had contributed by intensifying competition and leading firms to resort increasingly to their R&D as a source of competitiveness.
(3) Finally, government policies for promoting industrial R&D may well have stimulated additional spending. The table 3.1 shows the BERD for OECD countries[15].

Some information as to the factors which firms regard as influencing their present levels of R&D expenditure was obtained in a survey of European companies. The findings are summarised in table 3.2[16].

For the industry groups as a whole, two factors were dominant: company strategy/objectives and the competitive climate. These factors were rated by all industrial groups not only as highly important in the circumstances then but then also as increasing in significance. Next in order of influence were several factors concerned with technology: technical sophistication, the rate of technical change, the state of

Table 3.2 Factors influencing R&D expenditures.

Source: OECD Science and Technology Indicator

Product-process factors	Rating*
1 Technical sophistication of product	6.2
2 Rate of technical change	6.1
3 Uniqueness of know-how	5.5
4 Time needed for R & D/commercialization	4.0
5 Cost of commercialization	3.4
Internal company factors	
6 Company strategy/objectives	8.0
7 Existing R & D capacity	6.3
8 Financial resources of company	5.9
9 Image of R & D within company	2.2
10 Backlog of problems	2.1
External factors	
11 Competitive climate	7.0
12 State of technology	6.0
13 Energy/materials situation	4.9
14 Economic climate	4.6
15 Social-political climate	0.7

*Scale of importance 0-10

technology and the uniqueness of know how. A third class of factors which were rated as important included the internal company aspects of existing R&D capacity and the financial resources of the company.

3.6.2 Internationalisation of Industrial Innovation

Industrial R&D spending was concentrated in large multinational firms. Such firms were responsible for approximately 75% of all industrial R&D funding in the OECD member countries.

The 1981 spending levels of some of the largest multinationals are presented in Table 3.3.[17]. An appreciation of the magnitude of these spending levels is given by noting that Siemens spent more on R&D than all of Swedish industry combined,and nearly as much as all Italian firms. Among the strategies used by multinational firms were:-

(1) Various kinds of arrangements with universities.

(2) Co-operative R&D programmes between firms.

(3)Acquisition of limited shares in other companies engaged in developing the new technologies.

These strategies may be viewed as:-

(1) Approaches to reduce the cost.

(2) Spreading the risk.

(3) Expanding the areas of R&D and innovation .

Costs are rising rapidly and R&D increasingly requires large teams of researchers, sophisticated equipment and considerable capital investments. Risks, always great in R&D and innovation, have become even larger as competition intensifies, the pace of innovation accelerates and the life cycle of products diminishes. Finally, needs and possibilities for R&D may cover a wider spectrum than some firms can afford to encompass in their own programmes, or include areas of technologies which can be pursued more effectively in smaller organisations.

3.6.3 Summary of New industrial strategies

Industry adopted new strategies for developing and exploiting the array of technologies. These include:-

(1) Joint R&D programmes.

Table 3.3 The 1981 spending levels of some of the largest multinationals are presented below.

Source: OECD Science and Technology Outlook

	Millions in National currency
Siemens	3 300
Hoechst	2 199
IBM	1 612
General Electric	814
Hitachi	139 700
Toshiba	84 000
Philips	2 907
Ciba-Geigy	1 076
Compagnie Générale d'Electricité	1 950

(2) Technology exchange agreements.

(3) The acquisition of limited shares in foreign firms engaged in developing new technologies.

(4) Joint ventures for innovation ,production and marketing.

The reasons for these private sector collaborations were:

(1) The pooling of capabilities and resources and the sharing of the rising costs and risks in bringing high technology to the market.

(2) To gain access to technology and to foreign markets.

(3) The ability to tap into the science and technology base of the countries involved.

Such cooperation can erode the significance, and even the meaning of conventional concepts such as "national competitiveness" and "technological leadership", while increasing the interdependency of countries with respect to technology and know-how.

3.7 Government Policy for Industrial Innovation

The governments clearly had a role and responsibility for promoting R&D innovation. Problems arised, however, from differing views among countries to the degree and kind of government involvement which was appropriate. There were views often strongly conditioned by the prevailing political and economic philosophy.

The following are some developments and trends in selected areas of government policy for industrial R&D and innovation over this period. An extremely wide variety of policy tools was used and they are illustrated in table 3.4[18].

3.7.1 Taxation Incentives

Indirect support for innovation was favoured by most governments although direct support was still used in many countries. Some countries introduced extensive packages of new measures, while others strengthened their existing tax relief provisions. Behind this was a concern that, unaided, firms lacked the financing capacity to undertake the broad range of activities involved in innovation, particularly under conditions of low profits and high level of borrowing.

Of all financial incentives, this class of measures involved the least amount of government intervention, with administration being mainly within the existing tax apparatus, and the greatest discretion for spending decisions by individual firms.

Table 3.4 Government policy tools for innovation.

Source: Adapted from Rothwell, R (1982).

Policy tool	Examples
Public enterprises	Innovation by publicly owned industries
Scientific and technical	Research Laboratories
Education	General education, universities, technical education
Information	Information networks and centres, advisory and consultancy services
Financial	Export credits, grants, loans, subsidies, financial sharing arrangements, loan guarantees
Taxation	Company, personal, indirect and payroll taxation, tax allowances
Legal & Regulatory	Regulations, standards, patents, inspectorates
Political	Planning, regional policies, encouragement of mergers or joint consortia
Procurement	Central or local government purchases and contracts, prototype purchases
Public services	Transportation, communication, health services
Commercial	Trade agreements, tariffs, currency regulations
Overseas agents	Commercial and defence sales organisations

3.7.2 Direct Financial Assistance

In its wider meaning, direct financial assistance can apply to any measures which involve a transfer of funds from government to enterprises to enable them to carry out activities which they would not otherwise perform. With direct assistance however, the intentions behind schemes are often more clearly identifiable and separable .

Three main forms of general aid were grants, risk sharing investment and assistance with loans. Clearly, these measures provided a spectrum of cost sharing, with grants most

advantageous to firms and most expensive for governments, and conversely for loans.

A great deal of effort was concentrated upon this phase of the innovation process. This was partly due to its importance and partly because it was a relatively well defined activity towards which policy measures could be aimed. While an impressive structure of assistance schemes remained in place in many countries, and indeed strengthened in some countries, the trend during periods of financial stringency was to concentrate resources on specific priority areas, such as high technology.

3.7.3 Regional Innovation Policy

Regional policy for innovation can exist at different levels. In some countries with federal or other developed structures, the regional government has a considerable degree of financial autonomy and may have policies in parallel with those of central the government. Alternatively, regional innovation policy may be an instrument used by central governments to achieve differential economic growth between regions and thus eliminate unwanted economic and social disparities.

A survey of OECD[19] member countries inquired about the kinds of policies that were pursued or were being planned in order to introduce and encourage R&D activities and the adoption of innovations in companies. A wide range of policies and measures were identified by the study, as shown in table 3.5.

The table shows that policies were oriented toward enhancing the flow of information relevant to R&D innovation and improving the infrastructure related to these activities. In summary, there was much enthusiasm and many initiatives on the part of local

Table 3.5 Some regional policies for promoting R&D and innovation.

Source: OECD, 1982.

A	Direction Assistance to Enterprises for Technological Advance, Innovation, New Enterprises
	1 Form of Assistance
	Advice to individual firm General dissemination of information Financial
	2 Immediate Purpose of Financial Assistance
	Studies, surveys, pilot schemes Operations
	3 Target Beneficiaries
	Particular industries Particular types of enterprises
B	Assistance for Improving Infrastructure and Information Transfer
	1 Creation of new R & D institutions
	2 Extension of institutions' functions to aid in innovation
	3 Development of counselling services
	4 Training courses and sites
	5 Planning for and creation of Science Parks

governments in this area. Some central governments were, however, reappraising their long experience in regional development.

3.8 Co - ordination of S&T Policy

The science and technology policies of most countries were often sectoral, in origin and orientation. Ministries, councils and other bodies devise policies to meet their individual interests and needs, often with little coordination among them. As a result, "national " science and technology policies were

sometimes a conglomerate of various aims and measures which may lack cohesion and strategic purpose from a national perspective.

The closer coordination of the various science and technology policies assumed greater importance and urgency as countries sought to accelerate technological innovation in order to improve their economic growth, productivity and competitiveness. Rapid innovation required timely and relevant inputs from virtually all parts of the science and technology system and close interaction of its components.

Better co-ordination of science and technology policies and their closer integration with economic and other policies were among the main goals of several countries. Co-ordination, however, was made difficult by:-

(1) The institutional complexity.

(2) The diversity of science and technology systems (with components ranging from university to industry).

(3) The weak coupling between components and differences among them in purpose, values and outlook.

(4) A particular difficulty in co-ordination was in the time dimension: components of the system had widely different response times, ranging from the multi-year scale of institutions involved in long term research to the short time frame of applied work in industry.

Better coordination of science and technology policies will continue to be an important goal and a difficult problem for most countries. Further efforts can be expected to strengthen existing mechanisms for co-ordination. Furthermore, coordination may be improved considerably by the trend towards strategic planning of science and technology.

3.9 Strategic Planning

Governments have given increased attention to strategic planning for science and technology. By their nature, advances in science and, to some extent, developments in technology are difficult and often impossible to anticipate. Furthermore, such advances and developments create opportunities and options which may not have been forseeable at the time of planning. In these respects, science and technology themselves are major sources of uncertainty and because of their wide ranging impacts, they destabilise the broadened system within which they operate. Many countries found that economic, political and social conditions could significantly alter the best laid plans.

The trend towards strategic planning by governments for science and technology had several sources. One of the most significant and general of these was the increasing role which numerous countries expected science and technology to play in shaping conditions of the future. Planning increased also as a result of the importance many countries assigned to the development and introduction of new technologies for:-

(1) Restructuring their industry.

(2) Enhancing productivity.

(3) Restoring their productivity and restoring their economic growth and competitiveness.

The achievement of these goals, it was recognised, required sustained effort and the commitment of substantial resources over several years. Hence strategic planning became a necessity. This was reinforced by the paucity of resources available during the prevailing period of economic stagnation: careful planning and

judicious choice of priorities were needed if the scarce resources were to be focused on important goals and applied efficiently.

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CHAPTER 4: R&D IN THE UK From 1970-1989

4.1 Definition of R&D Activities in the UK

Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications.

A definition of R&D activities in the UK can be drawn between broad categories of R&D activities as follows[1]:-

(1)Basic Research

(2)Strategic Research

(3)Applied Research

(4)Development

The definition of the terms used above are based on those of the Frascati Manual[2]. They have been modified slightly to introduce the concept of strategic research.

Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

Strategic research is defined as applied research which is in a subject area which has not yet advanced to the stage where eventual applications can be clearly specified.

Applied research is also undertaken in order to acquire new knowledge. It is however, directed primarily towards practical aims or objectives.

Experimental development is systematic work drawing on existing knowledge gained from research and practical experience that is directed to producing new materials, products or devices, to installing new processes, or to improving substantially existing materials, products or devices.

The categories above are not clear-cut. Research spans a spectrum and it would be a misleading concept to suggest that any research project can be assigned to a particular point in the spectrum. A research and development project may involve elements from all categories in changing proportions as the work progresses. The categories are necessary to facilitate discussion with regard to the research activities of RAs but the difficulties must be kept in mind.

4.2 Historical Background

4.2.1 The Post-War Period

The wartime mobilization of scientists and technologists in Britain had an enormous effect on the country's post-war science policies. At the operational level, there was an expansion into nuclear, aviation, and electronic research. Advisory systems were established in the defence and civil sectors which, it was hoped, would steer the nation's growing R&D effort into areas of national concern. The Labour Government which took office in 1945 was committed to the relief of long-standing social inequities and to new programmes of social and economic planning. It was convinced of the importance of R&D to the achievement of its goals but the possibilities for implementing a science policy that took into account these new social priorities were strictly limited[3]. Britain's economic ar

political status was seriously undermined by the war, and international trade and finance had to be considered in all domestic policy-making.

The colonial legacy affected British defence policies for many years after the war and hindered economic cooperation with Europe. The "special" relationship with the United States and the government's determination to possess an independent nuclear deterrent forced the British to undertake a massive rearmament programme. The nuclear programme, its commitment to NATO and the defence interests in Near and Far East entailed an enormous diversion of resources and technological capabilities away from civilian industrial production, and Britain was launched into an arms race in advanced weaponry that she could not afford and that seriously distorted the R&D profile of the nation for many years and, to some extent, still does.

An attempt was made to improve the machinery for scientific advice and coordination with the creation, in 1947, of the Advisory Council for Scientific Policy (ACSP). The chairman, Sir Henry Tizard, was also the chairman of the new Defence Research Policy (DPRC) and it seemed at first that this machinery would be sufficient for the coordination of the national R&D effort. The powers of ACSP were, however, severely limited. It had no executive responsibility, no power to allocate funds, and no power to initiate research or determine priorities in any way. When Tizard resigned in 1951 the ACSP and DPRC were completely separated again, there were even less coordination of civil and military R&D. British science policy immediately after the war

was summarised by Vig[4] as follows:-

> "For the most part, the Labour Government's aspiration to redeploy science and technology for social and economic purposes came to naught. Civil research expenditure was increased significantly but pre-war institutional arrangements were largely consolidated in the post - war years. Science policy coordination was improved temporarily, but "mission" oriented programmes in military and other departments soon overwhelmed general policy considerations. These were expanded in the years thereafter."

In the expansion that followed, civil and military nuclear developments heavily influenced university research priorities as well as governmental ones. High energy physics and related disciplines, especially, began to dominate university research expenditures. Nuclear energy and aviation absorbed at least half of all civil research funds in the 1950's in addition to most of the military R&D expenditure. Thus, the priorities of rearmament and weapons developments led to a concentration on big science activities in the universities and government. This, in turn, led to ongoing commitments that had to be met, making priority planning an impossibility for ACSP or any other sub-cabinet advisory body.

By 1963, a serious crisis developed over government aid to science and technology. Public expenditure rose exponentially for some years, averaging 12-13 percent growth per annum, but there was no effective machinery for coordinating this expenditure or for establishing budgetary priorities. The Department of Scientific and Industrial Research (DSIR) and ACSP recognized the need for priorities but declared themselves incapable of setting

them. There was also concern in DSIR and ACSP over the apparent failure of the large R&D investments to pay off in the industrial and economic area.

A Committee of Inquiry into civil science was set up in the early 1960s under the chairmanship of Sir Burke Trend and in its report to the government in 1964 it recommended that:-

(1) A new Ministry of Education and Science be established.

(2) The ACSP be abolished.

(3) A new advisory committee, the Council for Scientific Policy (CSP) be established to advise the Secretary of State for Education and Science on the distribution of funds among Research Councils;

(4) Three new Research Councils be established. The Science Research Council would take over the granting functions of DSIR and appropriate research establishments. An Industrial Research Development Authority would take over the DSIR's industrial R&D promotion activities and appropriate research establishments.

The new Labour administration which took office in 1964 implemented all of these proposals except one. Instead of an Industrial Research Development Authority, a new Ministry was created, the Ministry of Technology, which was to fulfil Prime Minister Wilson's promise to remake Britain in the white heat of scientific revolution. A Central Advisory Council on Science and Technology, headed by a Chief Scientific Adviser, was established within the Cabinet Office to advise the government on the most effective strategy for the use and development of scientific and technological resources.

4.2.2 The Customer-Contractor Principle (Rothschild Principle

With the change of government in 1970, there were again changes in the organisation of the British Government's research system. The Ministry of Technology was abolished, a Department of Trade and Industry created instead. There was a complete review of governmental R&D carried out by Lord Rothschild[5], head of the Central Policy Review Staff. His detailed recommendations, which the government accepted, were that

(1) Applied research should be organized more widely in accordance with a customer-contractor principle under which the departmental "customers", aided by their scientific advisers, would be responsible for defining their research requirements in terms of departmental objectives and for commissioning work from in-house or external "contractors" who would advise on the feasibility of meeting particular requirements and put forward proposals for appropriate projects.

(2) In order to bring applied research in some areas covered by the Research Councils within the scope of the customer-contractor principle, some of the funds provided to the Councils should be transferred to customer departments.

(3) Departments should become more closely associated with the framing of the Research Councils' programmes by having full members on the Councils, not assessors.

(4) The Council for Scientific Policy should be abolished and a new Advisory Board of the Research Councils established to advise the Secretary of State for Education and Science on the allocation of the Research Council science vote.

(5) Adequate central machinery should exist for ensuring cooperation and coordination between departments and for providing a concerted view on scientific and technological aspects of the government's policies, both domestic and international. Responsibility for this should be exercised by the Lord Privy Seal, a Minister without portfolio.

From 1972 onwards, the customer-contractor principle was introduced into the departments and these now commissioned the applied R&D they needed from one of the Research Councils, industrial firms or one of the department's own laboratories. Decisions on research requirements were related to departmental objectives and did not fit directly into any national science and technology policy. Indeed, Rothschild specifically stated in his report that any attempt to formulate overall objectives for a supposedly collective activity like R&D would only lead to confusion (see App. 4.1).

By 1976, it seemed that the new system was not providing the expected results and the government reviewed the arrangements that existed for the coordination of its research activities. Changes were made in the hope of achieving greater coordination, among them the establishment of a new advisory body, the Advisory Council for Applied Research and Development (ACARD), which was to provide a forum of external advice to the government on applied R&D. An overall coordinating committee of Chief Scientists and Permanent Secretaries was established, the office of the Chief Scientific Adviser to the government was abolished and a Chief Scientist was appointed to the Central Policy Review Staff.

4.2.3 From 1979 - 1987

When the Conservative Government replaced the Socialist Government in 1979, a prime objective was to restore competitiveness in economy. Tax cuts were introduced and therefore there were constraints on public expenditure. The RAs, like any other beneficiaries of public funding, were affected.

Although Britain had an excellent record in basic research, its performance in exploiting the results of research still left a lot to be desired. The Government therefore encouraged the academic and the industrial spheres to move closer together. The Government believed that a beneficial by-product of the restrictions in public funding (provided they did not go too far) would create an incentive for that to happen. As a result, there was a considerable increase in universities' earnings from research contracts placed by industry - from £27 million in 1982-83 to £68 million in 1986-87. Another incentive given to universities was the property rights to scientific discoveries. Universities could keep any additional funds they attracted from the private sector without being penalized by a corresponding reduction in public funding.

Schemes such as Alvey initiative were established to foster the important areas of information technology. This concept was later broadened and the LINK scheme was introduced to provide a framework for collaboration between all Government departments, Research Councils, HEIs and industry in a range of areas of strategic importance.

British Business had more than doubled its support for UK universities through research contracts between 1984 and 1988 i.e. it went up by 140% to £78m during the five years (1984-88)[6].

In spite of this fast growth, contracts from British industry accounted for only 2.8 percent of the total university income in 1987/88, suggesting that there were distinct limits to the revenue which universities can expect from business[7].

In July 1987, the Government published its White Paper on Civil Research and Development[8]; and in January 1988 the Department of Trade and Industry (DTI) published its White Paper on Enterprise[9].

In the DTI White Paper, the Government emphasized that industry itself was best able to assess its own markets, and to balance the commercial risks of financing R&D and innovation. The Government believed that it should not take on the responsibilities which were primarily those of industry - whether directly through research subsidies, or indirectly through new tax concessions. Consequently, the Government was increasingly withdrawing from near-market research. A preoccupation of Government policy was the management of the resources for research.

There were a lot of changes going on during this period and the RAs felt that there ought to be greater stability since R&D was a long term business.

4.3 Elements in the UK's Research System

The advisory and executive elements of the British research system are shown in figure 4.1 and it can be seen that, on the surface at least, it appears to correspond to a coordinated system[10]. The following paragraphs will briefly describe the functions of these elements.

Source: R. Jarlath.(1984)

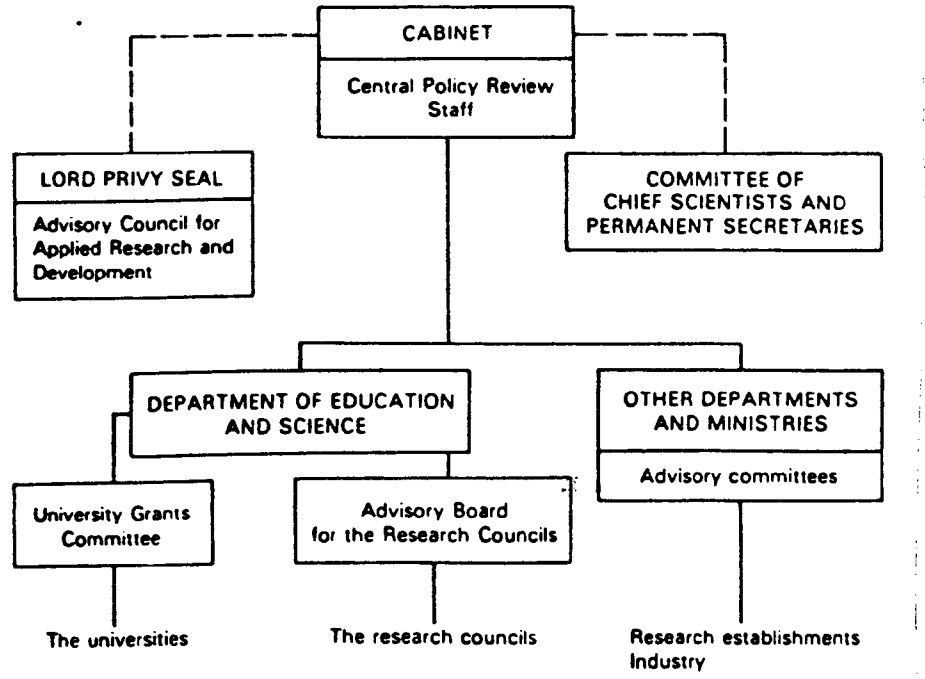

Figure 4.1 Main elements in the UK Government R&D system.

4.3.1 Cabinet Office

The Cabinet Office had two functions. The first was a general supervision of the coordinating links between two or more departments; the second was more creative in that it involved both the provision of a forum in which important issues could be discussed and the initiation of reviews of subjects of interest to a wide range of departments in which there was a significant scientific and technological input. Thus, in its scientific role, the Cabinet Office:-

(1) Provided a focal point for advising ministers or ensuring that advice reaches them on the science and technology aspects of the government's policies, both domestic and international;

(2) Invited studies on certain trans-departmental issues involving R&D;

(3) Monitored and advised on how the arrangements for the management of the government's R&D effort were working;

(4) Assembled information to ensure that Parliament and the public had readily available sources of information about departmental R&D programmes.

4.3.2 Committee of Chief Scientists and Permanent Secretaries

In order to ensure an overall review of R&D and other scientific matters at a top official level, the Committee of Chief Scientists and Permanent Secretaries under the chairmanship of the Secretary of the Cabinet was responsible for seeing that scientific questions were brought before ministers collectively and appropriately and that scientific priorities reflected those of the government as a whole.

4.3.3 Central Policy Review Staff (CPRS)

The CPRS was within the Cabinet Office and has responsibilities which covered the whole spectrum of government business but, from its inception, it had been interested in issues which had a scientific content, and it had always included a number of graduate scientists among its members. The CPRS assisted the government in:-

(1) Working out the implications of its basic strategy in specific areas.

(2) Establishing the relative priority to be given to different elements of the government's programme.

(3) Identifying areas in which new options could be examined;
(4) Ensuring that the underlying implications of the course of action were fully analysed and considered.

Prior to the establishment of the office of the Chief Scientific Adviser within the CPRS, concerted advice to ministers on science and technology aspects of government policies was arranged through the Cabinet Office machinery at an official level where the view of the departments and their chief scientists were coordinated - normally under the chairmanship of the Head of the Science and Technology Group. When the Chief Scientific Adviser was appointed to CPRS the Science and Technology Group in the Cabinet Office was dissolved. The Chief Scientific Adviser worked with other professional staff in a multidisciplinary team and was a member of the Committee of Chief Scientists and Permanent Secretaries. There was a considerable scope within the terms of his appointment for direct submission of advice to the Cabinet on scientific and technological matters, and he had access to, and could comment on, all departmental reviews and reports prior to their submission to Cabinet. The role of CPRS was not primarily one of coordination. Rather, it was one of asking fundamental or innovatory questions and undertaking studies or projects that were best led from the centre.

4.3.4 Advisory Board for Research Councils (ABRC)

The ABRC was set up in 1972 as the successor to the Council for Scientific Policy to advise the Secretary of State for Education and Science on two matters:-

(1) His responsibilities for civil science with particular reference to the Research Council system, its articulation with the universities and government departments, and the support of postgraduate students.

(2) The allocation of the science budget amongst the Research Councils.

The Board was also charged with the promotion of close liaison between Councils and the users of their research.

The most important function that the ABRC performs was the allocation of resources to the five Research Councils. In advising the Secretary of State on the distribution of the science budget amongst the Research Councils the Board used a forward planning procedure that it called the Forward Look. The Councils were asked to submit to the ABRC their own 'Forward Looks' in a format called the Common Framework, which allowed for comparison of the policies and activities of five different bodies.

4.3.5 Research Councils and Ministries

Since 1972 the Rothschild customer-contractor principle was built progressively into the management of government-sponsored R&D. Funds were transferred from the science budget of the Department of Education and Science to the "customer" departments so that they could commission appropriate research from the Agricultural, Medical and Natural Environment Research Councils (ARC, MRC, NERC). The SERC and the SSRC were exempted from the compliance with the customer-contractor principle because the former was concerned with pure rather than applied research and the latter was, at that time, very small. Arrangements were m

by amending Research Council charters, to appoint departmental representatives as full members of the Research Councils. The main intentions of the Rothschild changes as they affected the Research Councils and the work of the ABRC could be summarized as follows:-

(1) The customer-contractor principle already in use in major areas of government R&D would be applied more widely.

(2) The Research Councils would be preserved within the Department of Education and Science and not be transferred to the departments that would be expected to be their major customers.

(3) Departments would be more closely associated with Research Councils by full representation on the Councils themselves.

(4) The ABRC would be given information about the size and nature of the work to be commissioned by customer departments and to take this into account when advising the Secretary of State on a policy for the science budget.

(5) The ABRC's recommendations would be considered by the government in planning future public expenditure totals for R&D.

(6) The Councils would be responsible for the detailed management of the commissioned research. Partnership and cooperation between departments and Research Councils would be an essential feature of the new approach. The support which the Research Councils were giving to the universities would continue unimpeded.

In its second report, issued in 1976, the ABRC claimed that a good start was made toward realizing Rothschild aims. In March 1979, a major review of the effects of the Rothschild system on the Research Council was carried out. The review, which was presented by the Lord Privy Seal, gave the impression that in general the new system was working satisfactorily in all areas.

But the difficulties experienced by at least one Research Council in dealing with the customer-contractor principle would seem to cast some doubt on the value of this review. The MRC was violently opposed to the introduction of a customer-contractor relationship between itself and the Department of Health and Social Security (DHSS) and to a removal of a part of its budget to the Department. The DHSS for its own part had to build up the necessary expertise to discharge its own separate functions for developing health and social services research and did not feel competent to also develop expertise for a full commissioning role in the biomedical field because its research activities extend into other areas.

By 1981, the secretary of the MRC announced that the customer-contractor was abandoned in the MRC and that the Council regained control over the part of its budget which was previouly been earmarked for DHSS contracts.

4.3.6 ACARD (which was superseded by ACOST)

The Advisory Committee on Applied Research and Development (ACARD) was established as a separate body to improve the interface between government and external organization in the area of applied R&D. The ACARD complemented the work of the ABRC but was distinct from it, and differed from it in several ways. Unlike the ABRC, it concentrated mainly on technology and the industrial applications of science rather than on "pure" science. It did not manage scientific institutions nor did it allocate resources. In term of reference it was to advise ministers and to publish reports as necessary on[11]:-

(1) Future developments and application of technology;

(2) The role of the UK in international collaboration in the field of applied R&D.

(3) The coordination, in collaboration with the Advisory Board for Research Councils, of these activities, with research supported through the Department of Education and Science.

The members of ACARD were mainly senior industrialists and academics; the Chairman of ABRC and the Chief Scientific Adviser were also members. The Chairman of the Council was a leading industrialist. Its secretariat was provided by the Cabinet Office. The Council reported to the Prime Minister.

4.4 Coordinated R&D

The need for a more coordinated R&D effort was echoed by ACARD (1986):

> "Countries with a major technological capability have developed mechanisms for holding debates about directions in science and technology and the associated policy. In this country, we do not have a forum in which to carry out this activity. In fact, we do not even have the information which would allow this to be managed effectively, and our presently dispersed data are essentially non-interactive"

Responsibility for R&D in the UK was shared between many Departments. No minister was responsible for science and technology issues across the board.

The government agencies involved in the funding and performance of R&D (besides the Dept. of Education and Science) were the Ministry of Defence and the Department of Energy, Industry, Environment and Transport, and Health and Social Security. No single ministry or department was responsible for

the government's civil R&D effort, though most of the funds for civil research were channelled through just two - the Department of Education and Science and the Department of Industry.

The elements of coordinated science policy machinery were present but to describe it as such brings a negative official response. The official view on coordination was this[12]:

> "Whilst there is coordination of the UK policy implementation, it occurs much more at the working level than at a central steering coordination level. To this extent the UK system falls between Brickman's atomistic and low levels of coordination."

It appeared therefore that although there was a high level coordinating committee (i.e. the Committee of Chief Scientists and Permanent Secretaries), a Cabinet Office Chief Scientist and an independent scientific advisory committee (ACARD), the level of coordination of the nation's R&D effort was quite low. The ministers and departments set their own priorities and, in accordance with the customer-contractor principle, commissioned the research they needed. Interdepartmental rather than overall coordination would seemed to be the preferred science policy mechanism (see App. 4.2).

4.5 Priority and Exploitability

The realization that technological exploitation was a particular problem in the UK was evident and widely discussed for some years. It called for different kinds of government policies, accelerated sectoral concentration combined with attempts at central economic planning in the 1960s, new structures for the funding and direction of publicly funded research in the 1970s, a conscious attempt to increase private expenditure on new

ventures and development in the 1980s. Some of these were more successful than others, but it took the drastic effects of sustained recession in the late 1970s and early 1980s, and the realization that changes would be far more rapid in the new industrial environment, to create a new determination to get a greater economic return from scientific and technological activity.

UK contributed only about 5% of the world's output from research[13]. It would be difficult for the Government to change this figure no matter how generous the government could be towards R&D.

This implied that priorities and mechanisms for selecting and rejecting opportunities to spend public money on research had to be established. The need for such mechanisms was identified in a report by ACARD (1986)[14]:

> "a process should be established for identifying exploitable areas of science, which has some certainty of continuity, for the long-term economic health of the country."

A country that adopted this strategy of a more selective approach to research was Sweden. It recognised the need to concentrate its resources more than a decade ago and was successful in identifying scientific priorities. Even the US, despite its vast science budget, had to make hard choices[15].

But on the the other hand:

> "the more one concentrates, focuses and selects, the less flexibility one has." (Dr. Donald Braben, head of venture research at BP.)

In the UK, the basic mechanism to privatise and selection of research were as follows:-

(1) The first mechanism was through the Advisory Council for Science and Technology (ACOST)[1], representing both academic and industrial science. The Chairman reported to the Prime Minister, who can - indeed has - attended ACOST meetings. A good example of ACOST's work was a study of opportunities in opto-electronics, a subject it considered vital to Britain's future.

(2) The second mechanism was the Cabinet Office's science secretariat, headed by the Government's chief scientific adviser, who also had access to the Prime Minister. This secretariat was also responsible for assembling the annual report on Britain's research and development.

(3) The third mechanism, the Centre for the Exploitation of Science and Technology (CEST), was conceived in Whitehall but was mainly funded from subscriptions of science based British firms. CEST was expected to play a key role in identifying opportunities for IRCs.

4.5.1 CEST

The Centre of Exploitation of Science and Technology (CEST) was formally launched in Nov 1987. Some of the UK's leading companies were involved in and contributed about £5 million to the launch. The Government gave a further £1 million[16]. The establishment of the Centre was recommended in a 1986 report from ACARD.

The thinking behind CEST was that Britain urgently needed a mechanism for spotting and synthesising commercial opportunities. Although the country had a fertile intellectual

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[1] ACOST superseded ACARD in 1987.

base, it had a dismal record in exploiting high-yielding ideas of the kind that brought Japan international success[17].

The role of CEST was to[18]:

(1) Develop a demand-led industrial perspective,

(2) Develop methods for practical exploitation,

(3) Act as a focus to allow industrial relationships to form

(4) Reduce uncertainty in industrial investment in science and technology.

The new machinery for managing science began to have an impact. For example, the budget for Astronomy was cut back. Savings was channelled into new IRCs and other initiatives such as the £15 million Materials Commission announced by SERC in 1988.

4.5.2 IRCs

The idea of the IRCs originated with the ABRC in 1987 in a discussion document "A Strategy for Science Base"[19]. The proposals were set against the background of Britain's declining economic competitiveness, higher education's need to justify itself to government in increasingly utilitarian terms, and the ABRC's plans for stretching limited resources by further concentrating university science and scientific research in fewer departments and centres.

The first was announced that year at Cambridge. Four more centres, each with an engineering bias, were announced by the SERC in early 1989. These centres would be reviewed individually after a certain length of time (around six years), and may get backing for another two to four years. After that they may be asked to become self-supporting.

The IRCs were proposed as national centres of excellence in their respective fields. They were intended to pool expertise from different departments in various universities into single centres. The hope was that such centres would be better placed to use government money efficiently and to attract large-scale industrial backing than the existing, diversified university research structure.

But some scientists in the universities argued that the old, diverse and often small-scale ways of doing research were successful at the pure research level[20]. The grants involved were huge by SERC standards and people in the universities expressed concern that they would lose out if and when the IRC programme were to build up and more and more of the SERC budget was apportioned to it. Critics of IRCs claim that the programmes would erode the human and financial resources to a damaging extent. The IRC defenders' response was that IRCs attracted new money from both government and industry, so no damage would occur.

Another possible problem of trying to organise and concentrate resources was expressed by Prof. Denis Noble of the Save British Science pressure group[21]:

> "It is a mistake to over-organise science. Discoveries are not made by telling people to create something. You cannot plan them. The tactic of backing individuals has worked brillantly for this country".

The IRCs were fiercely controversial feature of the Government's strategy for science. They were set up from the funds of the science budget. Thus they could drain money which otherwise could help sustain present research in university

departments or national laboratories[22].

4.5.3 LINK

This programme was announced by Mrs. Thatcher in Dec 1986. It was a £210 million government initiative to boost industrial R&D and to make scientists and the business community more aware of the potential for profitable exploitation of science and technology[23].

The first five programmes were launched in Feb. 1988 at a cost of £83 million, of which the Government would provide up to half. Over the following five years further programmes were expected to take the total Government and industry spending on LINK to at least £420 million[24].

The main objectives of LINK were[25]:

(1) To foster priority areas of scientific research directed towards the development of innovative products, processes and services by industry.

(2) To stimulate a real increase in industry's own investment in R&D.

(3) To help industry exploit developments in science and make scientists more aware of industry's needs by strengthening the links between industry, higher education, the Research Councils and other research establishments.

(4) To develop technologies which cross the boundaries of industrial sectors and scientific disciplines.

4.6 HEIs

The universities, which received more than half of the funds provided by the Government to support the science base, the University Grants Committee (UGC) instituted a number of important changes. Its allocation procedures incorporated explicit recognition of the research dimension, and it undertook a series of subject reviews which would have far-reaching implications for the pattern of research support within system.

The Advisory Board for the Research Councils (ABRC), in its Strategy Advice on the Science Base, proposed a differentiation by institutions according to research role - the so-called R, T, X proposal[26]. The Government did not accept that such categories should be imposed.

4.7 Privatisation and Agency Status

In the 1980's, political philosophies which favoured freer use of market forces directly confronted the issues of flexible resource deployment. Increasingly, the "automatic" right of funding was removed from research institutions. The process started with organisations such as RAs which were already in the private sector and were in receipt of large tranches of extramural funding from the DTI.

4.7.1 Impact on GIREs

In June 1988, the DTI announced the decision to privatize one of its REs (NEL) and the remaining three REs would be given agency status (WSL, NPL, LGC) and greater autonomy with their own executive. Furthermore the accountability for their own performance would be clearer.

The decision to privatize NEL was a result of the recently declared policy of shifting the financial burden of "near-market" research away from the public purse. The government regarded 3/4 of the work at the the National Engineering Laboratory as falling into the category of industrially relevant R&D. Since the principal beneficiary was industry, the "market-pull" was felt to be more easily provided and understood when the R&D was carried out in an organisation whose progress depended on its success in providing services to industry. The DTI would still continue to support industrially relevant R&D carried out once NEL was privatized, subject to normal criteria applied to extramural R&D.

The agency status given to the remaining three REs was meant to give greater flexibility and responsibility to the REs. This was done in line with the policy described in "Improving Management in Government: - The Next Step"[27]. It was considered an appropriate structure for REs whose main task was to undertake research for public sector customers. Industrially relevant R&D and repayment work for industrial customers would each be limited in the future to 10% of the full cost of each RE. They were allowed to spend 10% of the full economic cost on strategic research carried out for the DTI. They were also allowed to work on collaborative research and receive up to 50% support.

4.7.2 UKAEA

The UKAEA was established in 1954 as a public sector organisation with a mission to act as a resource for technical excellence in support of nuclear power development. Since then, it expanded into a conglomerate of seven management centres

providing a wide range of research and development work and regulatory bodies.

In May 1989, the United Kingdom Atomic Energy Authority changed its status to an agency and called AEA Technology[28]. The aim was to convert a public sector, mainly government-funded institution with huge R&D resources to a commercial organisation. This would not be easy considering the civil servant culture that was imbedded in the organisation[29]:

> "Encouraging such changes within a large, unwieldy organisation which has not had a strong commercial ethos is easier said than done."

The Atomic Energy Authority had a total staff number of over 12000, about 5000 could loosely be described as being in management positions, most of them scientists and engineers.

Selling UKAEA's service was not an entirely new venture. In 1986, the Authority was allowed to become a Trading Fund with the aim of putting it on a more commercial basis, which in this instance meant emphasising the customer-contractor relationship for non-nuclear business rather than relying on government-orientated work. Since 1986, the industrial and overseas non-nuclear work has risen to about £40 million with prospects of a further £10 million in 1989. At Harwell, the biggest laboratory, the figure was 25%[30]. But this was only 10 percent of the Authority's work. The launch of AEA Technology was meant to open the doors of the largest research and develoment organisation in Europe and to launch a major marketing drive to sell its high-tech knowhow to industry and business throughout the world.

4.8 International Collaboration

In some advanced technologies the resources required to stay in the front rank are beyond the individual capacity of even the largest firms. International collaboration, especially within Europe, was therefore essential if UK firms were to be competitive in world markets. In the information technology and telecommunications sectors, in particular, collaboration became increasingly important, primarily because of the need to pool resources, develop common standards and exploit the forthcoming Internal Market.

In some other sectors there may be advantages for industry in international collaboration for certain large or longer-term projects in order to reduce costs, tap into other expertise, or to build better international links, particularly in Europe. For example, EUREKA was complementary to European Community R&D, being industry-led to a much greater extent and mainly concerned with the commercial exploitation of R&D. However, some of the programmes proposed by the EC were neither necessary nor particularly beneficial, and one sees little advantage in collaboration for collaboration's sake.

It was particularly important to bear in mind that the existence of a European activity did not of itself obviate the need for a domestic counterpart. In order to be seen as credible partners, to be in a position to significantly influence the content and direction of collaborative projects, and to be able to benefit from the eventual commercial exploitation, all usually require a strong national capability in the first place. In deciding the UK's negotiating line on the content of European Community R&D and in deciding on what projects to support (e.g.

what EUREKA projects), the Government therefore paid particular regard to what could best be done domestically and what could be done collaboratively in Europe.

4.9 Conclusion

4.9.1 Problems Faced by UK

The S&T policy of a country encompasses its innovation policy. Innovation is the introduction of new products or processes to the market, incorporating new technologies or using old technologies in a novel way. Successful innovation is an essential ingredient of wealth creation.

The UK industry overall has had a long history of failing to match the international competition in innovation. This was reflected in the relatively low level of resources invested by the UK industry as compared to the USA, West Germany or Japan (see Chapter 5). Dr. Eric Duckworth, President of the Association of Independent Research and Technology Organisations, points out: "It is a worrying fact that less than 1,000 of the 80,000 manufacturing companies in the UK spend anything at all on R&D. Within that group, there are 20 companies that account for half of the total expenditure." Among the most evident were:-

(1) UK industry performed too little R&D and tended to take too short-term a view, even in many large companies.

(2) UK industry was slow to exploit new technology.

(3) Technological weaknesses were widespread, there was a general lack of awareness of the importance of technology and a shortage of necessary skills in management and workforce.

(4) The UK's R&D was scattered around scores of institutions with very few centres of excellence.

(5) British science was underfunded, undirected and the research was too widely spread.

(6) Pumping more public money into companies traditionally benefiting from state contracts rather than spreading the net further to widen and strengthen the technological base

4.9.2 The Goals of the UK's R&D Policy

The whole thrust of the Government's industrial policy was directed at ending what was seen as spoon-feeding, whether in terms of grants or other forms of assistance. The new-styled Department of Trade and Industry, now wearing its mantle of the Department of Enterprise, is indicative of the change. Lord Young, Trade and Industry Secretary from 1987 to 1989, placed the emphasis on marketing services and advice to industry rather than providing hand-outs.

The above mentioned problems (see 4.9.1) should be seen against a background of:-

(1) A worldwide quickening of the pace of technological change.

(2) An increasing internationalisation of markets.

(3) An increase in the intensity of R&D in all major competitor countries.

(4) Very high costs of product and market development.

(5) A need for wider application of new "horizontal" technologies which cut across the traditional boundaries of industrial sectors.

In order to stimulate an improvement in the UK performance, the Government's policy was to create and maintain a climate in which successful enterprise can flourish. R&D policy had a vital role to play, alongside economic policy and education and

training policies, in creating the right climate.

To remedy the weaknesses identified earlier on, the goals of the UK's R&D policy were as follows:-

(1) To encourage British industry to increase its own expenditure on R&D.

(2) To encourage a greater commercial exploitation of new technology whether that technology originated in the UK or overseas.

(3) To obtain a greater contribution to wealth creation from R&D financed by Government.

(4) To foster the development of international collaboration in science and technology to complement UK domestic activities.

(5) To better target resources.

(6) To change from a widely distributed research base to one with fewer centres.

(7) Collective decisions among the various ministries on priorities of research.

(8) Withdrawal from big sciences.

4.9.3 The Changes in R&D Policy in the UK

The changes in R&D policy in the UK could be summarised as a move towards:-

(1) Providing financial assistance for collaborative research of medium/long term importance to industry.

(2) Financial assistance to bring forward good, innovative projects in individual companies.

(3) Provision of advisory and consultancy services to improve the performance especially of smaller companies.

(4) Schemes to encourage technology transfer, including the awareness of the developments overseas.

(5) The need to better target resources. The task of the government was to support basic research and to contribute where business could not be realistically expected to carry all the risks. The Advisory Council On Applied Research And Development was set up to ensure that government spending was firmly directed towards areas of high national priority. ACOST played an important role in setting up The Centre for Exploitation of Science And Technology (CEST) to establish a process for the identification of exploitable areas of science which had some certainty of continuity for the long term economic health of the country.

(6) The commitment to fund and to face the conflicts with universities over the establishment of new centres of excellence (IRCs).

(7) A collective ministerial consideration of R&D policy under the Prime Minister's leadership.

(8) Withdrawing from "Big Sciences" especially big physics.

(9) Other actions to maintain the climate for innovation, such as pressure on companies to disclose their R&D spending.

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CHAPTER 5: R&D FUNDING IN THE UK

5.1 International Comparison

A comparison of OECD member countries spending on R&D for the last two decades has been carried out in Chapter 3. The following paragraphs are intended to highlight the disturbingly low level of civil R&D spending by the UK Government.

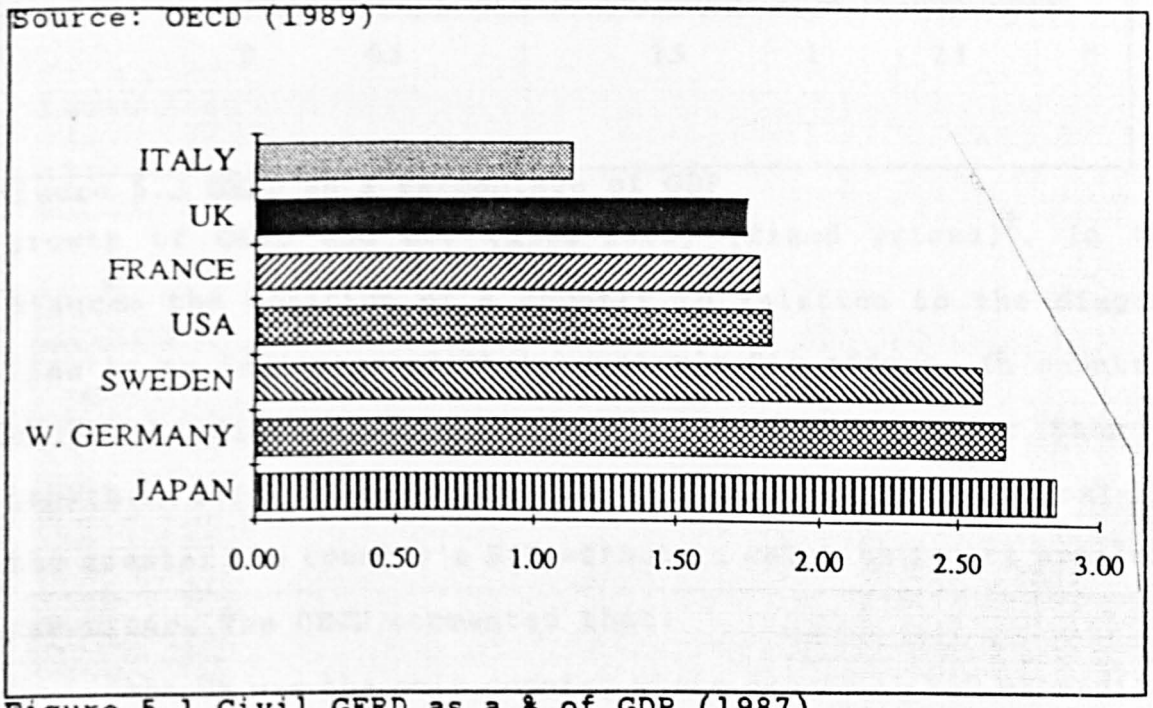

Figure 5.1 Civil GERD as a % of GDP (1987)

Figure 5.1 shows that the civil GERD as a percentage of GDP (1987) of UK was ranked below its main competitors i.e. Japan, Germany, Sweden, USA and France[1].

Figure 5.2 shows the GERD as a % of GDP (1987). On this basis, the UK's performance was below the level of Sweden, Japan, Germany and United States[2].

The above comparisons do not include a time factor and do not take into account the changes in GDP. A better indicator of a country's commitment to R&D is obtained by comparing growth in GERD against growth in GDP. Figure 5.3 shows the comparative

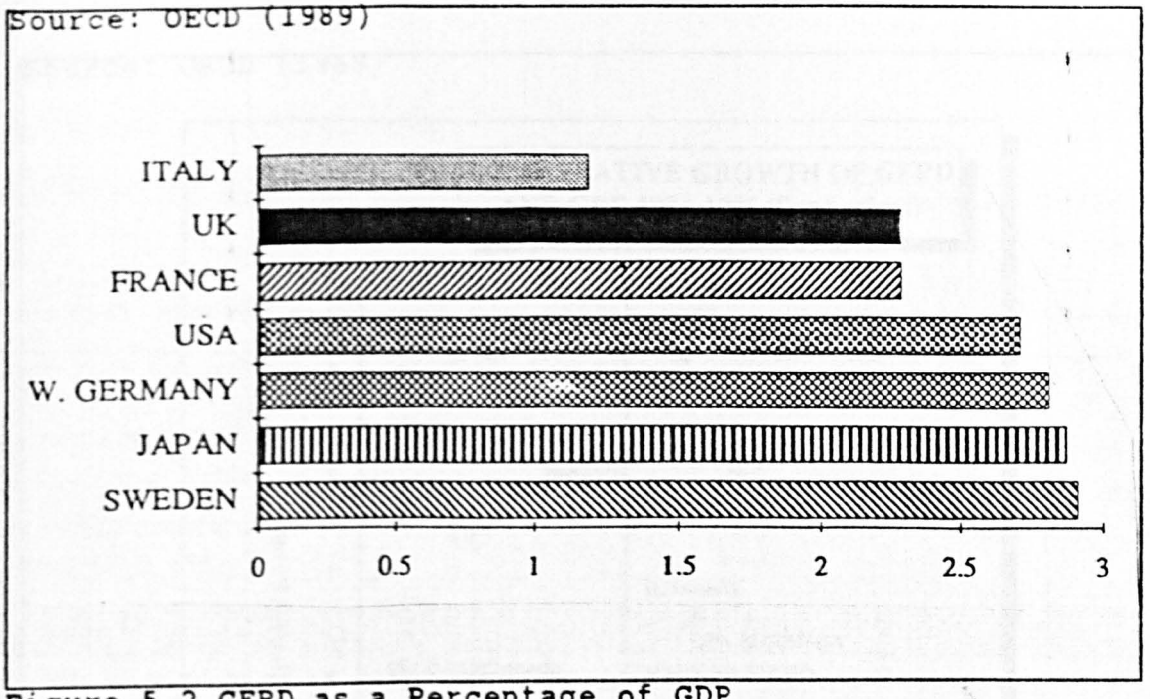

Figure 5.2 GERD as a Percentage of GDP

growth of GERD and GDP (1981-1985) (fixed prices)[3]. In this diagram the position of a country in relation to the diagonal line is an indicator of that country's R&D effort. In countries above the diagonal line, growth in GERD was greater than the growth in GDP and the greater the distance from the diagonal line the greater the country's R&D effort in relation to its available resources. The OECD commented that:

> "The UK was the only country where growth in R&D expenditure was lower than growth in GDP."[4]

Commenting on the above analysis, the Select Committee on Science and Technology said that[5]:

> "... therefore the disturbing conclusion that, as a nation, we are investing too little in civil R&D and the situation is getting worse. Our national expenditure (especially in the private sector) is not in line with our competitors"

Source: OECD (1989)

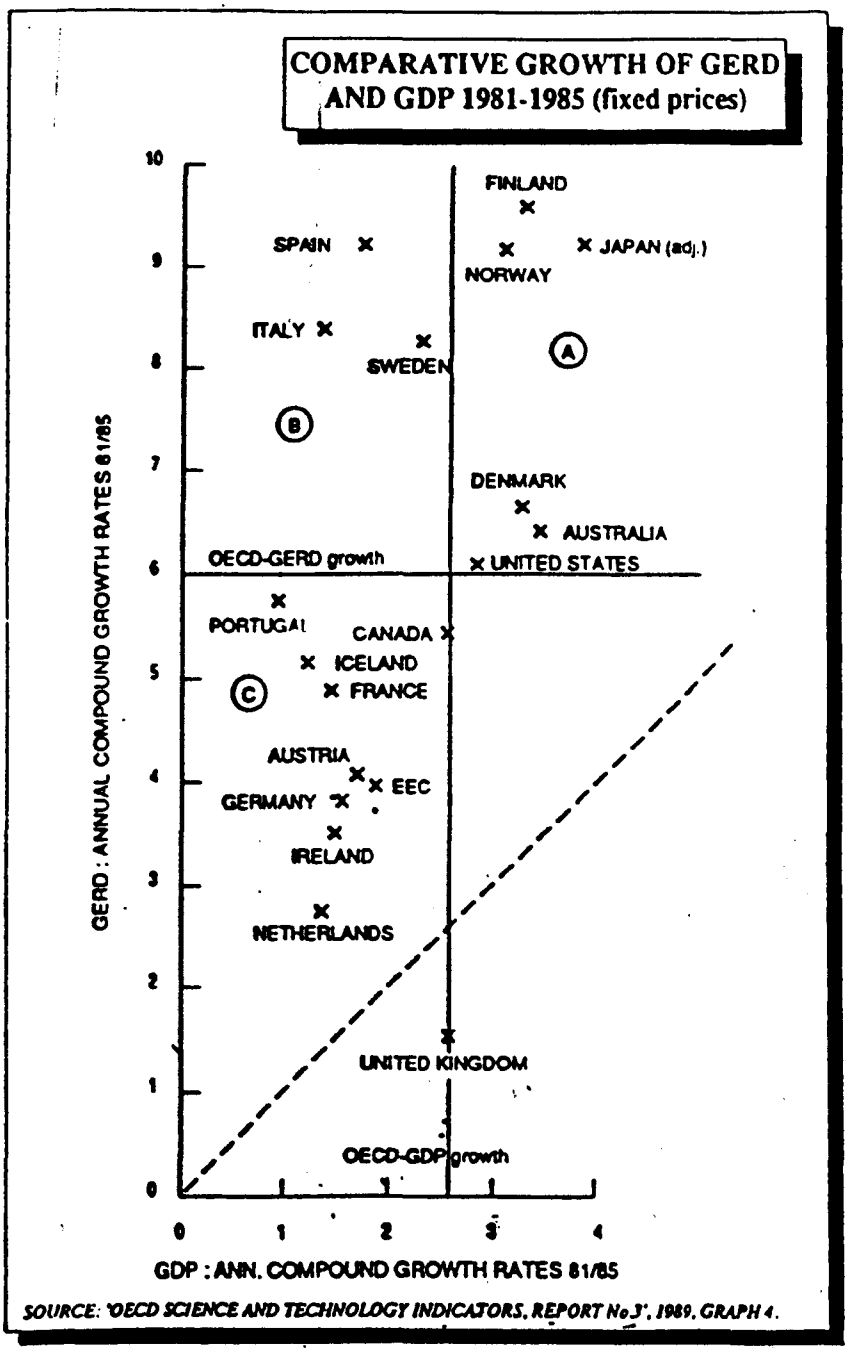

Figure 5.3 Comparative Growth of GERD and GDP 1981-1985 (fixed prices)

A study undertaken by SPRU for ABRC[1] which looks into the government support of basic research in six countries also

[1]Martin B R,Irvine J,"An International Comparison of Government funding of Academic and Academically Related Research", SPRU,University of Sussex.

concluded that the UK spends less on academic and academically related research than its two closest European competitors, France and Germany.

As was noted by the DTI in their Science and Technology Report for 1984/85, "Of the five leading industrial nations, the UK now devotes the smallest share of its gross domestic product to civil research and development. This disadvantage in quantity is not offset by any generally greater effectiveness of R&D in Britain."

5.2 Government Financed R&D

Government-financed R&D fell into two distinct categories:
(1) Research undertaken to advance knowledge, to maintain a fundamental capacity for research and to support higher education. The Secretary of State for Education and Science made resources for this research available to the universities, research councils and other bodies.
(2) Other R&D supported by government departments, each in its own areas in accordance with the customer-contractor principle, on the scale and pattern which it judged to be appropriate to the formulation and pursuit of its policies, whether relating, for example, to defence, industry, agriculture or environment, and the solution of specific needs and objectives, short or long-term.

It should be noted that while the two categories were distinct in terms of motivation and funding, there may well be substantial overlap in terms of scientific content.

The government financed civil R&D through the Science Budget for the Department of Education and Science (DES) and R&D

supported by other government departments (OGD) except MoD. Of the two sources, the RAs' main source of income came from the latter where the DTI was the main source of support. The role of DTI will be discussed in detail in Chapter 6.

The Science Budget was under the responsibility of The Secretary of State for Education and Science and it accounted for about half of the Government's annual expenditure on civil R&D. It could be broken into two main components i.e.:-

(1) Grant-in-Aid to Research Councils

(2) University Grant Committees (UGC).

The R&D supported by Government Departments other than the DES accounted for the other half. Many departments and government agencies had significant R&D programmes in support of their policies and responsibilities. Together these programmes (excluding that of MoD) accounted, in 1985-86, for 45% of the total Government spending on civil R&D. Nearly three quarters of this work was in the applied R&D category; over 20% was strategic and less than 5% basic research.

5.2.1 Why Finance Industrial R&D?

It was believed that the main responsibility for financing and conducting R&D and applying the result must rest with industry itself and be governed primarily by market forces. However, in a major review carried out jointly between DTI and the Treasury in 1985[6] it was agreed that it was appropriate for the Government to intervene where the market mechanism operated less than perfectly. Examples of such market imperfections from the review were:-

(1) Where projects with a potentially attractive economic return

were too risky (or benefits could be long-term) for companies to proceed on their own.

(2) Where industry lacked relevant information e.g. the potential of a new technology.

(3) Where competition was limited e.g. where entry costs were high.

(4) Where potential benefits of the R&D were low for the company undertaking the work, but much greater for the economy as a whole.

(5) Where it was necessary to secure a UK presence in certain key technologies or markets, especially where technologies were changing rapidly.

Other governments recognised the need to intervene to support industrially relevant science and technology, especially in certain advanced technology sectors. There was a clear risk, which UK industry felt strongly about, that in the absence of similar support by the UK Government, UK companies would be put at a competitive disadvantage internationally. This concern was particularly evident where UK companies took part in international projects where the overseas partners received substantial government assistance.

5.2.2 Defence R&D

Defence research, long eyed enviously by other sectors, was the first sector to suffer cut. The Cabinet Office statistics showed that the research portion of defence R&D was scheduled to contract from £408m in 1986/87 to £357m by 1990/91. Defence development, mainly devoted to big weapons projects, was to shrink from £1.93 billion to £1.66 billion over the same five years.

Some 225,000 people were employed directly, 170,000 indirectly and a further 120,000 if exports of defence equipment were included[7]. The MoD is British industry's largest single customer. The defence R&D programme, about £1.9 billion for development and £400 million for research, amounts to over 50% of the Government spending on R&D in 1985/86. This absorbs a higher proportion of GDP than in any other commercial competitor country except the USA[8].

The government considered a proposal to transfer control of the half-dozen non-nuclear research establishments away from the Ministry of Defence to an independent agency in 1988[9]. An agency outside the MoD's control would provide a more direct means of ploughing back money from contract work into the research establishments. The status would give them greater freedom to set new pay scales for their employees. The agency would inevitably want to eliminate duplication of work at the six establishments involved. Therefore some of the 15,000 employees in the non-nuclear defence research outfits would be laid off.

Most probably an executive agency would be formed with some private enterprise involvement, plus a government presence that would ensure protection of the national security interests.

In a report by ACOST in 1989[10], it recommended that the Ministry of Defence should pay more attention to national technology needed in spending its £2.4 billion R&D budget. The report called for reorganisation within the MoD to promote what it called spinning-in of new technology from the civil sector. Previously the focus was on harnessing spin-offs from defence for

civil use.

The inquiry found that 25% of the national R&D budget and 50% of government-funded R&D was devoted to defence, but only one fifth of the MoD's expenditure on R&D was likely to have any applicability in the civil sector.

5.3 Industrial R&D in the UK

Table 5.1 Research & Development Performed In The UK In Each Sector According To The Source Of Finance (1983)*

Source: Cabinet Office (1986)

sector providing the funds (£M)	Sector doing the work						(%)
	govnt	univ. and educ. estabs	public corps/ research assocs	private ind.	other	total in U.K.	
government	1228.8	634.0	39.9	1217.6	97.5	3217.9	(48.9)
universities†	—	25.0	—	—	—	25.0	(0.4)
public corporations and research associations	12.6	9.1	433.5	60.0	—	515.2	(7.8)
private industry	157.5	16.9	29.9	2099.2	50.7	2354.2	(35.8)
overseas	42.1	18.0	23.0	260.3	4.5	347.9	(5.2)
other	52.7	46.5	—	—	23.7	122.8	(1.9)
total cost of R&D performed	1493.8	749.5	526.3	3637.1	176.4	6583.0	

* Research in the social sciences is excluded.
† Including also further education establishments.

Table 5.2 Funding Of Industrially Performed R&D In The UK (1983)

Source: Cabinet Office (1986)

	£M	%
government	1257.5	30.2
public corporations and research associations	493.5	11.9
private industry	2129.1	51.1
overseas	283.3	6.8
total	4163.4	100.0

*Private industry, public corporations and research associations.

Table 5.1[11] shows that private industry funded only 36% of the total R&D in the UK in 1983. Table 5.2 shows that of the total of industrially performed R&D, industry itself funded only just over half. Government funded directly about 30% of the total.

Table 5.3 Industrially Performed R&D In The UK By Source Of Funds At Constant (1975 Prices) (£m)

Source: Cabinet Office (1986 & 1987)

	1967	1969	1972	1975	1978	1981	1983	1985
own funds	1028	988	866	853	994	1018	985	1149
overseas funds	58	72	92	85	125	145	106	196
government funds	446	481	473	414	458	498	472	406
total	1533	1542	1431	1352	1577	1661	1564	1751

* Private industry, public corporations and research associations.

Figure 5.4[12] (data in table 5.3[13]) shows that industry itself spent, at 1975 prices, £1,000m plus or minus £150m on R&D over a period of 18 years. Few historians looking at this figure would believe that this period coincided with the explosive growth of the integrated circuit, the advent of biotechnology, the start of home computing, the commercialization of space, the revolution of composite of materials, the use of radically new pharmaceuticals, and mass travel by wide-bodied aircraft with fuel-efficient jet engines[14].

Source: OECD (1986); Cabinet Office (1987)

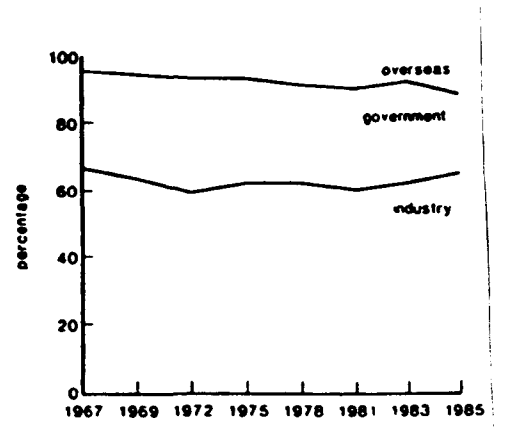

Figure 5.4 Trends In The Proportional Funding Of R&D In The UK, As A Percentage, For The Period 1967 -1985

The flat performance shown in figure 5.5 disguises marked

variations between industrial sectors. Figure 5.6 (data in table 5.4) shows that there was substantial growth in electronics and some growth in the chemical sector that offset declines in other areas, especially in mechanical engineering.

Source: OECD (1986); Cabinet Office (1987)

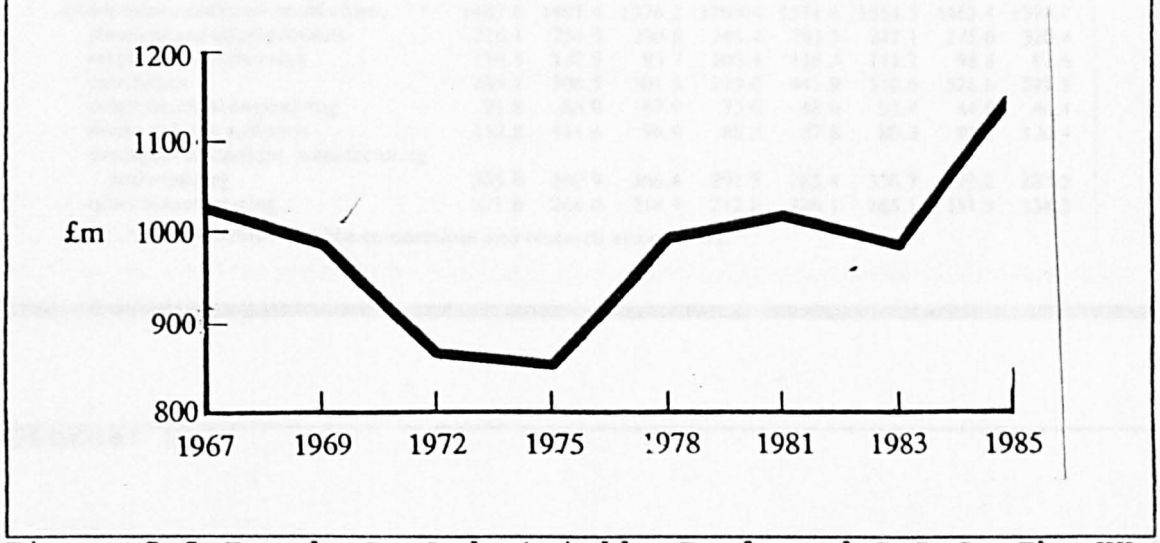

Figure 5.5 Trends In Industrially Performed R&D In The UK, 1967 - 1985 (1975 Prices)

Source: Cabinet Office (1986 and 1987)

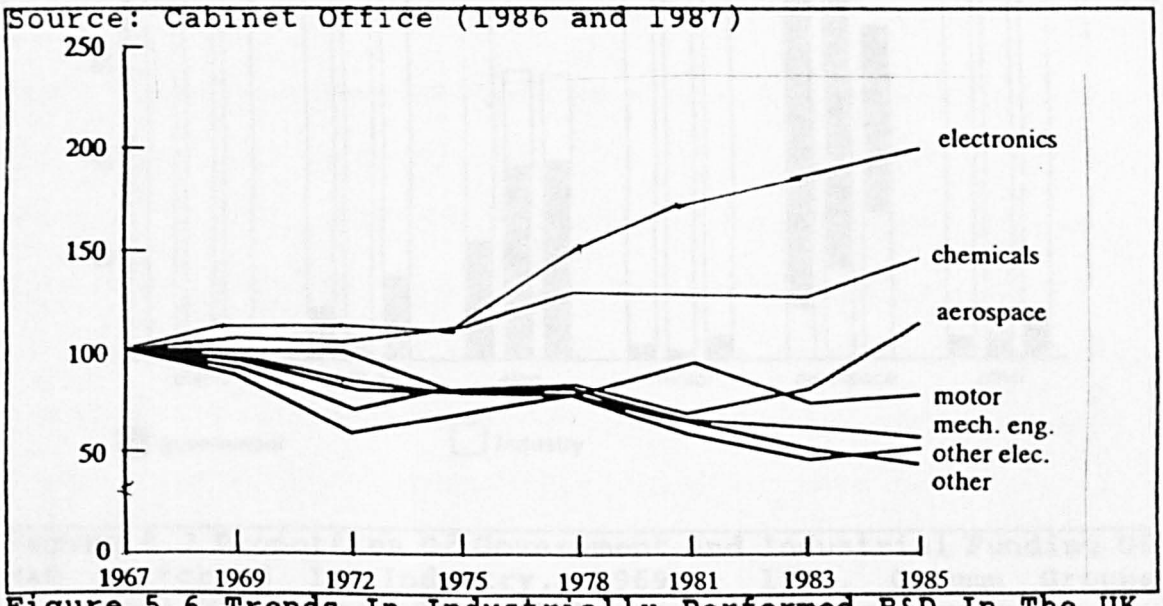

Figure 5.6 Trends In Industrially Performed R&D In The UK, 1967 - 1985, As A Function Of The Industrial Sector (1966 = 100)

Table 5.4 Industrially Performed R&D In The UK By Industrial Sector At Constant 1975 Prices (£m)

Source: Cabinet Office (1986 & 1987)

	1967	1969	1972	1975	1978	1981	1983	1985
all product groups	1514.1	1512.9	1417.6	1340.1	1566.2	1661.2	1564.1	1750.6
all manufactured products of which:	1487.8	1491.4	1376.2	1293.4	1511.6	1554.5	1465.4	1597.7
chemical and allied products	216.1	236.5	230.8	245.4	283.5	277.1	278.6	320.4
mechanical engineering	154.5	132.9	93.7	103.4	118.3	111.2	98.8	91.6
electronics	285.1	308.5	301.5	279.0	441.9	510.6	528.6	591.2
other electrical engineering	91.8	85.0	67.9	73.0	68.6	53.4	44.8	46.4
motor vehicles and parts	112.8	111.6	96.9	88.3	87.8	80.3	91.2	126.4
aerospace equipment, manufacturing and repairing	355.8	350.9	366.4	291.5	285.4	336.7	272.2	287.5
other manufacturing	271.6	266.0	218.9	212.8	226.1	185.1	151.3	134.3

* Private industry, public corporations and research associations.

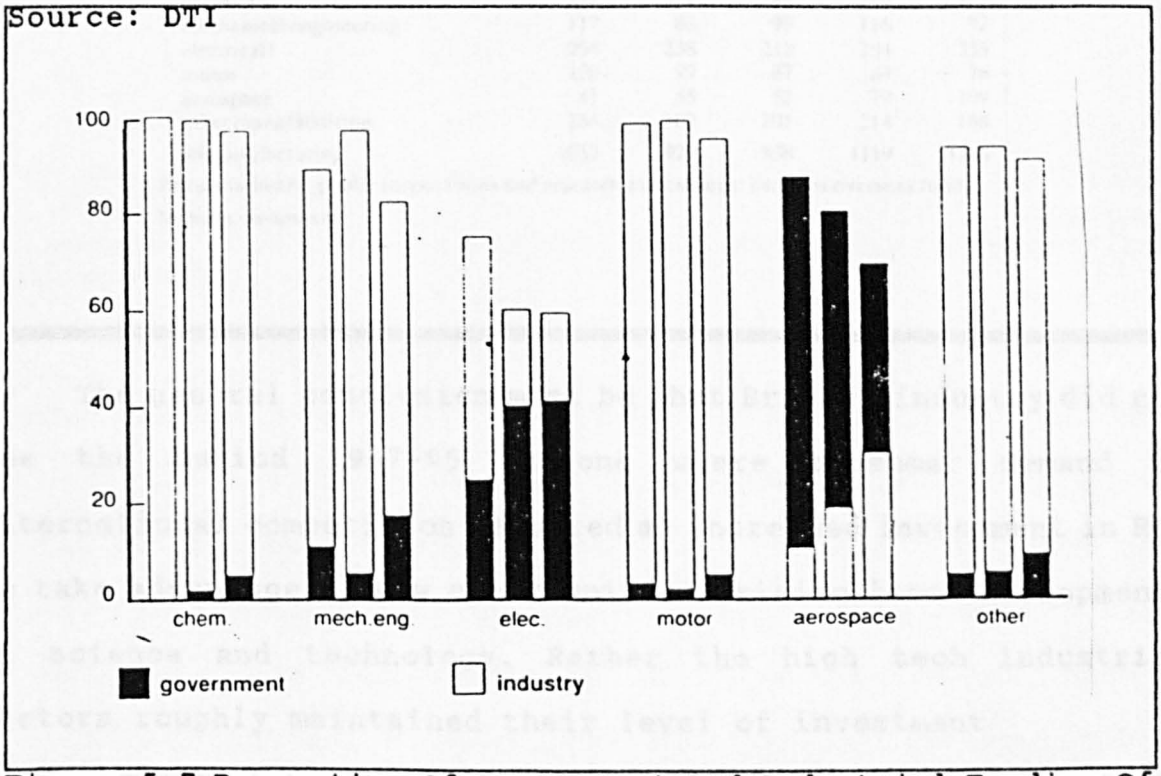

Figure 5.7 Proportion Of Government And Industrial Funding Of R&D Performed In Industry, 1969 - 1981. Column Groups Represent The Years 1969, 1975 and 1981 Respectively.

But figure 5.7 (data in table 5.5) throws a revealing light on figure 5.6 because it distinguishes industry-funded R&D by sector from industry performed R&D by sector. The increase in electrical and electronics R&D is shown to be largely government-funded while the industry's own investment in aerospace R&D has more than doubled, although industrially performed R&D in this sector has declined over the most of the period owing to a reduction in government funds.

Table 5.5 Industrially Performed R&D In The UK Funded By Industry At Constant (1975) Prices (£m)

Source: DTI

	1969	1972	1975	1978	1981
chemicals	237	238	244	289	267
mechanical engineering	117	88	99	116	92
electrical†	294	238	212	284	333
motor	108	99	87	84	76
aerospace	41	55	52	79	109
other manufacturing	254	202	201	214	168
all manufacturing	1052	920	938	1119	1163

* Private industry, public corporations and research associations; includes overseas funds.

† Includes computers.

The general conclusion must be that British industry did not see the period 1967-85 as one where consumer demand or international competition required an increased investment in R&D to take advantage of new opportunities arising from developments in science and technology. Rather the high tech industrial sectors roughly maintained their level of investment (pharmaceuticals R&D within the chemical sector increased dramatically) but one sector, electrical and electronics, benefited from rapidly increasing government funding of its R&D. The so-called matured sectors, such as mechanical engineering, showed a declining rate of investment in R&D; motor vehicles

showed a decline until 1985.

5.3.1 Expenditure on Industrial R&D in the Main Competitor Countries

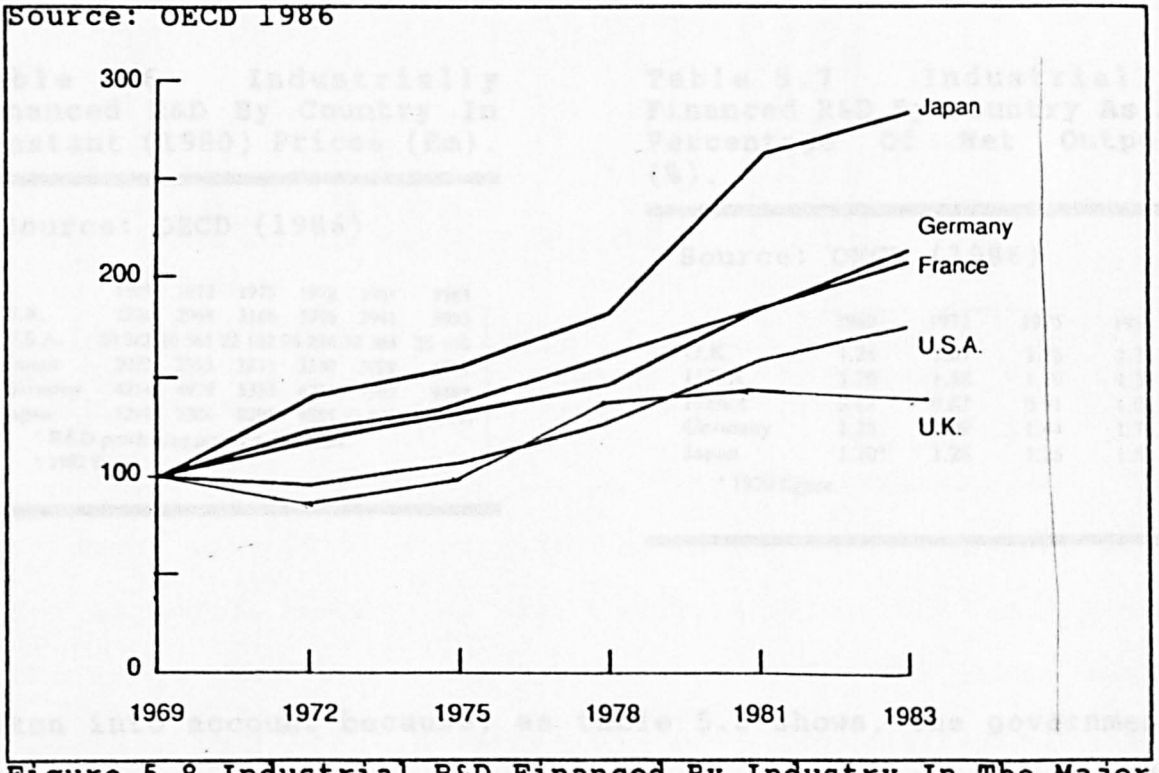

Figure 5.8 Industrial R&D Financed By Industry In The Major Industrial Nations, 1969 - 1983 (1969 = 100). Figures Converted From National Currencies On The Basis Of Purchasing Power Parity.

Figure 5.8 (data in table 5.6) shows that while industrially funded R&D in the UK increased by around 20% in the period 1969-83, that in Germany doubled and in the USA, after a slow period in the 1970s, almost doubled. Industrial funding of R&D more than doubled in France and it tripled in Japan albeit from low bases in each case. All four countries' GDP grew more rapidly than in the UK, but table 5.7 shows that industrially financed R&D in the USA, France, Germany and Japan also grew significantly as a percentage of net output with the German performance being especially impressive, whereas the British figure in 1981 only

just exceeded the 1969 percentage as it recovered from the slump in the 1970s.

Industrially performed R&D in the UK was somewhat less of a disparity with competitor countries when government funding was

Table 5.6 Industrially Financed R&D By Country In Constant (1980) Prices (£m).

Source: OECD (1986)

	1969	1972	1975	1978	1981	1983
U.K.	3226	2968	3166	3796	3941	3995
U.S.A.	20 282	20 561	22 102	26 234	32 384	36 146
France	2072	2553	2831	3330	3929	4514
Germany	4214	4979	5353	6251	7987	9482
Japan	5247	7386	8206	9555	13 886	15 317†

* R&D purchasing power parity basis.
† 1982 figure.

Table 5.7 Industrially Financed R&D By Country As A Percentage Of Net Output (%).

Source: OECD (1986)

	1969	1972	1975	1981
U.K.	1.24	1.07	1.16	1.31
U.S.A.	1.20	1.18	1.19	1.39
France	0.82	0.87	0.91	1.04
Germany	1.25	1.39	1.44	1.76
Japan	1.20*	1.26	1.26	1.59

* 1970 figure.

taken into account because, as table 5.8 shows, the government contributed around 30% of the total funding in the UK and USA compared with around 20% in France and Germany and even only 2% in Japan.

Table 5.8 Industrially Performed R&D By Source Of Finance And Country, 1981 (%)

Source: OECD (1986)

	U.K.	U.S.A.	France	Germany	Japan
own funds	61	68	71	82	98
other funds*	9	—	7	1	—
government funds	30	32	22	17	2

* Other funds mainly overseas throughout

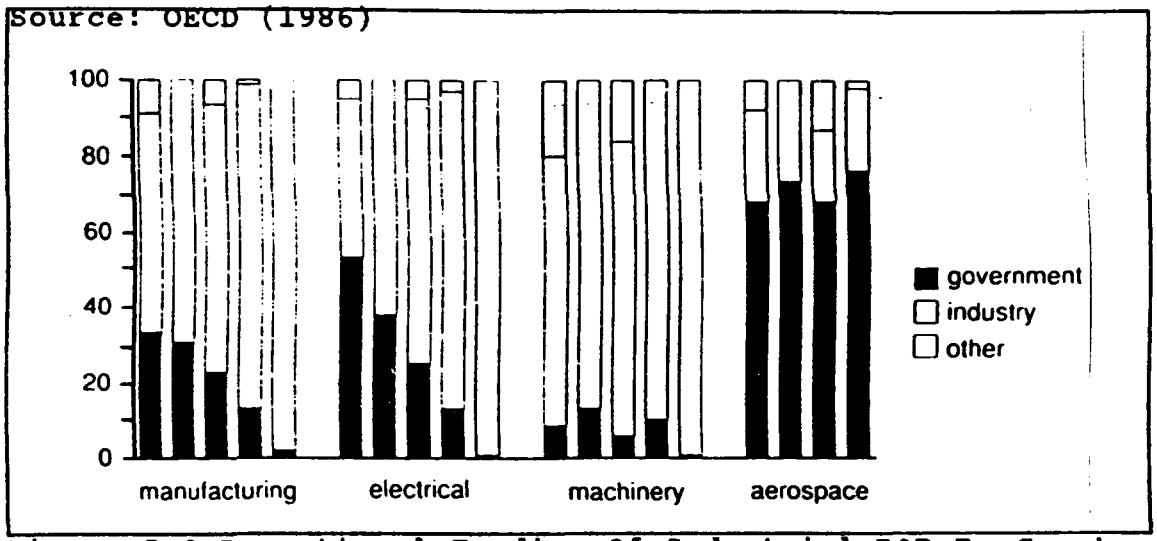

Figure 5.9 Proortional Funding Of Industrial R&D By Country And Industrial Sector. Colulmn Groups Represent, Left To Right, The UK, USA, France, Germany And Japan.

Figure 5.9 (data in table 5.9) also shows that the government subsidy of aerospace R&D in the four countries with major aerospace industries was broadly similar and that in the machinery sector was largely self-financed. The large extra element of government funding in the UK fell mainly with the electrical sector.

Table 5.9 Industrially Performed R&D By Source Of Finance, Country and Industrial Sector, 1981 (%).

Source: OECD 1986)

		manufacturing	electrical*	machinery*	aerospace
U.K.	own funds	57.3	42.3	71.0	24.7
	other funds†	9.4	5.0	19.8	7.8
	govnt funds	33.3	52.7	9.2	67.5
U.S.A.	own funds	69.0	62.1	86.9	27.4
	other funds	—	—	—	—
	govnt funds	31.0	37.9	13.1	72.6
France	own funds	70.2	69.6	78.5	18.2
	other funds	6.7	5.4	15.6	13.4
	govnt funds	23.1	25.0	5.9	68.4
Germany	own funds	85.4	84.7	89.8	22.1
	other funds	1.4	2.7	0.5	2.0
	govnt funds	13.3	12.6	9.7	76.0
Japan	own funds	98.1	98.7	98.8	—
	other funds	0.2	—	0.3	—
	govnt funds	1.8	1.4	0.9	—

* OECD industrial sectors have computers in machinery.

† Other funds mainly overseas throughout.

These disparities in government funding of industrially

Table 5.10 Government R&D Expenditure By Country As A Percentage Of GDP, 1983 (%)

Source: OECD (1986)

	U.K.	U.S.A.	France	Germany	Japan
total*	1.33	1.18	1.41	1.14	0.61
of which: civil	0.67	0.42	0.95	1.03	0.60
defence	0.66	0.75	0.43	0.10	0.02

* Total expenditure and expenditure on defence R&D are estimated in different ways, so the subdivision of the total is not exact.

performed research resulted mainly from the large defence R&D expenditures in the UK and USA and, to a lesser extent, in France, as shown in table 5.10. Perhaps surprisingly, this did not greatly affect the proportion of own funds and government funds in aerospace and the small element of subsidy was also similar across the machinery sector. But the electrical sector and, to a lesser extent, the manufacturing sector, would appear to be at some advantage in the UK and USA compared with their counterparts in France and Germany.

5.3.2 Short-termism

In a conference organised by DTI on Innovation and Short-termism in 1990, the Innovation Advisory Board (IAB) highlighted the danger and shortcomings of short-termism[15]. The study by IAB showed that Britain was at the bottom of a league table of growth of industrial research and development spending. Such worries were also reflected in the Confederation of British Industry report carried out in 1987[16]. Indeed, apart from chemicals and pharmaceuticals, R&D spending actually fell in real terms during the late 1980's, partly because of a reduced government input.

At the same time, the profits of leading British companies went up by 10% a year in real terms during 1985-1988) and the surging growth of dividend payments (16% a year) increased. The IAB concluded that the City set too high a priority for short-term profits and dividends at the expense of R&D and other innovative investments; the prevalance of take-over bids damaged the companies' ability to adopt long-term strategies.

The Government wanted to force companies to publish details of research and development spending in their annual accounts in 1990[17]. The Government was hoping that the change would send a signal to the investment community about the commercial importance of R&D.

The Select Committee on Science and Technology[18] felt that Britain should conform to definitions of R&D laid down by the OECD in its Frascate Manual and now incorporated into an accounting standard for industry (known as SSAP 13).

Although some critics would consider the study to be too simplistic, one would tend to agree broadly with the findings. This was based on the interviews carried out with the RAs. The research directors raised the difficulties of convincing industry to invest more in strategic research rather than just concentrating on development work. The directors also felt that most firms did not look at R&D as a long-term business. This forced the RAs to tailor their R&D programme to the short-term needs of industry. Without Government support, the RAs would not be able to carry out any strategic research. Therefore, it was important for the RAs to have a balanced portfolio of R&D activities to survive. Over the last 2 decades, the RAs were able to respond well to the needs of the market. In the next decade,

the RAs will have to think carefully about their R&D portfolio and not be tempted to settle for any short-term gain.

5.3.3 Capitalising on Scientific and Technological Expertise

> "Britain is facing a national emergency in its failure to capitalise on scientific and technological expertise and turning them in successful commercial products" [19]Ivor Owen, Director, Design Council.

But even this scientific base was fading, Britain was near the bottom of a league table on R&D spending, according to a survey by the Organisation for Economic Cooperation and Development[20]. According to the survey, Britain spendt less per capita on R&D than any main competitor.

In the early 1980's, the UK was the only western industrial nation with a declining share of national income devoted to R&D. The UK state funding for civil R&D was set to decline further[21]. Meanwhile, spending on R&D continued to increase in Japan, Germany, Sweden and the US. This could be due to Britain's failure to see beyond the market conditions and technical limitations of the day[22].

Where British research led the world, its industries had all too often failed to exploit it productively. The Japanese had mastered the development and practice of technology transfer. The key to success appeared to lie in a mutual understanding between government, industry, HEIs and research organisations and a willingness to commit resources on a scale necessary to exact good returns[23].

"Research in British Universities is far too mission

(market)-oriented. Some of the best ideas developed from fundamental research are in danger of being starved out in a climate which certainly would not have allowed me to follow the path I did" Prof. George Gray, pioneer of liquid crystal display technology[24].

Already 80% of the science and engineering departments in Britain's higher education sector lacked the equipment required to carry out the necessary research[25].

The failure to develop high technology, high volume products was irreversible in Britain and was starting to affect middle and low technology products, including the car industry.

5.4 Conclusion

The picture was one of British industry not perceiving any necessity, or not being able, to increase expenditure on R&D during a period of unparallelled excitement and advance in science and technology. Industry in all major foreign competitor countries took a sharply different view and backed that view with its own funds.

The picture was also one where British governments were seen to have been broadly competitive in R&D funding in industry with their foreign counterparts, albeit somewhat eccentric in their allocation of these funds and unsuccessful in gaining matching investment from industry.

The industry may argue that for reasons quite unconnected with the R&D scene, its profitability fell disastrously during the period under review, and that it was remarkable that R&D expenditure was even maintained in real terms. The situation substantially improved during the last 3 years as other burdens

on industry were reduced. It may even be argued that British industry was more efficient in its utilization of R&D expenditure than in competitor countries. Some would argue that foreign governments were far more adept at concealing subsidies for industrial R&D, even from the keenest eyes in the OECD. More convincingly, they would argue that foreign governments put more organizational effort into ensuring that publicly and privately financed R&D was mutually supportive rather than randomly aimed. Finally, some may argue that short-term financial outlook, believed to be characteristic of the City, prevented British industry from investing enough in R&D to keep its products competitive in the marketplace.

The government approach in trying to remedy this situation was through creating an economic and competitive climate in which companies were sufficiently profitable to be able to afford an appropriate level of R&D and also recognize that their profitability could only be sustained by competitive new products and manufacturing methods developed as a result of their R&D investment. The increased level of industrial funding of R&D that appears to take place since the early 1980's at 7% in real terms between 1985 and 1986 (i.e. about double the average rate of increase between 1981 and 1985) was encouraging. If this increase was maintained, it would allow government funding to be used more generously in the area of basic and long-term research in the universities and elsewhere.

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CHAPTER 6: DEPARTMENT OF TRADE AND INDUSTRY (DTI)

6.1 Historical Background - DTI

After the Conservative victory in 1970, Edward Heath was keen to develop a style of government based on a small cabinet and large departments. Furthermore, the machinery of the existing system, whereby responsibility for industrial and trade policy was spread among a host of different departments, was felt to be cumbersome and confusing. So, a new department was formed in 1970 from the Board of Trade and Industry and the new Ministry of Technology. At its peak, the DTI had around 26,000 employees.

In 1973 it lost its responsibility for energy. The next year, it was split into industry, trade, and consumer protection; the last was dropped in 1979, trade and industry reunited in 1983[1]. In the last seven years alone there were six Secretaries of State.

Without a clear role, the DTI was at the mercy of ministerial whim. Under Tony Benn, Industry Minister from 1974 to 1975, he wanted to develop a socialist industrial policy. Mrs. Thatcher's first industry minister, Lord Joseph, was dogmatically hostile to intervention. Norman Tebbit was Secretary of State between 1983 to 1985 and was not in the least interested in regional policy. He was followed briefly by Sir Leon Brittan, who was succeded by Paul Channon (1986-87) and Lord Young replaced him in 1987. Lord Young was replaced by Nicholas Ridley after being there for over 2 years. And in 1990, Nicholas Ridley resigned and was replaced by Peter Lilley. Such a high turnover was particularly unfortunate in a department like the DTI, which

after all, was supposed to be at the heart of wealth creation in the economy.

Officials, not surprisingly, found it difficult to accommodate all this. Tensions between ministers and officials continued under Mrs. Thatcher. While ministers with differing political views came and went, an unbroken official line was maintained. First laid down by Sir Anthony Part, in the early 1970's, it was carried forward by Sir Peter Carey, permanent secretary at the industry ministry from 1976 to 1983, and was continued by Sir Brian Hayes. The central job of the DTI, as its officials saw it, was to protect the private sector from political interference[2]. The key concept was "sponsorship", the idea that divisions of the DTI look after specific industries and, whenever industry-support schemes were on the statute books, channeled money to them.

Of the department's 12,700 civil servants, no more than 100 senior officials were actively involved in sponsorship, but they had set a tone for the whole department. As successive Tory governments shrank the budget for industrial support, sponsorship was eroded. Privatisation sharpened this trend. Lord Young, who arrived at the department in 1987, was Lord Joseph's political adviser at industry. He was well acquainted with the system of sponsorship and was totally opposed to it, which brought him in direct confrontation with his officials. Lord Young saw the DTI's job as one of showing the private sector how best to help itself. His strategy was in the first place to improve the department's performance as a regulator, secondly to go on cutting support schemes and thirdly and most importantly to reorganise the department to look at markets, not industries. These market

sectors would be concerned with the interests of both suppliers and customers[3].

6.2 The DTI's R&D Expenditure

The DTI accounted for 15% (innovation budget) of the civil R&D expenditure. It provided partial support for innovation in industry. The support was provided in the form of grants and contracts to assist specific activities or to spread awareness of new technology.

The innovation budget was fixed at £500 million in 1988/89, £527 million in 1989/90 and £501 million in 1990/91. In real terms, there was going to be a substantial decrease[4].

Funds for statutory and regulatory work, including consumer protection and technological support, would fall from an estimated £217 million in 1989 to £60 million in each of the next 3 years. This was due to the transfer of GIREs and Patent Office spending to this part of department. NPL, NEL, WSL and LGC became executive agencies.

The Department had considerable difficulty in switching aid for R&D from single companies to longer-term collaborative efforts involving joint research. The number of participants in the LINK programme to bring companies together with HEIs attracted only 40 participants in 1989 at a cost of £8 million. The plans envisaged a rise in the number of participants in the programme to 270 at a cost of £40 million, to 500 in 1990 at a cost of £76 million. The number of companies involved in the advanced technology programme was expected to rise from 80 in 1989 to 248 in 1991, with an increase in programme cost from £34 million to £113 million.

6.3 Background to Requirement Boards (RBs)

In 1972, Requirement Boards were set up to operate in accordance with the Rothschild principle and act as proxy customers for the applied research of the Department. The Boards approved projects and provided funds for contractors from industry, research councils and research associations, as well as the Department's own R&D establishments. The Boards generally consisted of 12 members which included 6 independent members from industry, 2 independent scientists, and appropriate representatives of DTI main customer divisions. A new Research Requirements Division under the Department's Chief Scientific Adviser was set up to provide technical, management, and financial back-up services for the Boards.

In May 1981, the DTI's Requirements Boards were reorganised and reduced in number from nine to five[5]. The new Boards delegated responsibility to existing supporting executive committees for approving the bulk of projects. This allowed the Boards more time to consider longer-term issues. In 1985, a new structure was introduced by which a single high-level Technology Requirement Board (TRB), supported by 16 advisory committees, provided advice to Ministers and the Department's sponsoring divisions on all aspects of science and technology policy including advice on priorities between sectors and technologies.

In its White Paper[6] in 1971, the Government reaffirmed its intention to implement the customer-contractor principle recommended by Lord Rothschild for the control of Government R&D in the Green Paper with the same title[7].

The White Paper said:

"... departmental customers must work in partnership with their research and development 'contractor', whether inside or outside the Department. Responsibilities are then clear. Departments, as customers, define requirements; contractors advise on the feasibility of meeting them and undertake the work; and the arrangements between them must be such as to ensure that the objectives remain attainable within reasonable cost. This is the customer-contractor approach."

Each of the Boards was concerned with customer interests in its appropriate technological field. The function of the Boards was to determine, in agreement with the minister concerned, the objectives and balance of the Department's intra-mural and, where appropriate, extra-mural R&D programme in the relevant technical field within the funds available.

6.4 DTI - The Department For Enterprise

In January 1988, the DTI published a White Paper[8] announcing major changes in its industrial policy. This policy, however, continued what the Department believed to be one of its prime objectives:

"We will encourage the transfer of technologies and cooperative research[9]"

The White Paper declared:

"The UK's overall weakness in industrial innovation performance lies not in the adequacies of scientific or inventive capability, but in the transfer of that capability into commercial application[10]".

The main provisions of this White Paper on DTI reorganisation with regard to innovation are summarised as:

(1) Greater emphasis would be placed on technology transfer - especially linking educational institutions and industry - for small firms, for the regions and for new technologies.

(2) Greater emphasis would be placed on collaborative research on both a national and a European scale.

(3) Initial assistance would be given to technologically advanced projects in small companies, and to a very restricted number of projects offering exceptional national benefits. There would be less support for projects in single companies.

The particular changes involved:

(1) Ending Support For Innovation (SFI) grant assistance in individual companies.

(2) Ending the Microelectronics Industry Support Programme.

(3) Ending the Support for the Software Products Scheme.

(4) Ending the Fibreoptics and Opto-electronics Scheme.

(5) Encouraging collaborative research through:

(1) European programmes such as ESPRIT and EUREKA.

(2) LINK, which encouraged companies to undertake joint research with HEIs and Research Councils. This research would be pre-competitive but industrially relevant.

(3) National collaborative research programmes that promoted longer-term industrially-led collaborative projects between UK companies concerned with advanced technologies.

(4) General industrial collaborative projects. It was meant to help to serve the interests of fragmented industries where small firms typically did not have the resources for advance technological projects.

The Government also made provision for supporting individual companies in exceptional circumstances, despite its belief that:

"Firms themselves are best able to assess their own markets and to balance the commercial risks and rewards of financing R&D and innovation. The Government should not take on responsibilities which are primarily those of industry[11]".

However, the Government recognised:

"that reliance on the decisions of firms may produce a level of innovation and use of technology which fails to provide the maximum benefits for the economy as a whole[12]".

The support of these "exceptional" projects, which were "significantly" innovative and high risk and were expected to generate wider and additional benefits to the UK economy, would, however, only be offered in a very restricted number of cases, and had a very limited budgetary provision.

Some of the particular schemes and developments to be encouraged were only at very early stages of existence. The regional technology centres were supported by the Local Collaborative Projects programme, which itself was only announced in November 1986. As the case of one of these centres in Lowe and Rothwell[13](1987) shows, their formation was not unproblematic.

The LINK programme (announced in 1986), a £210 million programme devised to develop industrial collaboration with universities in speculative areas.[14] The first set of projects to be approved by the programme was announced in February 1988. LINK provided little by way of additional funds and controversy over the level of university overhead costs delayed its progress[15]. SMART was another programme conducted on a very small scale with an allocation of a budget below £1 million.

The White Paper placed considerable emphasis on supporting high technology SMFs (Small and Medium-Sized Firms). Apart from SMART, innovation grants for SMFs with fewer than 25 employees in Development Areas were introduced. There was also a planned increase in the use of consultants in SMFs.

Although there was a considerable need for increased focus on policy measures to support high technology SMFs, it would be some years before the impact of the proposed measures could effectively be evaluated[16].

Under the Enterprise Initiative, independent firms with payrolls of less than 500 were offered financial support for specialist consultancy for between 5 and 15 man-days in a number of key management functions e.g. marketing, design, quality, manufacturing systems, business planning, financial and information systems.

6.5 Next Steps

Executive agencies were set up as a result of the Next Steps report, prepared by the Prime Minister's Efficiency Unit[17]. The report recommended a devolution of responsibility to increase efficiency in the Civil Service. The DTI and the Ministry of Defence were the most enthusiastic departments in creating agencies.

Among the executive agencies set up by the DTI were Companies House (Oct. 1988, 1,200 staff), National Weights and Measures Laboratory (April 1989, 50 staff), WSL (April, 1989, 310 staff), NEL (Nov. 1990, 500 staff). The other candidates included Patent Office, Insolvency Service, Radiocommunication Division, LGC, NPL. The DTI's target was to see that 50 percent of all the 13,000 staff be employed in executive agencies[18].

6.6 Conclusion

All in all observers felt that the DTI was becoming increasingly marginal in its role in the economy and could become more so with the growing importance of Europe. The power of national departments would be curbed as issues such as competition policy were decided in Brussels.

Looking at the changes in the DTI during the Thatcher years it was hard not to conclude that it was a steadily declining department[19]. Privatisation and the policy of non-intervention drastically reduced the Government's interest in industry. Expenditure on R&D projects was cut, even for long-term, high-technology infrastructure programmes such as the development of a broad band fibre optic fibre network.

The planned cut in DTI spending from 1988 to 1993 would mean a significant reduction in funds for regional and general industrial spending, support for aerospace, shipbuilding, regulatory work and consumer protection. RAs would no doubt be affected by these cuts, especially those serving the shipbuilding and aerospace industry as well as those carrying out regulatory work for DTI.

In a publication by the Confederation of British Industry in 1990, the difficulty companies faced in applying for research funding from the DTI was highlighted[20].

The industrialists' criticisms were contained in a report "Technology and Enterprise", based on a series of questionnaires sent out to high technology companies with experience of various government-funded programmes, asking for comments on how these programmes were conceived and run. While quoting a generally high level of satisfaction with the programmes, the replies indicated

widespread dissatisfaction with the procedures and paperwork involved.

> "The difficulties of obtaining DTI support, combined with the limited nature of that support, has led to the strong opinion among some industrialists that the programmes are more concerned with the public relations effect than with supporting UK industry[21]".

It recommended that the procedures for the handling of applications should be simplified and accelerated.

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CHAPTER 7:- BACKGROUND TO RAs

7.1 Introduction

The UK government tried to create a climate for the emergence of industry based and technology-based RAs after each of the two World Wars. It was modelled on a far-sighted concept from the Department of Scientific and Industrial Research (DSIR). Collaboration was an underlying precept, and the Associations were "companies limited by guarantee" and able to qualify for tax-exempts status by operating predominantly to produce new knowledge through research, and distributing no dividends from profits.

The RAs carried out collaborative research programmes on behalf of their members, themselves part of a coherent industry sector (e.g. Rubber and Plastics, Ships, Electrical) or having an interest in the application of underlying technology (eg. Welding, Production Engineering). Members paid subscriptions which were augmented by Government grants, and these two sources of income were a major proportion (and in some cases the total) of the funds available to pay for the staff, facilities and buildings. In a few cases (e.g. Constsruction Industry) the RA was simply an agency commissioning work elsewhere.

All subsisted, mainly successfully and under the original DSIR constitution, until about 1970 when the process of fundamental and far-reaching change in the national and world industrial scene began to dictate major changes in the RAs at a pace previously inconceivable. These changes became necessary for the survival both of their industrial partners and the RAs

themselves in an increasingly world competitive environment, and the RAs responded each in its own way.

Altogether ,the RAs employed nearly 5347 staff in 1963. This expanded to 5957 in 1970. By 1988, there were only 33 RAs left and their total staff number declined slightly to 5515.

In 1988, the total RAs' turnover accounted for 1.50% of the total R&D expenditure in the UK in comparison to 1.65% in 1968. Considering the fact that the RAs faced a very difficult situation during the last two decades, the RAs performed relatively well.

7.2 Definition of Research Associations

The term "research association" refers to two types of organisation. Firstly, there are the grant-aided industrial research associations. These derived their income partly from government departments (usually the Department of Trade and Industry) in the form of grant - aid, from industry, membership subscriptions, contract research for industry and government.

In addition to these, there were a number of cooperative industrial research associations which were not grant-aided, but financed wholly by their membership. This number was less than 20, mostly small associations. The subject of this study is the the formerly grant-aided industrial RAs.

Each grant-aided RA was legally the responsibility of its members and was controlled by a Council elected by the membership. But because this used to receive grant-in-aid from the Government, it could be regarded as one of the means by which

Government attempted to encourage and direct the development and application of technology in industry.

7.3 Development of RAs

The Government of the United Kingdom became deeply interested in the encouragement of industrial research towards the end of the 19th. century when there were signs that the country was in danger of ceasing to be one of the leading nations in applying science to industry. The first major steps taken to improve the position were the establishment, in conjunction with the Royal Society, of the National Physical Laboratory in 1900 and the formation of the Imperial College of Science and Technology in 1907.

The outbreak of the first world war stimulated government interest in research still further. In 1915 the Committee for the Privy Council for Scientific and Industrial Research and an associated Advisory Council were set up by Order-in-Council. The Advisory Council was appointed by and reported to the Chairman of the Committee, the Lord President of the Council. In this way the responsibility to Parliament was placed. The Advisory Council was mainly of eminent scientific men and industrialists.

The primary function of the Advisory Council was the application of any sum of money provided by Parliament for the organisation and development of scientific and industrial research. A white paper was published announcing the scheme.

The Department of Scientific and Industrial Research was set up as a separate Government Department in 1916 to carry out the duties which the Advisory Council was charged with. It was empowered to institute specific researches, to establish or

develop special institutions or departments of existing institutions for the scientific study of problems affecting particular industries or trades and to establish and award Research Studentship and Fellowships.

The Advisory Council remained until 1956 when, under the Department of Scientific and Industrial Act in 1956, it was replaced by an executive Council for Scientific and Industrial Research (Research Council) in whose charge the Department of Scientific and Industrial Research was placed and which was required, formally, to comply with any directions given to it by the Committee of the Privy Council for Scientific and Industrial Research. The members of the Research Council were to be appointed by the Lord President who remained responsible for the Department. In 1959, the office of Minister for Science was created and the holder became the responsible Minister for the Council for Scientific and Industrial Research as well as other organisations concerned with civil research and development.

7.3.1 The Inception of RAs

One of the first matters to which the Advisory Council, set up in 1916, directed its attention was the serious gap between scientific research and industrial practice and the extent to which the United Kingdom was falling behind other industrial countries. It was decided to encourage industrial research through the promise of grants to approved Associations for Research to be founded and maintained by industry. Such Associations were to be non-profit -making companies (incorporated under Companies Act, limited by guarantee and not having a share capital), which had as their main object the

carrying out of research in a specified industry or groups of industries which were governed by a Council elected in a General Meeting by and from their Ordinary Members. A cardinal feature of the government support was that it would take the form of grant-aid for the general purposes of the Associations rather than contracts for specific items of work.

The companies were to receive subscription from manufacturers and were to be autonomous and independent of the Government. By 1917 the Government had set aside a fund of £1 million for the grants, a Model Memorandum and Articles for the Associations was drawn up (see App. 7.1) and the "Government Scheme for Industrial Research" was approved and publicised.

Parallel with the setting up of the research associations, an early start was also made in various way on the support of research in universities and in establishments of Research Stations under DSIR.

The objective of these new associations was that, by their means, companies of compatible technical interests (whether making similar products, being raw materials suppliers, or sharing similar processes) should cooperate to raise their levels of technical skills and efficiency through voluntary membership of their industry's association. The companies should pay a subscription, usually related in some way to their size, which, together with the government grant, went to finance the research and information services that the association provided. Government grants were provided in relation to the amount of industrial support obtained by each RA. It later changed to a one-to-one basis and finally, in the last decade, grant-in-aid was abolished. The amount of support obtained by the RAs was an

indication of the relevance of their research to the needs of the market and the kind of R&D the market supported.

Members were entitled to elect the Council, or controlling body, of the RA and thus possessed, in a democratic sense, control over the programme and activities of the association. But among the problems the RAs faced was to get a programme of research which was agreed upon by all its members. Since its members were different in terms of size and the amount of investment in R&D and objectives were different, problems arose in trying to accommodate every member.

By 1925 the number of RAs in existence totalled about 20. Their early history was not one of unmixed success. Edwards (1950)[1] recorded that "between 1922 and 1928 more associations were wound up than new ones formed, industrial income was only slightly higher at the end of the period, and total income actually lower. Industry was slow to believe that associations had something valuable to sell". Despite these difficulties, amounting in some cases to great financial uncertainty, the number of RAs stabilised and most managed to survive the depression years. It was a question of survival, however, rather than growth and by the early forties there were still fewer RAs in existence than there had been twenty years earlier.

In 1917, it was intended that the DSIR grant support be used only to help establish RAs over their first five years' existence. But at the end of the first five years of the scheme, and again after 10 years (1927), it was admitted that the associations required longer to take root than expected, and grants were made available beyond the five-year period. The eventual depletion of the £1 million came in 1932 and, while it

was still envisaged that the RAs would and should eventually become self-supporting, the idea that this should be achieved by a set time limit was dropped. The grant system was renewed, and later it became subjected to an annual parliamentary vote.

7.3.2 Overseas Membership

Following the Ottawa Conference in 1932, it was decided that Commonwealth organisations should be eligible for membership in RAs and there was considerable support from the Commonwealth for many RAs. Commonwealth members were admitted as Ordinary Members but their representatives were not normally eligible for election to or for service on the Council. In addition to manufacturers, there were also instances of membership by Commonwealth Government Departments and Universities.

In 1960, it was considered by DSIR that the international climate in research was favourable to throwing open membership to foreign manufacturers but restricted it to a non-voting form. Accordingly, the RAs were invited to admit foreign companies, and could have a number of such members. These members could attend General Meetings but were not allowed to vote or be elected to the Council. Towards the end of 1970's, overseas members were allowed full membership with the right to vote and to hold positions in the Council.

The idea of Overseas Membership was a common feature among RAs in the late 1970's. In the 1980's, membership was accepted from any organisation anywhere in the world.

Source: DTI; OECD (1967)

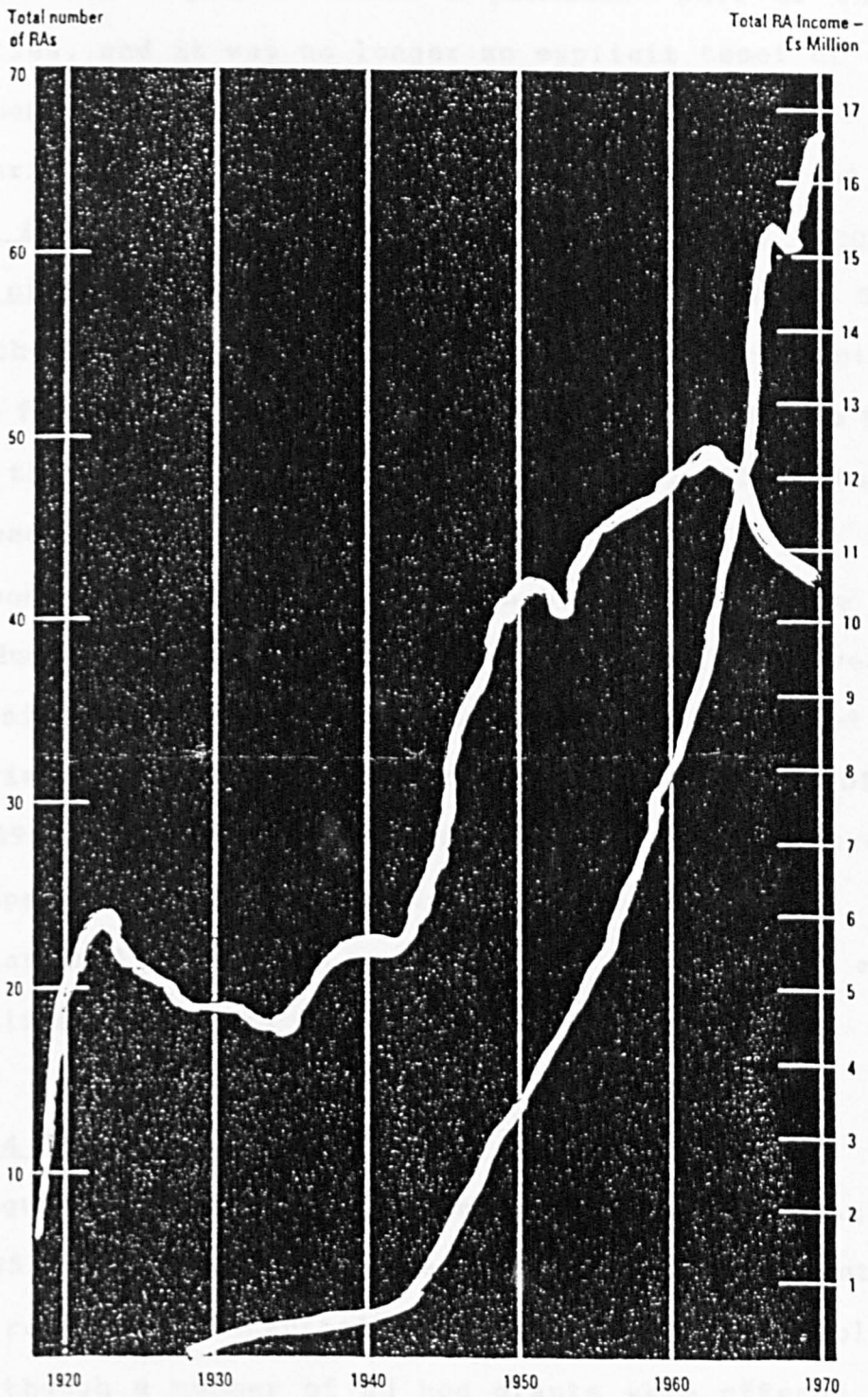

Figure 7.1 Numbers and Total Income of RAs from 1918 to 1970 (current prices).

7.3.3 Development of RAs After the War

Figure 7.1 shows the change in the number of RAs from 1918 to 1970 and the total income of RAs[2]. In November 1945 the Government decided to continue supporting the RAs in the nation's interest. Their grants became a permanent part of the DSIR's activities, and it was no longer an explicit tenet of government policy that the RAs should within time, or even necessarily at all, become entirely independent of grant support. It was from 1945 to the early sixties that the second major period of RA growth occurred. Their number doubled to 50 and in 1963, their total income reached £10 million (current prices) for the first time. Hereafter, the number declined (due to merger rather than closure) to 40 in 1971, although the total income continued to rise.

Looking at the second and highest peak in figure 7.1, one can deduce that the RA concept was most well received in the early sixties. The concept could not be extended to new industries. Instead there was a continued contraction of numbers (in 1989 there were 32 RAs left!). The RAs that were set up overlapped in terms of their activities. And in view of organisational overheads there was scope for effective rationalisation in the form of merger.

7.4 Government Grants

Figure 7.2 shows the trend in total government grants to RAs from 1951 to 1971[3]. During the post-war period, grant-support policy remained substantially the same as that established in 1945 although a number of ad hoc grants were offered. In 1948 non-recurrent grants were introduced for capital projects.

Source: Civil (Supply) Estimates

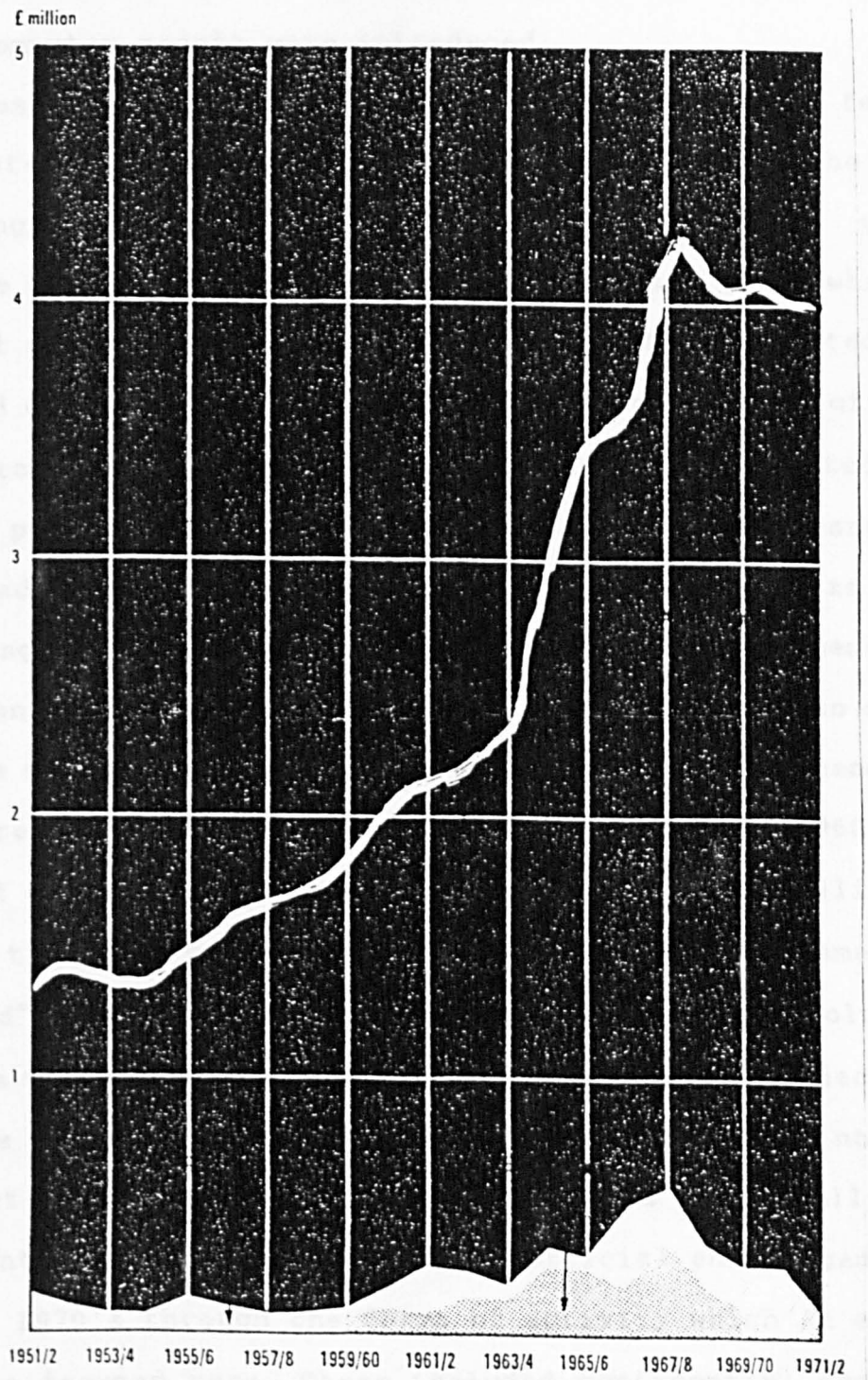

Figure 7.2 Government Grants to RAs from 1950 to 1971 (current prices).

Between 1959 and 1964 special assistance grants were offered to improve liaison services. In 1963 "earmarked" grants were introduced to assist RAs to undertake desirable projects which, because of their speculative or long-term nature, could not be adopted under normal grant and subscription conditions. In 1968, special computer grants were introduced.

In respect of the general grant itself, the major feature of the post-war period was the introduction in 1951 of the grant "stiffening" policy. This sought to eliminate the purely indefinite quality of grant support and to affirm that, while no time-limit was set to its existence, it was still expected that RAs should endeavour to derive an increasing proportion of their finance from industry. Henceforth, the DSIR was committed to a policy of progressively stiffening grant terms. This meant that each RA had to renegotiate the grant with DSIR. This was meant to encourage industry to invest resources into R&D themselves rather than to depend on the Government. This policy also served to provide some control over the growth of government expenditure in this area, a limit which was rendered explicit in 1968 when, as part of general economy measures, a ceiling of £4 million was placed on the total value of all grants to RAs. At the same time, "earmarked" grants were discontinued. The overall volume of support in succeeding years, with continued stiffening, declined. The volume of the ad hoc grants had diminished almost to nothing. The object of stimulating the RAs to become financially more independent was reflected also in the official encouragement in the early 1970's through the forms of activity which in earlier times were frowned upon. These included confidential sponsored work for individual members, projects undertaken for a group of

members only, and ancilliary services such as training and conferences.

Government grant in 1970 was equivalent to one-quarter of the total income of the 43 RAs in existence. The effect of the ceiling figure was that most RAs faced the prospect of a level of grant, which, in real terms, was declining. The RAs felt that the principle of government grant was still of importance to their operations. They pointed out that even though the grant was relatively small in proportion to their total income, its marginal effect was vital. Without it, an operating balance (or slight profit) would often turned into a deficit of unacceptable proportion. While no formal government policy was declared then, some RAs, in order to pre-empt the most serious possibility, were beginning to think in terms of a future without grant at all.

7.5 Industrial Support

The industrial income of RAs was for the great majority, subscribed voluntarily. Time and effort had to be spent by the staff of the RAs in trying to increase their membership by further recruitment of members or even, because of an inevitable turnover in membership, in keeping membership static and preventing a drop in industrial income. For this reason compulsory levies for research imposed by statute on all manufacturers in specific industries were attractive. Five RAs, those for Cutlery, Furniture, Cotton, Hosiery and Wool used to have statutory levies under the Industrial Organisation and Development Act, 1947.

The weakness was that, while this increased the amount of technical know-how available, it had no direct effect on the utilisation of the know-how in industry. The danger of the system was that it had no real effect on the companies' awareness, and the payments were regarded simply as taxes which must be paid.

By the 1970's, there were but few industries whose members would willingly agree to the imposition of levy and a major extension of the system was halted. The levy system did not accord with the customer-contractor principle. It was felt that industries should be left free from government stipulation or limitation as to the nature of support given to RAs[4]. The Conservative Government policy of allowing market forces to dictate would not legislate laws that imposed levies on industries.

When the levy schemes were withdrawn, this caused a lot of difficulties for RAs which were dependent on them. HATRA went through a lot of difficulties when the levies was withdrawn in the mid seventies and it never recovered from it. WIRA and SI too faced similar difficulties which brought about their merger in 1988.

The question of whether confidential sponsored work for industry i.e. work paid for completely by the sponsor, who retains the right to the results of the work, was an appropriate activity for an RA was discussed both by the DSIR and the RAs, particularly soon after the war. The general opinion in the 1950's was that there was little demand for it in the UK and what work existed was better carried out by consultants than by RAs i.e. especially those which were near-market. The view was also held that it would not be possible successfully to carry on

research on both a cooperative and a sponsored basis in the same organisation, if only because of the inevitable flow of information between the two types of projects. Also, the governing Councils of the RAs were unwilling to allow activities over which they had virtually no control. There was also a formal difficulty in that it was not clear to what extent the position of the RAs as regards to income tax exemption would be jeopardised if sponsored work were undertaken. The DSIR's attitude at that time was that it did not object to sponsored work but did not encourage it.

In 1958 the Department, partly because of the growing volume of sponsored work being placed abroad by UK manufacturers, decided to encourage RAs to undertake sponsored work, provided it was not in any way done at the expense of the cooperative activities.

7.6 RA's Activities

The RAs provided their customers with:-

(1) Consultancy, problem-solving.

(2) General level of science/technology of industry.

(3) Credibility that was obtained by being a member.

(4) Good forum to meet other companies in industry.

(5) A special role RAs played in helping in standards or accreditation.

(6) The use of the RAs' facilities as a buffer e.g. when their own laboratories were over-loaded, or to even out peaks and troughs; or if a piece of research required to be done quickly, to tap the expertise or resources at the RAs.

The kinds of R&D activities that were carried out by RAs in the 1970s were:-

(1) General programmes. This was cooperative work undertaken in the interest of the whole membership, the results of which were freely available and publicized to members. This was the original purpose of the RAs' existence and, for some, it comprised the main bulk of work. These programmes were selected and controlled by the RAs' Council or Research committees, and were thus only indirectly controlled by members in the sense that they elected these bodies. In some cases, the general programme was made more sectional in its appeal by dividing the membership into product-classes, for each of which a committee controlled a portion of the total programme.

(2) Information services. The purpose was to perform the dual role of supplying unsolicited information to members and answering technical queries posed by them. Information services often included extensive library, reference and translation facilities.

(3) Repayment work. It embraced all the work done by RAs at the specific request of individual members and for which a definite charge was made. It thus included research and development projects done on contract and confidentially on behalf of an individual member. Since fees paid for repayment were not regarded by the Government as industrial income for grant assessment purposes, most RAs were careful to charge for it in such a way that no grant subsidisation occured. It was decreasingly the case that membership subscriptions alone provide access to all the services which RAs offer. It was common for RAs to charge specifically (and additionally to subscription) for

items of work undertaken on behalf of individual members.

(4) Group projects. These occupied a position between the subscription-funded general programmes and repayment work. It was a relatively new type of activity which in several RAs was of considerable importance. They were given a variety of names:-

(1) Joint projects.

(2) Special investigations.

(3) Special industrial projects.

(4) Group projects.

The character of such a project was that, unlike some repayment work, it was not confidential, or subjected to a period of confidentiality before results were made freely available. For this reason the Government viewed income raised for group projects as qualifying for a grant. Group projects, however, differed from general programmes in that they arose from a specific request for technical assistance from a group of members with a common interest in a particular problem. This type of work could be summed up as multi-client sponsored work of limited confidentiality. The group project formula combined two features which were of importance to many RAs:-

(1) It ensured that a greater proportion of their work was felt by members to be directly in their interest and directly applicable (since they directly requested that it be undertaken).

(2) It served to increase the amount of grant received, which a fully confidential contract would not.

7.7 Legal Status

As mentioned earlier, RAs were incorporated under the Companies Act. The liability of members was limited to £5 each, a nominal figure which did not change since 1917. A few RAs have changed their status in 1989 i.e. WRc and BHRA. The reasons and implications of this change will be looked into in greater detail in later chapters.

Because of their objects and non-profit-making character, the Associations were normally granted, under Section 19 of the Companies Act 1948, a licence by the Board of Trade to omit from their title the word "limited"; this distinguished them from commercial organisations. Some RAs prefered not to omit it to project the image of a commercial organisation. It also reflected the changes that were going on within the RAs towards a commercial organisation.

The RAs did not qualify for charities reliefs which applied to charitable organisations as such or scientific societies. They were exempted from payment of income tax (as long as they were limited by guarantee) through specific provisions of the Income Tax Act, 1952. Through provisions of the same Act, any payment, whether membership subscriptions or voluntary donation, made by a trader to an RA may be counted by the trader as a business expense provided he was engaged in a trade which was served by the Association in question.

7.8 RAs Representation - AIRTO

Most of the RAs are members of AIRTO (The "Association of Independent Research Technology Organisations"). It groups together 44 independent research establishments which depend on

research services provided for clients. It is the largest contract research organisation (CRO) grouping in the EC.

Table 7.1 Members of AIRTO (1989)
Source: AIRTO Directory (1990)

(1)ARA	Aircraft Res. Asso. Ltd.
(2)AMTRI	Advanced Manf. Tech. Res Inst
(3)BCIRA	British Cast Iron Res. Asso.
(4)BHRA	Bri. Hydromechanics Research Asso
(5)BNF	British Non - Ferrous Res. Asso
(6)BCR	Bri Ceramics Res. Asso
(7)BGI	Bri Glass Ind Res Asso
(8)BIC	Bri Internal Combustion Engine Res Ins Ltd
(9)BLC	Bri Leather Confederation
(10)BMT	Bri Maritime Tech Ltd
(11)BRA	Building Services Res Information Asso
(12)CCL	Cambridge Consultants Ltd.
(13)CIRIA	The Construction Ind Res and Information Asso
(14)CAT	Cutlery and Allied Trades Res Asso
(15)ERA	Electrical Res Asso
(16)FCR	Fabric Care Res Asso
(17)FUL	Fulmer Ltd
(18)FIR	Furniture Ind Res Asso
(19)HAZ	Hazleton UK
(20)HAT	Hosiery and Allied Trades Res Asso
(21)HRC	Hydraulics Research Ltd
(22)INV	Inveresk Res International Ltd
(23)LAM	Lamberg Industrial Res Asso
(24)LIFE	Life Science Res Ltd
(25)MIRA	Motor Ind Res Asso
(26)NCC	The National Computing Centre Ltd
(27)NEI	NEI International R&D Co Ltd
(28)PR	Paint Res Asso
(29)PERA	Production Engineering Res Asso
(30)PIRA	Paper Ind Res Asso
(31)RAPRA	Rubber and Polymer Res Asso
(32)RIC	Ricardo Consulting Engineers plc
(33)SAT	Shoes and Allied Trade Res asso
(34)SRC	Shipowners Refrigerated Cargo Res Asso
(35)SI	Shirley Inst
(36)SIRA	Scientific Instruments Res Asso
(37)SMI	Smith Associates Ltd
(38)SRA	Spring Res and Manufacturers Asso
(39)SCR	Steel Casting and Trade Asso
(40)TRA	Timber Res and Development Asso
(41)TOX	Toxicol Laboratories Ltd
(42)WRc	Water Res Centre
(43)WI	The Welding Inst
(44)WIRA	Wool Industry Res Asso

Table 7.1 shows the list[5] of members of AIRTO(The Association of Independent Research and Technology Organisations) as of 1989.

The AIRTO is the result of a merger of two professional groups in 1986:-

(1) The Association of Independent Contract Research Organisation (AICRO):- Was set up in 1975 and its members consisted of research establishments like Fulmer, Ricardo, Huntington, Inveresek and Roberston which were totally independent of any industrial sector, and others such as ERA Ltd. which became independent. These establishments received no particular aid from authorities.

(2) Contract Research Association (CORA):- This group was made of the "Research Associations" (RA).

Another group of members of AIRTO are those which were previously government industrial research establishments. They were privatized by the Government in the early 1980's. Among them were BMT, HRc and WRc. All of them are now private limited companies (limited by guarantee) with the exception of WRc, which is limited by share holdings (implemented in 1988).

The two large families (i.e. AICRO and CORA) are now united in a single movement but nevertheless retain major differences. Among these differences are:-

(1) In their legal form:- The "RTOs" (members of AIRTO) which stem from the AICRO, are public or private limited companies.

The RAs have in most cases taken the legal form of a "company limited by guarantee", receive subscriptions and are not profit making. Their members are liable for the establishment.

(2) Financing:- In some cases the RAs still receive voluntary

contributions, sometimes up to 40% of their income (for example British Leather Confederation - 43%)[6]%.

(3) Field of activity:- The RTOs are by tradition open to the whole of industry and any client from the UK or abroad, whereas the RAs are closely dependent on their industrial sector. The RAs tend to conduct pre-competitive collaborative research but are also willing to accept individual contracts. Their members have access to the results of joint research.

The consolidated balance sheet of AIRTO showed a turnover totalling £250million[7] (1988) broken down as shown in Figure 7.3. About 48% of their income cames from UK firms'; 32% from public bodies and 20% from foreign firms.

The AIRTO has more than 20,000 clients out of 80,000 UK firms and is equally well established in small and large companies where:-

(1) 80% of the clients are SMES.

(2) 93 of the 100 largest industrial groupings are clients.

Clients come from many countries (20% on average from outside the UK) .

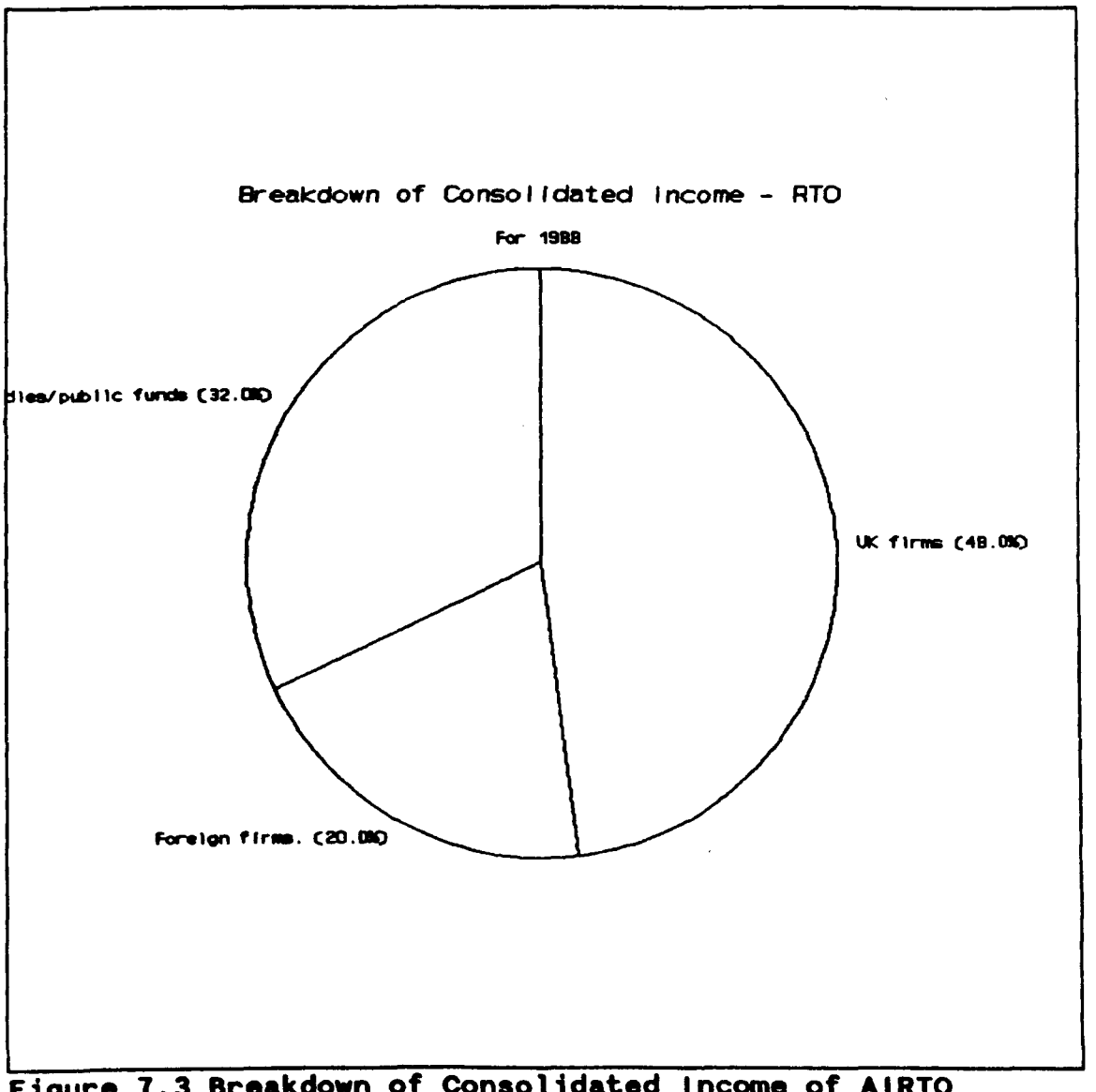

Figure 7.3 Breakdown of Consolidated Income of AIRTO
Source: Bossad (1989)

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OECD: Industrial Research Associations in UK. Paris: OECD Publications, 1967.

3. Civil (Supply) Estimates, various years.

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7. cf. 5.

CHAPTER 8: STATISTICAL REVIEW OF THE RAs

8.1 Staff Number

Altogether, the RAs employed 5343[1] staff in 1963 and this increased to 5957 in 1970[2] as shown in table 8.1. By 1988, this figure dropped to 5515[3] i.e. a decrease of 442 staff or 7% in comparison to 1970.

Table 8.1 Total Number of Staff

Sources:- CSII (1972); Hammond (1967); Annual Reports of RAs

Year	No of Staff	No.of RAs
1963	5343	43
1970	5957	43
1988	5515	33

8.1.1 Average Staff Numbers

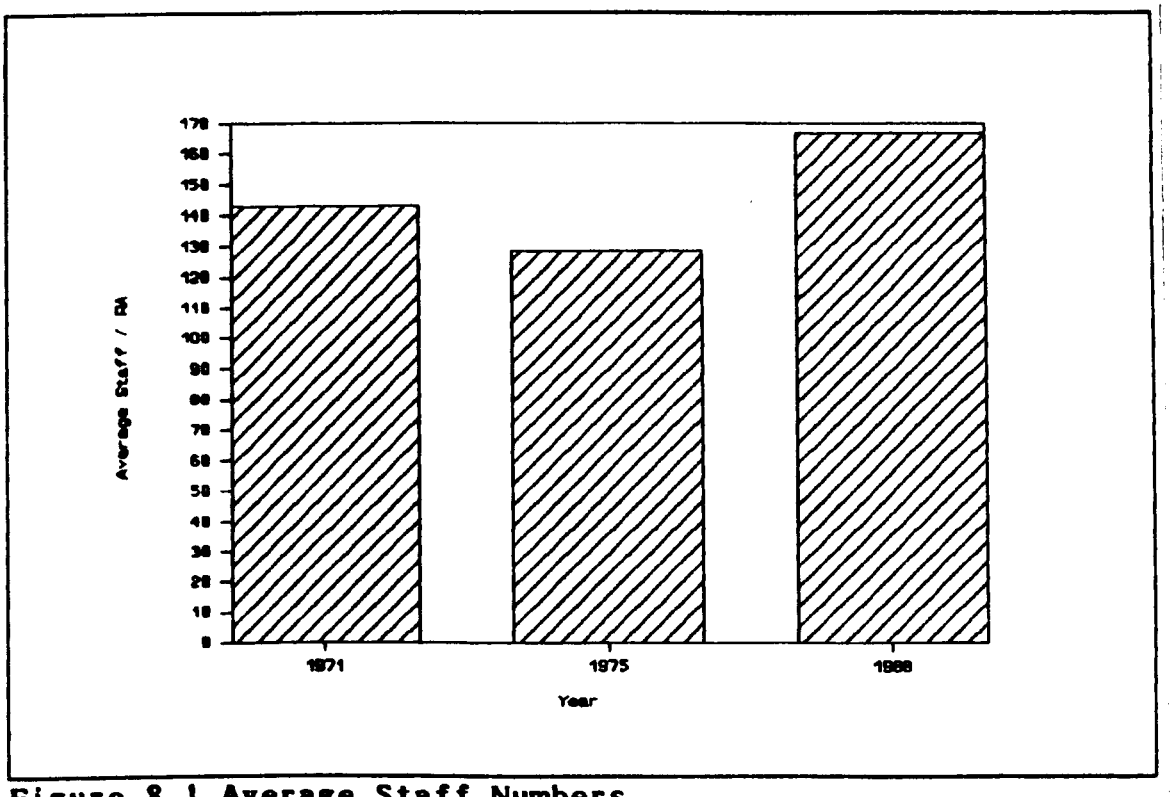

Figure 8.1 Average Staff Numbers
Sources:- CSII (1972); Bessborough (1973); Annual Reports of RAs

It is important to note that although the total number of employees dropped in 1988 in comparison with 1970, the average number of employees increased. This is shown in figure 8.1. The average staff number of RAs in 1970 was 138[4]. By 1975, the average staff number dropped to 128[5] but it increased to 167[6] in 1988.

Over the last two decades, the number of RAs decreased from 43 to 33, either due to closure (e.g. British Coal Utilisation Research Associations) or merger (e.g. SI merged with WIRA in 1988). The surviving RAs had to fight to survive in a very competitive environment over the last two decades. The increase in the average size (staff number) of the RAs could indicate that the remaining smaller RAs had to enlarge their size to offer a wider range of services to the market. The increase in size could also indicate a growth of expertise.

8.1.2 Distribution of Staff Number

Table 8.2 Number and Distribution of Staff

Number and Distribution of Staff

Year	10 to 150	As %	% of Total Employment	151 to 300	As %	% of Total Employment
1971	24	63%	33	10	26%	37
1975	22	59%	26	13	35%	51
1988	17	52%	19	11	33%	41

Year	301+	As %	% of Total Employment	Total RAs
1971	4	11%	30	38
1975	2	5%	18	37
1988	5	15%	40	33

Sources:- Bessborough (1973); Annual Reports of RAs

Table 8.2 shows the number and distribution of staff in RAs. In 1971, 63% of the RAs' staff were in a 10-150 employees range. By 1988, this dropped to 52%[7] with the number of RAs dropping from 24 to 17. This range experienced the biggest drop in comparison to the other two ranges. This could indicate that the number of smaller RAs (10-150) decreased due to merger or closure. These RAs were facing difficulties in trying to compete in the environment. It would not be surprising if the number of RAs of this size were to continue to decrease - they might either have to merge or face closure. Another difficulty was that the smaller RAs tended to serve a very narrow niche of a particular industry e.g. SRAMA. They could be too closely dependent on one industry and be affected by its fortune. A single down-turn could prove too much for that particular RA. Many of these smaller RAs tend to serve mature and declining industry (e.g. HATRA). Unless they are able to diversify in the future, they might risk closure. But diversifying into other areas could be difficult because of their size. The other option could be a merger (in the last 2 years, 3 RAs merged i.e. SI merged with WIRA to form BTTG and BNF merged with FULMER to form BNF-Fulmer). It would be interesting to see how these RAs (which opted for merger) perform in the next decade.

The number of RAs with staff numbers in the range of 151 to 300 increased from 10 in 1971 to 13 in 1975 but fell to 11 in 1988 i.e. from 26 to 33% of the total. This could be regarded as approximately the minimum size in which an RA could operate in a competitive environment. PIRA[8] was one example where a merger in 1967 enabled it to compete more effectively because of its improved facilities and resources. It would not be surprising

if the RAs that fall into this category achieved the biggest growth in the next decade.

The number of RAs with more than 300 staff increased from 4 in 1971 to 5 in 1988 i.e. from 11% to 15% of the total number of RAs with an accompanying increase in the total employment in RA's from 30% to 40%.

In 1971, 63% (10 to 150 region) of the total number of RAs employed 33% of the total employment. By 1988, 52% (i.e. more than half) of the total number of RAs employed only 19% of the total employment. This reflects the widening gulf between the smaller RAs and the larger ones. If the government aim was to promote the RA principle, the government might have to promote different policies for RAs in the different size ranges to improve the smaller RAs as well as to encourage the continuous growth of RAs in the other two ranges.

In 1971, 26% (those in the 151 to 300 range) of the total number of RAs employed 37% of the total employment. By 1988, 33% of the RAs employed up to 41% of the total employment.

RAs with over 300 staff experienced the biggest change. In 1971, 11% of the total number of RAs employed up to 30% of the total employment. By 1988, 15% of the total number of RAs employed 40% of the total workforce. In other words, 15% of the total number of RAs employed up to twice the amount of staff employed by 52% of the RAs (those in the region of 0 to 150). It would not be surprising to see this trend continue i.e. the larger RAs continuing to grow and the smaller RAs having a declining staff number. Some of the bigger RAs changed their status to one that was limited by shares (e.g. WRc and BHRA), which enabled them to raise captital for expansion. Their former

status i.e. one that was limited by guarantee did not allow them to raise capital through shares. Some took various steps to restructure their organisation. For example MIRA appointed a new managing director who was more commercially oriented and he in turn made major changes in the organisational structure.

8.1.3 Changes in the Types of Staff

Table 8.3 Staff Types

	Staff Types(%)		
Year	Technical Degree	Technical Assistant	Support Staff
1971	27	32	41
1975	28	32	40
1982	34	← 66 →	

Sources:- Bessborough (1973); Kennedy (1985)

The purpose of this section is to give an idea of the types of RA staff. It can be divided into 3 types: those with a technical degree, technical assistants and support staff. Table 8.3 shows the percentage breakdown in staff types. In 1971, the percentage of staff members with a technical degree was 27%[9]. In 1982, the percentage increased slightly to 34%[10]. There was a tendency for all RAs, whatever their size, to have graduate employments at 20 to 30% of the total[11].

In 1971, 32% of the total RAs' staff consisted of technical assistants and this figure remained unchanged in 1975. In 1971, 41% of the total RAs' staff were support staff, which also remained much the same in 1975. In 1982, the combined technical and support staff percentage came to 66%.

Table 8.4 Ratio of Research Staff to Support Staff in 1988

Company	Staff Total	Research	Ranking of ratios of research staff to total
SCR	82	70	85.37%
SI	191	146	76.44%
HUNT	1000	750	75.00%
BRA	82	61	74.39%
CCL	245	180	73.47%
LEA	250	183	73.20%
SRA	21	14	66.67%
SMI	60	40	66.67%
ERA	383	254	66.32%
WI	536	350	65.30%
INV	262	170	64.89%
BGI	41	25	60.98%
PA Tech	270	164	60.74%
AMTRI	61	36	59.02%
RAPRA	170	100	58.82%
BCR	223	130	58.30%
BLC	55	32	58.18%
HRc	260	150	57.69%
BMT	350	200	57.14%
BNF	90	48	53.33%
BHRA	199	100	50.25%
NEI	500	250	50.00%
WIRA	100	50	50.00%
CIRIA	40	20	50.00%
SIRA	261	120	45.98%
FUL	194	81	41.75%
ARA	294	100	34.01%
PR	56	19	33.93%
TRA	125	40	32.00%
PERA	330	100	30.30%
LIFE	455	135	29.67%
FIR	93	26	27.96%
RIC	375	95	25.33%
BIC	67	8	11.94%
Total	7721	4247	55.01%

Source:- Bossad (1989)

Table 8.4 shows the percentage breakdown of RAs' research and support staff for 1988[12]. The percentage ranges from 28% to 85%. Some RAs, however, lumped together the researchers with technical degrees and the technical assistants whereas others quoted only the figure for researchers with technical degrees.

That is why there is so much difference in the number of research staff. The general picture appears to be that, the percentage of graduate researchers amounts to between 20 and 30% in 1988.

8.1.4 Recruitment of Staff

Recruitment of staff was one of the major problems encountered by the RAs. This problem was highlighted by practically every RA visited. They faced a lot of competition from industry in trying to attract the best graduates. They also faced problems in recruiting graduates with the kind of qualification they were looking for. Therefore, the RAs had to provide an in-house training for the recruits.

The turnover of staff among RAs was relatively higher than that in the industry they served. They faced competition from industry in trying to retain their staff. In order to do so, the RAs had to provide the proper incentives in terms of renumeration and job satisfaction as well as a clear career path as most recruits did not see themselves making a career out of working for RAs. On the other hand, the turnover of staff was of advantage to both the RAs and industry. Industry gained by being able to recruit personnel with the expertise and experience required and the RAs gained by having former staff members working for the industry the RAs served (which created an important contact for the RAs. This is especially important with regard to industrial marketing where loyal customers and repetitive buying is high).

8.1.5 Ranking of RAs According to Staff Numbers

Table 8.5 Ranking of RAs' According to Staff Number (1988)

RAs	Ranking of RAs According to Staff Number (1988) (1988)
WRc	667
WI	520
ERA	388
PERA	350
BMT	340
HRC	281
MIRA	266
SIRA	250
Lea	235
BCR	225
BHRA	199
SI	187
PIRA	180
RAPRA	165
SAT	165
CAMP	152
BCIRA	137
TRA	125
WIRA	100
FIR	93
BNF	90
BRA	85
SCR	80
AMTRI	61
LAM	56
PR	55
BLC	53
BGI	40
CIRIA	39
FCR	33
SRA	20
HAT	16
CAT	14
BTT	NA

Source:- Annual Reports of RAs

Table 8.5[13](see also Appendix 8.1) shows the ranking of RAs according to staff numbers in 1988. Ranked on a descending order the top five employers were (with staff members greater than 300):-

RAs	No. of Staff
WRc	667
WI	520
ERA	388
PERA	350
BMT	340

Of the top five RAs, two were former government research establishments (WRc was the responsibility of DoE and BMT was a merger of NMI and BSRA in 1985[14]). These two RAs "inherited" the rather large workforce. In the case of BMT, it trimmed down its workforce since the merger. It was also interesting to note that WI, ERA and PERA are not "particular industry"-based RAs. They are "horizontal technology"-based RAs. The latter have a wider market. RAs like WI and PERA have moved towards information services, training and conferences, and consultancy.

In 1988 there were 17 RAs with less than 150 staff members. These would probably be the most vulnerable group because of their size. Included in this group are 6 RAs which had less than 50 staff members. They are:-

RAs	Staff numbers
(1) BGI	40
(2) CIRIA	39
(3) FCR	33
(4) SRA	20
(5) HAT	16
(6) CAT	14

Some of these RAs will probably have to fight very hard in the next few years in order to survive. For example HATRA had over the last two decades, shrunk to a size where it will be very difficult to build on. BLC was trying to restructure in 1988 to enable it to face greater competition in the next decade.

Table 8.6 shows the difference in staff numbers between 1971 and 1988. The three RAs with the biggest increase in absolute numbers were WI (136), LEA (114) and CAMP (93). Out of these three RAs, two (LEA and CAMP) served the food industry. It could be a reflection of the increase of R&D demand from the food industry. This was predicted in the Bessborough report (1972).

The three RAs which experienced the biggest decrease in absolute numbers were PERA (200), BNF (90) and HAT (64). BNF has now merged with Fulmer. HAT was going through a phase of trying to improve its position. PERA decreased its staff number over the last decade and the number is now stabilising at around 350.

In terms of percentage change, the top three with the biggest increase were CAMP, LEA and BHRA. The bottom four were

Table 8.6 Ranking of Staff Number Difference Between 1971 and 1988

Ranking of Increase or Decrease of Staff No.		Ranking of Percentage Increase of Decrease	
RAs	1988-1970	RAs	As %
WI	136	HRC	ERR
Lea	114	SI	ERR
CAMP	93	BRA	ERR
BHRA	77	BTT	ERR
MIRA	66	BLC	ERR
SIRA	61	BMT	ERR
ERA	28	FCR	ERR
TRA	19	WRc	ERR
FIR	13	CAMP	158%
CIRIA	9	Lea	94%
BCR	5	BHRA	63%
SRA	0	WI	35%
SAT	0	MIRA	33%
CAT	-3	SIRA	32%
AMTRI	-7	CIRIA	30%
PIRA	-15	TRA	18%
LAM	-17	FIR	16%
SCR	-21	ERA	8%
BGI	-22	BCR	2%
BCIRA	-36	SRA	0%
RAPRA	-40	SAT	0%
PR	-42	PIRA	-8%
WIRA	-61	AMTRI	-10%
HAT	-64	CAT	-18%
BNF	-90	RAPRA	-20%
PERA	-200	SCR	-21%
BRA	NA	BCIRA	-21%
WRc	NA	LAM	-23%
SI	NA	BGI	-35%
HRC	NA	PERA	-36%
BLC	NA	WIRA	-38%
FCR	NA	PR	-43%
BMT	NA	BNF	-50%
BTT	NA	HAT	-80%

Sources:- Annual Reports of RAs; Bessborough (1973)

WIRA, PR, BNF and HAT. Out of these four, two (WIRA and BNF) merged with other RAs. WIRA merged with SI to form BTTG. This merger could help them to consolidate their position in the textile R&D market. BNF merged with Fulmer to enable it to widen its field of coverage beyond non-ferrous metals.

8.2 Turnover

Table 8.7 Comparison of RAs Turnover with UK's Total R&D

Year	Total(£mil) RA Turnover(A)	Total(£mil) UK R&D Turnover(B)	A/B %
1968	16.80	1016.60	1.65%
1988	155.00	10303.00	1.50%

Sources:- CSII (1972); RAs' Annual Reports; Central Statistical Office (1990)

In 1988, the total RAs' turnover accounted for 1.50% of the total R&D expenditure in the UK in comparison to 1.65% in 1968 i.e. a drop of 0.15%. This is shown in table 8.7[15]. Considering the fact that the RAs faced a very difficult situation in the last two decades, the RAs performed relatively well.

Table 8.8 Comparison of RAs' Turnover With Industry's and Government's

Year	Total(£mil) RA Turnover(A)	Industry (£mil)(B)	Govt(£mil) (C)	A/B %	A/C%
1968	16.80	601.90	372.00	2.79	4.5
1988	155.00	6861.00	3443.00	2.26	4.5

Sources:- RAs' Annual Reports; CSII (1972)

Table 8.8[16] shows the comparison of the RAs' turnover with industry and Government. The total RAs' turnover to total industry expenditure on R&D dropped from 2.79% to 2.26% i.e. there was a decrease of 0.53%. Although in percentage terms it dropped, in real terms (in 1988 prices), there was an increase of £50 million in turnover in comparison to 1968. But the decrease in percentage terms does indicate that the RAs' turnover was not able to grow as fast as the industry's R&D expenditure growth. The ratio of the RAs' turnover to the total government

R&D expenditure did not alter much. It remained unchanged at about 4.5%.

8.2.1 Comparison of RAs' Turnover with University R&D Expenditure

Table 8.9 Comparison of RAs' Turnover With HEIs' R&D Expenditure in 1968 and 1988

Year	Total($mil) RA Turnover(A)	HEI's R&D Expenditure(B)	A/B %
1968	16.80	84.20	19.95%
1988	155.00	629.00	24.64%

Sources:- Annual Reports of RAs; University Funding Council (1988/89)

Table 8.9[17] shows the comparison of RAs' R&D turnover and the total university R&D expenditure in 1968 and 1988. The ratio of the RAs' turnover to the total university R&D expenditure increased from 19.95% to 24.64%. The figure does indicate that the RAs were more competitive than universities in obtaining income for R&D. One would have expected the percentage to decrease because over the past decade, the universities were encouraged to obtain as much funding as possible from industry. The universities were in direct competition with the RAs.

Table 8.10 Comparison of University and RAs' Research Income

	University 1988	RAs 1988
Total Cost(mil)	3081	155
R&D Expenditure(A)	629	155
R&D Income from:-		
Industry(B)	78	117
As % Expenditure(B/A)	12.4%	75.48%
Government(C)	315	38
As % Expenditure(C/A)	50.08%	24.52%

Sources:- RAs' Annual Reports; University Funding Council

Table 8.10 shows the comparison of the breakdown of research income of universities and RAs. RAs obtained up to 75% of their research income from industry whereas universities obtained only 12.4%. The government support for RAs came to 25% of the RAs' turnover whereas government support accounted for up to 50% of the universities' R&D income.

8.2.2 Overall Turnover

Table 8.11 Analysis of RAs' Turnover in 1968 and 1970

	1968	1970
Total income(£mil)	4.80	16.40
Average income per RA(£mil)	0.34	0.38
Median income or RAs(£mil)	0.24	0.30
Number of RAs with income		
-over £1m	3	4
-500k to £1mil	6	7
-250k to 499k	11	14
-100 to 249k	13	10
-under 100k	10	8
Total	43	43

Source:- CSII (1972)

The overall turnover in 1970 was £16.4m[18] (£95m in 1988 prices) as shown in table 8.11. By 1988, the overall turnover increased to over £157m as shown in table 8.12 i.e. with an increase of 54%. This is quite significant because despite the difficulties encountered by RAs over the last two decades which brought about closures and mergers, the RAs performed quite well.

Appendix 8.2 shows the comparison of a selection of RAs' growth in turnover from 1980 to 1988. Among the RAs with the biggest annual growth were SIRA (12.92%), LEA (10.51%), WRc (10.32%) and PIRA (8,42%). Some RAs had negative growth. Among them were HATRA (-8.26%), BGI (-3.62%), BCIRA (-3.4%), and BNF

(-2.04%). HAT's turnover in 1988 shrank to about 1/3 of its turnover in 1980.

8.2.3 Distribution of RAs According to Turnover

Table 8.12 Distribution of RAs According to Turnover

	1970	1988
Total income(£mil)	94.628	155
Average income per RA(mil)	2.1926	4.813
Median income or RAs(mil)	1.731	2.75
Number of RAs with income		
-over £5.5mil	4	10
-£2.8mil to £5.5mil	7	6
-£1.4mil to £2.8mil	14	8
-550k to £1.4mil	10	5
-under 550k	8	3
Total	43	32

Source:- CSII(1972)
:-Bessborough (Updated Appendix 5 in 1975)

Note:- The six RAs with incomes exceeding $5.5mil(in 1975) were MIRA,Water RA,SI and WI.
:- The 3 RAs >£5mil in 1968 were ERA, PERA, BSRA

Table 8.12[19] shows the number of RAs in different ranges of turnover. In 1970, there were only 4 RAs with turnovers exceeding £5.5m (1988 prices) but in 1988, there were 10 RAs. In 1970, there were 8 RAs that had a turnover of less than £0.55m but only 3 in 1988. The biggest decrease in numbers of RAs came from the £0.55m to £1.4m range. The number decreased from 10 in 1970 to 5 in 1988.

8.2.4 Ranking of RAs According to Turnover

The income of the individual grant-aided RAs varied widely. In 1970 the largest had an income of about £1.7 million[1] (£9.81

[1]Pera

million in 1988 prices), and the smallest under £0.18m (£0.112m in 1989 prices).

Table 8.13 Ranking of RAs According to Turnover (1988)

(£mil 1988 Prices)

RAs'	(1988)
WRc	22.00
PERA	15.444
WI	15.00
ERA	10.500
BMT	10.024
MIRA	9.082
HRC	8.000
SIRA	7.763
Lea	6.331
BHRA	5.600
PIRA	5.000
BCR	4.609
RAPRA	3.500
SI	3.200
BNF	3.000
SCR	2.80
SAT	2.700
TRA	2.70
BCIRA	2.643
FIR	2.300
BRA	2.300
WIRA	2.20
CIRIA	1.700
AMTRI	1.409
PR	1.000
BLC	0.970
LAM	0.700
FCR	0.700
BGI	0.700
SRA	0.50
HAT	0.400
CAT	0.260

Median of turnover =£2.75m
No. of RAs above 5.5m = 10
£2.8m - 5.5 = 6
£1.4 - 2.8 = 8
0.55m - 1.4m = 5
Under 0.55m = 3

Source: RAs' Annual Reports

In 1988[20] (see appendix 8.3), the RA with the highest turnover was WRc with a turnover of over £22m. This is shown in table 8.13. WRc was followed by PERA (£15.4m) and WI (£15m). WRc was the first RA which changed its status in 1988 from one limited by guarantee to one limited by shares. It will not be

surprising to see WRc's turnover increase especially so since the Water Industry (1988) and Electricity Industry (1990) were privatised. The success of WRc is reflected in the big gap in turnover with PERA (a gap of over £7m). It does reflect the growing competitive-ness among RAs and the environment they operated in. The turnover of PERA was ranked second, but in real terms (1988 prices) its turnover increased by over £5.6m over the last two decades.

The RA with the smallest turnover in 1988 was CAT with a turnover of £0.26m whereas the smallest turnover in 1970 was £0.163m (1988 prices).

The RAs' turnover was distributed fairly evenly across this wide spread. In 1970, the median was £0.3m (£1.73m in 1988 prices) as shown in table 8.12. The average income in 1970 was £0.382m (£2.2m in 1988 prices). One can see that the spread of turnover was skewed towards to right. By 1988, the median increased to £2.75m and the average turnover per RA increased to £4.8m.

8.2.5 Overseas Income

Table 8.14 RAs' Overseas Income

(1988 Prices)

	UK		Overseas	
Year	(£mil)	As % Turnover	(£mil)	As % Turnover
1970	90.70	96.00	3.75	3.97
1975	72.50	96.00	2.82	3.74
1988	134.00	86.50	21.00	13.5

Sources:- RAs' Annual Reports

Table 8.14 shows the breakdown of the RAs' income according

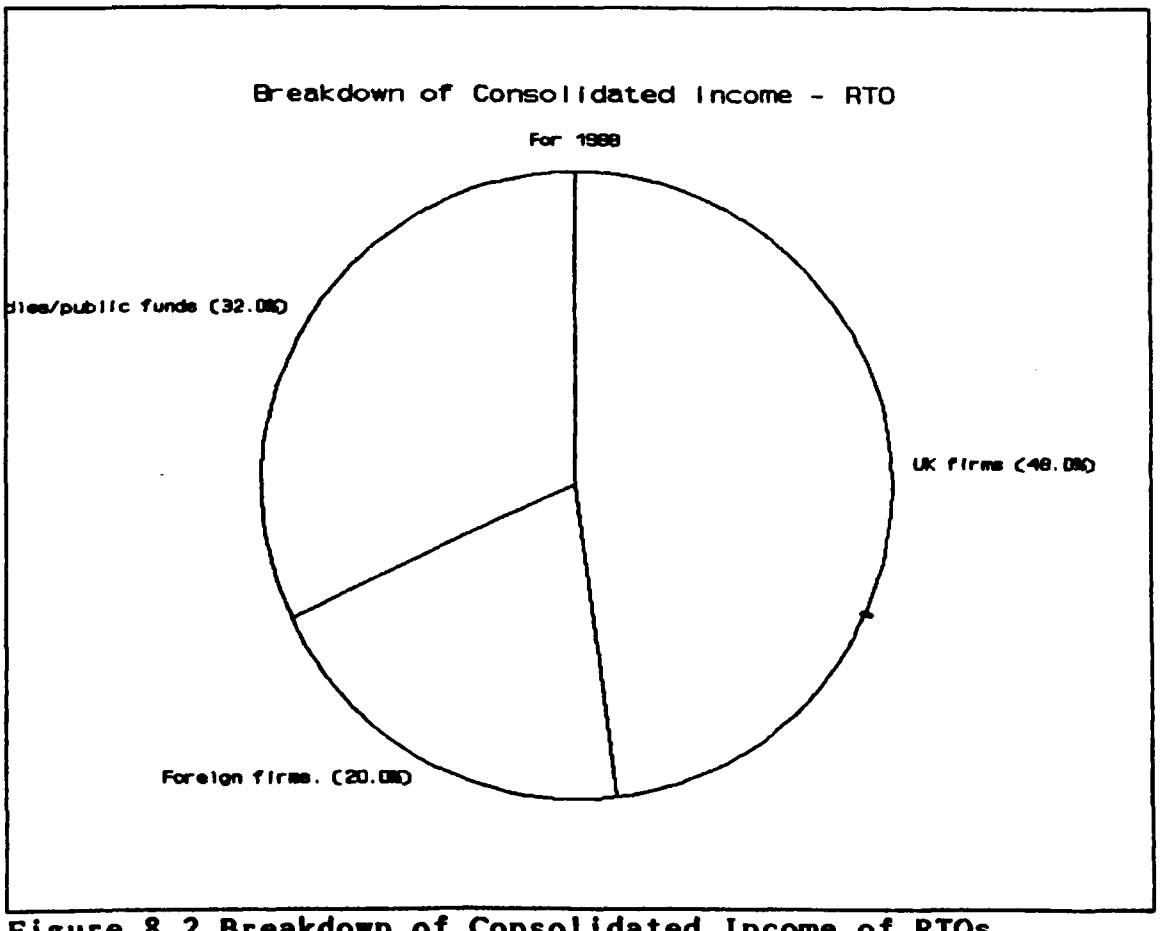

Figure 8.2 Breakdown of Consolidated Income of RTOs
Source:- Bossad (1989)

to region. In 1970[32], only 4% of the total RAs turnover came from overseas sources. This figure did not change too much by 1975. By 1988, however, there was a big increase in income from overseas. It came to over 13.5%[33]of the overall turnover of the RAs. A survey conducted by Bossad Consultants[34] showed that the income from overseas could be as high as 20% of the overall turnover of RAs in 1989. This is shown in figure 8.2.

In real terms, income from the UK and Overseas increased from £90.7m to £134m and from £3.75m to £21m respectively.

These results showed that in the 1970s, there was a lot of resistance from the RAs Council against overseas membership and

contracts. The policy of DSIR at that time was ambiguous. It neither objected to it nor encouraged it[24]. Only towards the end of the 1970's and the 1980's, memberships of overseas manufacturers and organisations were encouraged.

8.2.6 Income From Government and Industry

Table 8.15 RAs Income From Industry and Government

Turnover is in 1988 Prices

	Industry		Government	
Year	(£mil)	As % Turnover	(£mil)	As % Turnover
1970	63.6	68	30.8	32
1988	128.5	83	26.5	17

Sources:- Bessborough (1973); RAs' Annual Reports; Cabinet Office (1990)

Table 8.15 shows the breakdown of the RAs' overall turnover. In 1970[25], 32% of the RAs' turnover came from government sources in the form of grants or repayment work. By 1988[26], only 17% of their turnover came from the government in the form of contract work. Nevertheless, the Government remains the biggest single customer. In real terms (1988 prices), the income from government sources decreased slightly from £30.8m in 1970 to around £26m in 1988. Instead, the income from industry increased dramatically.

In 1970, the income from industry accounted for 68% of the RAs' total turnover and it increased to 83% in 1988. In real terms, the RAs' industrial income nearly doubled in this period, increasing from £63m in 1970 to over £128m in 1988. These figures show the development of the commercial capability of the RAs over the last two decades.

8.2.7 Income From the RAs' Activities

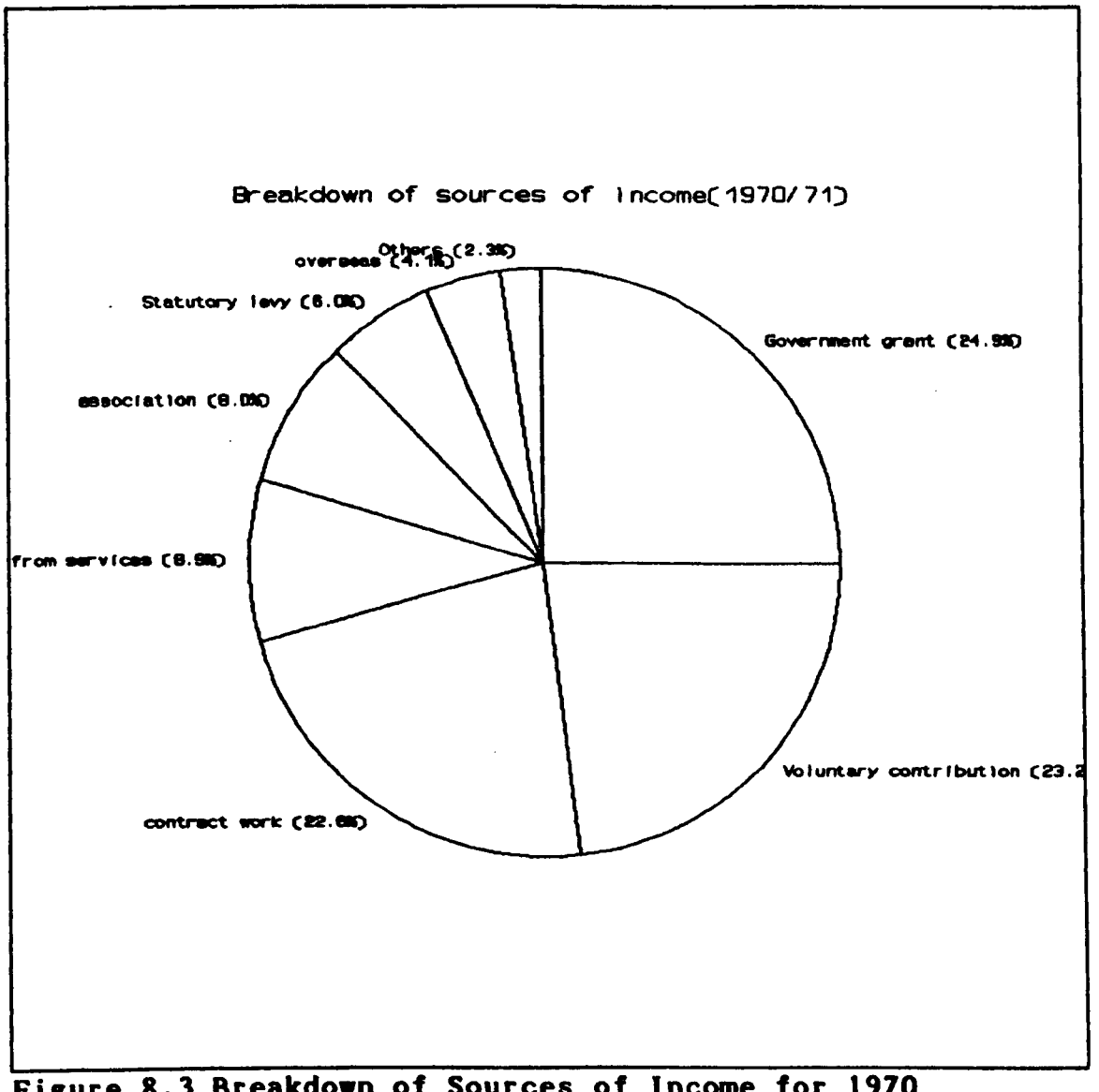

Figure 8.3 Breakdown of Sources of Income for 1970
Source:- Bessborough (1973)

Figure 8.3 and 8.4 show the breakdown of turnover according to activities for 1970 and 1988 respectively. In 1970, income from government grants, which comprised of 25%[27], was replaced by government contract works. Income from contract works, which came to only 22% in 1970, increased to 56% in 1988[28] and in real terms, it increased from £20.8m to £87m over the same period. Contract research is presently the main activity of the RAs.

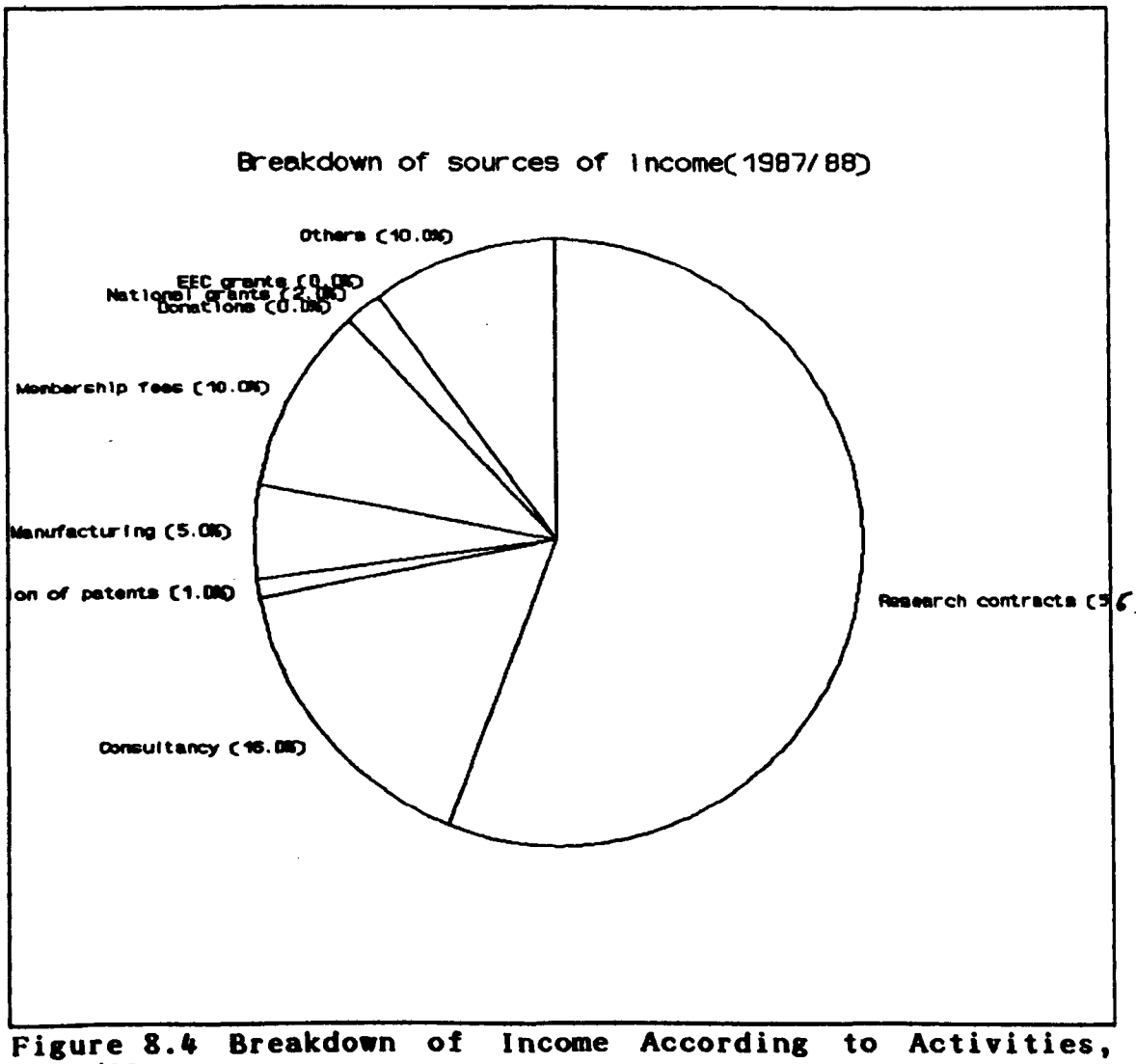

Figure 8.4 Breakdown of Income According to Activities, 1987/88
Source:- Bossad (1989)

During the last two decades, statutory levy was abolished and block support from trade associations was also stopped. Because of this, the RAs lost two of their most stable industrial income sources in addition to the loss of automatic government grants. Membership subscriptions remained on a voluntary basis. The income from membership subscriptions decreased from 23.2% in 1970 to 10% in 1988 but a more accurate figure for subscriptions income for 1988 would be 20%[29] of the total turnover.

In the 1980's, activities like information services, training, conferences and publications, consultancy and trouble

shooting became increasingly important to RAs in achieving a more balanced portfolio of activities for the RAs.

8.3 Membership

In 1970, the 43 RAs had about 20,000 members of all categories[30]. In most industries there was a number of small manufacturers who were not members of any RA. There were also some industrial sectors which did not have a relevant RA at all.

According to the survey[31], despite the variety of criticisms which RAs faced, almost all of them managed to retain the membership of the major firms of their industries. These companies regarded a withdrawal from membership of their RA to be a significant step and were reluctant to take this simply on the grounds that they were not in any one year receiving adequate value for money from their membership. Considerations of the overall good of industry do appear to enter into such decisions. This intangible factor may have contributed to the stability of RA membership.

Also of importance to many RAs was the growth in overseas membership. Only in 1962 were RAs first permitted to accept membership by non-Commonwealth manufacturers. In 1970, nearly 8% of all membership were by foreign organisations, and only 4 RAs had no overseas members at all. In some industries which faced intense competition from overseas rivals, the admission of overseas members had sometimes seemed inappropriate; but on the whole there was almost a total acceptance of a policy of at least limited recruitment of membership abroad.

A survey conducted by TCC in 1985 on a group of RAs (inclusive of non-grant-aided RAs) showed that there was a

decline in the numbers of companies in full membership from 7798 in 1975 to 6703 in 1985 - a reduction of 14%.

The overall changes embody a number of factors: mergers between companies, the winding up of companies, membership being identified with a group rather than with constituent companies, the admission of overseas members to full membership.

Since the early 1970's, a number of factors served to alter the pattern of membership. In particular, changes in government policy towards the support of RAs, membership dissatisfaction with unfocused programmes, rapid technological change and general economic factors forced the rapid evolution of many RAs into bodies which are now more akin to contract research organisations. Membership subscriptions now often make a less important contribution to turnover, and co-operative programmes have either disappeared entirely, or have been largely supplanted by collaborative projects specifically tailored for groups of members. In some cases, RAs will carry out work for non-members under contract.

Several problems inhibit an analysis of RA membership numbers. For these reasons figures of memberships of individual RAs must be treated with reserve. They are:-

(1) All RAs had a number of categories of membership, and these were not always common to each other[2].

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[2]The most usual classifications were those of "ordinary" and "associate" members,the difference between these lying in rights of representation and degree of access to association services.But some RAs did not distinguish these two ,while others may have additional categories such as "subscribers" or "contributors" .Also found were "individual" ,"honorary","private",and "university" membership.

(2) Some RAs list separately the divisions or subsidiaries of a large company, while others group these together under one entry. (3) Some associations have a form of group membership for trade or technical associations which may cover many separate firms who are thereby given access to association services. Total memberships of individual RAs varied widely and did not necessarily reflect the RA's size. Some of the smaller RAs have relatively large numbers of members.

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2. Centre for the Study of Industrial Innovation (CSII): Research Associations - The Changing Pattern. London: CSII Publications 1972, p. 23.

3. Extracted from Annual Reports of RAs from 1970 to 1990.

4. cf. 1, p. 23, Table 5.

5. The Earl of Bessborough: Industrial Research and Development - The Report of the Committee of Enquiry into the Research Associations 1972/73 - Revisions to Appendix 5, pg. 4, Table 4. Luton: White Crescent Press 1975.

6. cf. 3.

7. cf. 3.

8. The Earl of Bessborough: Industrial Research and Development - The Report of the Committee of Enquiry into the Research Associations 1972/73. Luton: White Crescent Press Ltd. 1973.

9. cf. 8, p. 4, Table 5.

10. A Kennedy, N Read, C Crossley: Changes in the Research Associations Over the Decade 1972 - 1982. London: Technical Change Centre 1985, p. 9.

11. cf. 8, p. 4.

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13. cf. 3.

14. Minister of State Treasury: Treasury Minute relating to the transfer of the undertaking and assets of the National Maritime Institute to NMI Ltd. Cmnd. 8677. London: HMSO September 1982.

15. cf. 3;
cf. 2, p. 21, Tables 1 and 2;
Central Statistical Office: Economics Trends No. 443. London: HMSO September 1990, p. 92, Table 1.

16. ibid.

17. University Funding Council: University Statistics 1988-89 vol. 3, Finance. London: University Statistical Records 1988/89.;
cf. 3;
cf. 2, p. 21.

18. cf. 2, p. 23, Table 4.

19. cf. 8; and cf. 3.

20. cf. 3.

21. cf. 8, Appendix 5, Table 5.

22. cf. 3.

23. cf. 12, p. 50.

24. OECD: Industrial Research Associations in the UK. Paris: OECD Publications 1967, p. 49.

25. cf. 8, p. 186, Table 6. Note that Government repayment work came to about 8.5% of turnover. This was added as well.

26. cf. 3.;
Cabinet Office: Annual Review of Government Funded R&D 1990. London: HMSO 1991, p.58, Table 1.9.

27. cf. 8, Appendix 5, Table 6.

28. cf. 13, p. 25.

29. cf. 3.

30. cf. 2, p. 24, Table 6.

31. cf. 2.

CHAPTER 9: THE RAS' ENVIRONMENT

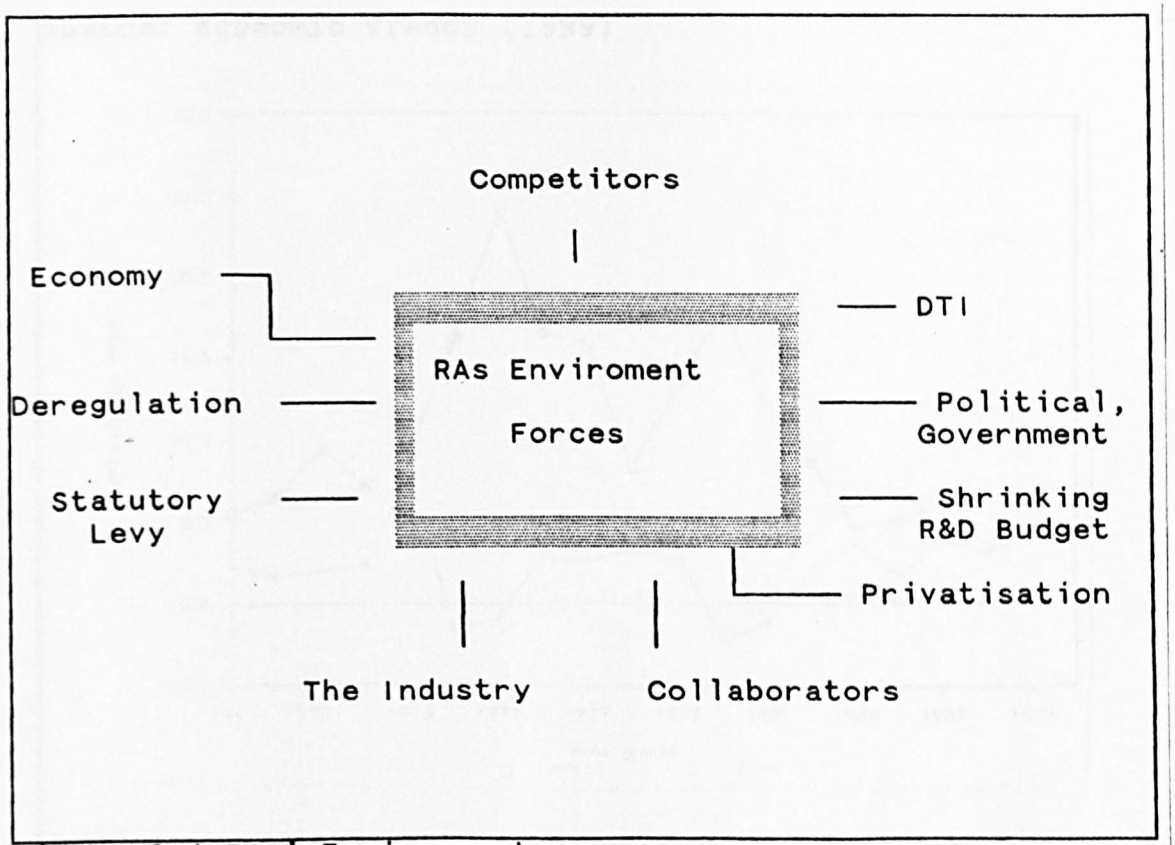

Figure 9.1 RAs' Environment

The environment audit involves the evaluation of competitors, social forces, political and legal forces, collaborators, the Industry, deregulation, and economy for the purpose of identifying the key opportunities and threats to the RAs for the last two decades and beyond. This is shown in figure 9.1. By identifying and evaluating when, where, how and why relevant trends had impacted the RAs, the environment audit can help in identifying and evaluating the strategies formulated and implemented by the RAs. The environment audit could also assist in formulating and implementing strategies for the RAs in the future.

9.1 The Economy

Source: Economic Trends (1989)

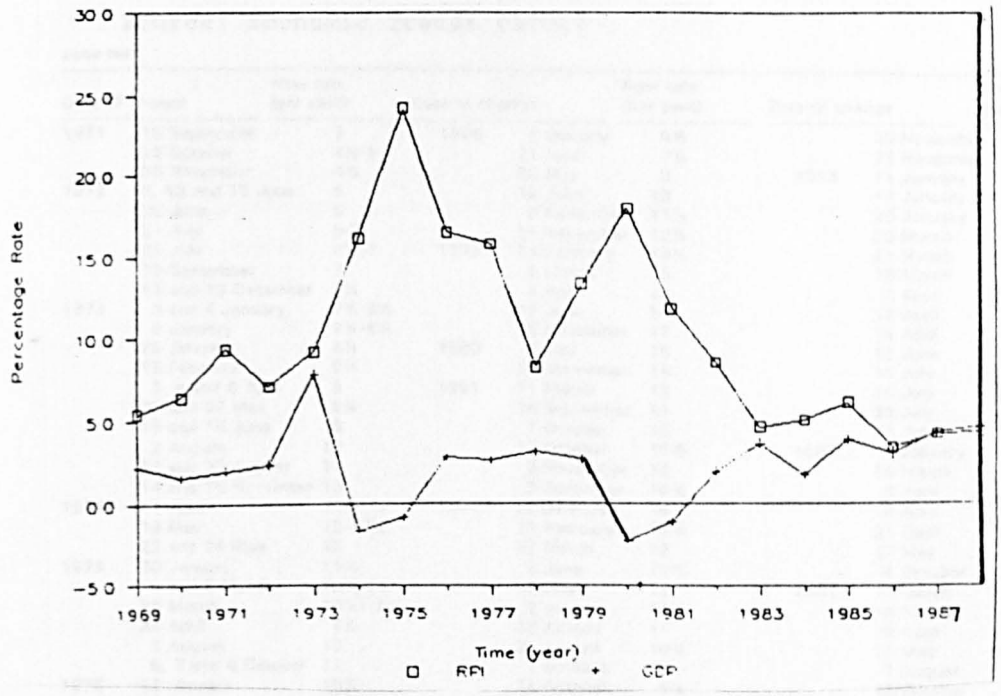

Figure 9.2 Retail Price Index and Gross Domestic Product (1969 to 1988)

Figure 9.2[1] shows the GDP change from 1969 to 1988. Looking at the GDP change over this period, it is clear that the UK went through a recession (if production declines for two or more consecutive quarters, a recession has occurred[2]) in the mid 1970's, early 1980's and the beginning of 1990. The first two recessions were very difficult for the RAs and it would be too early now to analyse the impact of the current recession which started in 1989.

The UK went into a recession in the first quarter of 1974 and it recovered by the first quarter in 1976 (see fig. 9.2). The weak trends in activity in 1974 continued into 1975, accompanied by rising unemployment and rapid inflation. By Nov. 1973, the short-term money rate for selected retail banks went up to 13%

Table 9.1 Selected retail banks: short term money rates.

Source: Economic Trends (1991)

base rate

Date of change		New rate (per cent)	Date of change		New rate (per cent)	Date of change		New rate (per cent)
1971	16 September	5	1978	9 January	6½		20 November	9¾-10
	15 October	4½-5		21 April	7½		23 November	9½-9¾
	26 November	4½		10 May	9	1985	11 January	10½
1972	9, 13 and 15 June	5		12 June	10		14 January	12
	30 June	6		6 November	11½		28 January	14
	21 July	6-7		15 November	12½		20 March	13.50-14.00
	25 July	6¾-7	1979	14 February	13½		21 March	13.50
	19 September	7		6 March	13		29 March	13.00-13.50
	12 and 13 December	7½		6 April	12		2 April	13.00-13.25
1973	3 and 4 January	7½-8¼		15 June	14		12 April	12.75-13.00
	9 January	8¼-8½		16 November	17		19 April	12.50-12.75
	25 January	8½	1980	4 July	16		12 June	12.50
	15 February	9½		25 November	14		15 July	12.00-12.50
	3, 4 and 5 April	9	1981	11 March	12		16 July	12.00
	22 and 23 May	8½		16 September	14		29 July	11.50-12.00
	15 and 16 June	8		1 October	16		30 July	11.50
	2 August	10		14 October	15½	1986	9 January	12.50
	22 and 23 August	11		9 November	15		19 March	11.50
	14 and 15 November	13		3 December	14½		8 April	11.00-11.50
1974	11 April	12½	1982	22 January	14		9 April	11.00
	13 May	12-12½		25 February	13½		21 April	10.50
	23 and 24 May	12		12 March	13		27 May	10.00
1975	20 January	11½		8 June	12½		14 October	11.00
	4 and 6 March	10¾-11		13 July	12	1987	10 March	10.50
	25 March	10¼-10½		2 August	11½		19 March	10.00
	22 April	9½		18 August	11		29 April	9.50
	5 August	10		31 August	10½		11 May	9.00
	6, 7 and 8 October	11		7 October	10		7 August	10.00
1976	12 January	10½		14 October	9½		26 October	9.50
	30 January	10		4 November	9		5 November	9.00
	6 February	9½		26 November	10-10¼		4 December	8.50
	25 May	10½	1983	12 January	11	1988	2 February	9.00
	13 September	12		15 March	10½		17 March	8.50
	8 October	13½		15 April	10		11 April	8.00
	21 October	14		15 June	9½		18 May	7.50
1977	26 January	13		4 October	9		3 June	8 00
	4 February	12½	1984	7 March	8¾-9		6 June	8.50
	18 February	11½		15 March	8½-8¾		22 June	9.00
	14 March	10½		10 May	9-9¼		29 June	9.50
	31 March	9½		27 June	9¼		5 July	10.00
	26 April	9		9 July	10		19 July	10.50
	3 May	8½		11 July	10-12		8 August	10.50-11.00
	9 August	8		12 July	12		9 August	11.00
	13 September	7		9 August	11½		25 August	11.00-12.00
	17 October	6		10 August	11		26 August	12.00
	29 November	6-7½		20August	10½		25 November	13.00
	5 December	6¾-7½		7 November	10	1989	24 May	14.00
							5 October	15.00
						1990	8 October	14.00

as shown in table 9.1[3]. Industrial production in the first four months of 1975 was at about 3% below the level in the second half of 1974, and some 5.5% below the 1973 peak level[4]. By June 1975, unemployment reached a total of 864,000 and the number of persons on short-time jumped to 250,000. Manufacturing investment

weakened markedly in the first quarter of 1975. The rate of inflation increased dramatically to a peak of 24% in 1975 (as shown in table 9.2[5]) and consequently it affected the annual rate of increase in basic wages.

Table 9.2 Rate of Inflation From 1970 to 1986.

Source:- Department of Employment (1987)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Average
1948						9.7	7.2	7.9	7.6	7.0	5.1	4.9	6.0
1949	4.6	2.9	2.3	0.6	2.6	1.3	3.0	3.1	3.2	3.6	3.3	3.5	2.8
1950	3.6	3.7	4.2	4.9	3.3	2.3	2.2	1.7	2.0	2.5	2.9	3.2	3.1
1951	3.9	4.6	5.0	6.3	8.7	9.6	11.3	12.2	12.3	11.9	11.9	12.0	9.1
1952	13.0	12.0	11.8	11.8	9.1	10.6	8.8	7.6	6.7	6.9	6.3	6.4	9.2
1953	4.4	4.6	4.8	4.1	3.8	2.5	2.7	2.6	2.6	1.7	2.2	1.0	3.1
1954	1.4	0.9	1.1	0.6	0.6	0.7	2.4	2.4	2.4	2.8	3.0	4.0	1.9
1955	4.1	4.4	3.4	3.5	3.6	5.2	3.8	3.8	4.6	5.3	6.4	5.8	4.5
1956	5.1	5.1	6.4	7.3	7.3	5.0	4.3	5.2	4.4	3.9	2.7	3.0	5.0
1957	4.4	4.3	2.8	1.8	2.0	3.2	4.5	4.0	3.9	4.3	4.5	4.6	3.7
1958	3.5	3.2	4.1	4.9	4.4	4.3	1.8	1.8	2.2	2.1	1.9	1.8	3.0
1959	2.1	2.5	1.8	-0.1	-0.1	-0.8	0.5	0.9	0.3	-0.2	0.2	0.0	0.6
1960	10.5	-0.4	-0.5	0.7	1.1	1.5	1.9	1.0	1.7	2.0	1.7	1.8	1.0
1961	2.2	2.2	2.7	2.7	3.0	3.3	3.2	4.8	4.5	3.9	4.5	4.4	3.4
1962	4.6	4.7	4.8	5.6	5.7	5.5	5.1	3.2	3.3	2.9	2.3	2.6	4.2
1963	2.7	3.5	3.2	2.1	1.7	1.0	0.8	1.4	1.8	2.3	2.2	1.9	2.0
1964	1.9	1.2	1.4	2.0	3.0	3.4	4.0	4.7	4.4	4.1	4.6	4.8	3.3
1965	4.6	4.5	4.5	5.6	5.0	4.9	4.9	4.7	4.8	4.8	4.4	4.5	4.8
1966	4.4	4.5	4.3	3.6	3.9	3.9	3.5	3.9	3.6	3.8	4.0	3.7	3.9
1967	3.7	3.7	3.5	3.0	2.2	2.4	2.2	1.4	1.5	2.0	1.9	2.5	2.5
1968	2.6	3.0	3.4	4.4	4.6	4.6	5.3	5.7	5.9	5.6	5.2	5.9	4.7
1969	6.2	6.2	6.3	5.5	5.3	5.3	5.3	4.9	5.1	5.4	5.4	4.7	5.4
1970	5.0	4.9	5.1	5.6	6.1	5.9	6.7	6.8	7.0	7.4	7.9	7.9	6.4
1971	8.5	8.5	8.8	9.4	9.8	10.3	10.1	10.3	9.9	9.4	9.2	9.0	9.4
1972	8.2	8.1	7.6	6.3	6.1	6.1	5.8	6.6	7.0	7.9	7.6	7.7	7.6
1973	7.7	7.9	8.2	9.2	9.5	9.3	9.4	8.9	9.3	9.9	10.3	10.6	9.2
1974	12.0	13.2	13.5	15.2	16.0	16.5	17.1	16.9	17.1	17.1	18.3	19.1	16.1
1975	19.9	19.9	21.2	21.7	25.0	26.1	26.3	26.9	26.6	25.9	25.2	24.9	24.2
1976	21	22.9	21.2	18.9	15.4	13.5	12.9	13.8	14.3	14.7	15.0	15.1	16.5
1977	16.6	16.2	16.7	17.5	17.1	17.7	17.6	16.5	15.6	14.1	13.0	12.1	15.8
1978	9.9	9.5	9.1	7.9	7.7	7.4	7.8	8.0	7.8	7.8	8.1	8.4	8.3
1979	9.3	9.6	9.8	10.1	10.3	11.4	15.6	15.8	16.5	17.2	17.4	17.2	13.4
1980	18.4	19.1	19.8	21.8	21.9	21.0	16.9	16.3	15.9	15.4	15.3	15.1	18.0
1981	13.0	12.5	12.6	12.0	11.7	11.3	10.9	11.5	11.4	11.7	12.0	12.0	11.9
1982	12.0	11.0	10.4	9.4	9.5	9.2	8.7	8.0	7.3	6.8	6.3	5.4	8.6
1983	4.9	5.3	4.6	4.0	3.7	3.7	4.2	4.6	5.1	5.0	4.8	5.3	4.6
1984	5.1	5.1	5.2	5.2	5.1	5.1	4.5	5.0	4.7	5.0	4.9	4.6	5.0
1985	5.0	5.4	6.1	6.9	7.0	7.0	6.9	6.2	5.9	5.4	5.5	5.7	6.1
1986	5.5	5.1	4.2	3.0	2.8	2.5	2.4	2.4	3.0	3.0	3.5	3.7	3.4

The second recession during the last two decades started during the steep decline in GDP, which began in the second half of 1979 and continued into the second quarter of 1982 (see fig. 9.2). Unemployment continued to rise, reaching 11.5% at the end of November 1981. The rate of inflation reached a peak of 18% in

1980. During this period[6], the short-term interest rate went as high as 17% in Nov. 1979 (see table 9.1). The sluggish demand at home and the need to remain competitive abroad caused the profits of industrial and commercial companies to fall to historically low levels. Manufacturing production dropped markedly and in September 1980; it was at the lowest level since 1968.

The rebalancing process of the UK's economy remained gradual and uneven in the last few years. Following a decline in the second half of 1989, domestic demand picked up markedly in the first half of 1990, growing faster than output. Unemployment which reached a low in March 1989 at 5.5% (6% according to the OECD's average) of the labour force, crept up since then. The underlying rate of growth of effective earnings reached 10% in the middle of 1990. Excluding mortgage interest, the effects of the Community Charge and higher oil prices, the twelve-month increase in the retail-price index still exceeded 8% in 1990. The interest rate went up and the short-term interest rate reached a peak of 15% in Oct 1989.

The recovery of the UK's economy in the last two decades was quite strong, especially in the last decade. After the recession from 1979 to 1981, there was a strong growth from 1982 to 1988, when the rate of growth (GDP at market prices) reached 4.6% in 1988. But the growth declined since then. It has been predicted that the growth rate for 1991 may be as low as 0.7% or even less and that economic activity was projected virtually to stagnate up to mid-1991, possibly declining a little in one or two quarters, and to recover only slowly thereafter.

All the RAs were affected by the recession in the mid 1970's and early 1980's, when the industrial R&D expediture dropped to

as low as £3.73 billion and £4.6 billion respectively. The following statement reflected the difficult state in which the RAs had to operate during these periods[7]:

> "During the past year BCIRA has had to operate against a background of depression in much of manufacturing engineering industry, which has had a profound effect on most sectors of the foundry industry. Demand for iron castings was at the lowest level since the end of the second world war, giving rise to continuing closure of foundries (...). All of this indicates a changing climate of operations such that British manufacturing industry may never be the same again. (...) the circumstances of the foundry industry have forced us to examine our activities in the light of this climate of change."

9.2 Political, Legal and Government Forces

Table 9.3 shows the various government policies and DTI reviews that affected the RAs from 1972 to 1988. They are shown in chronological order. Most of the factors discussed below have already been dealt with in detail in Chapters 4 to 6.

9.2.1 The Rothschild Principle

Over the last two decades, the Rothschild Principle has been one of the main changes in government policy which affected the RAs most and will continue to do so. With the implementation of this principle, the RBs were set up.

The RAs had to adapt to become more commercially minded and less dependable on government funding. It also changed their

Table 9.3 Government policy and DTI reviews that affected RAs from 1972 to 1988.
Sources: DTI; Annual Reports of RAs.

Policy that affected RAs	Year
Rothschild Principle - Setting up of RBs.	1972
Progressive ending of levy	from 1970s onwards
Moratorium on Defence contracts	1980
Privatisation	from 1979 onwards
DTI Review on RAs - Support on individual project basis. - Maximum support of 50% - A ceiling of of one third and shortly after to one quarter of turnover.	1983
DTI White Paper on Enterprise - Difficult transition period - Emphasis on collaborative research and technology transfer - Not funding "near market" research	1988
Continuous contraction of DTI support; greater stringency.	

Note: A review on RAs carried out by DTI in 1988 recommended that the maximum overall support for RAs to be increased from one-quarter to one-third of individual turnover. It was turned down by the Secretary of State then.

profile of research activities towards one that was more market-oriented. This principle had fundamentally changed the mission of RAs in the last two decades.

A survey was carried out on RAs in 1985[8] to find out their views on the Rothschild Principle. The outcome of the

implementation of this principle was reflected by the following comment[9]:-

> Contract work (from RB) forms an increasingly important element in the programmes, leading to greater emphasis on commercial analyses, to a search for new customers, particularly overseas, to new lines of work, and to internal changes in organisation and management. Basic research and exploratory research, at all levels, have suffered, and financial pressures have increased. Cash flow is a problem for RAs with low reserves when contract payments are settled on receipt of the final report.

These views were also expressed by the RAs' Directors when they were interviewed (see appendix 1.6). One setback of the RBs was the diversity and width of research programmes under their responsibility and furthermore, they did not set any priority for the research programmes under their control. Nevertheless, the support from RBs, though representing a progressively reducing proportion, was vital to maintain the RAs' technical skills at the highest levels[10] as well as to maintain their core research. This was reflected in the statement made by BHRA's Chairman[11]: "As in our general research programme, Government support through this and other Requirements Boards has been basic to our ability to maintain ourselves in the forefront of our technology."

Prior to the implementation of the Rothschild Principle the government used to match every pound which the RAs raised. RAs had to be organised in such a way that a council was needed to interface with the government as well as to account to the government. Gradually, the role of the council changed when the mechanism of funding changed. The survival of the RAs rested on

the shoulders of the research directors when RAs were forced to the market place to market their expertise. RAs had to restructure in order to be able to respond to the market needs. A "council" type of structure with numerous committees was not suitable to respond to the market place. In the case of PIRA, a board of management was set up in 1986 because the success or failure of the RA depended not on the council but on the capability and calibre of the staff. The role of the council has been limited to Policy, Politics and Public Relations.

9.2.2 Government Funding Policies Towards RAs

A review was carried out by DTI in 1983 on the future role of the RAs and this brought about another difficult period for RAs with regard to DTI funding. The review was strongly supportive, setting the scene and providing new ground rules for a constructive relationship between the RAs and the Department, in support of industry. But one of the major implications of the review in 1983 was the reduction of the DTI's support. The RAs felt the reduction quite strongly as shown by the statement made by Chairman of PIRA[12]:-

> "Necessarily the cutback will lead to less cooperative research for members, and we may not be able to make up the loss in income very quickly. We shall become less dependent on Government support, obviously, and must respond by being more competitive and active in our market place."

After the review, groups of individual research projects were submitted to the RBs, seeking funding at a level appropriate for each project, but generally at not more than 50% of total cost.

The industrial income came mainly from Consortia and, to a limited extent, from the RAs' own funds. Overall, the DTI placed a one-third of turnover ceiling on the total funds it was prepared to make available to an individual RA (it was later reduced to one quarter). In another review that was carried out by RTP in 1988, it was recommended that the maximum overall funding be raised from one quarter to one third of each RA's turnover, provided that any increase over one quarter was associated with support for projects mainly of benefit to independent firms with fewer than 500 employees[13]. The Secretary of State decided against it.

In 1985, the DTI adopted the practice of Market Related Pricing. Already in use for BHRA's MoD contracts, this enabled RAs to price government work on the basis of a "best customer" commercial rate and greatly simplified and sped up the Government auditing procedures. It brought about a beneficial effect on the RAs' cash flow.

Another difficult period for RAs with regard to the DTI's support was from Autumn 1987 to December 1988 when the Enterprise Initiative was launched. This was reflected by the following statement[14]:

> "The Board and Council have to report that although much effort has been put into complying with the new DTI schemes, it is unrealistic to assume that we will recover this income quickly"

There were a lot of changes going on within DTI as it was setting out new guidelines for the approval of funding and in the meantime only the Secretary of State was allowed to approve the funding for the projects until the guidelines were set. Some

RAs (eg. BHRA) went through a difficult period then because most of their programmes with the DTI ended during that period and it was awaiting the approval from the DTI for the funding of its new programme. Furthermore, there was no clear signal from the DTI as to the kind of R&D programmes that it would fund. Consequently, there was a big reduction in the DTI's support. For example, in the case of BHRA, it received about £1.5m at the end of 1987 but in 1988 it received only £0.5m and £0.56m in 1989. During that period, BHRA faced a cash flow crisis and in effect, the uncertainty within the DTI had wiped out about 20-25% of its income. It resorted to gaining more research contracts from industry as well as to cut costs. By the end of the 1987/88 financial year, it ran a loss of over £0.2m.

9.2.3 White Paper: DTI - the department for Enterprise

The implementation of this White Paper added to the difficulties encountered by the RAs (especially smaller RAs with a large membership of SMEs and serving mature industry) in the following ways[15]:-

(1) The White Paper emphasised collaborative and played down cooperative research. The main criteria[16] (see appendix 9.1) that distinguished cooperative from collaborative research were:-

(a) the number of companies involved (e.g. over 50 for cooperative research);

(b) the median size of company (e.g. not exceeding 250 employees) for cooperative research;

(c) that funding for cooperative research was for a programme of research rather than a single project (refer to table 9.4).

Consequently, this policy affected RAs where most of their

Table 9.4 The difference between programme based cooperative research involving mainly SMEs and project based collaborative or contract research involving mainly large, or at least scientifically literate companies.

	Programme Based Cooperative Res. (Normally membership or industry supported)	Project Based Contract Res. (Can be single company or collaborating club)
Usual customer type	90% SMEs	Large companies
Number of firms supporting	Can reach several hundred.	1 - 10
Expertise exists in company to interface with research staff	Practical factory management	Scientific or strong technical/ engineering
Development stage required for commercial acceptance	Available for fairly trouble free implementation onto factory floor without major production hold-ups	Can be picked up at working prototype stage or even earlier.
Implementation resources and skill available in company	Very limited, usually part time and additional responsibility on managers' shoulders	Usually have qualified staff that can be seconded full time to project implementation
Commercial assessment of economics of a single R&D project	Required skills and information not normally available in many SMEs. A small group of selected individuals from different companies give balanced judgement on each project and or complete programme	A necessary skill requirement for the funding of any contracted research

members were SMEs (e.g. SATRA). These RAs organised research programmes which were cooperative in nature rather than collaborative.

(2) The principle of "innovation" was present in DTI funding decisions and some RAs were concerned with the concept of innovation i.e. a concept very dependent on the type of industry concerned. What is highly innovative for a medium size manufacturer could be mundane for British Aerospace. If a reasonable judgement of innovative contact was not present in DTI, this policy could cut government support for R&D in the lower technology SME type industry[17] (see appendix 9.1).

(3) The concept of "distance from the market" could be interpreted so narrowly that co-operative research was defined as "non-pre-competitive" (i.e. near-market) research and would therefore not qualify for government support.

The White Paper emphasised the transfer of technologies and collaborative research. This policy could create more opportunities for the RAs because they were effective agents in transferring technology[18] and collaborative research was nothing new to them.

Another problem faced by RAs due to the increase in stringency for government-financed R&D was the new audit system which evaluated government-funded research programmes every three months. This was thought to be ridiculous because research was a long-term business and it took some time before it could be evaluated. Furthermore, the administrative costs in preparing the documents for auditing were costly and are shouldered by the RAs (see App.1.6, LEA).

The RAs continued to get funding from the DTI for their research projects (but with growing stringency) and there may come a time when the DTI stops their funding because of not wanting to fund research where industry can undertake it themselves.

9.3 Instability of the DTI

The DTI did not have a clear role since it was formed in 1970. In the last 8 years alone, there were seven Secretaries of State. Without a clear role, the DTI has been at the mercy of the ministerial whim. The RAs in turn have had problems in trying to adapt to the changing policy of the DTI towards R&D. For example, when the DTI's Enterprise initiative was launched in 1988, the RAs had to adapt to this new environment as reflected by the statement made by the Chief Executive of AMTRI[19]:

> "Such a major change in policy and the associated considerable personnel changes in those Divisions of the Department with whom we have traditionally dealt, have inevitably had an adverse effect on negotiations and on the placing of contracts."

This was particularly difficult in the last 4 years, when a considerable number of changes took place. Among them were the:

(1) Usage of the ROAME statement to evaluate projects.

(2) Funds being controlled by the Secretary of State - causing a huge back-log.

(3) Revamping of the marketing divisions.

(4) Abolishing of the RB.

(5) Introduction of the White Paper in the Department for Enterprise .

(6) Publication of the Next Steps, which brought about the agency status for GIREs. NEL was also given an agency status with the goal of achieving commercial viability as soon as possible. This would bring about increasing competition for some RAs.

With all these changes going on, it was difficult for RAs to plan on a long-term basis. Since, however, R&D is a long-term business for the RAs, it is important for them to have stability within the DTI.

9.4 The Shrinking R&D Budget

Since the Conservative Party came into power in 1979, there was a continuous cut in government spending on R&D in real terms. Because of historical reasons, the UK's R&D resources were skewed towards defence. Of late, there has been a move away from defence spending towards civil research[20]. RAs which historically used to obtain a large proportion of their income from defence research have had to diversify into civil research. As defence contracts were usually quite substantial, some RAs fell into the danger of over-depending on defence contracts (e.g. FULMER). An example of the outcome of a reduction of defence spending on an RA is the case of BHRA during the recession in the early 1980's[21]:

> "This year saw increasing financial stringencies in industry, a continuing death of major civil engineering projects and the moratorium on defence spending (my highlighting); all factors which made

business more difficult for the Association."

The reduction in defence spending could affect RAs which are traditionally dependent on defence research. On the other hand, the shift towards civil research could help provide more resources for the RAs.

Industry, too, received less government support in the last two decades. In 1967, the Government paid for 29% of the industry's R&D. By 1987, this fell to 20%. Inevitably, this reduction affected the DTI's innovation budget and it resulted in the reduction of support for the RAs' programme under the General Industrial Collaboration Budget. The following statement by ERA's Chairman reflected the feelings of the RAs towards the reduction in government spending on R&D[22]:-

> "However, it became apparent early in 1985 that ERA's plans were under threat from unexpected reduction (my highlighting) in Government expenditure on research and development and that the company was faced with a challenging problem."

The RAs did not see why the UK Government was reducing the already small contribution towards industrial R&D as shown by the following statement[23]:-

> "(...) the attitude of the UK Government to research and development remains an enigma. The public admissions of ministers that the level of civil research and development in the UK falls seriously short of our main industrial competitors, is in contradiction with the current policy of further reducing the Government's small contribution to industrial R&D, and is therefore hard to comprehend."

The RAs have over the last two decades learnt to depend less and less on the government for financial support mainly by increasing the volume of business of their industrial contracts.

9.5 Implications of Privatisation and Establishing of Agencies

The privatisation of the water and electricity industries would bring about more opportunities as well as threats for the RAs (e.g. in the case of WRc). The newly privatised industries could contract out more of their research instead of increasing their own research capacity, since this helps them to cut down research costs and to tap readily available research facilities and expertise. On the other hand, the privatised industries could seek to carry out more strategic research in their own laboratories instead of out-sourcing it because of the fear that the information may fall into competitors' hands.

The privatisation of GIREs (in the case of NEL) and the creation of an agency status (WSL, NPL, LGC) would also create more competition in the research market within the UK. When the decision to privatise NEL was made, many RAs' directors expressed their fear of unfair competition from NEL. Another example is to look at the effect of the privatisation of the Hydraulic Research Station. When the Government planned to privatise HRS in 1980, there was a fear of increasing competition as expressed by the Chairman of BHRA's Council[24]:

> "(...) as required by Members, the Council has been keeping a close watch on developments. This will continue to avoid any adverse effects on the interests of the Association."

In April 1986, UKAEA was placed under a trading funds basis and in May 1989, it changed its status to an agency under the name of AEA Technology. UKAEA will seek to fight off its money problem by winning more non-nuclear R&D contracts, possibly at the expense of the RAs.

9.6 Termination of Statutory Levy

In 1972, five RAs received income through a statutory levy[25]. The nature of the levy subscription was attractive to many RAs because of its greater certainty and it reduced the need to canvass and administer a large number of member subscriptions.

There were few industries whose members would willingly agree to the imposition of a levy and, to a lesser extent, the block funding system did not accord with the customer-contractor principle. By 1990, none of the five RAs received any income from statutory levy anymore. The government revoked the last Research Levy (the Iron Castings Scientific Research Levy) in June 1990[26]. After the levies were revoked, all subscriptions from members were voluntary.

There was of course strong resistance on the part of the RAs to the stopping of the levies, especially from those with a high dependence on income from levy. For example, 38% of FIRA's income in 1981 (when its levy was revoked) came through the levy. FIRA had to make dramatic changes to meet a completely new category of membership and markets for its programme[27]. And in the case of HATRA, the termination of levies was one of the main reasons of its downfall.

9.7 The Industry

9.7.1 Termination of Block Grant from Trade Associations

In a survey carried out by The Council of Directors of RAs (CDRA) in 1972, it was shown that up to 10 RAs received money from trade associations and in five of these it was the largest source of income[28]. As inthe case of the statutory levy, few industries were willing to agree to the continuation of block grants and again, it did not accord with the customer-contractor principle. Towards the end of the 1970's, all block grants from trade associations were stopped and replaced by voluntary membership subscriptions.

9.7.2 Industry Investment in R&D

The industry in the UK did not see the period the last two decades as one where consumer demand or international competition required an increased investment in R&D. Industry in competitor countries like Germany, USA, France and Japan more than doubled their R&D spending from 1969-1983 whereas the increase in the UK was only 20%. In the last few years, however, there have been encouraging signs that the UK's industry is slowly addressing this problem.

Growth in R&D expenditure differs from one industry to another. Over the last decade, there has been substantial growth in electronics, some growth in the chemical sector declines in other areas especially mechanical engineering.

9.7.3 Out-sourcing of Research

There was an increasing trend in out-sourcing of research by industry. For example, in 1985, industry contracted out over £332 million on research and development[29]. Some R&D policies of companies have moved towards favouring the view that R&D was better commissioned as and when needed, and from the best available contractor, and this would consequently increase the funds for external institutions like RAs and HEIs.

The increasing need for industry to contract out research could be due to:-

(1) The need to ensure a long-term competitive edge through innovation and the incorportion of new technologies.

(2) The sophistication of research and inadequate access to new technologies, particularly for SMEs. For example, the automotive industry became more complex and the pace of automotive development increased dramatically. Even the largest automakers found themselves driven by free market forces to develop more new or revised models than their own resources (people and facilities) would allow[30].

(3) Not having their own in-house R&D resources. A good example was the shoe industry where the majority of the manufacturers did not have their own in-house R&D.

(4) A realization of the high real cost and sometimes uncertain economics of internal R&D work with its fixed costs.

The terms of contract research were stiffened by industry and sometimes contracted out on a fixed-cost basis and at times risky for the RAs (see Case Study on SIRA).

A recent postal questionnaire[a] survey of 100 innovative UK SMFs showed that:-

(1) 40 companies contracted out a proportion of their R&D to other firms;

(2) 27 companies engaged in collaborative inter-firm R&D ventures;

(3) 16 companies manufactured other firms' products under licence.

In addition, in some industrial sectors, most notably semiconductors, joint R&D ventures and other forms of corporate alliance grew in both number and strategic importance. Among the most significant factors underlying this increased interest in inter-firm collaboration were:

(1) the rising costs and high risks of investment in some high technology areas;

(2) the convergence of technologies;

(3) the need for capabilities that span both scientific disciplines and business experience.

The universities built up their industrial relationships and experience and as a result, the competition for research contracts is becoming steadily tougher. In addition, the research charges made by the universities were significantly lower than those which an RA could economically accept.

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[a]M Beesley & R Rothwell; Small Firm Linkages in the UK in R Rothwell & J Bessant (Eds), Innovation: Adaption and Growth; Elsevier 1987.

9.7.4 Mature Industries

Industry-based RAs, especially those serving mature industries, were more badly affected than those serving industries like electronics or technology-based RAs. Among those which were affected by the declined in R&D expenditure by industry were BCIRA and BNF (serving the foundry industry), BMT (shipping industry), and SI, WIRA, and HATRA (serving the clothing industry).

In the case of BMT, the reduction in the market for shipbuilding research and development was compounded by reduction in offshore model testing work[31]:

> "(...) the financial position of that industry (shipping) and the intense competition for the work that was available resulted in material losses."

The decline of BNF was partly triggered by the inadequate support of its members in the early 1980's as reflected in the following statement[32]:

> "At the end of the day, however, the ability of industry to spend money on research, even though it may be highly relevant, is limited and this picture is not expected to change (my highlighting) rapidly as far as the UK is concerned."

At the peak performance of the knitting industry (1974), it employed over 135,000 workers and now it employs less than 70,000. HATRA never recovered from that difficult period in the mid 1970's when the knitting industry went into decline.

9.7.5 Short-Sightedness of Industry

The short-term financial outlook believed to be characteristic of the City could have prevented British industry from investing enough in R&D to keep its products competitive in the marketplace. This problem was also compounded by other problems as shown in a study conducted by NEDC[33]. In this study, managers in government laboratories, commercial research and technology organisations and technology brokers note:-

(1) a reluctance among UK companies to take up external technology;

(2) an inability to view technology transfer and accumulation as a long-term process.

British industry tended also to be slow in exploiting research, probably due to an unwillingness to commit resources to do so.

Takeovers and mergers decreased the R&D investment of industry. In the case of the automotive industry, takeovers or mergers decreased the amount of research out-sourced and might even compete with an RA like MIRA for contract research. Another example of an RA which was affected by mergers is the SRAMA. This is reflected in a statement made by its President[34]:

> "However, we have lost only 10% of our Members, not all of these losses being due to the change in the membership structure, as some companies amalgamated and others no longer produce springs".

9.7.6 Pace of Technology

In the last few decades, the pace of advance in technologies and in the science which underlies them has been extraordinary. This has also led to the wide applicability of new technologies, not only in manufacturing, but also in communication, banking and insurance.

In some advanced technologies, the resources required to stay in the front rank are beyond the individual capacity of even the largest firms International collaboration, especially within Europe, can therefore be essential if UK firms are to be competitive in world markets. This creates opportunities for RAs especially so with their vast experience in carrying out collaborative research.

The whole of the information scene has also changed drastically since the early 1970's. New technology, new information systems, cheap packages, all these have made it possible for those who at one time depended on the RAs for up-to-date specialist technical information within their area of interest, to attempt their extraction for themselves. Expert interpretation and evaluation of information remain valuable assets of the RAs and are widely called upon.

9.7.7 Global Competition

Industry has to compete globally and in order to do so, it has to invest in R&D globally, too. In the last 20 years, there has been a tremendous growth in overseas-funded R&D programmes in the UK. In 1987 alone, it accounted for up to 12% of the total R&D spending of industry.

Global competition can also increase the necessity for industries from overseas to become members of RAs in order to keep them informed about the latest technology as well as to tap the research potential of the RAs. Overseas membership is increasingly important to RAs as shown in a statement made by the Director General of PERA[35]:

> "Overseas membership is important to PERA. It allows us to keep overseas industry and competitive issues in perspective and provides good opportunities for our British members to collaborate with overseas companies, particularly within the various European funded collaborative programmes."

9.7.8 Unfair Competition From The EC

The annual cash handout to manufacturing industry between 1981 and 1986, the most recent years for which figures can be compiled, was Ecu 13 billion in Italy, Ecu 7 billion in West Germany, Ecu 7 billion in France and Ecu 5 billion in the UK (one Ecu =73p). Per manufacturing employee, this works out to an Ecu 6200 in Italy, Ecu 1650 in France, Ecu 980 in West Germany and Ecu 970 in UK[36].

Among the types of subsidy that need cutting are general discretionary aid not tied to particular industries or regions, and government-funded R&D which would have been funded anyway for commercial reasons. Soft loans, capital restructurings of nationalised industries and other techniques which may be used to disguise aid need to be looked into, especially where more obvious handouts are banned.

A survey conducted by The European Commission on contract research associations[37] showed that direct funding by the state is virtually zero in the UK, whereas in other major European countries such organisations receive up to 51% of their income as aid.

The survey also showed that the UK, France and Germany have by far the strongest research sectors and that the UK is unique in providing no public funds.

9.7.9 Human Resources

The greatest single challenge facing the manufacturing industry in the 1990's will be the chronic shortage of science and engineering skills[38]. Training and re-training will be a priority. RAs are well placed to run a range of courses tailored to the needs of individual companies and to work closely with company managers to implement successful long-term human resource strategies.

Another area of growth for retraining is the Enterprise Initiative Scheme (initiated by DTI), which is targeted at SMFs. The scheme seeks to help the SMFs in retraining through the help of consultants. Once again, the vast experience of RAs in dealing with SMFs would put them in a good position to exploit this opportunity for retraining.

9.8 Competitors

"Future availability of contract research funding may be eroded partly by changes in Government policy (...), where industry is expected to pay its own way, and partly by increased competition from other

research organisations including government laboratories, other research organisations, universities and some members' own research laboratories[39]."

The Government is trying to encourage the academic world to move closer to industry by decreasing its support to HEIs. But in doing so, the HEIs end up competing against the RAs for research contracts. The HEIs are able to bid at a lower price (their over-heads being covered by government funds) in comparison to RAs in bidding for research contracts. Some RAs, for example LEA, avoid having to bid against the HEIs for contracts. The advent of University Science Parks introduces another competitive element in the marketplace[40].

For the year 1986/87 universities were awarded £70 million by UK firms, the main part of which (in excess of 95%) was in the form of research contracts. This figure represents 22% of contracts awarded by firms and an increase of 16% compared with the year 1985/86, due to the effort of, inter alia, the Research Councils which encouraged universities to become more self-financing and gradually to reduce their dependence on grants. These contracts now represent sizeable resources amounting to, on average, 15% of university revenues.

Another competitor for RAs are the Interdisciplinary Research Centres (IRCs). Since 1988, 13 IRCs have been set up in the UK[41]. Three more will most probably be approved by 1991. To support the first nine centres £60 million of extra government money has been provided for the first six years of their existence. Funds for another four years are available if they do well.

Although the kind of research carried out at IRCs is further away from the market in comparison to the majority of the RAs' activities and therefore not in direct competition, the RAs might need to compete with IRCs for government support in the future. But they can also be collaborators in certain areas of strategic research. Nevertheless, the RAs ought to be aware of the activities of the IRCs.

The most important public research establishment accepting research contracts is Harwell Research Establishment (now AEA Technology), which was a part of the United Kingdom Atomic Energy Authority (UKAEA) and handles some £30 million worth of outside contracts. The four GIREs under the DTI which were given agency status also compete with the RAs for research contracts, especially goverment contracts where the bids are open to all. Out of the four GIREs, three are allowed to carry out repayment work of up to 10% of their individual turnover. In the case of NEL, however, it is encouraged to obtain as much income from industry as possible.

The other competitors of RAs include the RAs' members themselves, RTOs like PA Technology and CROs in the EC.

9.9 Collaborators

Over the last 10 years, the HEIs have been encouraged to seek industrial support for their research. Thus, HEIs have naturally been attracted to RAs which have been close to industry for decades, since RAs can help them to look for industrial sponsorship. The RAs, too, have good reasons to foster a good working rapport with the HEIs. For e.g. RAPRA considers two of its collaborative programmes with two

universities as important because these programmes attract funding both from the Government and industry. The regional factor is also important i.e. it is considered important to attract regional funding as well as to be close to industry. Among the other advantages for the RAs in collaborating with HEIs are:-

(1) Access to a level of a more fundamental research.

(2) Lower costs for certain wórk.

(3) Ongoing training for research staff.

For their part, the universities acquire:-

(1) Knowhow in applied research.

(2) Work for their research workers and postgraduate students.

(3) Training for students in industrial applications.

This mainly involves the biggest RAs which subcontract part of their work to universities or publicly funded centres.

Another form of collaboration that is of growing importance is the collaboration among CROs in the EC. For the past few years, the EC has been trying to encourage collaboration among CROs in the EC (including RAs) in order to promote technology transfer and the dissemination of innovation within the EC with the ultimate objective of making European industries technologically competitive. This would also enable RAs and especially the less advanced ones to acquire and update their technological base.

A survey carried out by Bossad[42] showed that 98% of CROs in the EC are interested in cooperation. It showed that:-

(1) 92% would like to cooperate with another CRO.

(2) 81% would like to cooperate with another university.

(3) 54% would like to cooperate with another engineering firm.

(4) 46% would like to cooperate with another consultancy firm.

But the survey also showed that only:-

(1) 65% of CROs stated that they were cooperating on R&D work.

(2) 36% stated that they were cooperating on the technical level.

(3) 32% stated that they were cooperating on the marketing level.

One possible interpretation of the result is that there is a willingness to cooperate but that there are nevertheless difficulties in effective collaboration between CROs in the EC.

Among the problems faced are:-

(1) The high cost that would be incurred in trying to land a EC collaborative research contract.

(2) The long lead time from the announcement of a contract to the actual award.

(3) The problem of getting an appropriate European partner. In most cases the contract insists that partners must be found in less developed European countries.

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CHAPTER 10:- THE INTERNAL AUDIT OF RAs

10.1 Organisational Structure

10.1.1 The Council

In the original constitutions of the RAs, the governing bodies were defined as councils composed of members of the RA with power to co-opt. Though differing somewhat in their functions from one RA to another, the Council was normally concerned with the overall policy decisions. The Council size varied considerably, from 11 (Shipowners Refrigerated Cargo RA) to 50 (Leatherhead RA) - both 1982 figures. Over the period 1972-82, more RA Councils decreased in size than increased, and the total membership of the Councils fell by 12% (110 people).

One of the most important tasks of the Councils was to carry out corporate planning for their respective RAs. Planning is often considered to be the foundation of management. Planning increases the likelihood that desired results will be achieved. Organisations that use formal planning approaches are generally more profitable than those that do not[1]. Among the reasons are:
(1) that planning allows an organisation to identify and take advantage of environmental opportunities; it allows an organization to minimise the impact of environment threats.
(2) that an organization can achieve synergy through planning.
(3) that planning allows an organisation to adapt to changing environments, and thus to shape its own destiny.

After interviewing RAs on their approach to planning and after analysing their annual reports and accounts for this piece of research, it became clear that the RAs had no clearly stated

goals and objectives, no overall strategy for competing and no written mission statements. A survey carried out on RAs in 1985[2] also showed that not all RAs subscribed to the idea of planning.

One of the main reasons identified for the lack of planning especially at top management level was the absence of continuity of the Council as shown by the following statement[3]: "(...) in recent years, some Council members thought its structure to be unwieldly and outdated, suffering from a lack of continuity."

A second reason was that the Council, which was normally drawn in the main from members, was too large (e.g. 50 members in the case of LEA in 1982). Also, the Council structure consisted of too many committees e.g. BCIRA's Council had 5 committees and 11 sub-committees in 1982[4]. Furthermore, neither the Association's Director nor any of the other full-time executives were a member of it!

Thirdly, the Council structure seemed unsuitable because of the shift of accountability of the RAs from the Government to the market (see appendix 1.6, PIRA). The Government used to match every pound the RAs raised and consequently, RAs had had to be organised in such a way that the Councils both interfaced with and accounted to the Government. Gradually, the role of the Council changed when the mechanism of funding changed. RAs were forced to the market place to exploit their expertise. This was triggered by the Rothschild Principle.

Later on a ceiling support figure of 25% of turnover was imposed on the RAs. Consequently, they had to restructure in order to be able to respond to the market.

Another difficulty encountered with the Councils was membership restrictions which prevented the RAs from expanding

its membership base as well as from recruiting overseas members. Thus, it was only in 1990 that SATRA's membership was opened to foreign firms from countries with low labour costs (see appendix 1.6, SATRA).

BNF is an example of an RA which suffered partly from the inability of its Council to plan effectively (see Case Study on BNF). Its income dropped from £3.8 million (1988 prices) in 1970 to £2.6 million in 1988 and its staff number dropped from 180 to 90 during the same period.

In the last two decades, most RAs have transferred the working power to a smaller Board, operating on lines of a Company Board of Directors.

10.1.2 Divisional Structure

The most common organisational structure among the RAs is the divisional structure e.g. BHRA. A divisional structure has some clear advantages. Among them are:

(1) A clear accountabity.

(2) The creation of career development opportunities for managers.

(3) Allows local control of local situations.

(4) Leads to competitive climate within the RA.

(5) Allows new businesses to be added easily.

On the other hand, the divisional design is not without some limitations. Among them are:-

(1) A divisional structure is costly.

(2) There is a duplication of staff services, facilities and personnel.

(3) Managers must be well-qualified in order to use the divisional structure to promote effective delegation of authority.

(4) Special treatment sometimes given to certain regions, products or customers makes it difficult to maintain consistent practices within the RA.

(5) With the Council structure, the chain of command is longer and therefore communication becomes more difficult[5].

The RAs are aware of the advantages and disadvantages of this structure as shown by the following statement[6]:

> "The present PIRA structure makes a Divisional Director accountable for all activity in an industry sector. The advantage is sharp accountability via an individual for a discrete sectoral area of business operation. The disadvantage is duplication, conflict between divisions and sub-optimisation of PIRA's main assets, its people and expertise. Activities which sit between two divisional areas are ignored to the disadvantage of PIRA's members. The present divisional structure also makes it almost impossible to operate across (my highlighting) PIRA activities such as environmental research and consultancy."

10.2 Cultural/Individuals

10.2.1 Leadership Style

The leadership of the RAs tended to be more "academic" in style, which was useful before the RAs became more commercially minded in the mid 1970's. Today, the RAs need leaders who are well aware of the needs of the market they serve. Besides this,

the leaders need to:-

(1) establish and maintain stable, reputable and creative teams with the ability and desire to operate as a group and as individuals in the world of R&D and consultancy.

(2) strongly promote the personal identification of staff with the overall activities and interests of the RAs by improving internal communications and encouraging collaboration between divisions.

(3) develop and sustain a winning attitude by raising the morale, emphasising teamwork and establishing greater confidence in the RAs' abilities through positive recognition of technical, managerial and business achievement.

(4) focus investment in training upon a balance designed to meet the RAs' technical, managerial and business needs and ensure that the skills gained are fully utilised by the effective delegation of tasks and responsibility.

(5) strive to create a work environment where change - a fact of life in RAs due to diverse internal and external forces - is recognised as necessary and beneficial, so that individuals can adapt more easily.

(6) change the civil servant culture of those RAs which were formerly GIREs e.g. BMT and HR Ltd.

Failure to provide effective leadership in the time of change can be disastrous as in the case of HATRA (see appendix 1.6, HATRA).

10.2.2 Research Culture

The research culture of the RAs was formed mainly on the old concept of an RA which was largely concerned with the

general programme of cooperative work determined by its Council and financed by membership subscriptions and general government grant. The RAs also provided technical services for members and sometimes carried out a relatively small amount of directly commissioned work. This concept was appropriate from the 1920's to the 1970's, but it seemed far less relevant by the end of the 1970's. Commentators on the RAs found that the RAs had been suffering from the weaknesses of this concept as early as the 1960's. Among the weaknesses then were[7]:-

(1) The fact that most firms would carry out R&D because it yielded an advantageous commercial benefit to them. For this reason, the most exciting and rewarding industrial research was usually undertaken in firms' private laboratories rather than under the cooperative auspices of an RA.

(2) The results of cooperative research could not equally be utilised by all companies because of their different sizes, management skills, goals and objectives as well as their resources. Firms of different sizes and in-house resources may require widely differing services from their RA.

(3) The discrimination of certain sections of an RA's membership, since it was impossible to run programmes of interest to everyone all the time.

(4) Large, successful innovative firms may eventually reach a point when their subscription becomes so great that they question whether the money could not be more usefully spent internally, rather than in bolstering the position of their weaker rivals through the RA's general programme of research.

(5) The RA research programmes were sometimes dominated by the wishes of strong personalities, by bigger and more influential

members, by the highest common factor of the Council, or by sectionalism prevailing within the industry.

(6) The RA Councils that control the cooperative programmes did not necessarily comprise the people best qualified to contribute to commercial decisions. Constitutionally democratic, they may in fact become self-perpetuating as members lose commitment for other reasons, and so member control may break down.

It was widely recognised, not least among RAs themselves, that the traditional RA formula of activity suffered from these and other weaknesses. Therefore the RAs had to change their research culture which was:-

(1) built on a specialised or multidiscipline team which was not accustomed to an interdisciplinary form of research.

(2) confined to a narrow idea zone.

(3) forming its staff into individual specialists with a narrow band of expertise.

(4) technology-driven and therefore over-looking the market needs.

10.3 Staffing

The analysis of the average size of RAs indicated that some RAs could fall below an optimum size which might prevent them from offering a wider range of services to the market (e.g. HATRA) and consequently they might have to close or merge (e.g. BNF) as reflected in the decreasing number of RAs in the 10-150 range (see Chap. 8). Although there are no rigid criteria for defining the optimum size of an RA, the following criteria might be helpful (see appendix 1.6, PIRA):-

(1) the optimum size for market credibility is a minimum size of 200.

(2) the size should be big enough to form clusters of experts, which also helps to boost the morale of the staff.

> "A concern for us and for the whole foundry industry is the short supply (my highlighting) of competent and qualified engineers and technicians and we have still not achieved our full staff complement needed to undertake the work which our Members believe to be necessary"[8].

The problem of recruitment is still a difficult one for RAs. They have to compete with industry for staff[9]: "Skill shortages in the 1990s (my highlighting) will mean consideration being given to job sharing and greater attention must be given to well-planned staff training and development". Besides the problem of recruitment, the RAs encounter difficulties with regard to a higher turnover of staff in comparison with the industry they serve. One of the reasons was the limited career paths for the staffs in the latter part of their career within the RAs.

10.4 Marketing

To operate successfully as a viable RA, there is a need for a fundamental change in its business objectives and strategies. The marketing strategy has to be clearly focused on maximising sales and revenue by identifying more high-value income opportunities, converting these into sales and efficiently operating the resulting projects to a high level of quality. Everybody in the RA, led by senior management, must recognise

these requirements and be motivated to maximise sales and revenue. Selling and marketing must be given a very high visiblity, including the setting of individual sales and revenue targets to marketing staff and technical centres, and rewarding people for meeting their targets. In this context, government departments should be regarded as clients in exactly the same way as commercial clients.

The strategy outlined above does not imply that commercial consideration will be substituted for technical excellence. The maintenance of a high standard of technical excellence will be essential to sustain a long-term commercial success. The business must, however, be market-led and not technology-led.

The RAs have recognised that increasing commercial revenue and a move towards higher value services will require considerable cultural changes, which again is critically dependent on the attitudes and leadership of the RAs' magagement team.

The RAs encounter many difficulties because:-

(1) of the uncertainty of their role in the 1970's, which has prevented a definitive commercially focused corporate strategy. And it follows that there has been no demonstrable marketing strategy.

(2) of the lack of clear quantifiable objectives and industry focus.

(3) operating and marketing staff do not always work closely enough to develop commercial opportunities.

(4) poor inter-divisional communication and awareness has meant that major opportunities for interdisciplinary work have not developed significantly.

(5) responsibilities are diffused and ill-defined.

(6) client targeting is poor and often aimed at too low a level or at the R&D function rather than at strategic decision makers.

(7) of too much concentration on the RAs' capability rather than industry needs.

10.4.1 Information Systems

A proper management of information system is essential to support sales and marketing of an RA; a particularly good example occurs in WRc. The system typically consists of a central integrated database linked to a number of peripheral modules (e.g. financial, project costing, personnel, sales and marketing). As an enquiry or lead proceeds through the proposal phase to become an active project which must be controlled and invoiced, so the sales and marketing information system might need to integrate with the project management and financial module of the system.

10.4.2 Quality Assurance

The establishment and maintenance of adequate quality standards is just as important in a business delivering a service like an RA as in a business delivering manufactured products. Although quality assurance must run through every facet of a business, nowhere is its presence (or absence) more apparent than in the relationship between the organisation and its clients. Therefore, it is appropriate that RAs consider quality assurance in the context of their marketing plans.

RAs do not have an organisation-wide accreditation. More importantly, there is no quality manager, quality policy or

quality plan. This does not mean that work is not undertaken to a high standard. However, it does mean that quality relies on the attitudes, levels of training and professionalism of individual staff rather than a coherent and uniform organisation-wide policy. It also means that quality is not seen by clients and potential clients to be an important issue to an RA. Although it would be impossible to quantify the effect of this on commercial (and public sector) sales, it is certain to be significant, whether or not deficiencies in quality are real or only imagined.

10.4.3 Income From Government and Industry

Government income, whether in the form of grants or contracts, has always occupied an important place in the RA world, and for most RAs, it still does. Even for those in which government income accounts for a relatively small proportion (say under 20%) of their total income, it is generally of a sufficient magnitude to be of importance in the balance of the RAs' incomings and outgoings, at least in the short term. To a certain extent RAs still rely on the presence of government income in planning the scale of their activities.

RAs used to depend heavily on government income but this has changed considerably, especially in the last two decades. In 1970, 32% of the RAs' turnover came from government sources but by 1988, it had reduced to only 17%. Although the overall dependence on government income has decreased, there are still RAs which rely heavily on government funding[10], for example CATRA (31%) and WIRA (30%)(1985/86 figures). In real terms (1988 prices), the total government income decreased slightly from

£30.8 million in 1970 to £26 million in 1988. The RAs will have to prepare for the eventuality of further cuts in government income. The DTI, which is the greatest source of government income for most RAs has cut its innovation budget and plans have already been announced for further cuts.

RAs will have to become less dependent on this segment of their market and be prepared for more competition especially after all government contracts have now been opened to competitive tendering. The uncertainty of government income is one of the main worries of the RAs, especially of those which are accustomed to a long-term programme of strategic research e.g. HR Ltd. (see Case Study on HR Ltd.). Nevertheless, the Government remains the RAs' biggest single customer and therefore there is a great need to exact greater influence on the Government especially through the DTI.

The RAs' income from industry, which used to account for 68% of their total turnover in 1970, increased to 83% by 1988. In real terms, the total turnover increased from £63 million (1988 prices) to £128 million in the same period. Over the last two decades, the RAs have played a more pro-active role rather than being reactive to the needs of industry.

10.5 Marketing Function

10.5.1 Pricing

There are two types of markets:-

(1) those in which the basis of competition is price and

(2) those which provide opportunity for differentiation and which tend to be value-driven.

Unless RAs have uniquely differentiating features, they will often be competing in price-driven markets. Routine testing is an example of a price-driven market, where it is necessary to undercut competitors to secure a job which then has to be operated at low (or even negative) margins. Unfortunately, contract R&D in general has many of the characteristics of this type of market. Very often the potential client judges costs on his own internal R&D costing system, which usually underestimates its true costs. That is why it is essential for RAs to develop higher value-driven markets. Only then will they have control over pricing and margins.

10.5.2 Overseas Market and Regional Presence

In 1970, only 4% of the RAs' total turnover came from overseas; by 1988, it had increased to 13.5%. Now that the initial resistance to overseas membership has been overcome, the RAs will have to increase their marketing efforts overseas. Some RAs have set up regional offices overseas (RAPRA has set up new US joint ventures[11]) and have appointed overseas agents e.g. HR Ltd. RAs have found it difficult to obtain a significant European Commission income without incurring high marketing costs but it remains an important longer-term opportunity.

Within the UK, it is also important for an RA to strengthen its regional presence. For example, BHRA has set up CALTEC in Aberdeen[12]; RAPRA has set up an office in London, Optimat Ltd. in Scotland and a testing laboratory in Teeside[13].

10.5.3 Publicity

One of the aims of publicity for an RA is to dispel the image of an academic centre and to project the image of a centre of excellence with expertise to offer to industry. This is reflected in the following statement[14]:-

> "It gives us some cause for concern to find out that in spite of a main move towards work for individual members over the past years we are still looked upon as a Research Institute (my highlighting). It will be part of the objective of our future promotional activities to try to change this image in order that potential members, especially, think of us as an organisation with practical skills to offer, rather than merely as an academic institute ."

Among the other aims of publicity is the promotion of its activities and the building up of trust among its customers ("commercial-in-confidence").

The most common forms of publicity used by the RAs are discussed below:-

(1) Exhibitions

They place a demand on personnel resources within an RA. Two key questions arise in this context: how effective is an exhibition for marketing R&D, and how effectively could the resources (operating and marketing) be used in other marketing areas?

At an exhibition, companies that manufacture hardware or process products can gain by meeting existing customers and some new customers. However, for a contract R&D organisation, the customer base is smaller and very few purchasers attend the

exhibition, which limits sales prospects. In such circumstances, exhibitions are of less use and, moreover, require continual and effective monitoring (using carefully structured questionnaires at the exhibition with follow-up activity by operating and marketing staff, as appropriate) to ensure that the effort is worthwhile. They should be limited to the main market sectors of an RA.

Exhibitions can be used to expose operating personnel to the buying customer, although they are not regularly attended by the latter. The operating personnel should be present at exhibitions, but they gain far more experience by being involved directly in face-to-face meetings with prospective clients during focused selling and marketing initiatives.

(2) Conferences

By themselves, conferences can be effective forms of marketing, but again, they can easily place a heavy demand on the operating resource. Club meetings should continue, but attempts should be made to target senior attendees for future follow-ups with wider discussions. The organisation of conferences should continue but should be self-financing. Chairing conference sessions and presenting papers at selected conferences should also continue and be encouraged from within the various divisions of an RA.

(3) Videos

They have a limited impact except for internal training and awareness. Production for external audiences should be carefully targeted since they can prove very useful for club activities,

but they should be paid for by the club. They should not be used for cold selling or awareness activities with top executives.

(4) Brochures

They are required to inform generally potential customers about the RAs: what products are offered, and what benefits the the company will gain by working with the RAs. Some of the RAs' brochures need to be redesigned as they only tell industry what the RAs do but make little mention of the potential benefits of their developments to industry. They should all be produced by, or at least coordinated through, a group to ensure consistency of presentation of material.

Decision makers will not be swayed by a technical brochure. The brochure is necessary to stimulate their imagination into seeing a potential match for some requirements to solve their problems with the general expertise offered. Face-to-face meetings are necessary to sell project work.

(5) Press

The RAs can gain a lot of publicity through the press via authors of articles in the technical press or by mention-in-passing in the general press. The articles which are collected should be actively used to improve the morale within the RA.

(6) Advertising

Advertising capability in specific technical areas in contract R&D is not the most efficient means of publicity. Corporate advertising is used by organisations to raise the level of awareness with prospective customers. Unfortunately,

this form of advertisement is expensive. Advertising should be highly focused on strategic market areas.

10.6 Industry-Based and Technology-Based RAs

Technology-based RAs seem to have a particular advantage in that the diversity of their membership means that they can avoid the need which confronts the industry-based RAs to keep all its membership contented, giving rise to an inward looking attitude since dictated by a particular industry.

The smaller RAs tend to serve a very narrow niche of a particular industry e.g. SRAMA. They could be too closely dependent on one industry and be affected by its fortune. A single down-turn could prove too much for that particular RA. Many of these smaller RAs serve mature and declining industry (e.g. HATRA). Unless they are able to diversify in the future, they might risk closure. On the other hand, diversifying into other areas could be difficult because of their size. The other option could be a merger (in the last 2 years, 3 RAs merged i.e. SI merged with WIRA to form BTTG and BNF merged with FULMER to form BNF-Fulmer).

Appendix 8.2, which shows the annual growth rate of RAs from 1980 to 1988, suggests that there may be some truth in the notion that technology-based RAs perform better than industry-based ones, at least as far as the rate of growth is concerned. Many of the fastest growing RAs were not industry-based e.g. SIRA with 13% growth per annum, while at the other end of the scale, the majority of the RAs experiencing negative growth were e.g. Hatra and Bnf with -8.26% and -2% growth per annum respectively. This is perhaps not surprising. Moving away from

a single industry base, as for instance the BHRA had done, should almost inevitably open up a wide market for an association's services. But the distinction should not be given too much stress; it is possible for an RA to do quite well within a closed industry and in any case, there may be other objectives than growth.

10.7 RAs - Membership-Based Organisations

Is the concept of membership still relevant to RAs then? Apart from its money-raising function, the original objective of membership was to encourage companies to involve themselves in technical improvement: that RA results were only available to members was intended to act as a spur to other companies to take out membership.

However, it was probably in the RAs' interest that the basis of membership remained. It provided an element of continuity in an otherwise rapidly changing world and from an organisational point of view, this was important. Most firms regarded withdrawal from their RA as a significant step and were reluctant to undertake it except under extreme circumstances. The subscriptions attached to membership also provided some financial bedrock. For most RAs, this is declining in importance. Nevertheless, subscription income is still more reliable over a longer term than money derived from specific work. (In many non-profit private contract research institutions endowments provide a parallel small but relatively constant source of income). Then, however far an RA goes in charging specifically for services delivered, there are always some services - particularly information, library and small technical

services - which are administratively absurd to demand for separately. A membership subscription provides a sensible way of paying for these. Though it is prudent for RAs to retain the idea of membership it does not mean that they should work only for their members.

10.7.1 RA Control

The member company had a share in the definition of the RA's general technical programme although the programme concerned was usually a smaller proportion of the RA's total activity. This share of control was normally exercised through the right of members to elect their representatives who constitute the majority of the RA Councils. But it is a perennial fault of this type of democratic system that, especially if it is weighted in any way according to contribution levels, it fails to give proportionate representation to the requirements of minority sections of the constituency. And this had certainly happened over the years in most RAs. It had allowed the growth of a fatalistic view, particularly among smaller member firms, that there was little point in their requesting an item of work to be included on general programmes since they believed from past experiences that the RA would not in fact pay anything more than lip service to the general programme request of a small member firm.

Under no conceivable system could the individual requirements of all members be satisfied at once, or even over a reasonable term, by a relatively small institution which operated on a general programme basis. And it was perhaps inevitable that historically in many RAs the larger member firms

have tended to dominate research programmes. But if the signifance of general programme work diminishes, and that of directly commissioned work increases, the fact is that for many members programme control by a minority of members will decline in importance.

The replacement by a more practical membership whose prime right was simply preferential access to RA services, could prove beneficial.

10.7.2 SMEs - Membership

In no industry was more than a small proportion of small companies in membership of an RA. Taken with the observation that the RA concept was originally introduced to widen the application of technical skills among industry at large, this seems to imply that RAs have in general failed to achieve a fundamental objective. It could be argued that because the RAs received contributions from the Government, they ought to have helped out the SMEs in promoting the application of new technology. On the other hand, the RAs had a contribution to make to companies which were already receiving such help (e.g. active members).

The SMEs were hesitant to become members because of:-

(1) the not-invented-here (NIH) syndrome.

(2) their short-time horizon.

(3) they Could not afford it.

(4) confidentiality i.e. it was too risky to receive outside help.

(5) their research and development needs were different from the big firms i.e. they were oriented more towards the development

side. Furthermore, they were outnumbered by the bigger firms and therefore their needs were not catered for.

(6) running collaborative research with SMEs was more difficult since their needs differed from one to the other and they were more demanding for the amount of money they put in.

The problem of giving each member a feeling of value was, under the traditional RA formula, particularly acute in the case of small firms. It was likely that the demands of a small firm on a technical institution were different from those of a large firm. SMEs would be interested in less sophisticated information and troubleshooting services rather than in extended programmes of technical development.They had received these services from RAs, but their subscriptions had also been contributing towards general programme work which, because of the inherent inequity in the traditional control system, and because of small firms' lack of capital to invest in the application of RA results, had often been regarded by them as irrelevant to their needs.

The RAs need to make a sufficient effort to analyse systematically the technology of the various industrial sectors within its industry, with a view to revealing the technical needs of their members. The SMEs that operated in unstable technical conditions do not recognise that technical improvements were required. Under this condition, there must be a particularly strong effort on the part of the RA to reveal hidden possibilities for cost-saving programmes. On the other hand, a certain amount of activism on the part of any member was necessary to maximise its value for money from its RA. It was feasible in many cases for small firms with common low-level technical problems to join together in presenting a proposal to

their RA. But SMEs were not prone to take this kind of collective action. Perhaps the responsibility did ultimately lie back with the RA to take the initiative by making it clear that this kind of approach was open to SMEs and by encouraging them to present their technical needs accordingly, through regular opportunities for requesting work and assistance in the formulation of demands.

10.7.3 Members' Perception of RAs

In the shorter term, the RAs benefit from adopting a more sophisticated approach to member and public relations in order to dispel the misconceptions and ignorance of their activities. The members, too, in the short term review their relation to their RA.

There seemed to be a widespread feeling in industry that the payment of a membership subscription itself ought to yield technical results of immediate benefit to the firms. The absolute level of membership subscriptions had in the past led to the development of this attitude. The decline in the importance of general programme work after the early 1970's meant that there was less validity for this idea, but it had been in existence during the sixties. It had been intensified by the fact that many members themselves had not much direct say in what was done with their money, and had to take on trust that it was, in the long run, applied in their benefit. Yet many firms were dissatisfied and this situation prevailed for years without anything much being done to tackle it.

Thus it was sensible for the member firm itself to investigate the situation in a systematic way to see what the

situation was like and if it could be improved by any exertion on its part. A review of this type might lead to the definite conclusion that membership was not sufficiently attractive, and hence to withdrawal. Unless it happened on a wide scale, this might not in the long run be a bad thing for the RA itself, in that it would help to clear the air and give an indication as to where its areas of failure lay.

10.8 R&D Programme/Products

There is a need for RAs to engage in either forward integration or backward integration of their research programmes i.e. rather than just dealing with a particular kind of equipment, the RA can consider forward integrating by marketing the product or backward integrating by looking into the process the equipment operates in. SIRA is an example[15]:

> "On the R&D side, SIRA is increasingly developing a vertical integration of its activities within major business sectors, producing hardware and products to meet clients' needs as well as initiating R&D. This provides not only extremely valuable experience and feedback to the research and development staff but, where required, a route for clients through from concept to production within the one company. This philosophy is designed to enhance SIRA's abilities to win the initial R&D contracts and to provide a sensible route for growth and development of the organisation."

On the other hand, there are some RAs which have too wide a focus. For example, MIRA is worried about its breadth of

services and facilities, which is costly to maintain and spread too thinly (see appendix 1.6 on MIRA). PERA, too, will need greater focus because production engineering is not a core skill and the manufacturing sector which it serves is too broad an industry.

Some RAs tend to carry out research which is in support of the development and application of products and systems, rather than undertaking the development themselves. They undertake research and testing and develop design data and methodologies to underpin development and application. Longer-term pre-competitive research has limited opportunities for attracting higher fee rates but product development, which is much closer to the market, can bring in significant income. Furthermore, the former type of research tends to be run as club projects which have high hidden sales and marketing costs. This does not mean that RAs should neglect research which is in support of development and application in order to concentrate just on product development because they need to secure their core research programme. The pre-competitive research programme differentiates them from other research organisations besides creating opportunities for follow-up research.

Some RAs, for example SI, had great difficulties in securing matching industrial funding for their collaborative programme as shown by the following statement[16]:-

> "The provision of matching industrial funding usually poses a problem since it normally falls to the Institute to initiate the early stages of process work. Expressions of interest in projects help to secure a positive adjudication but it is rare for an

expression of interest to be accompanied by sponsorship money until there has been some quantifiable and positive output from the project work."

The difficulty of insufficient support from industry arises possibly because the prime impetus for the generation of project ideas comes from the RA. The RA might be able to obtain better support if it encouraged potential sponsors to be initiators.

If an RA is not able to secure sufficient industrial support for its general programme, it may have to subsidise it from its surplus income but this is a questionable practice[17]: "The significant, and seemingly ever increasing, loss on research and development available to all members by virtue of subscriptions clearly could not be allowed to continue."

10.9 Financial Audit

The profitability ratio helps to measure the RAs' overall management effectiveness as shown by the returns generated on sales and investment. Table 10.1 shows the net profit/turnover ratio (1988) for a selection of RAs: In 1988, MIRA made a profit of 13 pence per pound of turnover, which is the highest among the RAs.

Appendix 8.2 shows the comparison of a selection of RAs' growth in turnover from 1980 to 1988. Among the RAs with the biggest annual growth were SIRA (12.92%), LEA (10.51%), WRc (10.32%) and PIRA (8.42%). Some RAs had negative growth. Among them were HAT (-8.26%), BGI (-3.62%), BCIRA (-3.4%) and BNF (-2.04%). HAT's turnover in 1988 shrunk to about 1/3 of its turnover in 1980 and BCIRA's fortune reflects that of the steel

Table 10.1 Profitability Ratio of Selected RAs
Sources:- RAs' Annual Reports

RAs	Profit / Loss (%) 1988
MIRA	12.99%
PIRA	7.60%
BCR	6.54%
ERA	5.18%
SIRA	4.55%
PERA	4.35%
Lea	3.14%
HRC	3.07%
BRA	2.35%
FIR	2.00%
WRc	1.92%
BTTG	1.89%
CAT	1.18%
RAPRA	0.50%
TRA	0.23%
BLC	-2.06%
BHRA	-3.06%
AMTRI	-4.11%
BMT	-12.27%

industry it serves.

The turnover to staff ratio helps to give an indication about the RAs' effectiveness. Table 10.2 shows the comparison of the turnover to staff ratio for 1980 and 1988 for a selection of RAs (see appendix 10.1). The table shows that for most RAs, the ratio increased over the period with the exception of BCIRA, where it dropped from £19,000/employee to £18,000/employee. The biggest increase was in the case of PERA i.e. from £25,000/employee to £44,000/employee.

10.10 Facility Audit

The majority of the RAs are located in the South East and the Midlands, where most British manufacturing industries are. The close proximity with the industries is important in order to maintain close contacts.

One of the difficulties faced by RAs is the shortage of space. Some of their facilities and offices are located in listed buildings with very limited options for expansion or renovation e.g. the Shirley Towers. SIRA for example has many difficulties with its site for these reasons[18]:

"We are exploring with some urgency various options for providing additional working space without which

our growth will be restricted."

LEA is another example for a site being fully utilised and it might encounter some problems in the future if it were to expand.

Table 10.2 Turnover to Staff Ratios of RAs (£100,000)
Sources:- RAs' Annual Reports

Turnover to staff ratios						
RAs'/Year	1980	1982	1984	1986	1988	1989
AMTRI	ERR	0.000	0.017	0.018	0.023	0.016
BCIRA	0.019	0.019	ERR	ERR	0.019	0.018
BHRA	0.019	0.019	0.020	0.026	0.028	0.026
BNF	0.021	0.018	0.024	0.024	0.033	0.031
BCR	ERR	ERR	0.019	0.021	0.020	0.018
BGI	ERR	0.016	0.015	0.015	0.018	0.016
BLC	ERR	ERR	ERR	ERR	0.018	0.017
BMT	ERR	ERR	ERR	0.025	0.029	0.044
BRA	0.018	0.020	0.021	0.023	0.027	0.022
CIRIA	ERR	ERR	0.045	ERR	0.044	0.042
CAT	0.016	0.013	0.016	0.017	0.019	0.020
ERA	0.023	0.023	0.029	0.030	0.027	0.025
FCR	ERR	ERR	0.015	ERR	0.021	0.020
FIR	ERR	0.022	0.025	0.024	0.025	0.024
HAT	ERR	ERR	ERR	ERR	0.025	0.019
HRC	ERR	0.023	0.026	0.027	0.028	0.026
LAM	ERR	ERR	ERR	ERR	0.013	0.015
MIRA	0.023	0.021	0.027	0.034	0.034	0.028
PR	0.015	0.019	0.017	0.017	0.018	0.017
PERA	0.025	0.029	0.052	0.051	0.044	0.049
PIRA	0.019	0.019	0.024	0.028	0.028	0.037
RAPRA	0.017	0.016	ERR	ERR	0.021	0.025
SAT	ERR	ERR	ERR	0.018	0.016	0.015
SI	ERR	0.015	0.017	0.017	0.017	ERR
SIRA	0.020	0.020	0.027	0.031	0.031	0.034
SRA	ERR	ERR	ERR	ERR	0.025	0.028
SCR	ERR	ERR	ERR	ERR	0.035	0.037
TRA	ERR	ERR	ERR	ERR	0.022	0.026
WRc	0.023	0.030	0.033	0.034	0.033	0.033
WI	0.021	0.022	0.024	0.025	0.029	0.024
WIRA	ERR	ERR	ERR	ERR	0.022	ERR
BTT	ERR	ERR	ERR	ERR	ERR	0.024
CAMP	ERR	ERR	ERR	ERR	ERR	0.018
Lea	0.016	0.018	0.022	0.023	0.027	0.026

Some RAs' facilities are spread out and consequently the overhead costs as well as the costs of administration are higher. Furthermore, there are less possibilities for synergy. In the case of WRc its facitities are spread out in three sites i.e. Swindon, Stevenage and Medmenham. For the past few years, it has been trying to consolidate its activities and centre them on two sites i.e. Stevenage and Medmenham. When it changed its corporate status in March 1990, it decided to close its site in Swindon. One of the difficulties BTTG (formed in 1989) is still facing now is the location of its facilities, which are spread out in Manchester and Leeds.

Among the other problems faced by RAs with regard to their facilities are:

(1) obsolete facilities.

(2) high overheads in maintaining big facilities e.g. BMT had to close down certain testing sites.

(3) dealing with the problems of peaks and troughs in demand.

(4) too wide a range of facilities e.g. MIRA is considering narrowing down its range of facilities.

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CHAPTER 11: STRATEGIC CHOICES FOR THE RAS

11.1 Strengths / Weaknesses / Opportunities / Threats (SWOT) Analysis

To plan the course of development of an RA, it is essential not only to know what it is aiming for, but where the RA is starting from[1]. The planning process must begin, therefore, with an assessment of the internal strengths and weaknesses of the RAs and the external opportunities and threats facing the RAs in their business environment by carrying out a SWOT analysis. SWOT or the Harvard approach is a more focused form of planning and has a record of success[2]. It encourages managers to consider the changes which may be necessary in the RA if it wants to maximise its opportunities and to minimise the threats it faces.

The strengths, weaknesses, opportunities and threats have already been discussed in detail in the two preceding chapters (The Environment and The Internal Audit) and will now only be highlighted in point forms:-

11.1.1 Strengths

(1) Experienced and competent staff in many areas.

(2) Established track record and good technical reputation.

(3) A wide and potentially complementary range of technologies and facilities.

(4) Relatively stable ownership and good connections with the DTI.

(5) Greater freedom by being accountable to a Board of Directors.

(6) More commercially minded.

(7) Less dependent on government income.

(8) Close rapport with industry through membership and formation of clubs.

(9) Services/products more in tune with market needs.

(10) The RA that has changed its status to one limited by share is allowed to raise capital.

11.1.2 Weaknesses

(1) The RAs operate within an unstable political environment and are subject to the changing and sometimes unpredictable demands of the Government.

(2) Resources are spread too thinly.

(3) Insufficient cohesion across different divisions or areas of business, and failure to exploit fully the collective technical strengths of the RA.

(4) The objectives of an RA do not, in general, provide a single focus for internal commitment or external recognition.

(5) Personal performance yardsticks and incentives are weaker than in the private sector.

(6) Management constraints by having to account directly to a Council.

(7) An organisational structure that does not encourage synergy between divisions in an RA.

(8) Resistance to change.

(9) Having to shed the civil servant culture (for privatised GIREs e.g. HRc and BMT).

(10) Unable to raise capital because of corporate status.

11.1.3 Opportunities

(1) Greater industry R&D investment in the UK.

(2) Out-sourcing of research in industry is gaining popularity.

(3) R&D income from overseas.

(4) Increased funding from the EC.

(5) A rapidly growing pace of technology which forces industry to invest sufficiently to keep abreast.

(6) In order for industry to compete globally, it has to invest adequately.

(7) Deregulation, particularly post 1992 will offer greater opportunities for collaborative ventures, increasing the RA's share in the R&D market as well as opportunities for standards work.

(8) Greater awareness among the public about environmental issues, which helps to create R&D opportunities for RAs.

11.1.4 Threats

(1) Instability of the DTI.

(2) The DTI's support for RAs is limited by a ceiling figure of 25% of the total turnover of the individual RA and there is a continuous reduction in the DTI's Innovation Budget.

(3) Competition from HEIs, IRCs, RAs' members, CROs in the EC, privatised GIREs, AEA Technology.

(4) Fierce competition from industry for staff in fashionable areas of technology.

(5) The pattern of the RAs' markets will continue to change and requires constant vigilance on the part of the RAs.

(6) Threat of recession world-wide (in particular within the UK),

high interest rates and unstable exchange rates.

(7) Cut in the overall government R&D budget.

(8) Privatisation and formation of agency status for public bodies.

(9) Short-termism in the City, take-overs and mergers.

11.2 Strategy Formulation Through SWOT Analysis

Source: F. David (1986)

Always leave blank	STRENGTHS—S 1. 2. 3. 4. 5. 6. List 7. strengths 8. 9. 10.	WEAKNESSES—W 1. 2. 3. 4. 5. 6. List 7. weaknesses 8. 9. 10.
OPPORTUNITIES—O 1. 2. 3. 4. List 5. opportunities 6. 7. 8. 9. 10.	SO STRATEGIES 1. 2. 3. 4. Use strengths 5. to take 6. advantage of 7. opportunities 8. 9. 10.	WO STRATEGIES 1. 2. 3. 4. Overcome 5. weaknesses 6. by taking 7. advantage of 8. opportunities 9. 10.
THREATS—T 1. 2. List 3. threats 4. 5. 6. 7. 8. 9. 10	ST STRATEGIES 1. 2. Use 3. strengths 4. to avoid 5. threats 6. 7 8. 9. 10.	WT STRATEGIES 1. 2. Minimize 3. weaknesses 4. and 5. avoid 6. threats 7. 8. 9. 10.

Figure 11.1 The SWOT Analysis.

A SWOT analysis can be used as a strategy formulation tool to develop four types of strategies[3] as shown in figure 11.1[4]:-

(1) Strengths-opportunities strategies:

Any RA would like to be in a position to use its strengths to exploit external opportunities. For example, SATRA uses its resources and expertise to exploit the R&D opportunities that exist in industry because the majority of firms do not have their own in-house R&D facilities or know-how.

(2) Weaknesses-opportunities strategies:

These strategies are directed towards improving internal weaknesses by taking advantage of external opportunities. Sometimes external key opportunities exist, but the RA has internal weaknesses that prevent it from exploiting those opportunities. For example, there are opportunities in the R&D market for materials but BNF could not exploit it fully because of its lack of expertise in the field of materials R&D except for non-ferrous metals. It was logical therefore for BNF to merge with FULMER, which specialises in materials research, in order to exploit the opportunities in the materials R&D market.

(3) Strengths-threats strategies:

These strategies are based on an RA using its strengths to avoid or reduce the impact of external threats. The aim is to capitalize on the RA's strengths in order to minimize external threats. Most RAs are using their expertise and resources to gain as much income as possible from industry and thereby to reduce their dependence on government income.

(4) Weaknesses-threats strategies:

These strategies are directed at overcoming internal weaknesses and avoiding environmental threats. The attempt is to minimize both weaknesses and threats. These forms of strategies are defensive. An RA facing many external threats and internal weaknesses may indeed be in a precarious position. It may have to fight for survival by merging or retrenchment or choose liquidation. For example BMT had to reduce its staff after privatisation as well as to liquidate some of its assets.

11.3 Evaluation of Strategy Options

The major difficulty faced in evaluating strategies is the need to use a number of different measures or criteria that cannot all be satisfied simultaneously. There are three main classes of criteria which can be used for strategy evaluation[5]:

(1) Criteria of suitability:

This attempts to measure how far proposed strategies fit in with the situation identified in the strategic analysis. This involves providing a clear picture of the organisation and the environment it operates in. A useful summary of this situation might include a listing of the major opportunities and threats which face the organisation, its particular strengths and weakneses and any objectives which seem to be a particularly important influence on policy.

After thus identifying the organisation's situation, certain questions need to be asked about the proposed strategy such as:

(1) To what extent does it overcome the difficulties identified in the strategic analysis (internal weaknesses and environmental

threats)?

(2) Does it exploit the RA's strengths and environmental opportunities?

(3) Does it fit with the organisation's objectives and values?

(2) Criteria of Feasibility:

It assesses how any strategy might work in practice. For example, whether the strategy's goal is achievable in resource terms. There are a number of fundamental questions to be asked when assessing the feasibility of any strategy:-

(1) Can the strategy be funded? This can be examined by producing a future funds flow forecast showing the estimated sources and uses of funds.

(2) Is the RA capable of performing to the required level (e.g. quality level, service level)?

(3) Can the necessary market position be achieved and will the necessary marketing skills be available?

(4) Can competitive reactions be coped with?

(5) How will the organisaton ensure that the required skill on both the managerial and operative level are available (training and recruitment)?

(3) Criteria of Acceptability:

It tries to assess whether the consequences of proceeding with a strategy are acceptable. For example, will it be profitable or generate the growth expected by the senior management, members or the Council? One important measure of acceptability is the level of risk involved in any strategy.

The assessment of whether the consequences of proceeding

with a strategy are acceptable or not is difficult since acceptability is strongly related to people's values, and therefore the issue of "acceptable to whom" requires the analysis to be thought through carefully. Some of the questions that will help to identify the likely consequences of any strategy are:-

(1) What will be the financial performance of the company in profitability terms?

(2) How will the financial risk change?

(3) Will any proposed changes be acceptable to the general cultural expectations within the RA (e.g. attitudes to greater levels of risk)?

(4) Will the function of any department, group or individual change significantly?

(5) Will the RA's relationship with members, Council, DTI or customers need to change?

(6) Will the strategy be acceptable in the RA's environment (e.g. will it face resistance and competition from its members)?

(7) Will the proposed strategy fit in with existing management systems or will it require major changes?

11.4 Strategy Selection

It is important to recognise that the selection of one or more strategies by the RA occurs by a number of very different processes. They are:-

(1) Selection against objectives:

This is a common view of how a rational choice of future strategies should be made, although it is normally impracticable to proceed in this way. This method of selection uses the RA's objectives, quantified where possible, as direct yardsticks by

which alternatives are assessed. Evaluation methods are therefore central to the decision-making process and are expected to provide quantifiable answers regarding the relative merits of various alternatives and to indicate the right course of action.

(2) Reference to a higher authority:

One form of selecting future strategies is to refer the matter to a higher authority. The managers responsible for evaluation may not have the authority to give the go-ahead to the solution. Equally the senior managers (e.g. in the Council) who must decide on a strategy may not have participated in the evaluation of alternatives. It is unlikely that senior managers will have the time or inclination to unravel all the detailed implications of an evaluation. They are more concerned with using their judgement of the available facts to decide on strategies and seeing how well these strategies fit in with the overall strategy of the RA. Thus the evaluation process is seen as a means of raising the level of debate which occurs amongst senior managers when they are using their judgement on the selection of a strategy.

(3) Incrementalism:

This takes place when strategic decisions are made in small steps, in isolated parts of an RA or as a reaction to events (usually outside changes). In these circumstances the selection of a strategy tends to result from experimenting with strategic changes in parts of the RA (e.g. in a division or area). It may well be that the initiative for such activity comes from decisions made in the various parts of the organisation and

through the political processes occurring between those parts.

(4) Using outside agencies:

Sometimes within the RA there are potential disagreements on a strategy between parties who have similar amounts of power within the RA. In these circumstances it will not be unusual for an outside agency, such as a consultant, to evaluate the situation for the RA. Very often this process of evaluation is described as an objective, rational process by virtue of the consultant's detachment from the situation. In practice, of course, all good consultants are aware of the political reasons for their involvement. To a large extent their role is one of an arbitrator and the evaluation must reflect those circumstances.

11.5 Strategies Adopted by RAs

11.5.1 Merger

The following are some of the circumstances in which an RA would consider merger:-

(1) when it falls below a critical size.

(2) when a synergy is possible.

(3) when it is in difficulties e.g. financial ones.

The advantages of mergers are as follows:-

(1) Synergy of strengths. Creation of new ideas, new thinking, new blood, new projects etc.

(2) Complementarity of resources. For example in the merger between FULMER and BNF, FULMER had enough cash and BNF had the site.

(3) Helps to diversify e.g. it helps BNF to diversify from Non-Ferrous into Materials.

(4) Creation of new expertise.

(5) New resources.

(6) New markets.

(7) Lower overheads - making it more competitive.

(8) Better image - bigger, stronger.

(9) Undertaking bigger and riskier projects.

(10) Possibility of future mergers or takeovers of other research establishments.

(11) Wider scope for overseas collaborations.

Among the disadvantages are:-

(1) coping with cultural changes.

(2) leadership clashes.

(3) loss of staff during negotiation (e.g. BTTG).

In the last decade a few RAs opted for this. Mergers took place between BNF-FULMER and SI-WIRA. Among the possible mergers in the future are BCIRA-SCRATA[6] and LEA-Campden (see appendix 1.6 on LEA).

11.5.2 Forward Integration

An RA can integrate forward, by acquiring another organisation[7] or setting up a subsidiary. Among the RAs that chose this option are BMT and SIRA.

SIRA for example, forward integrated by forming subsidiaries to market and exploit its research (see Case Study on SIRA). This strategy is useful when:-

(1) there are no firms which are willing to take up the research further and to exploit it.

(2) if its research programmes (contracts) are not earning enough revenue, forward integration might help to increase its revenue

especially if there is a growth market for the product.

(3) the RA has the capital and human resources needed.

(4) the product has a high profit margin.

11.5.3 Concentric Diversification

This strategy is used to add new but related fields of research activities or products and is practically used by all RAs to widen their market base. This can be achieved within the RA by greater synergy among the divisions. For example, most RAs are diversifying into:-

(1) new but related areas like environmental issues.

(2) selling products like software programmes.

(3) services like consultancy, testing, accreditation and database retrieval services.

(4) training, conferences and publications.

This strategy is useful when:-

(1) the RA is competing in a slow growth research area.

(2) the adding of new but related products or services can significantly enhance the sales of current product or services.

(3) the new but related services/products can be offered at highly competitive prices.

(4) the new, but related services have cyclical sales levels that counterbalance the RA's existing peaks and troughs.

(5) the RA's services/products are currently in the decline stage of the service/product life cycle.

11.5.4 Conglomerate Diversification

This strategy involves diversifying into new areas of research which are unrelated to its existing portfolio of

research. For example, BTTG diversified into biotechnology (see appendix 1.6 on BTTG), SATRA into textile and BMT into Fluid Mechanics. This strategy is useful when:-

(1) the industry which the RA serves experiences declining annual sales and profits e.g. the declining shipbuilding industry in the UK which forced BMT to diversify.

(2) the RA has the capital needed e.g. BMT liquidated its assets.

(3) the RA has the opportunity to purchase a research organisation/consultancy that is an attractive investment opportunity.

(4) there is fierce competition in an existing area of research.

11.5.5 Joint Ventures, Agents

Joint ventures are a strategy where an RA works with another organisation on specific projects. It will be a popular strategy after 1992, when RAs will be encouraged to enter into joint ventures with their European counterparts.

This is a strategy adopted by WI[8] when it formed a partnership with Edison Welding Institute in the USA to:-

(1) assert its influence.

(2) recruit more members.

(3) sell its services and products.

This strategy is useful when:-

(1) the RA forms a joint venture with a foreign organisation, thereby providing the RA with local management in a foreign country.

(2) the distinctive competences of two or more of the research organisations complement each other.

(3) the project is potentially profitable, but requires a lot of

resources and risks.

(4) two or more research organisations have trouble competing with a large organisation.

(5) the RA wants to introduce a service or product in the market quickly.

11.5.6 Market Development

This strategy is used when an RA wants to introduce its existing products or services into new geographic areas. It is a common feature among RAs to form a subsidiary, setting up of a regional office or appoint agents in new geographic areas where the RA wants to enlarge its market. Two examples of this are the setting up by HRc of regional offices in the Far East[9] and RAPRA setting up offices[10] in the USA.

This form of strategy is useful when:-

(1) the RA is successful.

(2) new untapped or unsaturated markets for the RA's services/products exist.

(3) the RA has the needed capital and human resources to manage expanded operations.

(4) the demand for the RA's services/products are growing rapidly and globally.

11.5.7 Market Penetration

This strategy is used when the RA seeks to increase its market share of its present services/products in present markets through greater marketing efforts. This strategy is used by RAs to compete in the local market (within the UK). For example, BHRA set up a testing centre known as CALTEC in Aberdeen[11] and RAPRA

set up regional offices in London and in Teeside[12].

This strategy is useful when:

(1) the current market for the RA's services/products is not saturated.

(2) the market shares of major competitors have been declining while the demand for the services/products has been increasing

(3) when increased economies of scale provide competitive advantages.

11.5.8 Retrenchment

Retrenchment is a strategy used by the RA when it needs to regroup through cost and asset reduction in order to reverse its declining state. This is a strategy used by most RAs during the recession in 1979-1982. Thus WRc reduced its staff from 535 in 1980 to 478 in 1982 through retrenchment and BMT reduced its staff from 456 in 1986 to 340 in 1988 (This was necessary after its privatisation in 1985 in order to stay competitive).

This strategy is used when:-

(1) the RA has a clearly distinctive competence, but fails to meet its objectives and goals consistently over time.

(2) the RA is a weak competitor in the market it serves.

(3) the RA is plagued by inefficiency, low profitability, poor employee morale, and pressure from members to improve its performance.

(4) the RA's management has failed in planning strategically for the RA.

(5) the goals and objectives set by the members differ from those of the management team. For example, MIRA replaced its Managing Director because of conflicting objectives (see appendix 1.6 on

MIRA).

(6) the RA has grown so large so quickly that major internal reorganisation is needed.

11.5.9 Liquidation

Liquidation is a strategy used by an RA to sell off parts of its assests for their tangible worth which occurred when BMT sold off its Feltham site to finance its diversification programme[13] and also when BNF sold off part of its assets and converted the remaining part of its property into a Business Park (see Case Study on BNF). A further example of the same strategy being used was the sale of BTTG of part of its property in Didsbury for development and the renting out of part of its existing site. The proceeds raised were used to help cash flow as well as to help it diversify (see appendix 1.6 on BTTG).

This strategy is useful when:-

(1) the RA has pursued both a retrenchment strategy and a divestiture strategy and neither has been successful.

(2) the RA's only alternative is bankruptcy. Liquidation represents an orderly and planned means of obtaining the greatest possible cash for an RA's assets.

(3) the members of an RA want to minimise the losses of the RA by selling its assets.

11.5.10 Divestiture

This strategy involves the RA selling a division or part of its set-up. For example, WRc was considering the selling of its Stevenage site to raise capital[14] and to consolidate its position.

This strategy is useful when:-

(1) the RA has pursued a retrenchment strategy and it failed to accomplish the improvements needed.

(2) a division needs more resources to be competitive than the RA can provide.

(3) a division is responsible for the RA's overall poor performance.

(4) a division is a misfit with the rest of an RA, which can result from radically different markets, customers, managers, employees, values or needs.

(5) a large amount of cash is needed quickly and cannot be reasonably obtained from other sources.

11.5.11 Combination

An RA usually does not pursue one strategy only but a combination of two or more simultaneously. For example, BMT adopted a strategy that was a combination of diversification, integration and liquidation.

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CHAPTER 12: CHANGES IN THE RAS

12

12.1 Ownership/Corporate Status

12.1.1 Limited by Guarantee

This is the corporate status most commonly adopted by Research Associations which have no capital and where liability is very limited since it is the members who are liable up to a maximum individual liability of £5. (There are, however, two exceptions, viz BHRA and WRc). This means that most RAs generate profits but cannot distribute them. They are managed by councils elected by the members. It is possible to maintain this form of status and yet retain staff control of the RA through the appointment of a Board of Directors to which management responsibilities are delegated. The Council on the other hand remains a body that represents the members. Among the RAs which have set up a Board of Directors, SIRA has gone the furthest towards staff control with up to five staff directors (see case study on SIRA).

One of the disadvantages of this status is the inability to to raise risk capital. One way of raising capital is through the Equity Participation Cooperative (EPC) (see appendix 12.1). It is not a popular option among the RAs because of the difficulties in administrating it although it can have the following advantages:-

(1) help transfer control of the RA to the staff.

(2) financial participation by the staff.

(3) optional equity ownership by member companies.

(4) opportunities for raising additional capital from outside investors.

12.1.2 Limited by Shares

This form of status is relatively new among RAs. The RAs that have adopted this status are WRc (now WRc Plc) and BHRA (now BHRA Ltd) in which cases the status change was carried out through management buy-outs. RAPRA is currently thinking of adopting this status.

In the case of WRc, some of the shares were bought over by the various Water Authorities, whose purpose was to show their commitment for the support of WRc under this new status. The Water Authorities also gave an undertaking that they would continue to fund WRc's core programme for the next five years. This acts as a safety net for WRc as well as to give it time to go through a transitionary period. In the case of BHRA Ltd, the RA (i.e. the old BHRA) bought part of the shares and the rest were taken up by the management. The "old BHRA" can still award research contracts to BHRA Ltd.

By adopting this status, the RA will lose its tax-exempt status (see appendix 12.2) but it benefits from:-

(1) being able to raise share capital.

(2) the possibility of being listed in the market.

(3) having greater freedom to give incentives to its staff.

(4) having financial participation by the staff.

(5) having greater control of the management of the RAs by the staff.

One major disadvantage of this status, however, is the possibility that the clients may not consider the RA to be

independent anymore and fear that a possible rival of the clients may one day take over the RA and have access to all the confidential information.

Adopting this status might signal the beginning of a complete break from the "RA principle" of a non-profit-making organisation that carries out collaborative research for its members. It might put pressure on the rest of the RAs to adopt a similar status because of the advantages it brings especially in being able to motivate the staff with financial incentives.

12.2 RA Objectives

An organisation's objectives specify the actions and commitments made to achieve its purposes and, in the long term, result in the organisation taking steps to realize those objectives.

Many problems are superficial compared with those of determining what objectives an RA can most profitably pursue in the 1990's. Most RAs operate to a memorandum of association which is relatively unspecific, defining their prime object as "to promote research and other scientific or technological work in connection with (their particular) trade or industry" (see appendix 7.1). The tradition of the RAs, dating back to 1917, enshrines a number of working objectives which can be summarised. They are as follows:-

(1) To encourage cooperation in R&D between individual members of an industry, and to make the industry research-conscious.

(2) To investigate problems of interest to a major sector of industry, which cannot conveniently or economically be undertaken by any single member; and as a corollary of this, to realise

economies of central operation, especially in the use of scientific manpower.

(3) To transfer new research ideas and technological know-how from a variety of sources into industry.

(4) To stimulate and assist smaller firms without research facilities of their own.

RAs still operate to these sorts of objectives, although they are to a significant extent outdated. The pursuit of objectives like these led to the weaknesses experienced by the RAs and to many of the difficulties which RAs have suffered since the beginning of the 1970's with the change in government attitudes towards R&D.

The above set of objectives contains a real conflict. Although not specifically enjoined to do so, there was, and often still is, a prevailing impression that it is an RA's duty to operate in the interests of its industry at large and to improve its overall level of technical competence. But at the same time, RAs are, and always have been, exclusive organisations; that is, their benefits are basically available only to member organisations. It seems odd that the RAs should be operating in the direct interests of precisely those companies least likely to take advantage of their existence by joining i.e. the members of the industry, usually in a majority, who were too small or technically too backward to regard an RA membership as relevant to them. If the objective of improving the technical level of an industry in a general way was taken to involve the recruitment of large sections of the more backward, smaller members of an industry, the RAs as a whole have not been conspicuously successful in achieving it over the period of their existence.

While all RAs have small firm members, only in few cases are these more than a small fraction of all the small firms in the industry. "(...) A proportion of those small firms which are members are unconvinced that their association has their interests at heart."[1]

The objectives of the RAs are still evolving from the ones set when they were established. In order to prepare themselves for the 1990's and beyond, they will have to re-state their objectives. They have to start by asking what their organisation should be doing and why it exists and by redefining what the organisation's business is. The following is a set of criteria derived from this research which summarises the goals which any RA is aiming for:-

(1) To be one of the foremost membership-based international research, consultancy, training and information centres in Europe/the world.

(2) To be a financially independent surplus-generating, non-profit distributing centre able to fund and sustain its own growth and development.

(3) To be a financial and intellectual attraction to talented persons for employment in the marketplace.

(4) To be an essential source of techno-economic strategic information and consultancy to management in the industry served.

(5) To be an agent-for-change through research to stimulate innovation, improve profitability and international competitiveness of the clients served.

(6) To be a prime source of policy advice to the Government and the relevant European Commission Agencies.

(7) To be a centre of influence for business synergy between the sectors of industry served, and the related suppliers and equipment manufacturers.

12.3 Marketing Factors

12.3.1 Less Dependence on Government Income

Table 12.1 The RAs' Income From Government Sources in 1988 (£100,000)

RAs	Govt.	Total	As %
AMTRI	1.15	14.10	8%
BCIRA	6.70	26.81	25%
BHRA	10.87	47.13	23%
BNF	3.36	24.00	14%
BCR	9.41	46.31	20%
BGI	2.04	6.80	30%
BLC	1.94	9.70	20%
BMT	30.00	100.00	30%
BRA	4.97	22.60	22%
CIRIA		17.50	0%
CAT	0.63	2.55	25%
ERA	31.50	105.15	30%
FCR	0.98	6.50	15%
FIR	4.60	24.04	19%
HAT	0.63	4.21	15%
HRC	35.00	80.04	44%
LAM	1.75	7.00	25%
MIRA	10.00	90.86	11%
PR	1.45	9.67	15%
PERA	12.30	154.40	8%
PIRA	9.06	72.11	13%
RAPRA	2.45	39.91	6%
SAT	5.44	27.20	20%
SI			ERR
SIRA	7.76	77.63	10%
SRA	1.44	7.20	20%
SCR	7.26	29.04	25%
TRA	2.77	30.20	9%
WRc	21.00	231.20	9%
WI	30.00	120.00	25%
WIRA			ERR
BTTG	9.00	53.00	17%
CAMP			ERR
Lea		66.80	0%
Total	265.46	1553.66	17%

Source: RAs' Annual Reports

In the last two decades, the RAs in general have become less dependent on government income. In 1970, 32% of the RA's total income came from government sources; by 1988, it had come down to only 17%. In real terms, it came down from over £30 million in 1970 (1988 prices) to £26.5 million in 1988. One of the RAs with the lowest proportion of income from the Government is SIRA with less than 6% of its turnover in 1989 (see case study on SIRA). The RAs have also to be less dependent on MoD contracts. FULMER for example had to merge with BNF and had to make redundant all its support

staff after going through a difficult time brought about by its over-dependence on MoD contracts.

There are some RAs which were over-dependent on government income and statutory levies e.g. BCIRA where in 1988 over 25% of its total income came from the DTI and 28% came from statutory levies[a] (see table 12.1). If RAs like BCIRA do not become less dependent on government income, they will face a very difficult time ahead due to the Government's attitude towards the funding of R&D.

Table 12.2 RAs' Overseas Income (1988) (£100,000)

RAs	overseas	Total	As %
AMTRI	0.50	14.10	4%
BCIRA	2.09	26.81	8%
BHRA	8.84	47.13	19%
BNF	4.32	24.00	18%
BCR	3.80	46.31	8%
BGI		6.80	0%
BLC	0.40	9.70	4%
BMT	18.55	100.00	19%
BRA	1.20	22.60	5%
CIRIA		17.50	0%
CAT		2.55	0%
ERA	16.63	105.15	16%
FCR		6.50	0%
FIR	1.80	24.04	7%
HAT		4.21	0%
HRC	30.04	80.04	38%
LAM		7.00	0%
MIRA	24.00	90.86	26%
PR	0.05	9.67	1%
PERA	6.00	154.40	4%
PIRA	10.82	72.11	15%
RAPRA	8.57	39.91	21%
SAT	2.72	27.20	10%
SI			ERR
SIRA	33.62	77.63	43%
SRA	0.05	7.20	1%
SCR	2.97	29.04	10%
TRA	1.58	30.20	5%
WRc	10.00	231.20	4%
WI	18.22	120.00	15%
WIRA			ERR
BTTG		53.00	0%
CAMP			ERR
Lea		66.80	0%
Total	206.77	1553.66	13%

Sources: RAs' Annual Report

12.3.2 Internationalisation

In 1970 only 4% of the RAs' total income came from overseas sources but by 1988, it has increased to 13.5%. In real terms (1988 prices), it increased from £3.75 million to £20.7 million. Table 12.2 shows the percentage of RA income from overseas sources in 1988. SIRA

[a] The Scientific Research Levy has been abolished in 1990.

for example had over 40% of its turnover from overseas sources in 1989[2]. The trend towards increasing overseas income among RAs is reflected by the following statement[3]:-

> "The growing internationalisation of our activity is evidenced by the many overseas contacts made by our staff in order to enhance AMTRI's visibility - not only in the Community but in the world at large. As 1992 approaches, Europe will become increasingly important as a market for our activities (...)."

This trend is expected to continue into the 1990's because of[4]:

(1) the increasing competition in the UK market.

(2) deregulation, in particular after 1992[5]: "In recent times, as technology has become an international commodity and trade barriers (my highlighting) have started to come down, technical excellence has become a prerequisite for survival in the world market."

(3) the increasing global competition and the pace of technological change.

(4) the UK's government and industry attitudes towards R&D.

But the cost of marketing overseas is high and there are RAs which are not very keen to obtain an EC funding because of:

(1) the high marketing costs.

(2) it only funds 50% of the total cost.

(3) the problem in finding suitable EC partners.

(4) the bureaucracy - it sometimes takes more than a year for the project to get off the ground after it has been approved.

12.3.3 Regional Presence

The importance of regional presence (within the UK and Overseas) is growing. This is essential if the RA wants to embark on a market development strategy or a market penetration strategy (see chapter 11). The following are some examples of increased RA presence within the UK and abroad:-

(1) SIRA - set up Ometron Ltd. in the USA in 1982 to market its products.

(2) RAPRA - set up offices in London (1988), the USA (1987), Billingham (Teeside)(1989) and Optimat in Scotland (1989).

(3) PERA - set up CALTEC in Aberdeen.

(4) WI - joint venture with Edison Welding Institute (1984).

12.3.4 Adopting a Higher Profile

The RAs are aware of the need to adopt a higher profile. WI for example puts special emphasis on selling (over 1800 visits a year), visits from clients and members (7000 a year) and encouraging its staff both to attend and organize conferences. The RAs in general have improved their publicity campaign through:-

(1) Promotions which are more focused. They are concentrating on the industry sectors and technologies which they have targeted including those of strategic importance.

(2) Promoting the awareness of the importance of marketing within by using training programmes and involving operating staff.

(3) Greater emphasis on on-site exhibition areas stressing commercial benefits arising from the work of the RA.

(4) The usage of conferences and training as a form of publicity. These activities are usually self-financing.

(5) The usage of publicity brochures that address industry needs and issues rather than technological capabilities. The target audience and objectives are taken into account when planning videos.

Among the other areas of publicity the RAs can improve are:
(1) The liaison between publicity and operational staff in covering strategic issues.
(2) Developing a new corporate image and logo at the appropriate time.
(3) Continually assessing the effectiveness of activities and improving their policy accordingly.
(4) Developing new promotional activities and eliminating or reducing less effective ones.

12.3.5 Proactive Attitude

The RAs are aware of the need to be more proactive than reactive to opportunities[6]: "To become pro-active in our approach to the world rather than merely reactive." There is a greater awareness of the necessity to influence their clients whether from industry or from the Government.

12.3.6 Open Membership

The RAs' total income from membership did not change too much between 1970 and 1988. In 1970, it constituted about 23% of the total turnover and in 1988 it dropped to around 17%. In real terms (1988 prices) it increased slightly from £25 million in 1970 to £27 million in 1988. Table 12.3 shows some RAs' membership income as a percentage of their total turnover.

Table 12.3 RAs' income from membership subs (1988)(£100,000).

RAs	subs	Total	As Percentage
Amtri	0.71	14.10	5%
BCIRA	10.39	26.81	39%
BHRA	0.92	47.13	2%
BNF	4.80	24.00	20%
BCR	12.41	46.31	27%
BGI		6.80	0%
BLC		9.70	0%
BMT		100.00	0%
BRA	2.94	22.60	13%
CIRIA		17.50	0%
CAT	0.40	2.55	16%
ERA		105.15	0%
FCR		6.50	0%
FIR	5.04	24.04	21%
HAT		4.21	0%
HRC		80.04	0%
LAM		7.00	0%
MIRA	3.64	90.86	4%
PR		9.67	0%
PERA	18.90	154.40	12%
PIRA	7.21	72.11	10%
RAPRA	2.90	39.91	7%
SAT	8.98	27.20	33%
SI			ERR
SIRA		77.63	0%
SRA		7.20	0%
SCR		29.04	0%
TRA	9.26	30.20	31%
WRc	148.21	231.20	64%
WI	30.00	120.00	25%
WIRA			ERR
BTTG	4.00	53.00	8%
CAMP			ERR
Lea		66.80	0%
Total	270.71	1553.66	17%

Source: RAs' Annual Reports

The RAs are aware of the need to open their membership door and to attract more members. PERA for example has up to 12 full-time staff members whose duty it is to recruit members. In 1988 alone, PERA's income from membership exceeded £1 million[7]. The benefits gained by the RAs through the increase in membership include:-

(1) income from the subscriptions. For some RAs, it constituted only a very small percentage of their turnover e.g. 1% of SIRA's turnover in 1974.

(2) contacts and an easy access to them.

(3) an increase of the RA's credibility.

(4) keeping in touch with industry needs.

SATRA was one of the last RAs to open its membership door in 1990 to members from low labour cost countries (see appendix 1.6 on SATRA).

12.3.7 Pricing

The RAs are learning to exploit their individual differentiating features in order to add more value to their services or products. Only then will they be able to have control over pricing and margins.

They are aware that in a price-driven market, competition is very keen and they often have to undercut their competitors (especially HEIs) to secure a job.

The RAs have also to ensure that a proposed project is not being over-resourced especially in price-sensitive projects. The projects could be lost because of unnecessarily expensive staff included for some activities or because more work was proposed than necessary to meet the client's needs.

Marketing overseas is expensive. RAs may have to charge a higher fee rate for overseas clients to cover additional marketing costs.

12.3.8 Collaboration with HEIs

Rather than to regard the HEIs as competitors, the RAs are learning to view them as collaborators. The HEIs have the advantage when they compete in a price-sensitive market i.e. the HEIs are able to undercut the RAs. LEA for example, would as far as possible avoid a direct competition with the HEIs.

Most RAs like RAPRA[b] would collaborate with the HEIs. The RAs benefit because:-

(1) they get value for money.

(2) the collaborative programmes complements their own research.

(3) the programmes can attract funding e.g. industrial, regional or government funding.

(4) they can keep abreast with the latest development.

12.3.9 Wider Market Base

RAs that appear to have a firm future are those working in fields such as production engineering, hydromechanics, materials, joining, food and electrical engineering. These RAs offer expert R&D and technological guidance in subjects which have wide applications across industry, and are not confined to one sector. For example, the goal of the new organisation, BNF-FULMER, is to extend its activities to the wider field of materials (see case study on BNF) instead of confining itself to metals only. Another advantage of a wider market base is that it helps to even out the peaks and troughs in the demand for services and products. Other examples of RAs widening their marketing base are:-

(1) BTTG - expanding into biotechnology.

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[b] Rapra is involved in a Research and Materials Centre based in South Wales, involving University College, Swansea.

(2) RAPRA - widening its activities beyond rubber and plastics into materials.

(3) SATRA - started a Clothing Technology Centre.

(4) WI - expanding beyond welding into joining.

The RAs that started life serving some narrow sectors well realised that the change to a technology (or set of technologies) base is the most promising way to go, but overall rationalisation on these lines could certainly result in fewer institutions.

12.4 The RAs' Services and Products

The RAs' services and products can be broadly be divided into collaborative research, general programme and near-market services/products (this includes contract research, consultancy, training, conferences, testing, accreditation, selling database, marketing softwares and exploitation of research). In 1988, the RAs received more than £130 million from industry in comparison to only £66 million (1988 prices) in 1970. This increase of industry income came mainly in form of near-market activities. The RAs' biggest increase of income came through contract research, which rose from 22% in 1970 to over 56% in 1988 of its total turnover.

12.4.1 Collaborative Research

Collaborative research is growing in importance. Collaborative projects are executed on the basis that the finance is contributed specifically, rather than subscribed with no particular objective in view. These acitivities help RAs to respond to industrial demand within their broad statutory limits of operation. They enable member companies to tie their financial

suppport for RAs to particular items of work which seem desirable to them. The increasing acceptance of collaborative projects have formed part of an overall policy of RAs which embraces also new ideas of membership and of the subscription basis.

The relative suitability of collaborative projects to individual RAs depends very much upon the history of the RA, the type of work its members require, and the likely acceptability of the different formulae to members.

The collaborative project is favoured by RAs[8] because of the following advantages:-

(1) It fosters closer links between RAs and interested industrial members.

(2) It helps to bring about a greater participation of members through joint project management.

(3) It allows the demonstration to members of a more direct return on money spent than the RA general programme did.

12.4.2 General Programme

Most RAs still carry out a programme of general work - R&D projects selected and defined by an association's representative bodies and executed in the belief that they will be of value to the membership as a whole, or to a large part of it. In many cases, such work is of diminishing significance, being replaced by directly commissioned (individual contract or collaborative) research. There is, nevertheless, a strong current of opinion among the member firms and the RAs themselves, that however far the RAs go in making their work directly-commissioned there should always remain a certain core of quite basic work not executed in response to direct industrial demand. Without the

core programmes, the RAs would soon be reduced to consultancy firms. Furthermore, they would lose their competitive edge over other R&D contractors as well as their reputation as centres of excellence. They have to maintain their technical competitiveness. For an RA to abandon all speculative or non-mission oriented work would lead to a situation in which, however successful it is in the short term, it would be living off its technical capital. Keeping the core programme would also serve the purpose of conveying some scientific satisfaction to association staff, who may be disenchanted if opportunities for undertaking work other than at the applied or development end of the technical spectrum were entirely closed. Another factor is the need for the association to remain a source of technical originality for its industry i.e. to be able to suggest new project ideas for potentially profitable investigations to its member firms, most likely some kind of core programme of relatively open-ended technical work.

12.4.3 Near-Market Research

A recent survey carried out on CROs in the EEC[9] (most of the RAs in the UK were in the sample size), showed that over 80% of the respondents' main activities were applied research (general or client-related) and only 6% basic research. Applied research is closer to the market, higher value and less risky to carry out.

In the last two decades, the RAs' activities have shifted from being technology-driven to being customer-driven mainly because of the changing attitudes of the Government and Industry

with regard to R&D and because of the need to be commercially viable[10].

> "A key feature is that HATRA, whilst attracting as many members as possible, must not become reliant on membership income, on grants or Government support (my highlighting) but must be financed primarily by its income from fee-earning acitivities and sales (my highlighting)."[11]

The RAs are active in product development on behalf of clients. Since these activities are closer to the market, they attract a significant income for the RAs. Some RAs have been successful in using their existing resource base by interdisciplinary working and objectivity in the selection of technologies to provide solutions for clients. The RAs have also been successful in developing software products in collaboration with their clients or software houses e.g. BMT and BHRA.

The RAs are also actively involved in testing, accreditation and consultancy i.e. activities which are closer to the market and with tighter deadlines on short-term projects. RAPRA's order book for example is only 6-8 weeks. WIRA experienced a 20% increase in consultancy income, 24% in instrument sales and 30% in testing in 1987[12]. The RAs' expertise built up in testings and accreditation enable them to carry out consultancy and the development of test regimes and testing systems for clients. Consultancy adds value to testing on its own. Though consultancy may not generate higher fees it can be a good marketing tool.

The RAs are interested in increasing the number of new commercial opportunities as well as those with higher value or

fees. In order to achieve this, the RAs' approach towards research has shifted from:-

(1) one that is just interested in explaining what the technology is all about to one where they ask themselves how they/clients can best exploit it.

(2) a skill-oriented to a task-oriented one.

(3) one that is used to carrying out long timescale programmes to one that takes on shorter timescale programmes.

(4) one that analyses the components in a system to one that analyses the system.

(5) being a sub-contractor to being the main contractor.

12.4.4 Consolidation of RAs Services/Products

The RAs have been consolidating their position by selling existing services to a broader client base as reflected by the following statement made by AMTRI's Chairman after a major restructuring programme in 1986[13]:-

> "Members will be well aware of the reasoning behind the decision for the change of name, organisation structure, and operating strategy (...). Thus today, AMTRI is well embarked on a new direction, with a much broader client-base (my highlighting) than in the past."

Another example is BMT, which sold off its old facilities and sites and used the capital raised to diversify beyond its traditional market e.g. into environment and transportation.

MIRA on the other hand is thinking of consolidating its position by cutting down its range of facilities and services and thereby bringing down its overheads as well as providing a

greater focus. This has to be achieved without sacrificing its flexibility for research.

The RAs' core programme (especially those attracting support from the DTI) has been more focused[14]:

> "Over the years, we have developed into an extrememly diverse organisation serving virtually every sector of indusry. At a practical level this has given us a unique blend of skills and experience, but modern technology requires continuous investment both in people and facilities. Realistically, we cannot expect to operate at the leading edge of every technology and difficult choices have to be made."

These programmes are not meant to generate income in their own right but as vehicles to develop technologies that can be exploited as single client projects at a later date[15]: "(...) we invest in research to ensure the retention and enhancement of our technology lead". Some RAs are finding difficulties in funding their core research programmes[16]: "(...) industrial support has been lower than expected. We clearly have much to do to persuade our industry to fund this activity, which is the nucleus of our operation."

12.4.5 Quality Assurance

RAs are increasingly aware of the need to up-grade their services to clients. RAs have to implement and communicate a quality policy among their staff to address the following issues:-

(1) a successful and consistent management of the proposal submission and selling process.

(2) the consistent application of best practices and procedures to project management.
(3) modifying attitudes and behaviour within RAs to ensure the total support for a long lasting quality improvement.

One way of achieving this is the appointment of a quality manager that would:-
(1) give a clear focus for the development and implementation of an RA-wide quality policy, which must also have a top level management commitment.
(2) give a clear signal to existing and prospective clients that the RA makes the achievement of quality a high priority.

12.5 Management

12.5.1 Flexibility in the Organisational Structure

The RAs are aware of the constraints of an organisational structure that is too rigid and does not enable them to respond to the changing environment. The Divisional Structure has its advantages but on the other hand it cannot respond quickly enough to the internal and external forces that affect the RAs.

The matrix form of structure is a popular one among the RAs and has been adopted by RAs like WRc, PERA and BTTG. ERA was the first RA to introduce this structure in 1980. It is a complex structure with a high dependence on both vertical and horizontal flows of authority and communication as shown in figure 12.1. LEA and SIRA for example, tried it but had to abandon it because of the complexity. Introducing the matrix structure requires quite a cultural change in the organisation. In contrast, the divisional structure depends primarily on vertical flows of

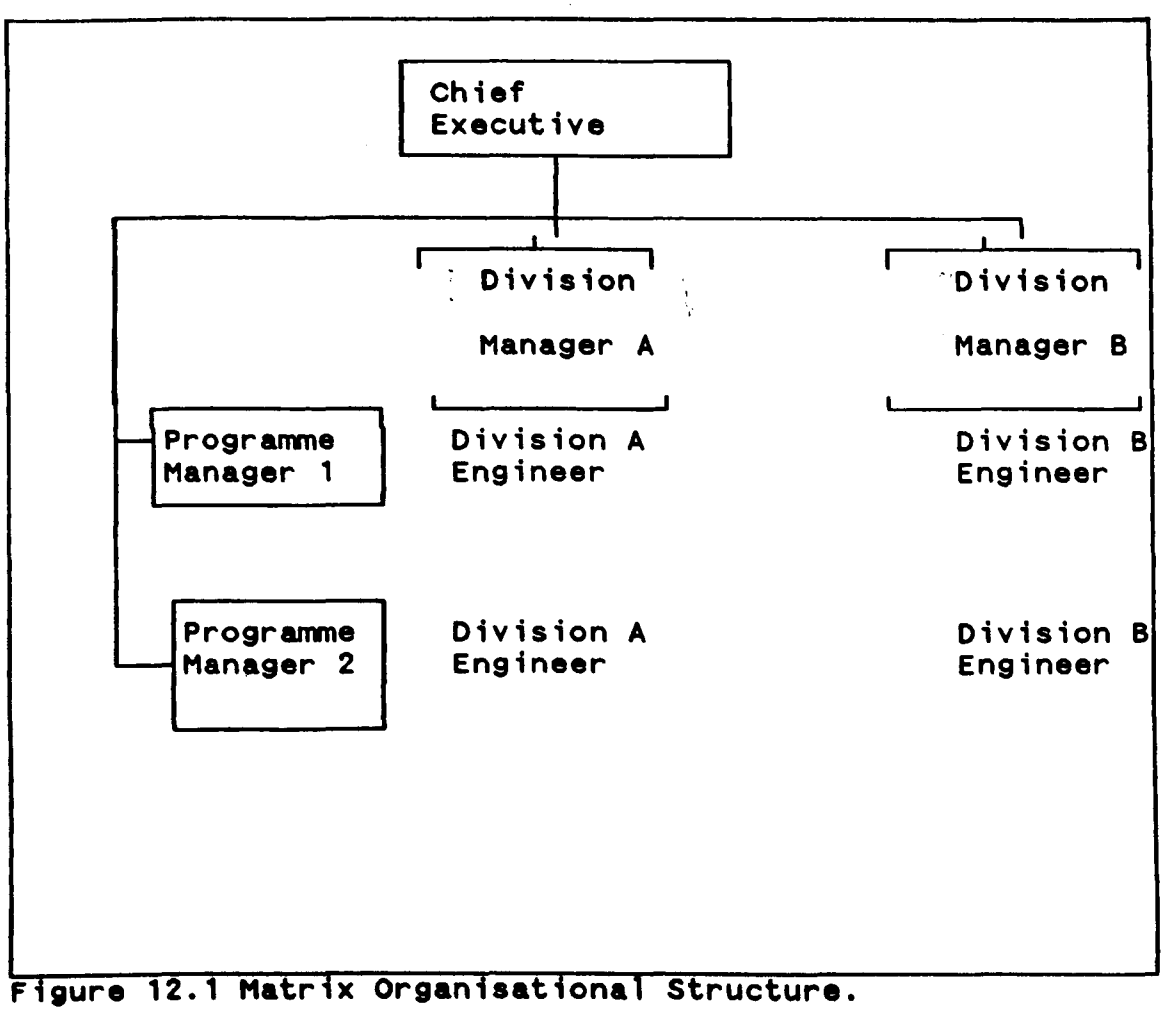

Figure 12.1 Matrix Organisational Structure.

authority and communication. In order for a matrix structure to be successfully put in place, great attention should be paid to such things as thorough participative planning, training, clear mutual understanding of roles and responsibilities, excellent internal communication, and mutual trust and confidence. Another important condition is that the RAs must be of a certain size so that there is a big enough pool of human resources to go around and to justify the cost of setting up the support systems for it (e.g. the management system). Despite its complexity, the matrix structure is useful when the RAs need to add new services/products, customer groups, and technology to their range of activities.

Whatever organisational structure the RA adopts, it needs one that can bring about the following benefits:-

(1) reduction in costs involved in senior management posts.

(2) elimination of activity duplication.

(3) increase in the minimum size work units together with improved back-up.

(4) greater flexibility in the use of resources.

(5) reduction in the tendency to protect an "empire".

(6) devolvement of responsibility to front-line management.

(7) better career opportunities and more flexibility in working practices.

12.5.2 Marketing Structures

In the divisional structure used by RAs, selling and marketing are done by individual divisions. This places a very clear focus and responsibility for the divisions to sell their individual capabilities. However, it has the serious disadvantage that opportunities for selling the combined resources of more than one centre may be missed. It also means that marketing to major clients is diffused and not targeted at the appropriate decision makers.

Another form of marketing organisation adopted by most RAs in the last decade (e.g. by WRc) is the matrix marketing structure, whereby all responsibility for marketing is placed on marketing executives who link with the operating staff required to pursue particular oppportunities. This overcomes the disadvantages of the first approach, but removes some of the involvement and responsibility for marketing from the divisions.

A third structure adopted by RAs is a compromise between the two above. It enables synergy and places clear responsibility on the divisions for marketing and selling their own services (see appendix 1.6 on PIRA).

Another major change in the organisational structure of the RAs which reflects the importance placed on the marketing function is the creation of posts and teams like:-

(1) Marketing Director

Some RAs have created the post of a Marketing/Commercial Director to give sales and marketing a higher profile. The status of the person is usually of that of a Research Director responsible for the operating resource. This helps to give a clear signal, internally and externally, that the RA is commercially-driven and that sales and marketing are given a high priority. It is essential that other responsibilities which need managing at a senior level, including administration, finance and personnel, should not dilute sales and marketing by combining these activities. These administrative duties should be the responsibility of the Head of Administration. The role of the Marketing Director is to:-

- ensure that a credible marketing strategy is in place, which is effectively implemented and clearly communicated internally and externally.
- have overall responsibility for formulating and meeting the RA's sales budgets.
- promote the image and capability of the RA at a senior level in major client organisations.

(2) Marketing Manager

In areas where there is a clear need for marketing the combined capability of the RA, a Marketing Manager would need to:-

- develop and maintain high level contacts in major client organisations.
- understand the commercial issues causing the change in these sectors.
- identify major opportunities for the RA in addressing these issues.
- coordinate an appropriate response.
- increase the income in these sectors.

Marketing managers should have a clear annual sales target for their industry sector.

(3) Business Development Manager

The key responsibilities of the Business Development Manager is to:-

- in conjunction with the Division Manager, develop rolling plans for selling services provided by the division (across a broad range of industry sectors).
- assist the Division Manager and operating staff in his centre to identify opportunities for selling services and for developing new services when a market need has been identified.
- assist the Division Manager in ensuring that potential opportunities are prioritised and followed up.
- coordinate and focus all sales activities within the division.
- provide focus of communication between divisions and the Marketing Director.

(4) Project Teams

Small marketing project teams can be established for each of the industry sectors identified as having significant growth potential. These teams would be led by the nominated Marketing mManager for the sector and would comprise an appropriate representative from each division on a temporary basis. Apart from fulfilling their prime marketing objectives, the teams would have the additional benefit of developing a greater breadth of technical and commercial awareness in industries outside the previous direct experience of individual participants.

An area which an RA has to look into is its relationship with the DTI. There is a need to be more proactive in the relationship with DTI HQ Divisions, and particularly in establishing good personal relations with individual HQ Officers and assisting the DTI to formulate their objectives. Rather than to have a fragmented approach to the DTI, a senior member of the marketing staff can be appointed as a DTI co-ordinator, with the responsibilities of:

- developing and maintaining the contact with the most important HQ Divisions.
- assisting in setting up and maintaining a database giving details of RA-DTI contacts, current requirements, attitudes of key DTI Officers and early warning of new policies, activities and opportunities.
- a co-ordinate response to new opportunities identified.
- ensuring that DTI Officers have a favourable view of the RA's capabilities.
- maintaining an up-to-date view of future DTI spending.

Other members of the RA's management staff will also have contacts with DTI staff. The role of the co-ordinator should not be to by-pass or undermine these relationships, but to make the overall communication with the DTI more effective and proactive.

12.5.3 Shifting of Control from the Council to a Board of Directors

There is a growing shift of the control of an RA from the Council to a Board of Directors especially so since RAs are becoming less dependent on member subscriptions (around 20% of the RAs' turnover in 1988). If the Council is still the body constituting the legal directors of the company, the staff obviously have minimal control. The RAs that have progressed well come closer to being run in the style of contract research institutes and it is inevitable that such changes will be reinforced with the passage of time, with the membership side of the house fitted in differently and the membership's position in respect of policy much reduced.

Among the RAs that are run by a Board of Directors are BICERI, RAPRA, WIRA, BNF-FULMER, CERAM, ERA, AMTRI, PIRA, MIRA[c] and SIRA. The Board of Directors has sole control of the business management of the RA, with the Council being retained as the body representing the members.

Among the RAs that adopted this change, SIRA appears to have gone the furthest towards staff control in 1982, now having a Board of Directors consisting of five staff (including the Managing Director) and five non-executive directors, all elected

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[c]Changed took placed in 1989.

by members of SIRA, plus a chairman (see appendix 12.1). It appears that the furthest one could go while retaining basically the Memoranda and Articles of the Association like the existing RAs, would be a Board comprising a majority of executive directors, no Council, a minimum of two members who would, of course, have basic control by their ability to appoint and dismiss board members (see appendix 12.1).

12.5.4 Information Systems

It is important for RAs to have good information systems, whatever organisational structure they adopt. RAs like WRc, HR Ltd., LEA and SIRA have their own form of management information system. The system can assist the RAs in:-

(1) becoming commercially driven.

(2) providing interdisciplinary support.

(3) giving a rapid and professional response to enquires.

(4) helping to act rather than react to opportunities.

(5) improving the coordination of operating and marketing activities.

It is particularly important to respond quickly and efficiently to telephone enquiries. A well designed and properly used sales and information system is an essential tool in making the RA more commercial in terms of how it is run internally and how it is perceived externally.

Besides being used in support of selling and marketing, information systems can also help to generate a high profile for selling and marketing as an essential core activity in an RA. The latter objectives can be achieved by circulating, on a weekly basis, selected information on the progress of leads and

submissions to operating and marketing divisions as it affects the individual staffs' areas of responsibility, but also in summary form, on the progress of the whole RA against budgets.

Finally, however well the system is designed and used, it can only be successful if it supports a management-led commercial culture.

12.6 Culture

12.6.1 Corporate Culture

The RAs are projecting an image of independence from any single source and to stress their ability to carry out R&D contracts in strict confidence. MIRA emphasises the fact that it is an independent financial unit without stockholders, and not controlled or influenced by any one major manufacturer, but instead is used by all of them[17]. Another example is BMT as reflected by the following statement[18]: "As a commercial organisation, independent of Government or other vested interests .."

The RAs are stressing:

(1) their impartiality and confidentiality.

(2) the change of their "academic image" to a centre of excellence tailored for industry.

(3) its multidisciplinary approach; being task-oriented rather than skill-oriented.

(4) that they are market-driven rather than technology-driven.

(5) quality assurance.

12.6.2 Individual Culture

On an individual staff basis, the culture is changing:

(1) from one that is narrow in concept zone to one that is wider and more flexible.

(2) from an I-shape (deep specialist) to a T-shaped one (with breadth and depth).

(3) towards one that can tackle inter-disciplinary problems.

(4) from one that is technology-driven to one that is commercially driven.

(5) from a civil servant culture to a commercial one (applies to former GIREs like BMT and HR Ltd.).

The leadership style of an RA is crucial. It needs to be more commercially minded, which is essential for the survival of the RA in the 1990's. For example, MIRA replaced its Managing Director in 1987 by one who was more commercially oriented and who brought in a few key people from industry to hold management positions in MIRA (see appendix 1.6 on MIRA). The reason for this was to instill a new working culture within the organisation.

12.7 Turnover

The changes in the RAs' turnover has been dealt with in detail in chapter 8. The following is a summary of the major changes:-

(1) In 1988, the RAs' total turnover accounted for 1.5% of the total R&D expenditure in the UK in comparison with 1.65% in 1968.

(2) In 1988, the total RAs' turnover to total industry expenditure on R&D expenditure dropped to 2.26% from 2.79% in 1968. But in real terms (1988 prices), it increased from £95 million in 1970 to £155 million in 1988 i.e. there was an

increase of over £60 million.

(3) In 1970, only 4% of the RAs' total turnover came from overseas in comparison to 13.5% in 1988.

(4) The income from the Government dropped from 32% of the RAs' total turnover in 1970 to only 17% in 1988. In real terms (1988 prices), it dropped from £30.8 million to £26 million in the same period.

(5) In 1970, 68% of the RAs' total turnover came from industry; by 1988 it had increased to over 83%. In real terms, it increased from £63 million to £128 million over the same period.

(6) Contract research accounted for only 22% of the RAs' total income in 1970 and it increased to 56% in 1988. In real terms (1988 prices) it increased from £20.8 million to £87 million.

12.8 Staffing

The changes in the staffing level of RAs has been dealt with in detail in chapter 8. The following is a summary of the major changes:-

(1) The overall total of staff numbers of RAs decreased slightly from 5957 in 1970 to 5515 in 1988.

(2) The average number of employees per RA increased from 138 in 1970 to 167 in 1988.

(3) The top five employers in 1988 were WRc(667), WI(520), ERA (388), PERA (350) and BMT (340). Among the smallest RAs in 1988 were SRA (20), HAT (16) and CAT (14).

12.9 Conclusion

The RAs are going through a period of critical change. It may be that the late 1960's and the 1970's will be regarded as a critical turning point in their history, when the historical notion of cooperative research of the old style lost its supremacy to be replaced by that of directly-commissioned work (contract research) in its various forms.

RAs as a whole are far from being dying institutions. R&D expenditure in RAs had expanded in real terms in the last two decades. But to improve their efficiency and their value to industry, RAs are to adopting new principles of operation. Many options are open to them - the days of the standardised formula organisation are gone. Some RAs have merged with complemetary RAs. Some are attempting to become centres of excellence within a specific technical field, or to adopt a functional approach in order to break away from over-dependence on a single industry.

Activities from directly commissioned projects - whether group or repayment work - is increasing. The importance of a general programme determined by an elected Council or research committee is diminishing.

The idea of membership has ceased to involve programme-control as one of its central benefits. Membership conveys the right of preferential, though not necessarily exclusive access to RA services.

Associations have reduced subscriptions levels to accord with these changes and simplified bases. Member subscriptions do not give right of access to all RA services or free access to services at the information end of the spectrum. All other services are now paid for at the time of receipt. The

remuneration may range from contributions for participation in a group project to fee-payment for a specific piece of confidential contract work or for an item of information service exceeding the basic minimum covered by subscriptions.

At the centre of RA affairs there should be a core programme of non-mission oriented work to serve as the source of technical stimulation or simply creativity for the RA as a whole. Membership subscriptions should not be expected to pay, if at all, for more than a proportion of this. It ought to be supported from surpluses generated from commissioned projects and/or specific government contracts.

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CHAPTER 13: CASE STUDIES

13.1 Case Study - BHRA

The British Hydromechanics Research Association (BHRA) was set up more than 40 years ago (1947) and its main objective then was to disseminate information to its members (from the pump and valves industry).

During the 1960s, it was one of the fastest growing research associations. It had an income of £363,000 in 1970 (£2.1m in 1989 prices). Among its early members were ICI and BP located at Cranfield. It is now a contract research organisation which still supplies information and data for its members but which has expanded into the off-shore industry and into the mechanical and civil engineering field.

In 1989, it changed its corporate status to one limited by shares through a management buy-out. This move meant that BHRA broke away completely from the RA principle and is now a profit-making contract research organisation.

13.1.1 Range of Activities[1]

BHRA's activities cover:-

- information, consultation, design and development services for the mechanical, civil and offshore engineering industries (covering all aspects of fluids engineering)
- problem solving
- contract research
- field investigations
- physical and mathematical modelling
- computer software development

- publications
- conferences
- fluid engineering databases.

13.1.2 Statistical Comparisons

	1971	1988
Staff number	122	192
Staff number ranking	*13	11
Turnover (1988 prices)	£2.19m	£4.7m
Ranking of turnover among RAs	N.A.	10
% Income from government sources	36	23
% Overseas income	less than 5%	19%

* Estimated; N.A.= Not available

Sources:- BHRA's Annual Reports

13.1.3 BHRA's Environment

- BHRA was affected by recession from 1974-1976 and 1979-1982. The effect of the current recession has not been ascertained.
- An internationalisation of research is going on. There is scope for increasing overseas income especially in carrying out collaborative research.
- There has been an increased demand for contract research and consultancy, for software, database, accreditation, training and conferences.
- Its core research has been threatened by reduction in government income especially after the DTI review in 1983[2]: "This shortfall (RBs support) in turn had an adverse effect on cash flow."

- It benefited when the DTI adopted the Market Related Pricing in 1985.
- It is affected by the instability of the DTI and the launching of the Enterprise Initiative Scheme[3]: "The Board and Council have to report that although much effort has been put into complying with the new DTI schemes, it is unrealistic to assume that we will recover this income quickly." Its income from the DTI dropped dramatically from £1.5 million in 1987 to £0.5 million in 1988 and £0.56 million in 1989[4].
- BHRA is threatened by the privatisation of HRS[5]: "(...) as required by members, the Council has been keeping a close watch on developments. This will continue to avoid any adverse effects on the interests of the Association."
- There is increased competition from HRS, GIREs (NEL) and IRCs[6]: "Greater competition from the proposed multi-disciplinary university research centres seems likely."
- There is a good working relationship with the Cranfield Institute of Technology.

13.1.4 Internal Audit

- BHRA is over-dependent on government income.
- There is a need to widen its market beyond the pump and valves industry. It has to break away from being a particular industry based RA.
- There is a potential for obtaining overseas income.
- BHRA should exert more influence on the DTI in the shaping of the projects it will support.
- It experienced the disadvantages of being run by a Council until 1986.

- Its span of control is too wide, caused by too many divisions in the structure.
- There is a need to project an image of a centre of excellence in the field of fluid engineering.
- Its membership was discontented with the high subscription rates. The subscription system was obsolete and the benefits of membership needed to be redefined. BHRA had to become less dependent on membership income.
- BHRA was over-staffed prior to the management buy-out. It required to increase its turnover to staff ratio.
- Staff appraisal and remuneration needed to be introduced and more emphasis put on training especially with its difficulties of recruitment.
- Its style of leadership required a change after the BHRA review in 1985.
- There was a need to set up a mangement system.

13.1.5 Strategies Adopted

BHRA adopted a combination of the following strategies:-

(1) Market development: This is a strategy planned to move away from dependence on government funding and to expand internationally to obtain more funding from the overseas market.

(2) Diversification: As early as the mid-sixties, BHRA expanded from catering for pump manufacturers alone to serving any organisation with an interest in the broad field of fluid engineering.

By the late 1970s, it had started to diversify into new areas[7]: "(...) there are clear signs of increasing contract business and opportunities for diversification."

It is now involved in the Offshore, Process and Manufacturing Industries.

One consequence of the change in the DTI's funding was that the traditional areas of BHRA business which used to enjoy DTI support became unprofitable and over the coming years efforts will have to be made to diversify and improve their market relevance[8].

Its strategy in the 1980's was to diversify into new areas outside its traditional market[9]: "Its new aim is to be able to respond rapidly to new technology and new business opportunities, taking an entrepreneurial role to expand into areas outside its traditional market of industrial contract R&D" (Annual Review of BHRA, 1987; Foreword from Chairman, pp 1).

(3) Retrenchment: BHRA had to make redundant over 30 (out of 220) of its staff in 1986.

(4) Forward integration: BHRA tried to take over NEL when it was put up for privatisation. Among the advantages were:-

- their expertise complemented each other especially the Flow Measurement Division of NEL.
- the benefits derived from taking over a possible competitor.
- BHRA needed a site in Scotland to be near the Petroleum Industry.

13.1.6 Changes in BHRA

(1) Organisational Structure

BHRA was organised along a divisional structure by services. In 1986, it was restructured. BHRA redeployed its technical staff[10] into Business Groups, broadly based on:-

(1) new technology, fluid sealing and fluid power

(2) industrial fluid dynamics

(3) multi-phase flow.

Three support groups provide financial, commercial and general services, while the information service has been placed in Business Group 3 to assist in the closer integration of its work with BHRA's engineering interests.

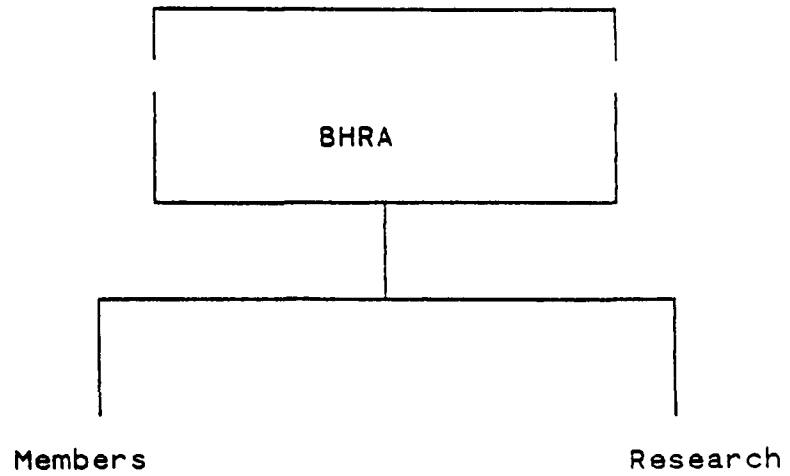
(2) Ownership/Corporate Status

The Council considered the change of its corporate status in 1988, which would enable BHRA to tackle the increasingly fierce competition both at home and abroad. It also contemplated new ventures and collaboration with other research institutes overseas.

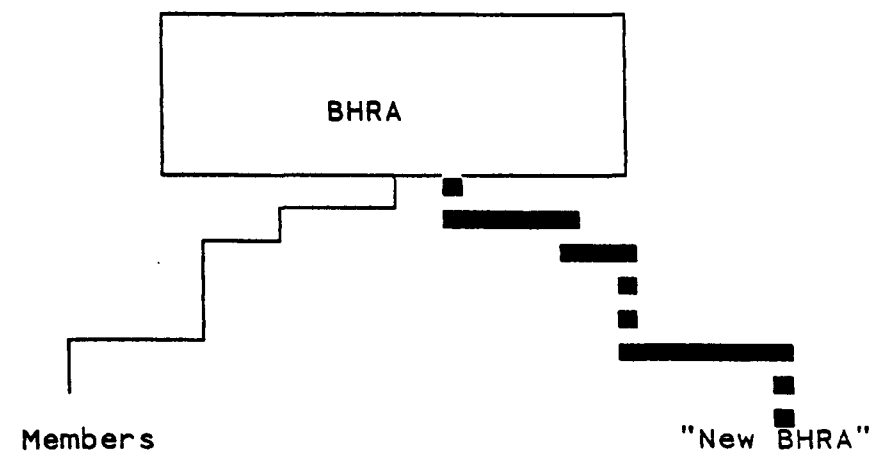
The reduction in subscription of course helped to reduce the power or influence of the Council and gave greater authority to the Executive Board. Finally, it paved the way for the management buy-out of BHRA in 1989. One of the reasons why BHRA's members were convinced of the change in status was the diffuseness of its membership (due to the widening of its membership base). Another possible reason is that most of its members were SMEs which tended to be less involved in the running of the RA.

The status change was finalized at the end of 1989. In the old structure, BHRA was responsible both for the control of membership and its research activities as shown in figure 13.1.1. In the new structure, membership and research activities are separated. BHRA continues to monitor the membership and the "New BHRA" takes over the research side as shown in figure 13.1.1. BHRA still has interests in the "New BHRA" through share

BHRA's Old Structure



BHRA's New Structure



- BHRA has shares in the "New BHRA".
- BHRA still contracts out its research to "New BHRA".
- Greater freedom for "New BHRA".
- "New BHRA" can raise capital.

Figure 13.1.1 BHRA's structure - before and after the Management-Buy-Out.

ownership and the contracting out of research to the "New BHRA". The "New BHRA" has the ability to raise capital and greater freedom in deciding the direction it will take in the future.

(3) BHRA's Goals

BHRA started looking into its long-term prospects as early as 1971 when the objectives and structure of the Association were redefined, and membership rules changed. In 1979, it also commissioned a study into its future in the mid 1980's.

In 1985, the Council approved a 5-year Business Plan for the Association which set ambitious targets of further growth and diversification, including growth of membership, and confirmed its basic aims[11]:-

(1) to be a centre of technical expertise, providing cost-effective engineering and information services which contribute to industry's strength.

(2) to be a viable business which makes and uses disposable margins effectively.

(3) to provide a pleasant and challenging working environment in which staff have worthwhile jobs which extend them fully.

The key elements of its strategy were to market its services with a highly commercial approach and to emphasize the exploitation of its technology[12]: "To become a profitable company, BHRA has also to make changes in its commercial policy and procedures, enhancing its management information systems in order to improve business efficiency and profit margins alike".

(4) Culture

When BHRA decided to diversify into other areas, it had to implement a policy that encouraged an attitude among all the staff of versatility and sensitivity to market opportunities. By 1985, it had introduced staff grading, an appraisal and remuneration structure, aided by job evaluation to improve employee policies further.

In 1987, a new staff reward scheme was formulated which was performance-oriented, and included personal, group and company performance factors. This new salary structure and staff appraisal system was implemented and following this change, a career development scheme was put into action. These actions were necessary in order to help in recruitment as well as to keep existing staff satisfied.

It is also interesting to note that most of BHRA's promotion came from within its own ranks, with the exception of the post of the Director of Research. The new Director of Research was formerly the Deputy Director of WRc (WRc changed its corporate status to one limited by shares in April 1989). One possible reason for this appointment was to guide BHRA towards a change in its own corporate status. Another reason was the need to instill a new culture that was more commercially minded.

(5) Staffing

Fig. 13.1.2[13] is a bar chart which shows the growth in staff numbers of BHRA from 1970 to 1988. In 1970, it had only a staff number of 122. This figure continued to grow until it reached a peak of 247 in 1985 i.e. the year before the review on BHRA was implemented by the Council. Right after the review, the staff

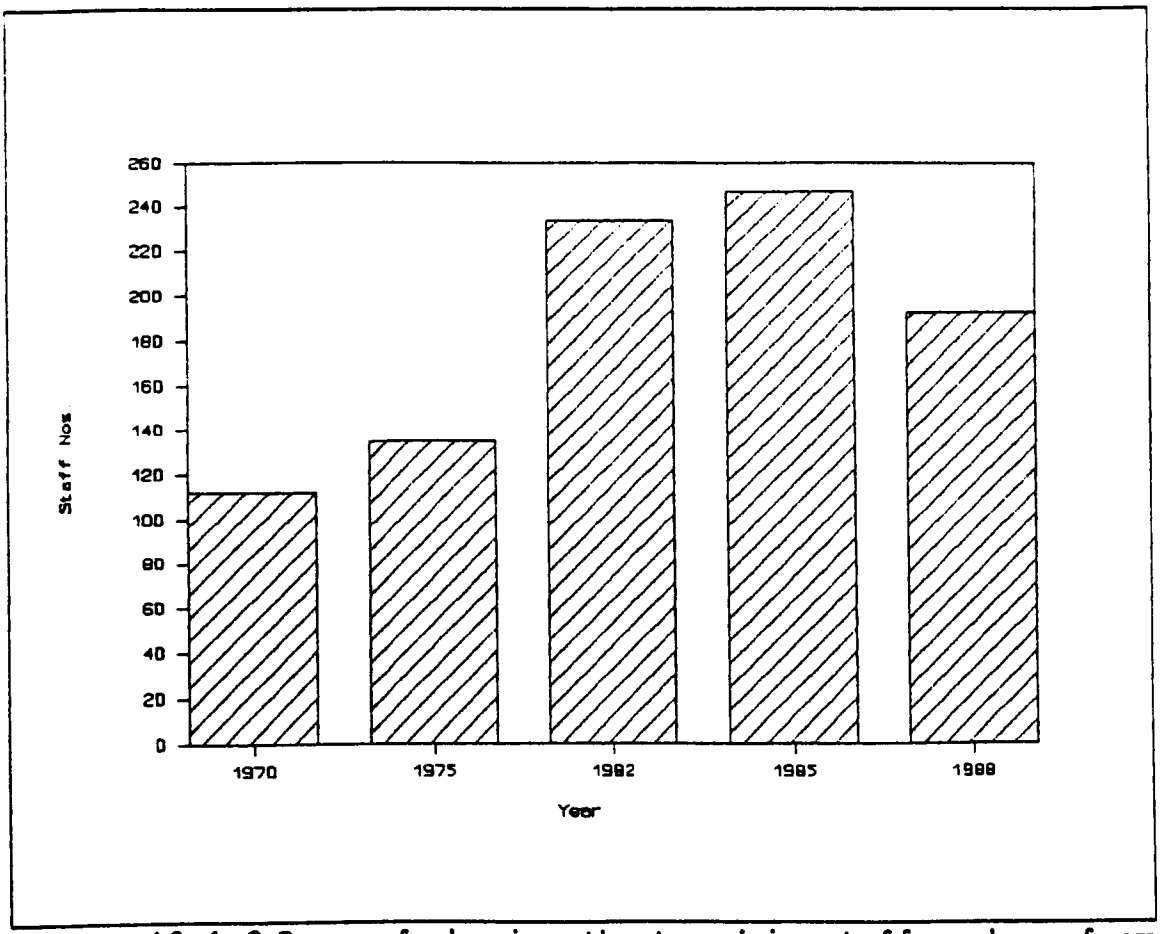


Figure 13.1.2 Bargraf showing the trend in staff numbers from 1970 to 1988.
Source: BHRA Annual Report (1980)

number decreased gradually to 192 in 1988.

Human resources are always a matter of prime consideration in an organisation like an RA. Like any other RA, BHRA tends to have a high turnover of staff and therefore it has to maintain recruitment at a level to keep pace with its expanding and diversifying business. Recruitment has always been a problem experienced by BHRA especially so in the early 1970's when it was experiencing growth. A typical statement made during the 1970s with regard to recruitment was as follows[1]:-

"This year it has been a matter of some concern that recruitment of bright young people has proved particularly difficult: so much so that we have fallen short of our

manpower targets despite a sustained recruitment campaign".

During the recession in the late 1970's and early 1980's, BHRA had fewer problems with recruitment as there was ample supply of engineers and scientists. But during the upturn in industrial activity in the mid 1980's, it was inevitable that the Association experienced some increased turnover among its research staff, with some of the able young research engineers deciding to move to enhance their careers. The problem of recruitment is still a difficulty experienced by BHRA.

Implementing its own review (carried out in 1985) in 1986, it had to reduce the number of its support staff by 34, and this was achieved by a combination of redundancy and early retirement. This was the first time in the last two decades that it had to make redundant a relatively high percentage of its staff (close to 14% of its total staff in 1985).

BHRA greatly emphasized training especially so since it was so difficult to recruit the people that matched its requirements. In 1985 alone, its external expenditure on in-service training exceeded 0.5% of its total turnover, which is believed necessary to maintain a viable training policy[15].

After the implementation of the review in 1986, group accountability was facilitated by a revised management accounting structure which is aimed at making it easier to channel human and financial resources into the promising areas.

(6) Turnover

Table 13.1.1 shows BHRA's sources of income for 1971 and 1988 respectively. The most apparent increase in income came from industry where it increased from 35% to 60%. The most significant

decrease in income came from government sources where the percentage dropped from 36% to 12%. Figure 13.1.3 shows that by 1983, its income from industrial research contracts had exceeded its government contract income[16]. Its income from other sources (which includes income from conferences and publications) dropped from 22% to 12% of the total income and so did its income from membership subscriptions which dropped from 7% to 3%.

Table 13.1.1: BHRA's income according to sources for 1971 and 1988 (in 1988 prices).

	1988		1971	
	£ (m)	as %	£ (m)	as %
Industrial income	2.81	60	0.774	35
DTI contracts plus OGD income	1.09	23	0.79	36
Publications and conferences	0.6	12	0.48	22
Memberships	0.13	3	0.156	7
Total	5.6	100	2.19	100

Sources : BHRA's Annual Reports

Table 13.1.1 shows that over the last two decades, BHRA had more than doubled its income from £2.19m in 1971 to £5.6m in 1988. In real terms, its income from industry increased from £0.774m to £2.81m i.e. there was an increase of over £2m. Its income from government sources also increased by £0.3m from £0.79m to £1.09m and its membership subscriptions dropped from £156,000 to £130,000 over the same period.

Source: BHRA Annual Report (1984)

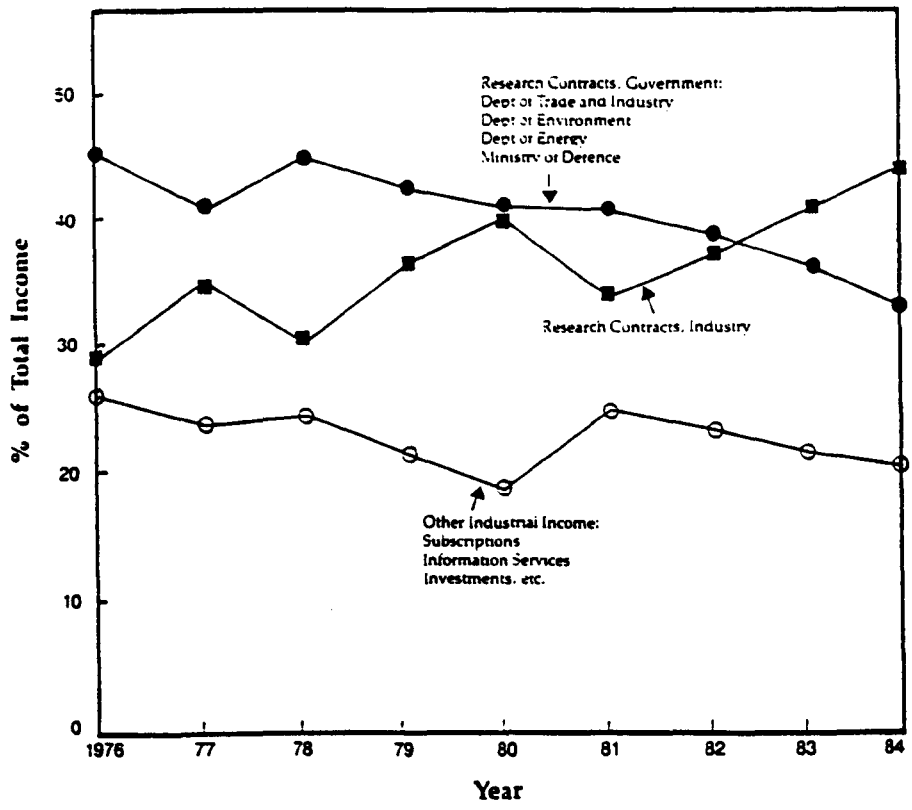


Figure 13.1.3 Distribution of BHRA's Income from 1976 to 1984.

(7) Membership

BHRA has been maintaining if not decreasing its membership subscriptions so as to attract as many members as possible.

Between 1966 and 1976, the membership subscriptions dropped by over 70% in real terms. The Council nevertheless recommended no increases in the subscription rate in order to continue to provide the strongest possible incentives for membership. Its membership scheme diversified into new industries and moved towards larger member companies. By 1980, overseas members alone constituted 23% of the total.

The original and complex turnover-based subscription system was replaced by a simple system which for nearly all members meant a considerable reduction in the amount paid. It thus

represents good value even to small firms; and perhaps particularly to the large firms where for a minimal amount they have access to information services as well as BHRA literature. The value of access to centrally organised information, abstracting and library service can easily exceed the relatively small subscription entailed. Beyond this, all services are paid for directly.

(8) Services/Products

One of the main reasons why BHRA has been successful in developing new markets over the last two decades is because it was less oriented towards a specific industry than some other RAs. Having moved away from a link with pump manufacturers alone, it is now angled towards users of the technology concerned, that is all companies and organisations applying principles of fluid engineering - which embraces a large number of very different industries. The RA has thus got out of the danger which stalks the strongly industry-oriented RA of becoming a "pawn of its industry". The diffuseness of BHRA's membership means that there is less need to "keep everyone happy" or to tread a careful path through the bickerings of an enclosed industry.

One of its most important decisions in the last two decades was to diversify into areas like the marketing of computer software; setting up its own data base (as early as 1978) and seeking financial support to identify and exploit its skills and knowledge (eg DIAJET and NIMIX). Presently, nearly a quarter of its staff are involved in collection and dissemination of technical information in the field of Fluid Engineering. It is also placing emphasis on activities like conferences, seminars

and publication activities. They are important if it wants to project an image of a "centre of excellence" in the field of fluid engineering. The advantage of this achievement is self-generating. Its reputation ensures that meetings and conferences are of sufficient status to attract "experts" both to address them and to attend. Even larger member companies, who quite possibly have more qualified staff in the technical areas concerned than the RA, can nonetheless recognise the value in an Association if its technical quality is sufficient.

The growth in straightforward contract work for individual sponsors has been particularly rapid - so much so that today the BHRA "makes more sense" if regarded as a specialised consultancy working for a wide range of clients rather than an RA (certainly a traditional RA). This is also one of the main reasons why the Council agreed to change its status to one limited by share through a management buy-out in 1990.

BHRA is also seeking to increase its influence within the DTI and help shape the kind of projects which the DTI plans to support. This is important because:

- the DTI is its biggest single customer.
- of the considerable personnel changes in the DTI that may have an adverse effect on negotiations and on placing of contracts.
- of the shrinking R&D budget of the DTI and competitive tendering.

(9) Core Programme

Although the profit margin in research is a lot smaller than in development contracts, BHRA still feels very strongly that it has to continue its core programme of research with the

financial support from the DTI. Wihout its core programme, BHRA might lose its competitive edge (this came out very strongly in the new Board of Directors' meeting after it changed its corporate status in 1989)[17].

BHRA is also aware of the need to maintain a good portfolio of research programmes. Part of it is the General Research Programme, which is more speculative in nature. In the process of obtaining as much industrial contract work as possible, there is also a need to update its core research as expressed by the following statement[18]: "While we have been successful in attracting contract R&D, it is important to remember that to maintain and update our technical base, we need to continue our General Research Programme at a high level."

Over the last two decades, BHRA's research has moved away from basic or fundamental research to one which is of interest to specific members and strategic or applied in nature. The control of the research programmes shifted from the Council to the Executive Board because it was better placed (knowing the market needs) and with a shorter response time.

(10) Overseas Income

Because of the adverse situation in the UK, increasing attention was paid to marketing its services overseas. BHRA decided to concentrate on the USA market in the early 1980's by setting up a joint marketing agreement with an American firm. By 1988 alone, 32% of its industrial contract income came from overseas (22% came from Europe).

In 1987, BHRA made special efforts to expand its overeas market by concentrating on the European markets in both the

Community and industrial sectors. This area of its business has shown steady improvement and is likely to increase in importance, particularly when collaborative projects are concerned.

(11) Financial

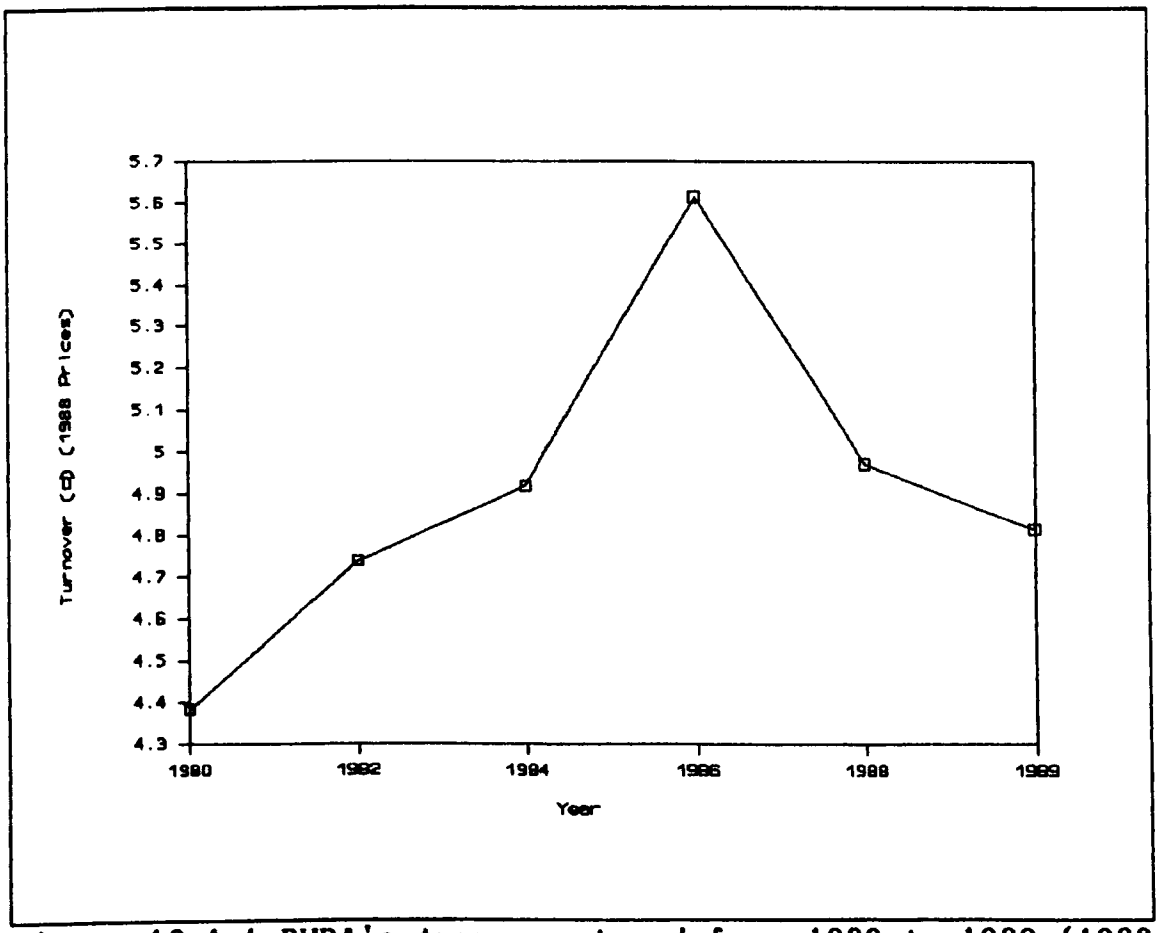


Figure 13.1.4 BHRA's turnover trend from 1980 to 1989 (1988 prices).
Source: BHRA's Annual Report from 1980 to 1990.

Figure 13.1.4 shows a line graph of the trend in BHRA's turnover from 1980 to 1989. Its turnover continued to grow from 1980 to 1986, reaching a peak of over £5.6 million (1988 prices) in 1986. From 1986 onwards, it declined to £4.8 million in 1989.

Figure 13.1.5 shows the trend in the surplus (or deficit) of income from 1980 to 1989. BHRA continued to show a surplus in income from 1980 to 1984. It was in deficit from 1985 to 1986

before it recovered in 1987 with a surplus of £0.189 million (after having made redundant 34 of its staff in 1986). In 1988, it was in deficit, mainly due to the reduction in DTI funding.

Figure 13.1.6 shows the trend of the turnover/staff ratio from 1980 to 1989. It grew from £19,000 per employee to a peak of £28,000/employee in 1988. Its ratio for 1988 was still slightly below £31,000/employee i.e. the 1988 average for the overall turnover/staff ratio of RAs.

13.1.7 Conclusion

Over the last two decades, the Rothschild Principle has been one main change in government policy which affected BHRA most. BHRA had to adapt to become more commercially minded and less dependable on government funding. This principle has fundamentally changed the mission of BHRA.

After changing its corporate status in 1989, profit making is explicitly its goal. This change in status involves taking great risks but on the other hand it brings along many advantages, for example the ability to raise capital. BHRA has to manage itself carefully especially when the UK is going through a recession or with high interests rates. BHRA will have to maintain a close rapport with the "old BHRA" as well as the DTI.

BHRA may have to consider changing its divisional form of organisational structure to a matrix form in order to respond more quickly to the changing environment. It ought to look at its portfolio of research programmes carefully and not neglect its core research. BHRA has been carrying out its business review periodically and with the change in its corporate status,

defining its prime object is a lot clearer.

The organisation's culture will need time to change to one that is versatile and sensitive to market opportunities. Over this period of change, the leadership provided is crucial. BHRA is now able to offer greater incentives in order to retain its staff as well as to attract bright young recruits.

The RAs whose status remained limited by guarantee are keeping a close watch on BHRA. If BHRA is successful, other RAs may well consider very carefully whether or not to change their status.

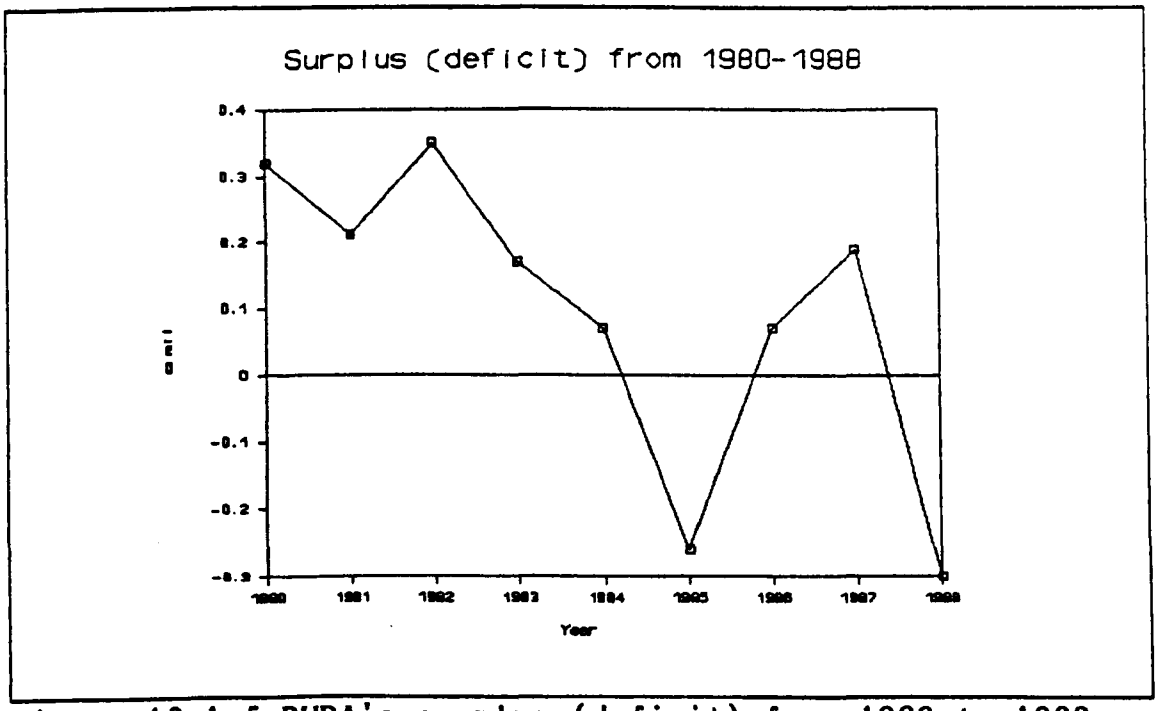


Figure 13.1.5 BHRA's surplus (deficit) from 1980 to 1988.
Source:- BHRA's Annual Reports from 1980 to 1989.

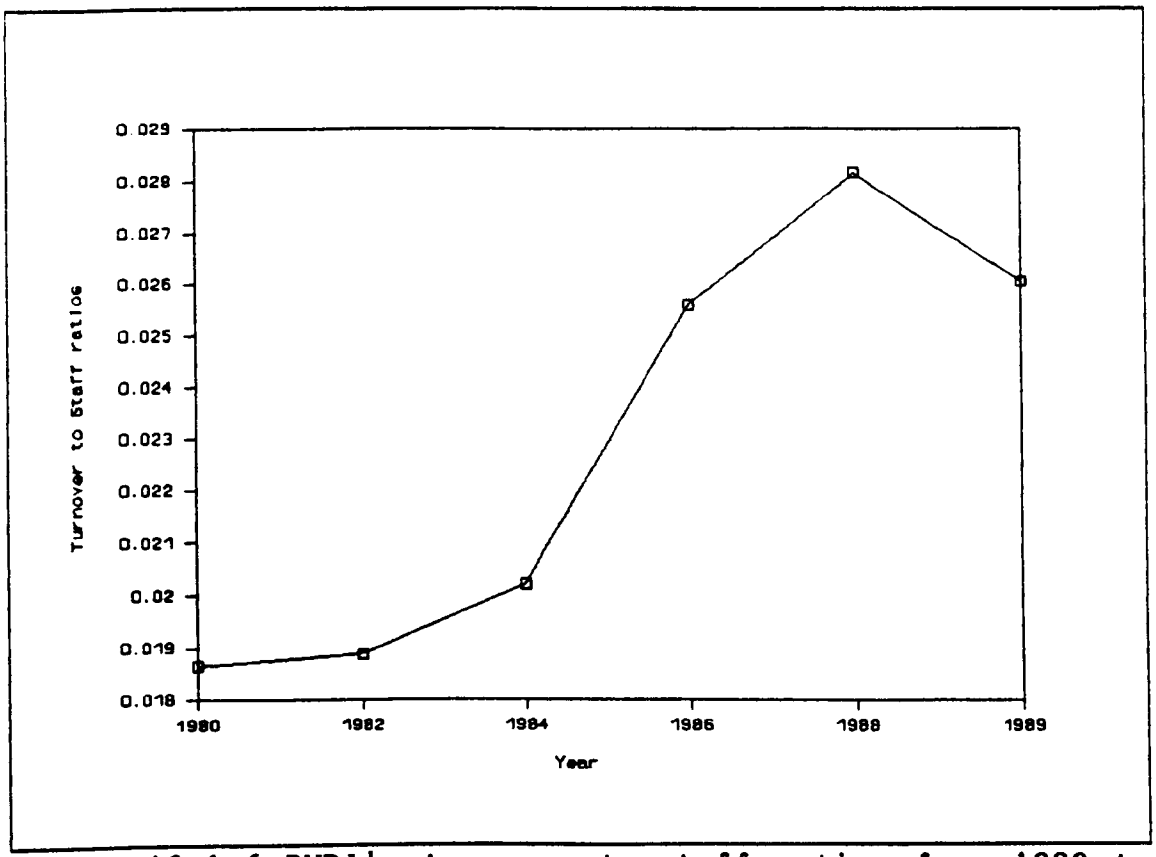


Figure 13.1.6 BHRA's turnover to staff ratios from 1980 to 1989.
Sources: BHRA's Annual Reports from 1980 to 1990.

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17. cf. 4.

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13.2 Case Study - SIRA Ltd.

Figure 13.2.1 shows the most important milestones in SIRA's evolution. SIRA Ltd. originated in 1918. It was known then as the Scientific Instrument Research Association. In the late 1960's, it changed its name to SIRA Institute Ltd. The change of name was significant for it marked the transition of SIRA from an organisation oriented towards a specific industry (namely, the scientific instrument manufacturers) to one which aims to promote the use of instrumentation and control methods in all industry. The event which is most closely identified with the change of SIRA's emphasis was the setting up of the Industrial Measurement and Control's (IMC) activity in the late 1960's. The IMC's programme was formulated with the simple objective of improving the utilisation of scientific control and automation procedures in production by technically less advanced industries. The launching of this programme could have represented a move by SIRA away from its traditional base within the scientific instruments manufacturing industry i.e. SIRA could be said to have changed from an industry-based to a technology-oriented RA.

Another significant milestone in SIRA's evolution was when its Articles of Association were changed to permit SIRA to hold a majority stake in an external company. This move cleared the way for the formation of subsidiaries.

Source: SIRA Internal Document

MILESTONES IN SIRA EVOLUTION

1918	Established as British Scientific Instrument Research Association [an exclusive collaborative research organisation for the British scientific instrument industry].
circa 1939/45	Non-instrument makers (reluctantly) allowed into membership.
1947	Moved from London to Chislehurst; major staff expansion.
circa 1950	Instrument users form collaborative project at Sira to evaluate process instruments.
1966	Open door policy introduced, membership exclusivity declining.
1969	Collaborative research programme abandoned, membership fees cut. - Sira moves to position of financial independence - Business based on contract R&D and test services with some group-sponsored projects - No safety net in the event of failure.
1970/80	Contract research thrives; Sira starts to bid competitively for contracts and develops overseas business.
1974	Board structure replaces Member Council as ultimate management body; Sira achieves management independence, membership subscription accounts for less than 1% of turnover.
1981	Articles of Association changed to permit Sira to hold a majority stake in an external company; way is clear for formation of subsidiaries.
1981/82	Ometron Ltd and Sira Safety Services Ltd formed.
1983	Ometron Inc formed.
1986	Image Automation Ltd formed.
1988	Sira Electro-optics Ltd and Sira Precision Ltd formed.
1989	Sira Holdings Inc, Sira Inc and Sira Communications Ltd formed.
1990	Sira Group Board structure introduced. Sira R&D and Sira Test & Calibration Centre managed as autonomous enterprises.

Figure 13.2.1 Milestones in Sira's evolution.

13.2.1 Range of Activities

SIRA's acitivities comprise:-

- measurement, instrumentation, control and optical systems technology
- research, development, design, testing, evaluation, calibration, safety assessment and training services
- production of prototypes and specialist products.

It has specialists in automatic inspection, test equipment, expert systems, process control, infrared optics, fibre optic sensors, space instrumentation and engineering stress measurement. SIRA operates internationally.

13.2.2 Statistical Comparisons

	1971	1988
Staff number	189	250
Staff number ranking	*9	8
Turnover (1988 prices)	£3.4m	£7.76m
Ranking of turnover among RAs	N.A.	8
% Income from government sources	48%	6%
% Overseas income	*4%	43%

* Estimated; N.A.= Not available

Sources: SIRA's Annual Reports.

13.2.3 SIRA's Environment

- The introduction of the IMC programme in SIRA by the Government helped to shift SIRA activities from purely scientific toward applied research and engineering.
- The implementation of the Rothschild Principle was seen as a threat to SIRA.

- The scientific instrument industry began to diversify in the 1960's. SIRA's limited resources could not cope with the range of resources required to meet the needs of the industry.
- The demand for collaborative research dropped in the early 1970's.
- There is a niche market for SIRA's products and services.
- SIRA was affected by the recession between 1974 and 1976 and between 1979 and 1982.
- The single market in 1992 will increase opportunities for testing and legislative work.

13.2.4 Internal Audit

- There are opportunities for it to exploit its research and patents.
- One possible problem encountered among the subsidiaries within SIRA Ltd. is the rivalry between them. Another difficulty is the cost involved in preparing the accounts of these subsidiaries.
- There is a possible danger of being too diversified.
- Its product lines are doing well with a niche market.
- It is non-dependent on government income.
- SIRA suffers from the peaks and troughs of demand for its services.
- It experiences difficulties using a divisional form of organisational structure.
- It uses the facilities and expertise in HEIs and GIREs to complement its own facilities.

13.2.5 Strategies Adopted

In the early 1970's, SIRA's strategy was a combination of concentric diversification and market development. In the early 1980's, it pursued a strategy of forward integration and at present, it adopts a combination of market development and concentric diversification.

(1) Concentric Diversification

SIRA adopted this strategy in the early 1970's to add new but related fields of research activities to its existing ones. It decided to abandon collaborative research and diversify into contract research and development, test services and some group-sponsored projects. This strategy was useful because:-

- collaborative research was a slow growth area.
- services like contract R&D and testing were in demand.

(2) Market Development

SIRA started to introduce its services/products into new geographic areas as early as 1970. SIRA was successful in developing its market overseas because its services were of high quality and the market was relatively new and untapped for them. This form of strategy is still adopted by SIRA.

(3) Forward Integration

SIRA changed its Articles of Asociation in 1981 to enable it to hold a majority stake in an external company. This paved the way for it to forward integrate by acquiring another organisation or setting up subsidiaries. This strategy helped SIRA to market and exploit its research e.g. by marketing SPATE through Ometron Ltd. SIRA adopted this strategy because:-

- of the negative response from firms to exploit its research.
- it helped to generate revenue.
- it had the capital and human resources.
- of the high profit margin.

Fig. 13.2.2 shows the subsidiaries controlled by SIRA Ltd. Once these subsidiaries are set up, they are supposed to survive on their own. Each of them is a profit centre with its own autonomy and the responsibility to improve its individual products/services or offer new services lies with the subsidiary.

13.2.6 Changes in SIRA

(1) Subsidiaries Controlled by SIRA Ltd.

In the early 1970's, the members felt that they could not manage SIRA and that SIRA was in direct competition with some of them. In 1972, the Council set up a committee to look into the running of SIRA. The committee recommended that the Council be dissolved and be replaced by a Board of Directors. The members of this Board did not need to be members and could be anyone from industry. The recommendation was accepted and the members became guarantors.

This move gave SIRA the independence it needed, greater flexibility and speed in responding to the needs of the members, as well as greater freedom in planning for the future and greater control of its destiny. The line of command was shortened with the elimination of the Council.

The subsidiaries of SIRA Ltd. are as follows:-

- SIRA R&D handles contract research and development; applications, consultancy, design; and specialist system supply.

Source: SIRA Internal Paper

SIRA LTD

- Scientific and industrial instrumentation
- Measurement, control and information technology

SIRA R&D

- Contract research and development
- Applications, consultancy, design
- Specialist system supply

SIRA MEMBERSHIP SCHEME

- Awareness and promotion of new technology and instrumentation

SIRA TEST AND CALIBRATION CENTRE

- Evaluation, calibration, testing

OMETRON LTD

- Instrumentation for engineering stress and vibration analysis

SIRA SAFETY SERVICES LTD

- Services in design and installation of electrical equipment in potentially explosive atmospheres

IMAGE AUTOMATION LTD

- Automatic inspection and process control systems

SIRA COMMUNICATIONS LTD

- Conferences & Courses
- Technical Training
- Technical administration services

SIRA ELECTRO-OPTICS LTD

- Optical quality assurance instrumentation

SIRA PRECISION LTD

- Manufacture and assembly
- Optics, electronics, mechanics
- Complete systems

SIRA HOLDINGS INC

OMETRON INC

SIRA INC

Figure 13.2.2 Subsidiaries controlled by SIRA Ltd.

The subsidiaries of SIRA can contract out research to SIRA Ltd. in the process of product development. SIRA Ltd. generates ideas or new products for its subsidiaries.

- SIRA Membership Scheme handles the awareness and promotion of new technology and instrumentation.
- SIRA Test and Calibration Centre handles evaluation, calibration and testing.

SIRA R&D accounts for about £3m of SIRA's turnover and SIRA Test and Calibration Centre for £1m. The income from its Membership Scheme is negligible.

The product line of SIRA Ltd. is run by three of its subsidiaries each of which contribute about £2m to SIRA's turnover:-

- Ometron Ltd. markets equipment like the Stress Pattern Analysis by Thermal Analysis (SPATE) or the Vibration Pattern Imager (VPI).
- Image Automation Ltd. markets equipment for automatic inspection and process control systems.
- SIRA Electro-Optics Ltd. supplies equipment for optical quality assurance instrumentation.

The rest of SIRA can be divided into 2 groups of subsidiaries. The first group consists of:-

- SIRA Safety Services Ltd., which was bought over from ICI in 1981. It offers services in design and installation of electrical equipment in potentially explosive atmospheres.
- SIRA Communications Ltd., which handles conferences, courses and training.
- SIRA Precision Ltd., which handles most of the manufacturing and tooling needs of SIRA's manufacturing subsidiaries.

The second group of subsidiaries deals with the marketing of SIRA's products and expertise in America. This group is controlled by SIRA Holdings Inc., which controls Ometron Inc and SIRA Inc.

(2) Ownership/Status

SIRA's members chose to retain its limited by guarantee status with its members as guarantors. The advantage of this status was that the members felt less threatened by SIRA and that it could not be taken over by another organisation. This form of corporate status will remain unless the Board of Directors sees a need for a change e.g. the need to raise share capital.

(3) Staffing

Figure 13.2.3 shows a bar chart of SIRA's staff number from 1970 to 1988. It shows that SIRA's staff number peaked at 250 in 1988. In the last decade, its staff number increased except for 1982, when it dropped to 158, which was brought about by the recession in the UK. The figure shows that between 1970 and 1988, its staff number increased by 60 i.e. more than 30%. In the last two decades, it has grown to a size that is large enough to form clusters of experts, which helps to boost the morale of the research staff as reflected by the ratio of 1:2 of scientific to support staff in 1989[1].

Just like most RAs, SIRA faces problems with regard to recruitment and the high turnover of staff. It has to compete with industry in attracting capable young recruits. The diversity of SIRA's activities and the problems arising from high staff

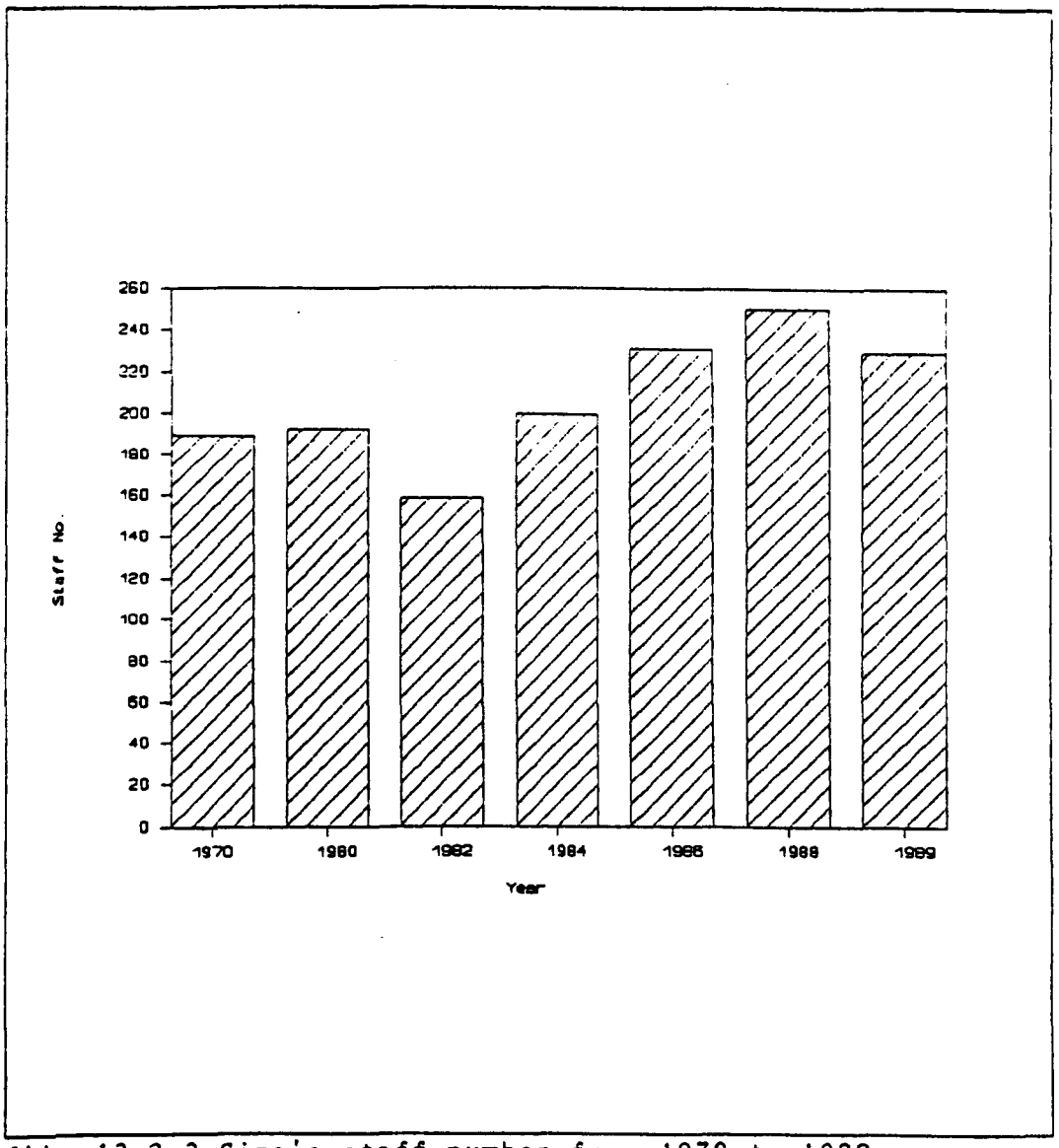

Abb. 13.2.3 Sira's staff number from 1970 to 1988
Source: SIRA Annual Reports.

turnover mean that consideration has to be given to job sharing. Greater attention must also be given to well-planned staff training and recruitment.

(4) Turnover

Table 13.2.1

	1970	as %	1988	as %
Industrial income (£m)	1.77	52	7.3	94
Income from govt. sources (£m)	1.63	48	0.466	6
Total (£m)	3.40		7.766	

(all in 1988 prices)

Table 13.2.1 SIRAs Income in 1970 and 1988.

Table 13.2.1 shows that SIRA's percentage of industrial income increased dramatically from 52% to 94% of its total turnover between 1970 and 1988. In real terms, it increased from £3.4m to £7.766m. Its income from government sources decreased from 48% to 6% over the same period. In real terms, it dropped from £1.63m to £0.47m.

SIRA's present income from the DTI is far below the ceiling figure of 25% of turnover set by the DTI which reflects SIRA's policy of not being dependent on DTI income since the early 1970's.

(5) Membership

In 1966, SIRA introduced an open door policy towards membership, which caused membership exclusivity to decline. It was one of the first few RAs to do this. Membership fees were cut

drastically and by 1974, they accounted for less than 1% of its turnover. Consequently, the members had very little control over the running of SIRA and it was taken over by a Board structure in 1974.

SIRA's open door policy helped it to get a head start over other RAs in obtaining income from overseas. In 1988 alone, more than 48% of its turnover came from overseas and this percentage was one of the highest among the RAs.

(6) Services/Products

SIRA abandoned collaborative research as early as 1970 and started concentrating on contract R&D, testing and some group-sponsored projects. Contract research is risky as it tends to be contracted out on a fixed cost basis.

Figure 13.2.2 shows the set-up of SIRA Ltd. and the range of services/products offered by them. These enable the company to integrate its activities within major business sectors, producing hardware and products to meet its clients' needs as well as initiating R&D[2]. This provides not only extremely valuable experience and feedback to the staff in SIRA but, where required, a route for clients through from concept to production within the one company. The range of services/products enhances SIRA's ability to win the initial R&D contracts and to provide a sensible route for its growth and development. SIRA needs to guard from being too thinly spread and having too broad a focus.

Like most RAs, SIRA suffers from the peaks and troughs of demand for its services. It has responded by having a wide spread of clients from different regions of the world and by serving a wide range of industries.

(9) Finances

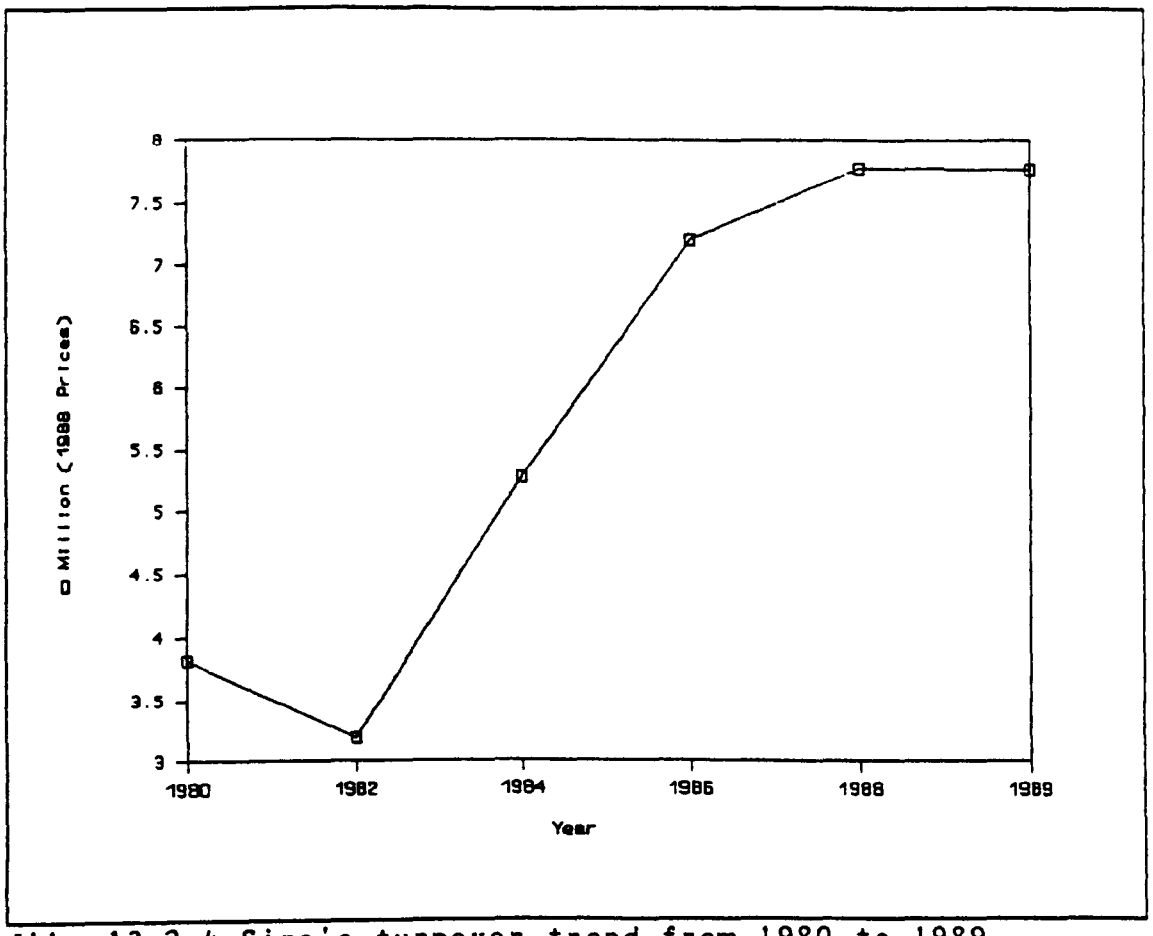

Abb. 13.2.4 Sira's turnover trend from 1980 to 1989.
Source: SIRA's Annual Reports.

(7) Core Programmes

SIRA places great emphasis on its core research, which is carried out by SIRA R&D. Though it is not an explicit policy, SIRA would ploughback approximately 10% of its turnover into its core research. This is important if it wants to continue to exploit its research and furthermore, some of the products'/services' life cycle may be coming to an end.

(8) Organisational Structure

In each of the subsidiaries, the organisational structure is organised along a divisional line. SIRA tried to introduce Matrix Management but conflicts arose in the allocation of

resources among managers. It finally abandoned Matrix Management.

(9) Finances

Figure 13.2.4 shows SIRA's turnover trend from 1980 to 1989.

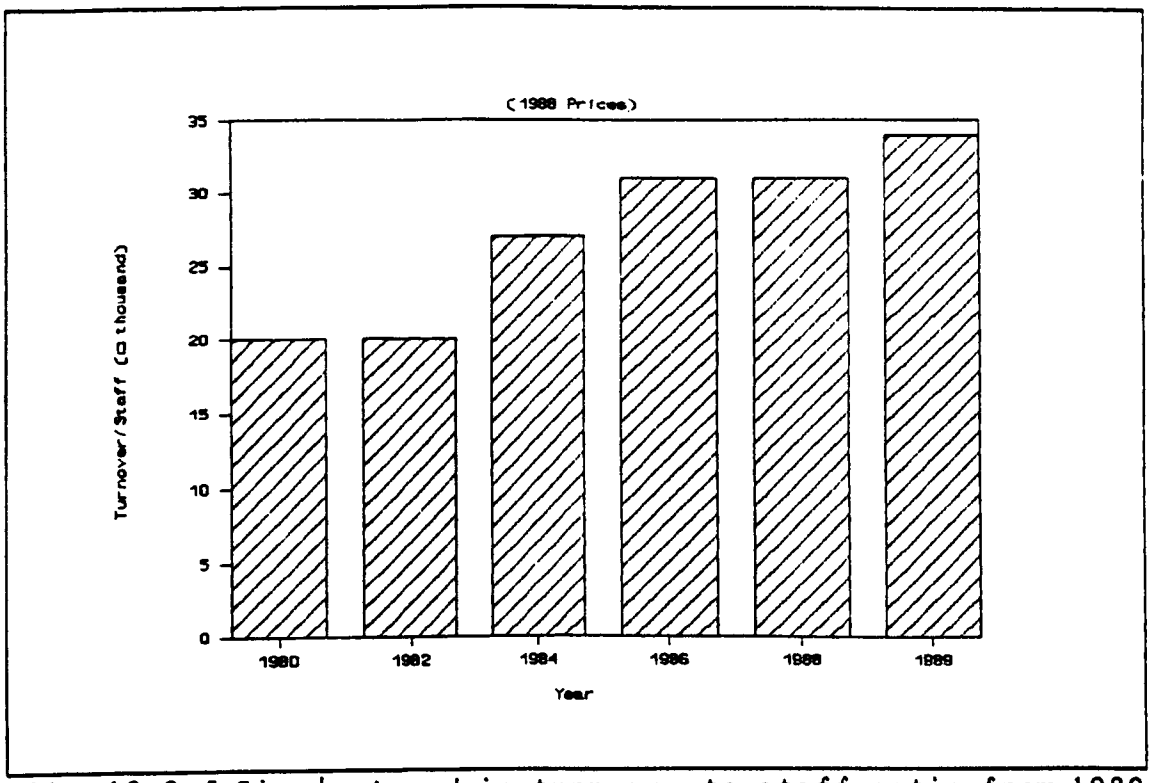

Abb. 13.2.5 Sira's trend in turnover to staff ratio from 1980 to 1989
Source: SIRA's Annual Reports

The trend increased in the last decade. On the average, its turnover increased by 10% per annum. In 1980, its turnover was £3.8m; by 1989, it had increased to £7.76m i.e. it more than doubled.

Figure 13.2.5 shows the trend in the turnover to staff ratio from 1980 to 1989 (in 1988 prices). The ratio increased from 1980 to 1989, reaching a peak of £34,000/employee in 1989. The 1989 ratio ranked number seven among the RAs.

Figure 13.2.6 shows the operating profit (loss) of SIRA over the last 10 years. In the last decade it made a profit every year with its biggest profit margin in 1985 (£0.914m) and the smallest in 1988 (£0.044m).

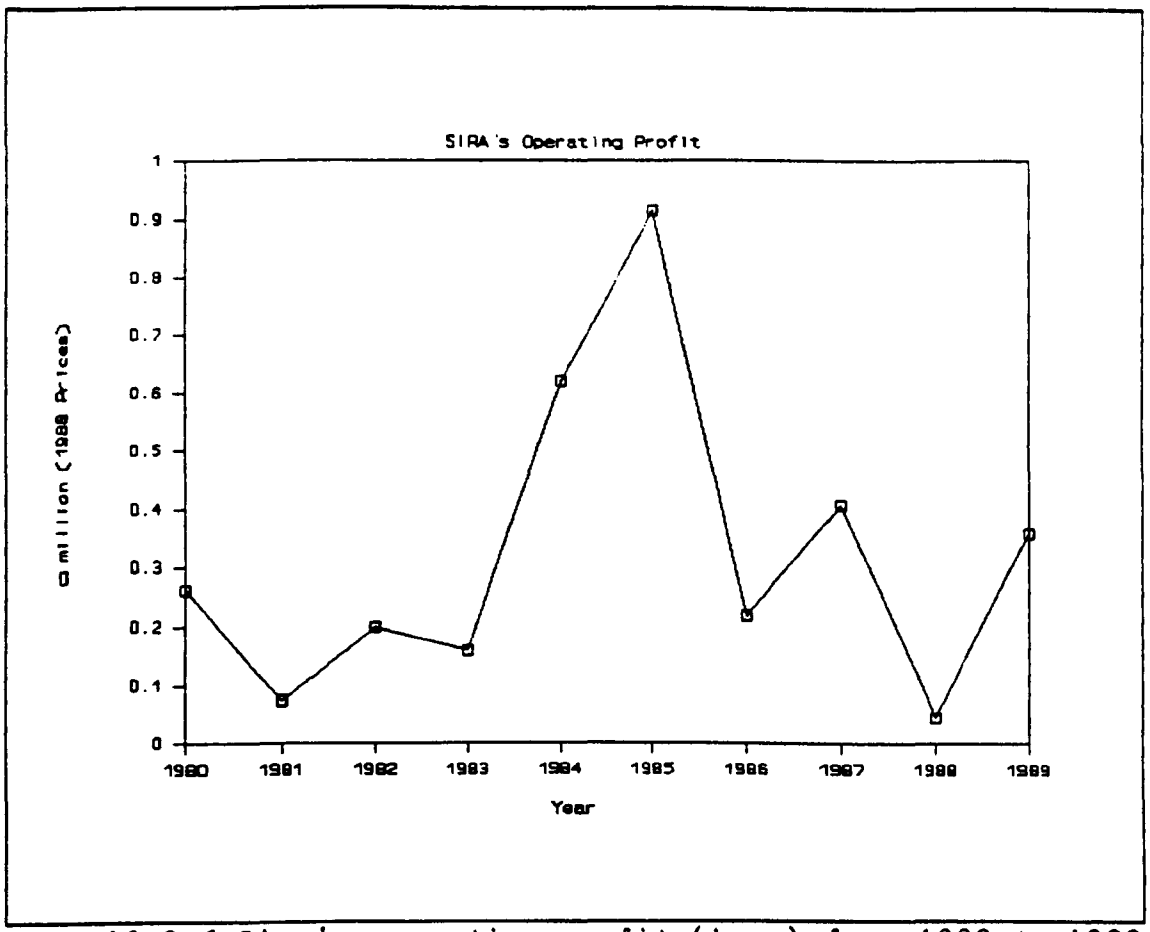

Abb. 13.2.6 Sira's operating profit (loss) from 1980 to 1989
Source: SIRA's Annual Reports.

13.2.7 Conclusion

SIRA was the first RA to achieve management independence by being independent of income from membership subscription. It was one of the first RAs to abandon collaborative research and concentrate on contract research. It pioneered the introduction of a Board structure to replace Member Councils as ultimate management bodies in 1974.

This independence helped it to be more versatile and responsive to market needs. It is not encumbered by the long chain of command experienced by most RAs. SIRA has to consider the recent changes in DTI policy[1] which encourages collaborative

1. The Secretary of State for the DTI: DTI - the department for Enterprise . London: HMSO January 1988, Cm. 278.

research, for this policy could create a good market for collaborative research - an area which SIRA has abandoned since the early 1970's. SIRA might have to increase its membership drive in order to help it to find partners for collaborative projects as well as to gain more contacts.

The present set-up of SIRA Ltd. is diversified. Any future plan for diversification will have to be looked into very carefully to avoid being spread too thinly.

One of the consequences of the Single Market will be the increased opportunities for testing and legislative work. SIRA has been marketing its services and products in the EC and with the coming of the Single Market, this is expected to intensify.

The difficult circumstances experienced by SIRA over the years have forced it to change from being too narrowly focused to being multi-disciplined and responsive to the market needs.

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13.3 Case Study - Hydraulic Research Ltd. (HR Ltd.)

The Hydraulic Research Station (HRS) was established by the Government in 1947 and moved to its present site, Wallingford, in 1952. HRS was established to provide a national centre of expertise in civil engineering hydraulics. During its 35 years under government patronage, it developed a substantial programme of basic research which achieved international recognition.

During the 1980's, political philosophies which favour a freer use of market forces directly confronted the issues of flexible resource deployment. Increasingly, the "automatic" right of funding was removed from HRS.

When the UK Government started its programme of privatisation in the late 1970's, HRS was one of the candidates. It was the result of a policy of shifting financial burden of "near-market" research away from the public purse. The decision to privatise HRS was announced in July 1979 and in April 1982, HRS was launched as a private company[1].

13.3.1 Range of Services[2]

HR Ltd. does contract research and consulting services in hydraulics for the Government and the civil engineering industry. It also markets packaged computer software for the water industry and for civil engineering applications.

13.3.2 Statistical Comparisons

	1982	1988
Staff number	255	285
Staff member ranking among RAs	4	6
Number of engineers/scientists	N.A.	150
Former civil servants	255	120
Direct appointment	\	165
Turnover (1988 prices)	£5.94m	£8m
Ranking of turnover among RAs	5	7
% Income from government sources	77% (£4.6m)	44% (£3.5m)
% Overseas Income	14%	30% (£1.2m)

N.A.= Not available.

Sources:- SIRA's Annual Reports

13.3.3 The Privatisation Process

HRS is an interesting case where a GIRE was privatised and converted to an RA style of organisation. It was one of the Government's more successful attempts to privatise GIREs whereas the privatisation of GIREs like NEL and WSL was more ambiguous. The following is a brief account of the privatisation process.

In July 1981, the Government appointed a "Shadow Board of Directors" to help steer HRS into the private sector. Its main purpose was, on the one hand, to negotiate with the Government on behalf of the future company on the financial and legal aspects of the transfer and, on the other hand, to negotiate with the staff of HRS on various issues associated with the terms of employment. The Board's report to the Government stated that HRS could be privatised successfully provided the following conditions were fulfilled:-

(1) Financial

- The assets of HRS should be transferred free of charge.
- Sufficient working capital should be provided to meet the cash flow needs.
- The Government should fund an initial capital investment programme to ensure the company was well funded.

(2) Staff

There should be a sufficient number of HRS staff agreeing to transfer to the new company. The staff union's response was that the terms and conditions of employment offered by the company should be no worse than those the staff enjoyed as government employees.

(3) Research

The Government should underpin a programme of strategic research for at least the medium term (5 years).

In order to allow time for the parties to reach a negotiated agreement without delaying the launch of the new company unnecessarily, a two-year transitional agreement was made. The company was formed, the assets of HRS were loaned to it free of charge and staff were seconded to the company on a voluntary basis. This enabled the company to continue the work of HRS but now trading as a private commercial company. At the end of the two years, offers of employment were made to and accepted by a sufficiently large number of the staff to satisfy both the Government and the Board of the company. The assets were transferred to the company, now known as Hydraulic Research Ltd., thus completing the privatisation process in April 1984.

13.3.4 Environment

- The income from government sources is decreasing and harder to secure.
- There is growing competition. "(...) the increasing competition from overseas laboratories is a challenge that will demand new and more vigorous marketing efforts if we are to retain or recapture the UK share of the world market"[3].
- There is a wide market for its services/products especially in Asia and Latin America.
- It was affected by the economic restraints in the UK and worldwide especially after its privatisation.

13.3.5 Internal Audit

- From the start HR Ltd. was over-dependent on government sources for income. There was a great uncertainty as to what level of funding it could expect from the Government when the five-year period ended in 1987, and this uncertainty has remained.
- There is a need to change the civil service Culture to a commercial one.
- It has had to cope with a high turnover of staff especially during the first two years after privatisation.
- There is a need to focus on the profit performance of the organisation without jeopardising its scientific capabilities.
- There is a need to develop a new market for its services/ products.

13.3.6 Strategies Adopted

The strategies adopted by HR Ltd. are a combination of concentric diversification and market development. It is

diversifying by exploiting spin-offs from its research. This is done through the development of specialist instrumentation and laboratory equipment and the development of computer software. But the success of this strategy is critically dependent on adequate funding of its basic research by the DoE. As the organisation's commercial position strengthens. it will need to devote an increasing proportion of its funds to in-house R&D projects.

HR Ltd. is developing new markets through establishing links in Asia and China and some middle eastern countries partly through direct marketing and through training and technology transfer arrangements.

A software house, Wallingford Software, was formed to sell commputer software developed within the organisation (or acquired through special contracts). HR Ltd. has also entered into marketing agreement with two instrument and equipment manufacturers to sell its specialised equipments worldwide.

13.3.7 Changes in HR Ltd.

(1) Organisational Structure

The organisation has four main divisions: River Engineering, Tidal Engineering, Maritime Engineering and an Overseas Development Unit. Each division is lead by a Head of Division and in each division, there are units lead by programme managers.

When HRS was privatised, it was necessary to recruit new blood at senior level in two important areas of discipline. Firstly, a Finance Director was brought in to provide the essential experience of private sector accounting and cost

control as well as to lay down the vital framework for the introduction of commercial project management and an improvement in productivity. Secondly, a new Marketing Manager was introduced. His function was to head the marketing and business development of the new organisation. He was to provide a framework which would enable HR Ltd. to be more proactive. The needs of its clients were to be identified by him and the necessary tools or services developed.

(2) Ownership/Corporate Status

The legal constitution of HR Ltd. is that of a company limited by guarantee. This is similar to the normal private company limited by share holding except that the members of the company ("guarantors") do not receive any dividends i.e. the company is non-profit distributing. Thus, in effect, the assets of HR Ltd. have been put in trust with the members of the company acting as trustees. Apart from this the company operates like any other private company. The members are responsible for electing the Board of Directors, appointing auditors and receiving the published accounts annually. The main focus of attention in the published accounts is on the performance of the company and within commercial success there is considerable freedom of action. There is a great contrast with the position before privatisation, when control was excercised through manpower and capital spending budgets to meet the objectives of the departmental or central government regardless of the financial success of the organisation.

The board members of HR Ltd. are corporate bodies selected to represent a cross section of the industry that the company

serves. They currently include two government departments (the founder members), three professional institutions (e.g. the Institution of Civil Engineers), five trade associations (e.g. the Association of Consulting Engineers) and three public utilities (e.g. British Gas). In addition to these thirteen corporate board members, the staffs of the company elect two members. Consequently, the company constitution is a subtle blend of private company, charitable trust and worker cooperative.

(3) Culture

For the future success of HR Ltd. the appropriate launch conditions were essential. However, the true work of "privatisation" really began after the launch. There was a need to transform the culture of the organisation and to replace bureaucracy with modern business management. The organisation had to become proactive in its approach to industry rather than merely reactive. It had to become more conscious of cost and time constraints and had to respond more promptly to its clients' needs.

HR Ltd. had to shake off the inevitable weaknesses of a public sector organisation. It had to become an efficient commercial company without losing the best qualities of the old HRS, in particular the ability to apply scientific research to the solution of real engineering problems.

(4) Staffing

No member of staff was obliged to join the privatised HRS. Therefore it was necessary to negotiate the terms and conditions of employment with the staff unions.

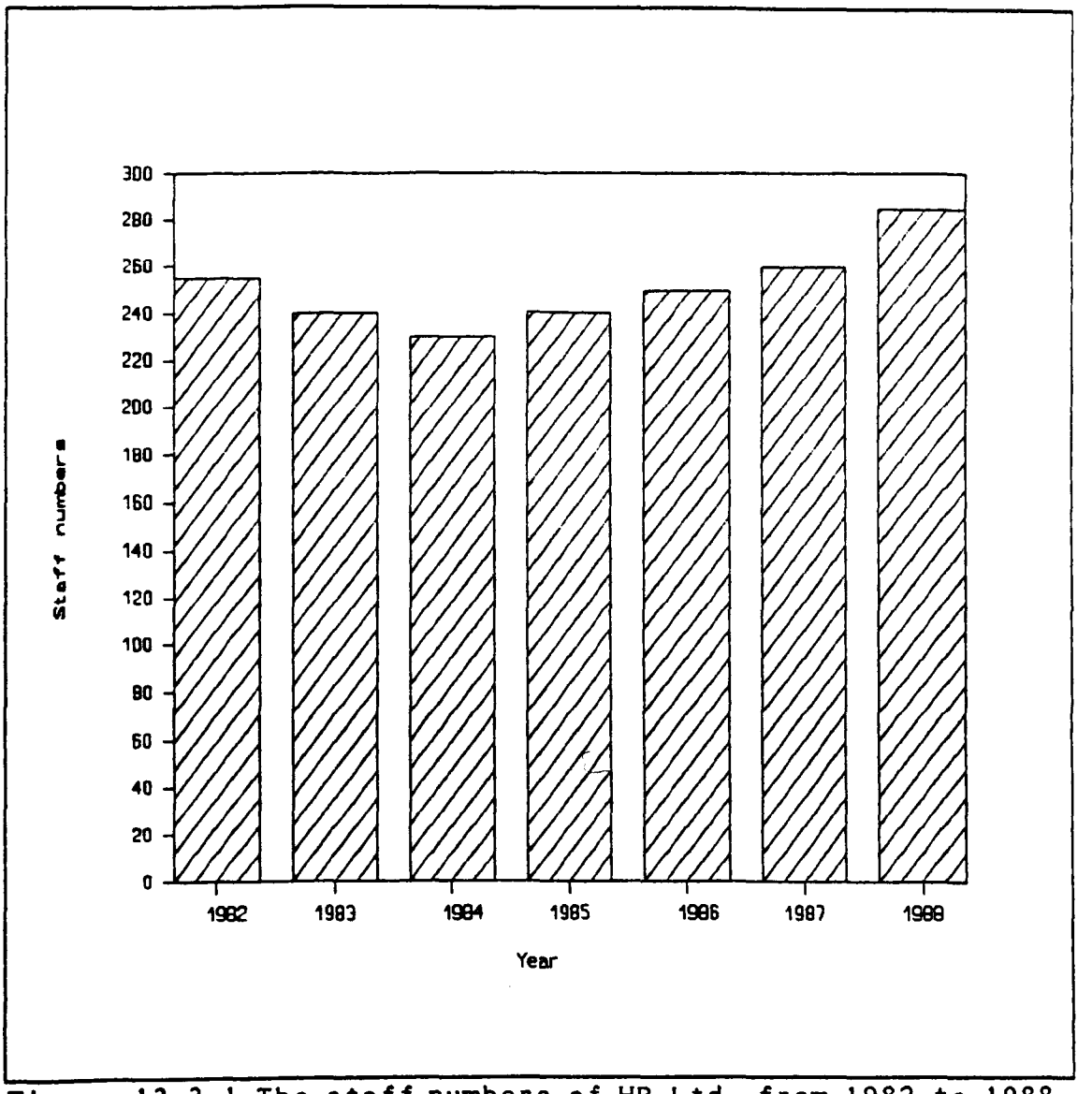

Figure 13.3.1 The staff numbers of HR Ltd. from 1982 to 1988. Sources: HR Ltd. Annual Reports.

The most difficult issue to resolve was the pension scheme, which required two full years of transitional period. A funded pension scheme was established that offered benefits identical to those of the civil service scheme, the main difference being that, as a commercial company, HR Ltd. could not guarantee inflation proofing of benefits quite as firmly as the Government can. The rest of the terms and conditions of employment (hours of work, annual leave etc.) were taken over largely unchanged. A new grading structure was

introduced in which the multitude of different civil service grades that existed at HRS were projected onto a single universal pay spine. The new pay structure was designed to provide greater flexibility to adjust the rewards of staff as befits a commercial company.

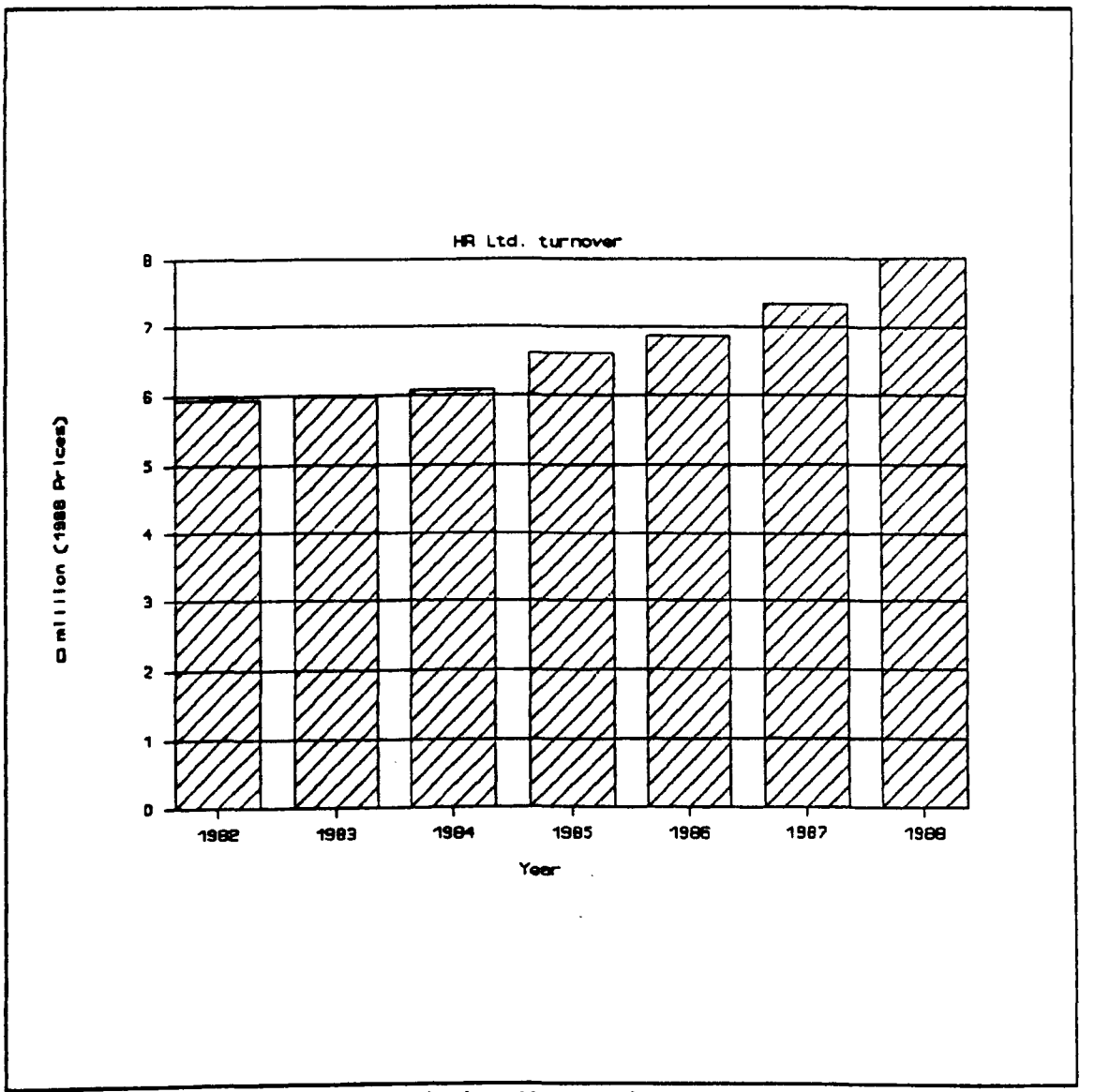

Figure 13.3.2 The trend in HR Ltd. turnover from 1982 to 1988.
Sources: HR Ltd. Annual Reports.

Figure 13.3.1 shows the staff numbers of HR Ltd. from 1982 to 1988. In 1982, its staff number was 255 and it increased to 285 in 1988. Its staff number dipped to the lowest in 1984, when

steadily.

The biggest turnover of staff took place during the transition period between 1982 and 1984, when more than a hundred of its staff left to remain in the civil service or due to

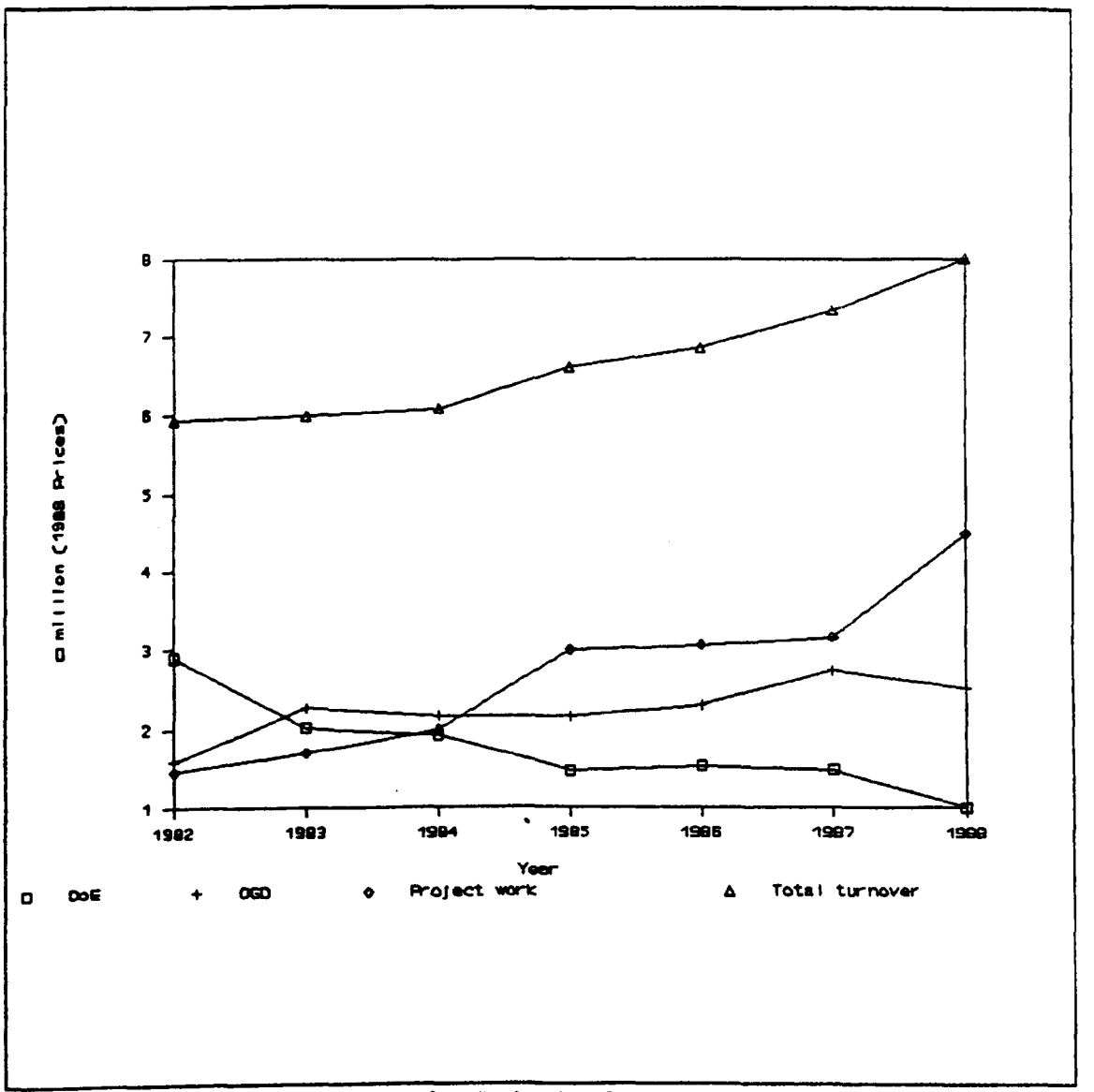

Figure 13.3.3 Sources of HR Ltd. Income.
Sources:- HR Ltd. Annual Reports.

natural wastage.

After privatisation, the total number of former civil servants decreased from about 150 in 1984 to about 120 in 1988. In 1984, the former civil servants constituted 65% of the total

number of staff, in 1988 only 43%. With the decrease in the percentage of former civil servants, it ought to be easier to inculcate a new culture within the organisation.

(5) Turnover

Figure 13.3.2 shows a bar chart of HR Ltd.'s turnover from 1982 to 1988 in 1988 prices. The figure shows that its turnover increased continuously with £8m as its highest turnover in 1988. In real terms, it increased from £5.94m in 1982 to £8m in 1988, i.e. there was an increase of over 30%.

Figure 13.3.3 shows a line graph of HR Ltd.'s income (1988 prices) according to sources. Its biggest single customer is the DoE, the income of which decreased from £2.9m in 1982 to £1.1m in 1988. In the near future, this income is expected to remain constant or to decrease slightly. The income from the OGD increased slightly from £1.85m in 1982 to £2.5m in 1988.

The biggest increase in income comes from project work carried out for industry. It increased from £1.2m in 1982 to £4.4m in 1988. In 1982, it constituted only 20% of its turnover but by 1988, it had increased to 55%. This shift away from government sources of funding, in particular from the DoE, reflects the policy of the management to become less dependent on government funding. Nevertheless, the percentage of the turnover from government funding is still relatively high in comparison to other RAs and this is mainly due to the nature of its activities where its main customers are public bodies.

(6) Services/Products

HR Ltd.'s expenditure on marketing and publicity is about

3% of their turnover annually, which is modest compared to many businesses but vastly more than was spent prior to privatisation.

Among the marketing efforts is the direct communication to their clients through courses and seminars and the exposition of the kinds of techniques available to clients through HR.

HR Ltd. has also extended its range of services by associating with various organisations in related fields. For example, "Wallingford Water" is a joint venture between the UK Institute of Hydrology and HR to offer a combined hydraulics-hydrology consultancy. It also markets HR instrumentation and equipment in association with Armfield Technical Education, a UK firm supplying laboratory equipment, which helps to give HR a ready access to a worldwide network of local agents.

HR Ltd. has established its own software house, Wallingford Software, which is responsible for the marketing, release and support of all packaged software. It extended the range of products to include software originally developed by one of their associates (e.g. a water treatment package which was originally produced by Severn Trent Water Authority).

It has also set up a number of joint venture companies to increase its range of services and to extend its geographical base. For example, it has set up a partnership with a Hong Kong based company.

In 1988, HR Ltd.'s income from overseas sources constituted 14% (£1.2m) of its overall turnover. There is still a lot of scope for it to develop new markets for its services/products overseas.

(7) Core Programmes

As a government laboratory HRS was accustomed to long-term programmes of strategic research, the direction of which was largely at the discretion of HRS, and the cost of which was met by the Government as deficit funding. This arrangement had to cease on privatisation and any research funding by the Government had to move to a contract basis. To ease the transition to the new arrangement a minimum level of contract research was guaranteed for the first five years after privatisation. It was understood that the Government was looking for an improvement in the efficiency of the privatised organisation and that this would permit a reduction in the level of government-funded research required to maintain the scientific base. At an unspecified level it was agreed, however, that the Government would continue to accept responsibility to support some long-term research. The lack of a firm guarantee of support for the scientific research base of HR Ltd. was and still is the most worrying aspect of the privatisation.

In 1981/82, the government-funded strategic research programme at HRS amounted to 35% of its turnover and it decreased to 18% in 1988/89. The turnover grew significantly in real terms during this period, but it is clear that the level of government sponsored research was reduced, as expected, after privatisation. An additional factor is that all of the research for the Government is in response to government needs and on a strictly contractual basis - it is not a subsidy for HR's commercial operations. This presents an obvious risk to HR's scientific base, a risk that has been countered in a number of ways. The pressure on external sources of research funds encourages a more

careful and selective use of these funds. Targets for strategic research are set more clearly and progress is monitored regularly to give better value for money as a result. These funds are increasingly supplemented by support from industry. HR in-house funds or contributions in cash or in kind from other industrial partners (e.g. water authorities).

There is a closer collaboration between researchers at HR and researchers in the university sector, from which both benifit greatly.

HR is looking for ways and means to make the reducing level of government support for strategic research stretch further in terms of the science base generated. However, there is a limit to how far this squeeze can continue and this remains an area of great concern to HR Ltd.

(8) Financial

The financial package agreed with the Government was designed to ensure that HR Ltd. would be launched as a well-funded independent commercial company. The working capital was drawn down over the first year according to the company's cash needs. In addition, the Government consented to meet those major items of capital investment that had already been in the public expenditure plans for HRS before privatisation. These included the replacement of the mainframe computer and the construction of a building to provide additional office space. It was also necessary for the Government to make a financial provision to set up a separate pension fund for those staff who chose to transfer their accrued pension rights to the new company. Once founded, it was to be the responsibility of HR Ltd. to maintain the

pension fund through annual contributions.

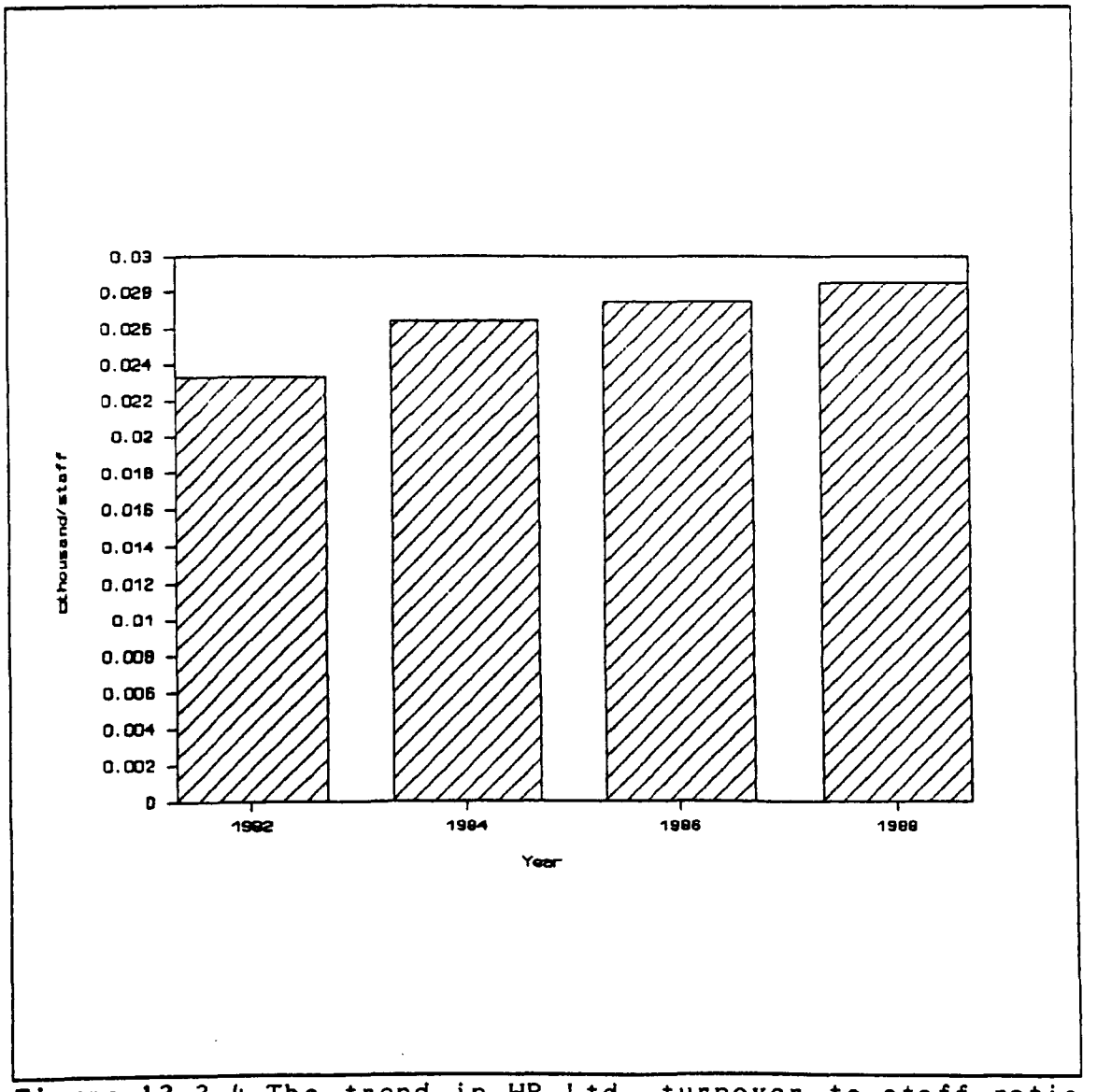

Figure 13.3.4 The trend in HR Ltd. turnover to staff ratio from 1983 to 1988.
Sources: HR Ltd. Annual Reports.

A monthly accounting procedure was introduced from the outset to help focus on the profit performance of the company. The monthly management accounts report the following:-

- profit and loss
- overhead expenditure
- staff time utilisation
- balance sheet and cash flow
- staff numbers

- order book level.

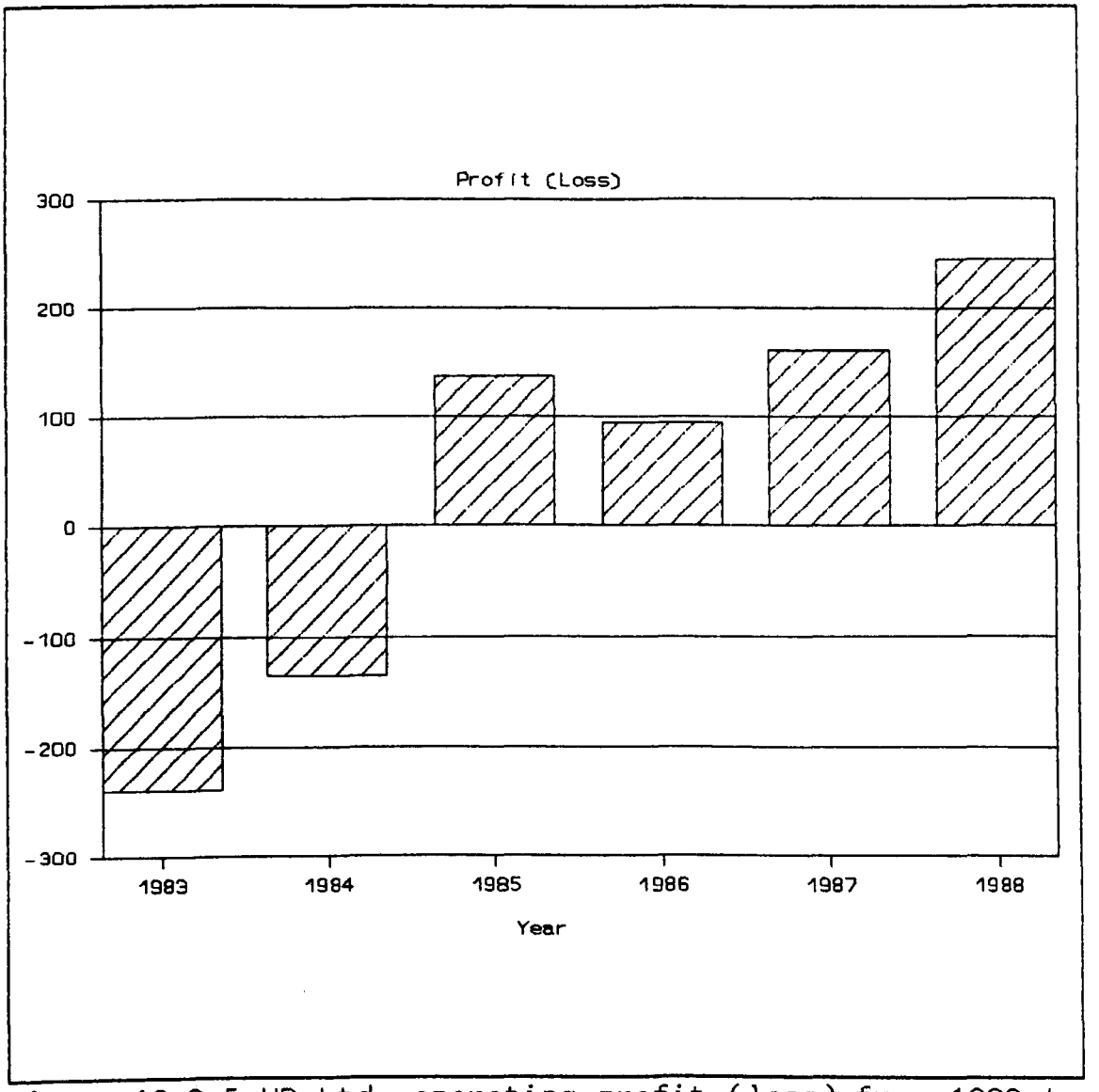

Figure 13.3.5 HR Ltd. operating profit (loss) from 1983 to 1988.
Sources: HR Ltd. Annual Reports.

Figure 13.3.4 is a bar graph showing the trend of the turnover to staff ratio of HR Ltd. It increased gradually from £23,000/staff in 1982 to £28,000/staff in 1988 (1988 prices). This could indicate that it has become more efficient since privatisation.

Figure 13.3.5 is a bar chart showing its operating profit (loss) from 1983 to 1988 (in 1988 prices). During the transition period (1982-84), it made a loss of £239,000 in 1983 and £134,000

in 1984. From 1985 onwards, it started making profit from its operations and by 1988, it had made a profit of £246.000. The reduction of government income in the near future will have an impact on its profitability unless it can develop new markets for its products/services.

13.3.8 Conclusion

The study shows that HRS was successfully privatised. The transition process was crucial but it enabled it to change and to adapt to its new status.

One of the greatest fears of HR Ltd. is the lack of a firm assurance by the Goverment to support its scientific research base. This policy of the Government is not expected to change in the forseeable future and this remains the most worrying aspect of the privatisation[4]: "The Board and management of the Company remain concerned about the level of support that can be expected from the Government for the strategic research programme that is the essential seed corn for the Company's future".

Because of the nature of HR Ltd.'s work, its main customers will always remain public bodies. The present policy of the Government of not funding what it "defines" as near-market research could affect HR Ltd. if it could not argue its cause with the DoE.

There is great scope to market its services worldwide. It will need to step up its marketing effort internationally especially so when threatened by the reduction in government income in the UK.

Privatisation may not be the only way to achieve management efficiency in the public sector although according to some criteria, it may have worked for HR Ltd. Like any change, it is not without its price and the greatest is probably the threat to scientific excellence and impartiality.

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13.4 Case Study - British Non-Ferrous Metals Research Association (BNF)

BNF was established in 1970 and it had over 400 members in 1970/71 including 76 overseas. BNF tried to broaden its marketing approach in the late 1960's to keep pace with the changing industrial climate it was confronted with. It saw that there was no longer the scope for the sort of basic injection of science into industry which had had a rapid and large pay-off before the war. The old concept of membership to support a general whole-front advance of technology had to change especially because industry was aware of the need to assure appropriate returns on expenditure. In 1990, BNF merged with FULMER to form BNF-FULMER.

13.4.1 Range of Activities

BNF's activities are:-

- contract research
- surface engineering, corrosion
- process and quality control and testing
- process development (powder metallurgy, metal refining, material forming, material joining)
- material development (magnetic materials, advanced alloys)
- casting technology (continuous casting, shape casting, metal matrix composites).

13.4.2 Statistical Comparisons

	1971	1988
Staff number	180	90
% scientists/engineers	N.A.	53%
Staff number ranking	9	21
Turnover in £m (1988 prices)	3.88	2.6
Ranking of turnover among RAs	N.A.	20
% income from government sources	20%	14%
% overseas income	15%	18%

N.A.= Not available.

Sources: BNF's Annual Reports.

13.4.3 Internal Audit

- BNF was overly dependent on membership subscription as a source of income. In 1970, over 50% of its income came in this form and was later reduced to around 19% in 1988.
- BNF was an industry-based RA and could therefore be affected by the performance of industry. It experienced difficulties in planning because it was influenced too much by the state of the industry it served.
- It had a narrow client base.
- It would need to increase its efforts in obtaining contract research and consultancy work and not over-emphasize speculative research.
- There was a need to consolidate its activities. There were areas to abandon and new ones to invest in.
- BNF was managed by a council structure that was outdated and suffered from a lack of continuity.

- BNF has a good source of income from the leasing of its property.
- BNF was reactive rather than proactive.

13.4.4 Environment

- BNF served an industry (non-ferrous metals) where most of the members have their own in-house R&D facilities.
- It was badly affected by the recessions in the mid 1970's and the early 1980's and did not recover from them. "In a year in which UK industrial activity slid sharply into recession, BNF's income rose by only 6%. Employment costs (...) rose by 17%"[1].
- It was affected by the Rothschild Principle, which stopped the automatic grant.
- It was affected by the value of the pound which went up as well as the interest rate. "Interest payments are becoming a significant item"[2].

13.4.5 Strategies Adopted

One of the difficulties experienced by BNF was the lack of decisions made with regard to its strategies. Throughout the last two decades, there was no concerted effort made to pull it out of the difficulties it was facing. The actions taken were to achieve short term goals and were incremental in nature rather than strategic. For instance, the decision to reduce staff was not coupled with longer-term plans as to what direction the organisation should aim for. Basically, the strategy it adopted in the 1970's and 1980's was one of retrenchment, which was used to regroup through cost and assets reduction in order to reverse its declining state. The savings from redundancies could have

been used to invest in new and more profitable areas and to diversify into areas like software, database, testing and accreditation as early as the the 1970's. Since it did not diversify into other areas, it was difficult for it to develop new markets for its products/services.

Towards the end of the 1980's, it was falling below a critical mass with only 90 staff out of which half were support staff and its only steady source of income was from the leasing of its property. If this situation had persisted, it would soon have had to liquidate itself.

In 1990, BNF made the decision to merge with FULMER. This strategy was suitable for BNF because:-

(1) It had fallen below a critical mass.

(2) A synergy was possible and could bring about the creation of new ideas.

(3) It would enable BNF to diversify into the broader areas of materials.

(4) With BNF having the site and FULMER, the cash, resources were complementary.

(5) It would open up new markets.

(6) There would be lower overheads.

(7) It would enable it to take on bigger and riskier projects.

It is yet too early to tell whether the merger has been a success or not. But among the difficulties it will have to face are:-

(1) the disruption during the transition period.

(2) changes in the organisation culture.

(3) leadership clashes.

13.4.6 Changes in BNF

(1) Organisational Structure

Before the merger, BNF had a divisional form of organisational structure which had advantages such as clear accountability and local control of local situations. But on the other hand, it was costly because of the duplication of staff services and facilities. BNF could have adopted a more flexible structure like the matrix form of management, but there was no need because of its small staff number. There was no problem of mobility and a task force could have been formed quite easily. After the merger, the new organisation will have to consider which form of organisational structure to adopt bearing in mind its goals and the complexity of reorganising.

BNF used to be managed by a Council which suffered from a lack of continuity and was unable to respond quickly to market needs and the changing environment. The Council failed in one of its most important functions i.e. to plan strategically. Planning was important to identify and take advantage of environmental opportunities and it would have allowed BNF to minimise the impact of environment threats.

After the merger, a Board of Directors structure was introduced. The Board consists of the Chairman of the old BNF Council, the BNF and FULMER research directors, the company secretaries and non-executive directors. The research shows that those RAs that have progressed well adopted a Board of Directors structure that came closer to being run in the style of contract research institutes. Adopting the Board Structure was inevitable with the membership side of BNF being fitted in differently and its importance in respect of policy much reduced. Now that the

new organisation has been forced to the market place to exploit its expertise, the staff ought to be delegated the authority to respond quickly to the market to take full advantage of the new constitutional arrangement.

(2) Leadership Provided

The leadership provided in this newly merged organisation will be crucial. It will need to establish and maintain stable and creative teams in the world of R&D and consultancy. It will need to promote the personal identification of its staff with the overall activities and interests of the RA by improving internal communications and encouraging collaboration between divisions.

Due to diverse internal and external forces, change will remain a fact of life for the new organisation. The leadership must create a work environment where change is recognised as necessary and beneficial, so that individuals can adapt to change more easily.

(3) Research Culture

The research culture of BNF was formed mainly by the old concept of an RA which was largely concerned with the general programme of cooperative work determined by its Council and financed by membership subscriptions and general government grant. This concept was appropriate from the 1920's to the 1970's, but it seemed far less relevant by the end of the 1970's.

Most member firms of BNF would carry out R&D because it yields an advantageous commercial benefit to them. For this reason, the most exciting and rewarding industrial research was

usually undertaken in their private laboratories rather than under the cooperative auspices of BNF.

The results of cooperative research could not equally be utilised by all member companies because of their different sizes, management skills, goals and objectives as well as their resources. Firms of different sizes and in-house resources required widely differing services from BNF.

The discrimination of certain sections of BNF's membership was inevitable, since it was impossible to run programmes of interest to everyone all the time.

BNF has recognised that the traditional RA formula of activity suffered from these and other weaknesses. It will need to change its research culture from one that was built on a specialised team to one that is accustomed to an interdisciplinary form of research. It will need to broaden its idea zone and the staff will have to be able to tackle interdisciplinary problems. BNF will need to change a research culture that is technology-driven to one that is commercially driven.

(4) Staffing

Figure 13.4.1 shows the trend in staff numbers of BNF from 1980 to 1988. From 1980 onwards, its staff number decreased continuously, falling from 170 in 1980 to 90 in 1988, due to the failure to recover from the impact of the recession in the early 1980's. BNF had to make redundant over 40 staff in 1984 and another 20 in 1987. Its staff number ranking among the RAs fell from number 9 in 1971 to number 21 in 1988.

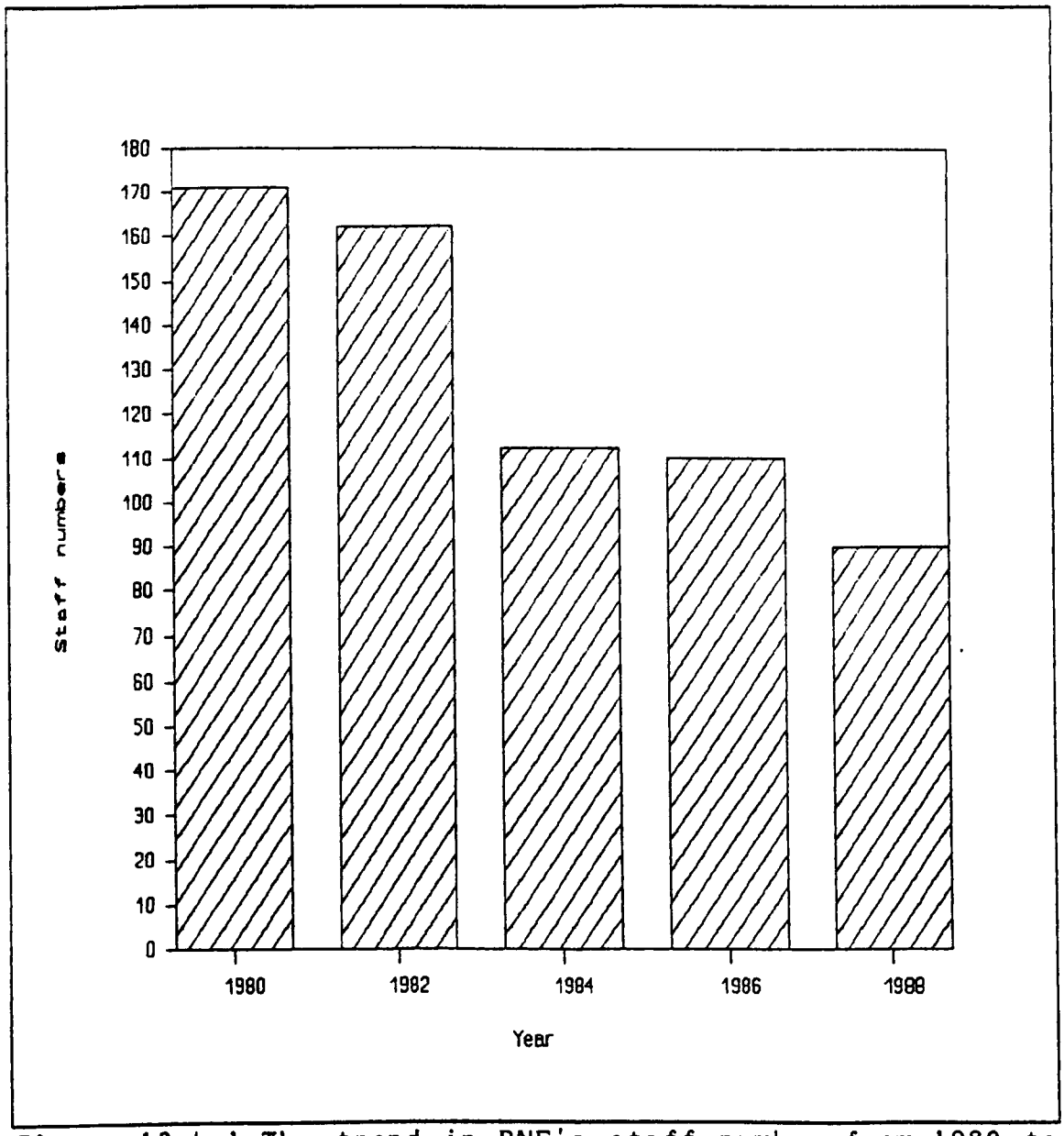

Figure 13.4.1 The trend in BNF's staff number from 1980 to 1988.
Sources: BNF's Annual Reports.

After the merger in 1990, the staff number increased to 180 and its ratio of scientists/support staff is expected to increase beyond 1:2. The increase in staff number could help to provide the nucleus for growth. BNF-FULMER is big enough to form clusters of experts and this would help to boost the morale of the staff.

The new organisation would need to focus on investment in training; the training programme ought to meet its technical, managerial and business needs and ensure that the skills gained

are fully utilised through the effective delegation of tasks and responsibility.

(5) Turnover

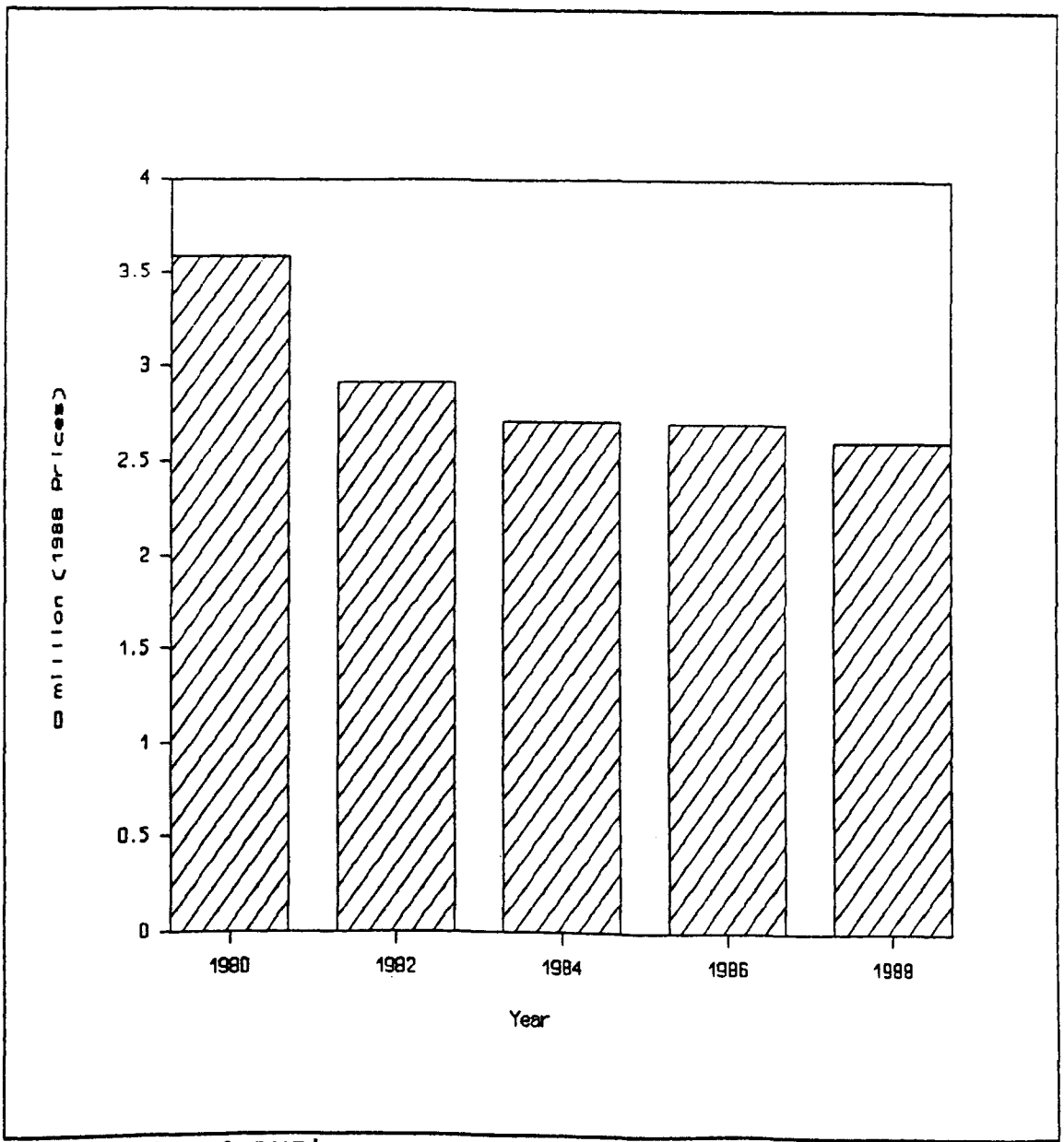

Figure 13.4.2 BNF's turnover trend from 1980 to 1988.
Source: BNF's Annual Reports.

Figure 13.4.2 shows a bar graph of BNF's turnover (in 1988 prices) from 1980 to 1988. It decreased continuously from 1980 onwards, falling from £3.58m in 1980 to £2.6m in 1988, i.e. there was a drop of over 27%. Its turnover in 1971 compared to 1988 fell by over 32%.

To operate successfully as a viable RA, the trend in the decreasing turnover has to be checked. It will necessitate a fundamental change in the business objectives and strategy of the newly merged organisation. Its marketing strategy will have to be more clearly focused on maximising sales and revenue by identifying more high-value income opportunities, converting these into sales and efficiently operating the resulting projects to a high level of quality. Everybody in the new organisation, led by its senior management, must recognise these requirements and be motivated to maximise sales and revenue. Selling and marketing must be given a very high visiblity, including setting individual sales and revenue targets to marketing staff and technical centres, and rewarding people for meeting their targets. In this context, government departments should be regarded as clients in exactly the same way as commercial clients.

(6) Membership

BNF-FULMER needs to evaluate its concept of membership which was centered on the fund-raising function. In 1988 alone, BNF's membership subscription amounted to 20% of its turnover in comparison to the average among RAs of 10%. For most RAs, membership is becoming less important than in the past. Nevertheless, subscription income is still more reliable over a longer period than money derived from specific work. The function of BNF's membership would need to be questioned in the light of the difficult years its members went through during the last decade.

BNF-FULMER will need to change the idea of membership which gave an apparent, but no real right of control. Its replacement by a more practical membership where the prime right is simply preferential access to RA services, could prove beneficial. Membership subscription could provide basic services like particular information, library and small technical services. Beyond these, the members would have to pay individually for them. BNF(-FULMER) might need to broaden its membership base to cover a wider range of industries, review its subscription rates and not overly depend on these subscriptions to fund its research programme.

(7) Services/Products

Before the merger in 1990, BNF was an industry-based RA and, in comparison to other such RAs, could not overcome the disadvantages of being one. One of its failures was not to widen its market or create its own niche markets. For example it did not invest in areas like computing software or database. Another area it failed to diversify in was the area of testing/accreditation and it was not a NATLAS accreditated centre until its merger.

BNF-FULMER will need to consider integrating its research programmes e.g. rather than just dealing with a particular kind of equipment, BNF-FULMER could consider forward integrating by marketing the product or backward integrating by looking into the process the equipment operates in. This will provide not only extremely valuable experience and feedback to the R&D staff but, where required, a route for clients through from concept to production within the one company. This could help BNF to secure

the initial R&D contracts and to provide a sensible route for growth and development. But it would need to avoid having too wide a focus, which could incur high maintenance costs, or being too thinly spread.

BNF concentrated too much on the longer-term pre-competitive research funded by subscriptions and government income. This form of research has limited opportunities for attracting higher fee rates. Product development, however, which is much closer to the market, can attract significant income. Furthermore, this form of research tends to be run as club projects which have high hidden sales and marketing costs. This does not mean that BNF-FULMER should neglect research which is in support of development and application and concentrate just on product development because the former differentiates BNF-FULMER from other research organisations besides creating opportunities for follow-up research.

(8) Marketing Function of BNF-FULMER

BNF-FULMER needs to adopt a higher profile through publicity campaigns. These campaigns require greater focus and should concentrate on the industry sectors and technologies it has targeted including those of strategic importance. It is essential that the awareness of the importance of marketing within the organisation is promoted through training programmes and involving operating staff.

Unless BNF-FULMER has unique, differentiating features, it will often be competing in price-driven markets. Routine testing is an example of a price-driven market, where it is necessary to undercut competitors to secure a job which then has to be

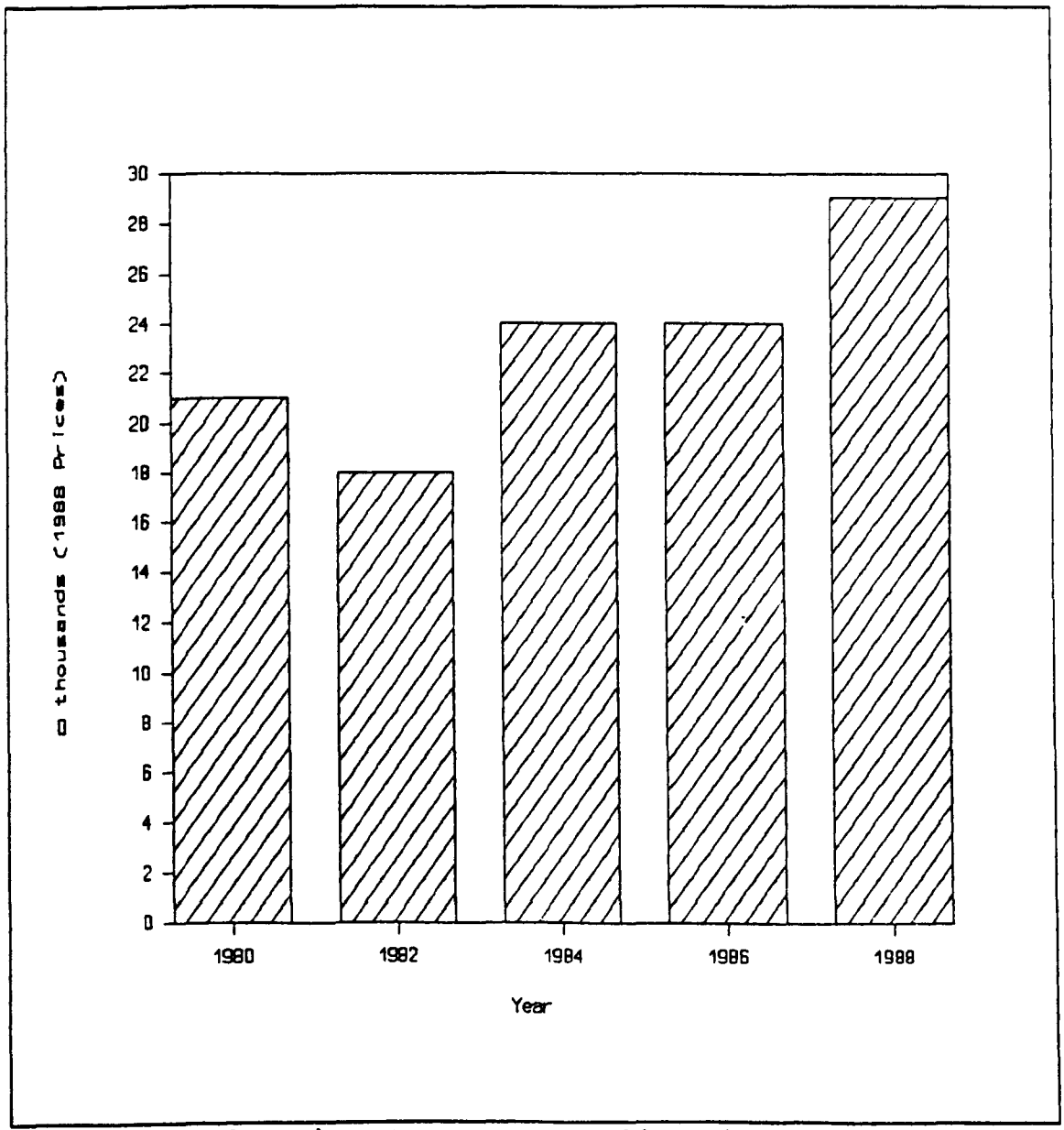

Figure 13.4.3 BNF's turnover to staff ratio from 1980 to 1988 (1988 Prices).
Sources: BNF's Annual Reports.

operated at low (or even negative) margins. Unfortunately, contract R&D in general has many of the characteristics of this type of market. Very often the potential client judges costs on his own internal R&D costing system, which usually underestimates his true costs. This is why it is essential for BNF-FULMER to develop higher-value driven markets. Only then will it have control over pricing and margins.

One important marketing function which it will need looking into is its publicity. It will have to project the image of a centre of excellence with expertise to offer to industry and to dispel the image of an academic centre.

(9) Financial

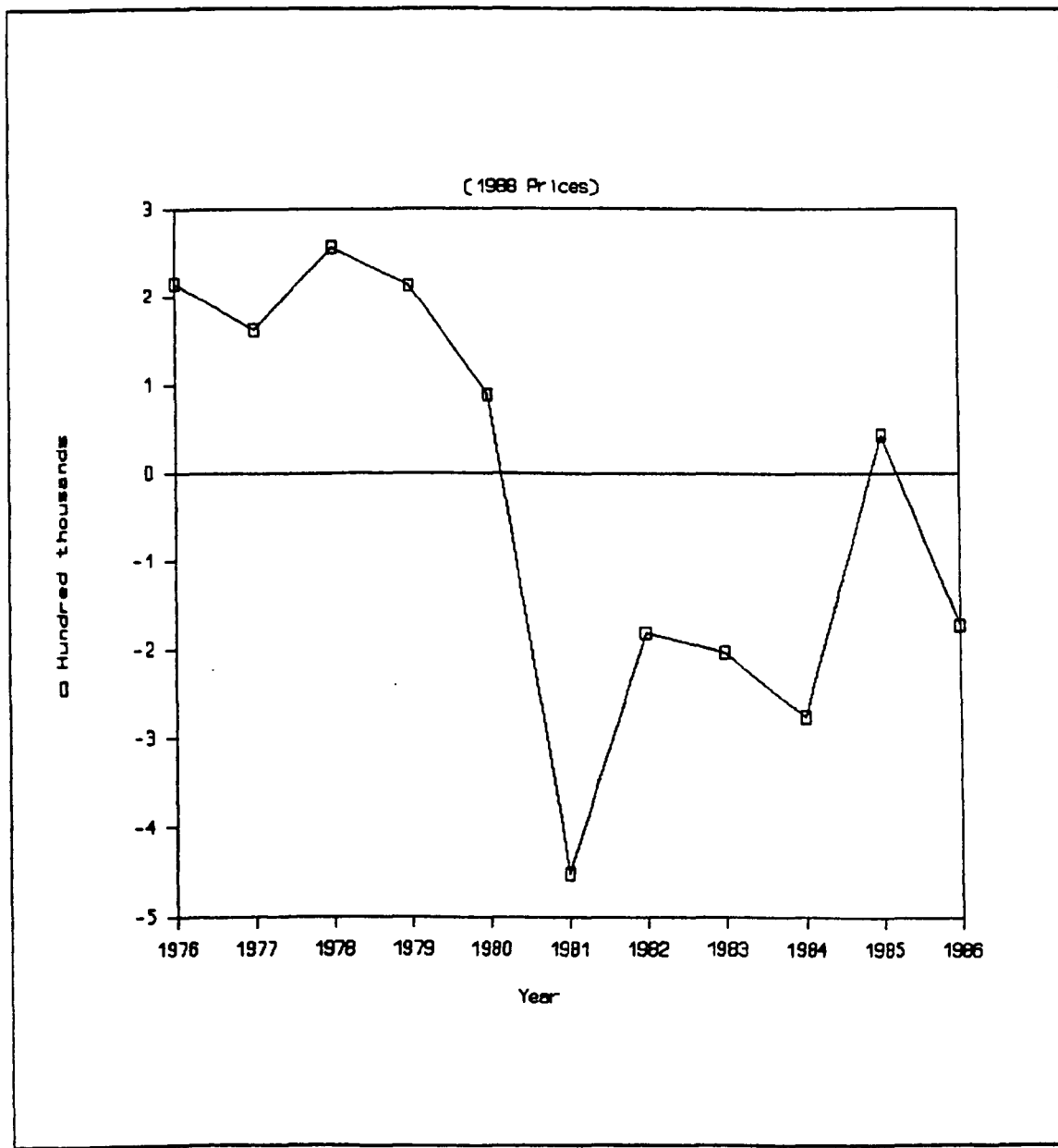

Figure 13.4.4 BNF's trend in operating profit (loss) from 1976 to 1986 (1988 Prices).
Sources: BNF's Annual Reports.

Figure 13.4.3 shows the trend in the turnover/staff ratio of BNF from 1980 to 1988 (in 1988 prices). The ratio dropped to its lowest point in 1982 with £18,000/employee and increased to £24,000/employee in 1984 after having made 40 staff redundant in that year. By 1988, it had increased to £26,000/employee after making redundant another 20 staff.

Figure 13.4.4 shows the trend in operating profit (loss) of BNF from 1976 to 1986. BNF made a profit from 1976 to 1980 but suffered losses continuously thereafter. Once again it manifests that BNF did not recover from the impact of the recession in the early 1980's. There are no figures to show its operating profit/loss in 1987 and 1988 but it is estimated that it broke even in these two years, brought about by the reduction in staff number in 1987 and the income from leasing its property.

13.4.7 Conclusion

BNF was overly dependent on the non-ferrous metal industry and was thus affected by the difficult period that hit the industry. The merger with FULMER could help it to widen the range of industries it serves and transform it from an industry-based RA to a technology-based one.

One of its failures was that it did not create a niche market of its own within the industry it served. Instead, it tried to cover the whole spectrum of the research needs.

The maintenance of a high standard of technical excellence will be essential to sustain long-term commercial success. The business must, however, be market-led and not technology-led. On an individual staff basis, the organisation culture will need to change from one that is narrow in its concept zone to one that

is wider and more flexible, commercially driven and able to tackle interdisciplinary problems.

BNF was one of the few RAs managed by a council structure until it merged with FULMER. After the merger, a Board of Directors was appointed, giving it greater control and the ability to respond more quickly to market needs.

BNF will need to review the function of its membership in line with its decision to serve a broader range of industries after the merger. This could be a good opportunity to widen its membership base, review its subscription rates and be less dependent on subscriptions to fund its research programme.

There is a short supply of competent and qualified engineers and technicians especially so in the 1990's and this will mean that job sharing and greater attention must be given to well-planned staff training and development. One area which the newly merged organisation will need to look into is the limited career paths for its staff in the latter part of their career within the organisation.

The new leadership will need to develop and sustain a winning attitude by raising the staff's morale, emphasising teamwork and establishing greater confidence in its abilities through positive recognition of achievement - technical, managerial and business.

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1. Chairman Statement in: BNF Annual Report 1979, p. 5.

2. Chairman Statement in: BNF Annual Report 1979, p. 5.

CHAPTER FOURTEEN

14.1 Conclusion

14.1.1 RAs' Environment

Hostile Government Policy

(a) Income from Government has been increasingly difficult to secure, causing uncertainty among RAs (see 9.2.2 and 9.4). Some RAs have moved away completely from being dependent on government support.

(b) Government policy, in particular the Rothschild Principle and the DTI White Paper on Enterprise, has forced the RAs to be more commercially minded and brought about greater accountability to their customers (see 9.2). These have changed the mission of RAs fundamentally (see 9.2.1).

(c) The launching of the Enterprise Initiative in 1988 brought about great difficulties for the RAs in the initial stage when the DTI was adjusting to the new guidelines for the approval of funding (see 6.4 and 9.2.2).

(d) The Enterprise Initiative emphasised collaborative research and played down cooperative research with the consequence that the smaller RAs with a large membership from SMEs were affected (see 9.2.3).

(e) The speed of change of government policy towards RAs has prevented RAs from planning strategically (see 9.2 and 9.3).

(f) Defence contracts have become uncertain. The RAs dependeding on them have been severely affected (see 9.4).

(g) Privatisation has brought about more competition as well as opportunities (see 9.5).

Instability Within DTI

(a) The instability within DTI has made it more difficult for RAs to plan on a long-term basis (see 9.3 and Chapter 6).

(b) One major setback of the RBs was the diversity and width of research programmes under their responsibility (see 9.2.1 and 6.3).

(c) The implications of replacing general grants by money given for specific contracts for the Government have made the RAs more competitive and responsive to the market (see 9.6).

The Industry

(a) The private industry in the UK did not see the period 1967-1985 as one where consumer demand or international competition required an increased investment in R&D. Only from 1983 to 1988, there was a continuous increase in industrial R&D expenditure (see 9.7.2 and 5.3). The RAs had to compete very hard to obtain industry income.

(b) There has been an increasing trend in out-sourcing of research by industry and this has benefited the RAs (see 9.7.3).

(c) The short-term financial outlook has prevented the British industry from investing enough in R&D. This has made the task of securing research contracts from industry more difficult for the RAs (see 9.7.5). Takeovers and mergers have affected the RAs as well.

(d) The area of training and retraining will be an area of growth for the RAs (see 9.7.9).

(e) RAs serving mature industries have not performed well (see 9.7.4).

Competition And Collaboration

(a) The RAs in the UK have faced unfair competition from CROs in the EC (see 9.7.8).

(b) The RAs' competitors have been research organisations, government laboratories, universities and members' own research laboratories (see 9.8).

(c) Collaborative research with universities has been important for the RAs (see 9.9). Collaboration with CROs in the EC is of growing importance.

General Economic Situation

(a) The RAs were hit hard by the general economic situation e.g. the recessions in the mid 1970's and the early 1980's, the fluctuation in exchange rates and high interest rates (see 9.1).

(b) The pace of technology and global competition have helped to increase research opportunities for the RAs (see 9.7.6 and 9.7.7). Global competition has helped to increase the overseas support for the RAs.

14.1.2 Internal Audit

RAs' Income

(a) The first decade after the implementation of the Rothschild Principle, the RAs' income from the Government paradoxically increased but it gradually dropped after that (see 1.2 (c)). Income from government sources dropped from 32% to 17% of their total turnover over the last two decades. In real terms (1988 Prices), it decreased from £31m to £26m (see 8.2.6).

(b) The income from government has been crucial for RAs (see 10.4.3). The bid for income from government sources has become more competitive.

Increasing Support From Industry

(a) Income from industry increased dramatically from £63m (1988 Prices) in 1970 to £128m in 1988 (see 10.4.3 and 8.2). In terms of percentage of turnover, it increased from 68% to 83%.

The Weaknesses of The Councils

(a) The Councils did not undertake the task of planning well, they were too large and suffered from a lack of continuity (see 10.1.1). The structure of the Council was also unsuitable due to the change of accountability of the RAs from the Government to the market (see 10.1.1).

(b) The RAs were prevented by the Council from expanding their membership base (see 10.1.1).

The Clearer Role Of Membership

(a) The concept of membership is still important to RAs (see 10.7).

(b) The member companies have lost control of the RA's research programme (see 10.7.1).

(c) Only a small proportion of SMEs were members of RAs (see 10.7.2).

RAs' Structure And Leadership

(a) The most common organisational structure that has been adopted by RAs is a divisional structure (see 10.1.2). This form has not made optimised use of the RAs' assets.

(b) The leadership provided by the RAs' Directors helped the RAs through in the last two decades (see 10.2.1).

RAs' R&D Programmes

(a) The general programme of cooperative work determined by the Council became insignificant (see 10.2.1).

(b) The RAs did not exploit their R&D programmes or products fully (see 10.8).

(c) Collaborative research has been easier to organise among companies who are familiar with research. Among SMEs, this form of research has been less popular and cumbersome to organise (see 12.4.1 and 9.2.3).

(d) The RAs faced problem in obtaining industrial support for collaborative projects (see 10.8).

Staffing Difficulties

(a) The size of some RAs has fallen dangerously below an optimum size (see 10.3 and 8.15).

(b) The RAs have encountered problems of recruitment and a high turnover of staff (see 10.3 and 8.14). The single market in 1992 could create even greater shortages brought about by the greater financial incentives of working in Continent Europe.

Marketing

(a) The concept of Quality Assurance was new to RAs. They did not consider Quality Assurance in the context of their marketing strategy (see 10.4.2 and 12.4.5).

(b) The RAs did not develop higher value-driven markets and consequently did not have control over pricing and margins (see 10.5.1).

(c) The RAs have dispelled the image of an academic centre and have projected an image of centres of excellence with expertise to offer to industry (see 10.5.3).

(d) Technology based RAs performed better than industry based RAs (see 10.6 and 8.15). Smaller RAs risked closure.

(e) Some RAs were in danger of over-diversifying (see 10.8).

(f) The RAs have not changed their marketing structure in order to capitalise on the opportunities of selling the combined resources of more than one division within the RAs (see 12.5.2 and 10.4).

(g) The RAs did not have an effective information management system (see 10.4.1).

RAs' Facilities

The problems of space and location of RAs' facilities have been quite acute for some RAs (see 10.10).

14.1.3 RAs' Strategic Choices

Strategies Generated

The strategies that have been available to RAs are merger, forward integration, concentric diversification, conglomerate diversifiation, joint ventures, market development, market penetration, retrenchment, liquidation, divestiture and a combination (see 11.5).

Evaluation And Strategies Adopted

(a) The RAs that merged have performed better than having to remain on their own (see 11.5.1). Merger is a good strategy for the smaller RAs i.e. those whose staff number is below 100

(see 8.1.5). Mergers are inevitable in the near future.

(b) Forward integration has been rarely adopted. It appeals only to the stronger RAs with good cash flows (see 11.5.2). It is a worthwhile strategy to consider for the future among the stronger RAs.

(c) Concentric diversification has been adopted by all the RAs in attempting to exploit their potential fully (see 11.5.3).

(d) The RAs that served a particular and problematic industry have had to diversify conglomerately (see 11.5.4). This is a risky strategy. The smaller RAs, among them, would need to merge before adopting this strategy.

(e) Joint ventures have been a good strategy in venturing into new overseas markets (see 11.5.5).

(f) A combination of market development strategy and joint ventures has been an effective way of expanding into new geographic areas. The RAs would need to have the necessary capital and human resources to implement this strategy (see 11.5).

(g) It has been difficult for RAs to adopt the market penetration strategy in a saturated market like the UK (see 11.5.7). This strategy has not been popular among RAs.

(h) Retrenchment has been carried out by every RA (see 11.5.8). This strategy has been inevitable due to the problematic and uncertain environment it has been operating in.

(i) Liquidation has been adopted by RAs with fixed assets to improve their cash-flow (see 11.5.9). The cash generated has been crucial in some cases to keep the RAs going or to fund their new strategies. The divestiture strategy has been used to eliminate a misfited division within an RA.

(j) The RAs have not adhered to only one particular strategy but to an amalgation of two or more concurrently (see 11.5.11).

(k) The selection of strategies among RAs has been carried out on an incremental basis and sometimes with the help of outside consultants (see 11.4). Planning has been an important function of the executive, especially so in the last decade.

14.1.4 Changes In The RAs

Major Organisational Changes

(a) The RAs have been given a considerable amount of freedom and autonomy by the Councils to take specific steps to ensure that the RAs would be able to compete in the market (see 12.5.3).

(b) Some RAs e.g. WRc have adopted structures, e.g. Matrix Management, that have enabled them to operate across their activities (see 10.1.2).

(c) The responsibility for the management of the RAs was shifted from the Councils to Boards of Directors (see 12.1.1; 10.1.1 and 12.5.3).

(d) Some of the organisational structures of the RAs have not changed in response to the changing environment. Consequently, they have not been able to respond quickly to the market needs (see 12.5.1).

RAs' Status

The majority of the RAs have maintained their Limited by Guarantee status (see 12.1.1). Only two RAs changed their status to one that is Limited by Shares (see 12.1.2), which signalled the complete break from the "RA principle" for them. If these two RAs are successful, others might be pressured to change their status as well.

Outdated Objectives

The RAs' objectives are outdated (see 12.2). The pursuit of these objectives have caused difficulties for the RAs. Some RAs have begun restating their objectives.

Alteration In RAs' Income

(a) The dependence of government income has been reduced significantly (see 12.3.1). Some RAs have over-depended on government income.

(b) The income from overseas has increased significantly from £3.75m in 1970 (1988 Prices) to £21m in 1988 (see 12.3.2). This reflects the internationalisation of the RAs' activities.

(c) In real terms, the turnover of the RAs increased significantly but it dropped slightly in terms of the percentage of total R&D expenditure in the UK and the total industry expenditure in the UK (see 12.7).

RAs' Attitude Towards Marketing

(a) The RAs have adopted a higher profile (see 12.3.4) and have been more proactive (see 12.3.5). The RAs have been aware of the need to influence their clients.

(b) Some RAs have exploited their individual differentiating features to add more value to their services or products (see 12.3.7).

(c) The RAs have widened their market base (see 12.3.9). They would have faced difficulties serving only their traditional market sector due to intense competition.

(d) The RAs' activities have moved towards near-market (see 12.4). The biggest increase of income has come from contract research.

(e) The RAs that had over-diversified have been consolidating their position to avoid spreading their resources too thinly (see 12.4.4).

(f) Some RAs have introduced a custom-made information system to cope with the growing complexity of their operations (see 12.5.4).

(g) The RAs have projected an image of being independent from any single source and able to carry out confidential research (see 12.6.1).

(h) Some RAs have intensified their regional presence (within the UK and overseas) (see 12.3.3).

Changing Concept Of Membership

(a) The RAs' total income from membership did not change too much between 1970 and 1988. In 1970, it constituted about 23% of the total turnover and in 1988 it dropped to around 17%. In real terms (1988 prices) it increased slightly from £25 million in 1970 to £27 million in 1988 (see 8.3 and 8.2.6). The role of membership as a source of income has declined (see 12.3.6).

(b) Although the concept of membership has no more solely a fund-raising function, it helps to provide an element of continuity, some financial bedrock and helps in marketing purposes.

RAs' Research Programmes

(a) Collaborative research is increasingly important to help boost their core research (see 12.4.1) and the general programme of R&D has become less significant (see 12.4.2).

(b) The general research programmes of the RAs which have helped to form their core research programmes have been threatened by

the uncertainty of government income and a shift towards near-market research by the RAs (see 12.4.2 and 12.4.3).

(c) The activities of RAs have changed from being technology-driven to being customer-driven (see 12.4.3) and the RAs have had to adopt an interdisciplinary approach to meet these demands.

(d) Testings, accreditation and consultancy have become increasingly important as vital sources of income for the RAs (see 12.4.3).

(e) The RAs have begun to treat HEIs as collaborators rather than competitors (see 12.3.8).

RAs' Culture

The culture of the RAs' staff members has changed to one that is more commercially minded and flexible (see 12.6.2).

Staffing

(a) The overall staff numbers changed slightly but the average number of staff per RA increased from 128 to 167 (see 12.8 and 8.1.1).

(b) The average turnover to staff ratio of RAs increased from £16,000/employee in 1970 to £28,000/employee in 1988 (see 8.1 and 10.9). This indicates that the RAs are becoming more efficient.

(c) The number of RAs employing 10-150 employees decreased significantly due to the difficult environment they were operating in. The numbers might continue to decrease in the future (see 8.1.7).

(d) In 1971, 63% of the number of RAs employed 33% of the workforce. In 1988, 52% of the number of RAs employed only 19% of the workforce. This reflects the widening gulf between the RAs (see 8.17).

14.2 Recommendations

14.2.1 A More Encouraging DTI's Policy

(a) The DTI ought to have a clear and stable policy towards RAs, recognise that the RAs are effective agents of technology transfer and encourage them to play that role (see Central Unit Report in appendix 14.1).

(b) The RAs have had problems trying to adapt to the changing policy of the DTI towards R&D. Since R&D is a long-term business for the RAs, it is essential that there is stability within the DTI and OGD (see 9.3).

(c) Now that most of the DTI research contracts are open to competitive tendering, the maximum support of up to 25% of the RAs' turnover by DTI ought to be scraped (see 9.2).

(d) The DTI could assist in increasing its funding beyond 50% of the cost of a feasibility study (see App. 1.6, MIRA). If the outcome of this study shows a high probability of success, the DTI could fund up to a maximum of 50% for the follow up research.

(e) Support cooperative research in RAs which are catered for the SMEs.

14.2.2 RAs' Position Towards Government Funding

The RAs should prepare themselves for further contraction of government support and greater stringency in the future mainly by increasing the volume of business of their industrial contracts.

14.2.3 Impact Of Privatisation

The RAs should carefully study the impact of privatisation on them and identify the possible opportunities and threats (see 4.7).

14.2.4 The Management of RAs

(a) The decision by RAs to shift the management responsibilities to Boards of Directors has helped to tackle the question of accountability. RAs which have not done so should consider this decision seriously.

14.2.5 Attention To Core Research

(a) In the last two decades, the RAs' core research has been one of the areas most threatened (see 12.4.3). No matter how far the RAs go in making their work directly commissioned, there should always remain the need for a certain core of quite basic work not executed in response to direct industrial demand.

(b) Collaborative research could form part of the core research programmes of an RA.

14.2.6 Change In Corporate Status

In planning strategically, the RAs ought to consider a possible scenario where they might have to change their status to Limited by Shares (see 12.1).

14.2.7 RAs' Products And Services (see 12.4)

(a) In order for the RAs to increase their commercial opportunities, they should:

- not just confine themselves to explaining the technology to their clients but to also to assist the clients in exploiting it.
- be task-oriented rather than skill-oriented. This would mean having to tap the capabilities across the RA rather than within the individual division.

- accustom themselves to carrying out shorter timescale programmes. This would mean having to cope with a high turnover of contracts and being able to deliver these contracts on time and give value for money.
- expand their capability beyond one that is confined to analysing the components in a system to one that analyses the system.

(b) consider combining testings and consultancy work since consultancy adds value to testings on its own.

(c) exploit the market for testings and accreditation of materials and equipments since the RAs are recognised as independent laboratories, the results of which can be quoted.

14.2.8 A Commercial Work Culture

(a) The RAs should continue building up a commercial culture among their staff members that emphasizes an interdisciplinary approach to solutions which is task-oriented rather than skill-oriented. They should encourage greater flexibility rather than to remain confined to a narrow concept zone and be commercially-driven rather than technology driven.

(b) The RAs ought to set up creative teams, promote the personal identification of staff with the RAs' activities, raise the morale of the staff, focus investment on training and help the staff to adapt to the changing environment (see 10.2).

(c) RAs which were formerly GIREs would have to discard the civil service culture and inculcate a commercial one.

14.2.9 A Stronger Representation

The RAs would need to maintain a high profile within the DTI and AIRTO could play this role (see 7.8, 12.3.5 and 12.3.4). Although AIRTO may be a good representative, the RAs have to be aware that the AIRTO members are divided into two camps i.e. the CROs which are profit-making and RAs which are not profit-making.

14.2.10 Effective Marketing Strategy (see 12.3)

(a) The RAs should continue to internationalise their market especially so when the competition in the UK market is increasing. The overseas link will also be of great importance to RAs because of the nature of R&D which is becoming global.

(b) The RAs should play a more pro-active role in the market and try to influence their clients more.

(c) The RAs should build a good portfolio of near-market research.

(d) The RAs should emphasise and capitalise on their differentiating features with other competitors in order to add more value to their services and products.

(e) They could widen their membership.

(f) The RAs could expand their market base. In the case of RAs which are too diffused, they would need to focus their activities instead.

(g) The RAs should consider implementing a quality policy to give a clear signal to clients that it makes the achievement of quality a high priority (see 10.4.2 and 12.4.5).

14.2.11 Reviewing RAs' Objectives

In order to prepare themselves for the 1990's, the RAs will have to re-state their objectives. They have to ask themselves what their organisation should be doing and why it exists and redefine the organsisation's business (see 7.2 and 12.2).

14.2.12 Opportunities for RAs

Training and retraining will be a priority for industry in the 1990's (see App. 1.6, PERA). The RAs should capitalise on this opportunity and organise a range of courses tailored to the needs of individual companies and help industry to implement long-term human resource strategies (see 9.7.9).

14.2.13 Approach Towards HEIs

(a) The RAs ought to avoid activities that come into direct competition with HEIs and GIREs because the latter can bid for contracts at lower prices (see 9.8, 9.9 and App. 1.6 on LEA).
(b) Collaborative work with the HEIs should continue as it can attract government and industrial funding. It gives the RAs access to a level of a more fundamental research, lower costs for certain work and ongoing training for research staff (see 9.8 and 9.9).

14.2.14 Indispensable Need For Information Systems

The RAs ought to examine the viability of setting up information systems to cope with the demand on their services (see 10.4.1 and 12.5.4).

14.2.15 Organisational Structure

(a) The divisional structure is the most common among RAs and it has serious disadvantages (see 10.1.2). In reviewing their organisational structure, the RAs should consider a structure that offers them:

- greater flexibility in the use of resources
- the elimination of activity duplication
- the reduction in the tendency to protect an empire
- the development of responsibility to front line management
- better career opportunities
- more flexibility in working practices.

(b) Problem of peaks and troughs could be eliminated through proper project management or the introduction of matrix form of management (see 12.5.1).

14.3 Future Research

Future research could have the following goals:

* to investigate how the RAs can improve their role as a bridge between universities and industry. The role of RAs as agents of technology transfer could also be examined.
* to analyse how the RAs can improve the collaborative activities with their EC counterparts. The role of the European Commision can also be examined within this context.
* to explore the attitudes of the RAs' members towards the RAs. It would also be interesting to find out how the industry view the RAs as R&D contractors in comparison with other contractors.
* to study in detail the impact of the DTI White Paper on Enterprise on the RAs.

* to investigate the viability of RAs adopting the Limited by Shares status and the impact this action has on the R&D market in the UK.

* to look into the possibility and the viability of merging the smaller RAs.

Appendix 1.1

List of Non-Grant-Aided RAs and Contract Research Organisations (1971)

Non-Grant-Aided RAs

(1) Cement and Concrete Association

(2) Aircraft Research Association

(3) Natural Rubber Producers Research Associations

(4) Tin Research Institute

(5) British Internal Combustion Engine Research Institute Ltd.

(6) The Motor Insurance Repair Research Centre

(7) Shipowners Refrigerated Cargo Research Organisation

(8) Institute of Brewing

(9) Permanent Magnet Association

(10) La Mont International Association Ltd.

(11) Microsurgical Instrumentation Research Association Ltd

(12) UK Panel on Gamma and Electron Irradiation

Contract Research Organizations in the UK (1970)

(1) Huntingdon Research Centre

(2) Ricardo and Co. Ltd.

(3) Fulmer Researc Institute Ltd.

(4) Inveresk Research International

(5) Hazleton UK

(6) Cambridge Consultants

(7) PA Technology

(8) LIFE Science Research

(9) NEI International

(10) W S Atkins Engineering

(11) Smiths Associates

Sources: (1) The Report of the Committee of Enquiry into the Research Association: Industrial Research Development. London: Conference of Industrial Research Associations 1973, p. 194f.

(2) Commission of The European Communities: Contract research organizations in the EEC. Luxebourg: Commission Of The European Communities 1989, p. 54.

Appendix 1.2

List of Grant-Aided RAs in 1970[1]

ASLIB	Association of Special Libraries
BBMRA	British Brush Manufacturers Research Association
CAMP	Campden Food Preservation Research Association
BCIRA	British Cast Iron Research Association
BCR	British Ceramic Research Association
CTRA	Coal Tar Research Association
BCO	British Coke Research Association
CIRIA	Construction Industry Research and Information Association
SI	Shirley Institute (Cotton, Silk, Man-made Fibres Research Association)
CAT	Cutlery and Allied Trades Research Association
DFRA	Drop Forging Research Association
DCRA	Dyers and Cleaners Research Organisation Ltd.
ERA	Electrical Research Research Association
FMBRA	Flour Milling and Baking Research Association
LEA	Leatherhead Food Research Association (British Food Manufacturing Industries Research Association
FIRA	Furniture Industry Research Association
BGI	British Glass Industry Research Association
BRA	Building Services Research Information Association (Heating and Ventilating Research Association
HATRA	Hosiery and Allied Trade Research Association
BHRA	British Hydromechanics Research Association
BIG	British Industrial Biological Research Association
LAM	Lamberg Industrial Research Association
BLRA	British Launderers Research Association

[1] The former names of the RAs are indicated in bracket.

BLC	British Leather Confederation (British Leather Manufacturers Research Association)
AMTRI	Advanced Manufacturing Technology Research Institute (Machnine Tool Industry Research Association)
MIRA	Motor Industry Research Association
NIIP	National Institute of Industrial Psychology
BNF	British Non-Ferrous Metals Research Association
PR	Paint Research Association
PIRA	Paper and Board, Printing and Packaging Industries Research Association
PERA	Production Engineering Research Association
RAPRA	Ruber and Plastics Research Association
BMT	British Maritime Research Association (a merger of British Shipping Research Association and the National Maritime Institute)
SATRA	Shoes and Allied Trade Research Association
SIRA	Scientific Instruments Research Association
SRA	Spring Research Association
SCRATA	Steel Castings Research and Trade Associations
TRADA	Timber Research and Development Association
WRC	Water Research Centre (Water Research Association)
WI	Welding Institute
WHRA	Welwyn Hall Research Association
WIRA	Wool Industry Research Association

List of Grant-Aided RAs in 1988

CAMP	Campden Food Preservation Research Association
BCIRA	British Cast Iron Research Association
BCR	British Ceramic Research Association

CIRIA	Construction Industry Research and Information Association
CAT	Cutlery and Allied Trades Research Association
ERA	Electrical Research Research Association
LEA	Leatherhead Food Research Association (British Food Manufacturing Industries Research Association
FIRA	Furniture Industry Research Association
BGI	British Glass Industry Research Association
BRA	Building Services Research Information Association (Heating and Ventilating Research Association
HATRA	Hosiery and Allied Trade Research Association
BHRA	British Hydromechanics Research Association
LAM	Lamberg Industrial Research Association
BLC	British Leather Confederation (British Leather Manufacturers Research Association)
AMTRI	Advanced Manufacturing Technology Research Institute (Machnine Tool Industry Research Association)
MIRA	Motor Industry Research Association
BNF	British Non-Ferrous Metals Research Association
PR	Paint Research Association
PIRA	Paper and Board, Printing and Packaging Industries Research Association
PERA	Production Engineering Research Association
RAPRA	Ruber and Plastics Research Association
BMT	British Maritime Research Association (a merger of British Shipping Research Association and the National Maritime Institute)
SATRA	Shoes and Allied Trade Research Association
SIRA	Scientific Instruments Research Association
SRA	Spring Research Association
SCRATA	Steel Castings Research and Trade Associations
TRADA	Timber Research and Development Association
WRC	Water Research Centre (Water Research Association)

WI	Welding Institute
BTTG	British Textile Technology Group (merger of SI and WIRA)
BNF-FULMER	a merger of BNF-FULMER
FMBRA	Flour Milling and Baking Research Association
FCR	Fabric Care Research Association

Sources: (1) The Report of the Committee of Enquiry into the Research Association: Industrial Research Development. London: Conference of Industrial Research Associations 1973, p. 194f.

(2) AIRTO: A guide to the members of the Associaton of Independent Research and Technology Organizations (1989).

Appendix 1.3

List of RA Director / Representative interviewed

RA	Represented by	Position
WI	Mr. A Braithwaite	Managing Director
	Dr. R Dolby	Director, Research
BMT	Mr. Dennis Jeffrey	Commercial Dir.
HR Ltd	Dr. T Weare	Managing Director
WRC	Mr. R Fellow	Asst. Director
	Mr. D Procter	Contract Manager
BHRA	Mr. J Muir	Finance Director
BNF	Dr. C Steiner[1]	Marketing Manager
SATRA	Mr. J Butlin	Director and Chief Executive
SIRA	Mr. S Cole	Director, Research
LEA	Dr. A Holmes	Managing Director
PIRA	Mr. B Blunden	Managing Director
PERA	Mr. B Blackwell	Business Manager
MIRA	Mr. R Stirley	Head of Business Development
BTTG[2]	Dr. D Jones	Business Manager
RAPRA	Dr. B Lindley	Director
SRAMA	Mr. J Bennet	Director
JUTERA	Dr. H Stout	Director

[1]Who is also the Marketing Manager of BNF-FULMER.

[2]A merger of SI and WIRA.

List of RAs' Representative interviewed by phone

RA	Represented by	Position
HATRA	Mr. B Johnson	Dir. of Commercial Ser.
AMTRI	Mr. I Bruce	Dep. Chief Exe.

List of UK CROs' Representative Interviewed

CRO	Represented by	Position
FULMER	Dr. E Duckworth	Managing Director
HAZ	Dr. T Houseman	Head of Business Development
RIC	Dr. C French	Vice-Chairman
ARRL	Dr. B Lindley	Chief Executive

List of EC CROs' Representative Interviewed

CRO	Represented by	Position
FhG	Dr. A Imbush	Strategic Planning

Consultants Interviewed

(1) Prof. Charles Suckling

(2) Mr. M Fox, PA Technology

Department of Trade and Industry

Division	Represented by	Topics discussed
Central Unit	Dr. B Dobbie	GIREs, Privatisation
RTP 2	Mr. I Coveney	Role of ABRC and SERC

RTP 1	Dr. T Connors	RAs
RTP	Mr. S Dennings	LINK Programme
RTP	Dr. G Jordan	Industry view on collaborative R&D.

Department of Trade and Industry

Division	Represented by	Topics discussed
RTP 2	Dr. M Porteous	CEST
RTP 2	Mr. B Bunce	Innovation Budget
Marketing	Mr. R Holmes	Marketing
RTP 2	Dr. R Aram	Strategic Planning

Requirements Boards (RB)

Mr. M Shirley - Secretary to RB (Vehicles)

Mr. Jack McKinley - Secretary to RB (Textiles)

Dr. Brian Lindley - Member

Dr. A Holmes - Member

Mr. G Butlin - Member

Members of ACOST interviewed

Prof. S Metcalf

Prof. R Williams

Dr. Brian Lindley

Representative of Government Industria Research Establishments interviewed

Mr. Andy McClintock - Head, Economic Assessment Unit, NEL

Dr. D Watson - Strategic Planning, WSL

Dr. I Aitken - Director, Morebun Research Institute

Other Organisations interviewed

Org.	Represented by	Position
AIRTO	Mr. G Butlin	President
	Mr. J Bennet	Hon. Secretary
IPCS	Mr. J Stephen	Researcher
PREST	Prof. M Gibbons	Director
	Dr. L Georghiou	Programme Coor.
SEPSU	Mr. M Ringe	Researcher

Appendix 1.4

Interview Questionnaires

1 Staff

1.1 What is the trend in staffing numbers?

1.2 What was the staff turnover?

1.3 What was the morale of the staff?

1.4 What forms of motivation were used?

1.5 What was the ratio of scientists to support staff?

1.6 How did the staff view the change of status?

1.7 What kind of skills were they looking for in the recruitment process?

1.8 What is the staff age profile like?

2 Unions

2.1 What was the reaction of the Union during the critical period of the RA?

2.2 Did the RAs recognise Unions?

2.3 Any single or in-house union deals?

3 R&D Programmes

3.1 Was there a move towards concentration or specialisation of research? What were the difficulties faced in its project management?

3.2 What was the change in its R&D programmes in terms of strategic, applied or experimental research?

3.3 Was there a vacuum created in the R&D market brought about by its change in emphasis?

3.4 Was there a move towards Collaborative Research or the management of satellite research centres?

3.5 Did they concentrate on testing or experimental work? Consultancy? Turnkey Projects? Information services and Technology transfer? Publications? Products e.g. software?

3.6 Any problem with the peaks and troughs of demands?

3.7 Do the RA till carry out a core research programme? How important is it.

3.8 What level of Government funding is deemed as relevant and appropriate in a strategic sense?

4 Competition

4.1 Who are their competitors?

4.2 Are HEIs considered as competitor or collaborators?

4.3 How do they view Interdisciplinary Research Centres (IRCs)?

4.4 What forms of collaboration do they have with HEIs? Other RAs? GIREs?

5 Transition Period (apply only for former GIREs)

5.1 What was the transition period like?

5.2 When was the transition period?

6 Financial resources /expenditure

6.1 Resources

6.1.1 What was their turnover?

6.1.2 What is their % breakdown of income ?

6.1.3 What are the main government policies over that period that affected their income most?

6.1.4 What were the changes in the funding mechanisms of RAs that affected it?

6.1.5 What was its ratio of Income to staff number over that period?

6.2 Expenditure

6.2.1 What is its breakdown in expenditure?

6.2.2 What is the percentage of resources allocated for the different type of research?

7 Government policies that affected its funding

7.1 Did the funding changes give them greater autonomy?

7.2 Did the policy improve their efficiency and competitiveness?

The following two questions applies only to former GIREs

7.3 Any problem of Gross Accounting?

7.4 Any government control over recruitment?

8 Autonomy

8.1 Did the changes in funding give them greater autonomy?

8.2 How did the change of status affected the autonomy of the organisation?

9 Organisational Structure

9.1 Was there a change in the organisational structure? If yes, in what forms? Matrix management? Project management?

9.2 Was there a change in leadership style?

10 Mission statements/objectives/goals

10.1 How did their mission statements/objectives/goals change?

10.2 What is their present short, medium and long term goals?

11 Size

11.1 What would be the critical /optimum size of the RA?

11.2 Is it considering a merger?

12 Customer /Marketing

12.1 Customer

12.1.1 With all the changes in the funding mechanism, how does the RA view DTI's programme e.g. collaborative research?

12.1.2 What is their level of work for government departments, industry, overseas clients?

12.1.3 Does it collaborate with European RAs?

12.1.4 What forms of links does it have with industry?

13 Marketing

13.1 What is the size of its market?

13.2 What is its attitude towards marketing? Does it have a marketing department?

13.3 What is its marketing programme like?

14 Location

14.1 What are the advantages of its location?

Appendix 1.5

Characteristics of RAs chosen for interviews

WI. It is relative new and its limited by guarantee. It has one of the highest turnover among the RAs with a high percentage of its turnover from industry in form of contract research. Its a horizontal technology based RA and its expanding its interests beyond welding into the broader field of joining. It has one of the biggest staff number among the RAs.

BMT. It is a particular industry based RA serving mature industry. It was a merger of a formera GIRE i.e. NMI and BSRA. It went through a difficult period after it was privatised in the mid 1980's. A high proportion of its income came from government sources and since privatisation, it has been trying to diversify its activities to gain a greater amount of industrial funding.

HR Ltd. It was formerly a GIRE. Income from government sources is still vital although since privatisation it has become significantly less dependent on government income. The majority of its customers are public bodies. It has an average staff number and turnover in comparison with the rest of the RAs.

WRc. It is the largest RA in terms of turnover and staff numbers. It recently changed its status to one that is limited by shares through a management-buy-out and it is the first RA that changed its status. It went through a lot of restructuring and consolidation in the last decade. It derives its main source of income through contract research for the various privatised

water authorities. It has a matrix form of organisational structure.

BHRA. It is one of the two RAs which changed its status to one that is limited by share. It has an average turnover and staff number in comparison with other RAs.

BNF. It went through a very difficult period in the 1980's and had to reduce its staff numbers drastically. Its staff numbers has fallen dangerously closed to being below a critical mass. Recently, it merged with FULMER to form BNF-FULMER.

SATRA It is one of the oldest surviving RA. A membership based RA which started diversifying its activities in the 1960's. It is one of the few successful RAs which serves a mature industry. The majority of its clients are SMEs.

SIRA It is one of the most successful RAs. It was the first RA to move to a position of financial independence from membership fees and government income.

LEA Its turnover has been growing consistently in the last two decades. Its staff numbers have doubled over the last two decades. Over 40% of its income come from overseas sources.

PIRA It is one of the most progressive RAs with a balanced portfolio of research. It is one of the few RAs that adopted a matrix form of management.

PERA It has one of the biggest turnover among the RAs. Its staff numbers have been cut down dramatically in the last two decades. In the 1980's, it made a significant change towards development of management consultancy services.

MIRA Over the last two decades, its cooperative research has decreased significantly. The majority of its income is now derived from individual contracts and testing services. One of its difficulties in the 1990's will be to cope with the diversity of its facilities and research.

BTTG Its a merger of SIRA and WIRA. Both SIRA and WIRA were badly affected by the lost of levy in the 1970's.

RAPRA Its growth in the last two decades has been steady. In the 1980's, most significant changes have been the introduction of a board of management and the possibility of a management-buy-out.

SRAMA It is one of the smallest RAs which serves a very specific industry ie. the spring industry.

JUTERA It was liquidated in the early 1970's and this was mainly due to the introduction of synthetic fibres.

Appendix 1.6.1

Visit to BHRA in Cranfield on 29/1/90

The person interviewed:- Mr.Muir, The Finance Director.

I.A.Introduction

British Hydromechanics Research Association was set up about 40 years ago (1947) and its main objective then was to disseminate information to its members (from the pump and valves industry). Among its early members were ICI and BP. It is now a contract research organisation which supplies information and data for its members and has expanded into the off-shore industry, mechanical and civil engineering field.

In the mid 1960's, it began to carry out a small amount of R&D in fluid engineering. It moved to Harlow in Essex and then to Cranfield in 1967. The facilities were then been built by DES and the condition was that at the end of the lease period, the property would belong to Cranfield Institute of Technology.

II.Government Funding

When it first carried out contract research for DTI, it was fully funded by DTI. In the late 70's and early 80's, DTI decided to fund its research programme only partially and BHRA was forced to obtain the rest of its funding from its members.

One of its most difficult periods was from autumn 1987 to December 1988 when the Enterprise Initiative was launched. At that time, it received about 25-30% of its funding from DTI. At that time, there were a lot of changes going on within DTI amongst which it was setting out the guidelines for the approval of funding. In the interim, only the Secretary of State was

allowed to approve the funding for projects. This was a most difficult period for BHRA because most of its programme with DTI were coming to an end. Waiting the approval from DTI for the funding of its new programme was a matter of urgency, particularly as there was no clear signal from DTI as to the kind of R&D programmes that it would fund. The outcome was that its income from DTI was about £1.5million in 1987. But by the end of 1988, it received only £0.8 million and £0.56 million. During this period, it was facing a cash flow crisis and in effect, the uncertainty within DTI had wiped out about 20 - 25% of its income. It had to resort to gaining more research contracts from industry as well as to cut cost. By the end of the 1987/88 financial year, it made a loss of over £200k. BHRA must have learnt an important lesson. Its present strategy is to try to move away from its dependence on Government funding and to expand internationally to obtain more funding from its overseas market. BHRA also seeks to increase its influence in DTI with regard to the kind of project which DTI plans to support. Mr.Muir also felt very strongly that there is not much profit in Research and that BHRA should have more Development contracts for he thought that is where the money lies. But on the other hand, it has to continue its core programme of research with the financial support from DTI and industry. Without its core programme, BHRA will lose its competitive edge (this came out very strongly in an early meeting of the new board of directors). BHRA's strategy would be to continue its core research and to exploit fully its research programme by re-packaging it or to apply the research finding. BHRA seeks to use its reputation, expertise and its wide contacts to sell its development research faclities - in other

words, BHRA will need to know its clients needs, to meet these needs on time at a competitive rate. Another thing is to seek big projects and not small ones with small profit margin or better still, to work on a project on a turnkey basis or being the main contractor. Furthermore BHRA has to operate at an international level.

BHRA still depends significantly on Government (DTI) funding to carry out its core research programmes. At present about 30% of its income comes from Government sources.

The civil servants in DTI also face problems when it comes to funding. DTI has to spend whatever budget it has been allocated by a specific time. Sometimes, it overspends and there are other times when it rushes to use up all its budget before the end of the financial year.

III.Management Buy Out

BHRA (the research facilities) has now been bought by the Management. The association still maintains an interest in the new company in form of shares and it contracts out its members research programme to the new company. The new company is not now limited by guarantee but is limited by shares. This new set-up gives "new BHRA" greater freedom (especially from the Council), greater range of activities and the ability to raise greater capital to carry out bigger projects and expansion. It is currently on a recruitment drive.

IV.Staffing

At present, it has a staff number of 168 and last year it has a staff number of 199. Its highest staff number was four years ago (1985) with a number of 225. Over the past four years it has been trimming down its number after a continuous increase since the early 70's. It plans to increase its staff number in the next few years.

V.Others

BHRA doesn't have a person based permanently in Brussels but it has a representative who pays constant visits to Brussels to establish contacts and to find out the requirements for European contracts.

European funding is still costly to obtain especially for a relatively small organisation like BHRA. It takes a long lead time before a project is approved. But there is a possibility that an increasing percentage of the UK Government's allocation to R&D will be channelled through EEC (one source has suggested that this may be as high as 40% of UK's R&D budget[1]).

An opinion expressed during the interview on the reasons why UK's industry is reluctant to spend money on R&D was that institutional (investors) in UK expect a high rate of return from their investment whereas say the institutions in Germany (e.g.Deutsche Bank) do not expect a high rate of return in the short run.

Its turnover for the 1988/89 financial year was approximately £6 million. Mr.Muir said that BHRA will be setting up a testing site in Scotland soon for the offshore industry.

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[1] Mr. Glynn Ford. A research director of GEC seconded to RTP.

BHRA has no subsidiary. It seems to organise relatively more conferences than most RAs (In 1989/90 alone, it organised about 12 conferences out of which five of them were international). They are a source of income as well as to improve its reputation.

Marketing is not done centrally. It is the responsibility of every research director to bring in research contracts.

Appendix 1.6.2

Visit to BNF. Person interviewed :- Dr.Steiner,Marketing Manager.

Date of visit: 20.6.1990

I.Background to BNF

It was established in 1920. Its turnover in 1970 was £3.8million (1988 prices) and its turnover in 1988 was £2.6mil. Its one of the few RAs where its income dropped over the last two decades. It could be one of the reasons why it merged with Fulmer.

In 1970, its income was very dependent on subscriptions (50%) and Govt. Grant (20%).

Its staff number decreased from 180 in 1970 to 90 in 1988.

II.BNF Today

One of the possible reasons in the decline of BNF was the fact that the members it served had their own R&D facilities. BNF was not able to create the niche market or help to supplement the research facilities of its members. It could be possible that it concentrated too much on speculative research and didn't build up its contract research activities or consultancy.

BNF, like any RA depended on the health of the industry it served. The industry went through a difficult period in the early 1980's and BNF suffered consequently.

During this difficult period, it did not take drastic actions to cut cost particularly through reducing staff level well as to abandon certain areas of research. This indecisiveness contributed to its difficulties.

Among the austerity measures it took was to abandon the computing division. This was a mistake it made in trying to cut cost by cutting investment in a vital new area.

III.Why Merge with Fulmer

Both Fulmer and BNF were going through a difficult time i.e. both of them were falling below the critical mass. One of the reasons why Fulmer was undergoing difficulties was because it depended on too few clients to provide big contracts but with a high uncertainty considering the fact that most of its clients were in the Defence Industry. Fulmer had to make redundant all its support staff i.e. about a 100 and move its research base to BNF. The possible advantages for this merger are as follows:-

(1) Synergy of strengths. Creation of new ideas, thinking, new blood, new projects etc.

(2) Complementarity of resources. Fulmer has enough cash and BNF has the site.

(3) Helps to diversify BNF activities from Non-Ferrous into Materials.

(4) Creation of new expertise.

(5) New resources.

(6) New market.

(7) Lower overheads - making it more competitive.

(7) Better image - bigger, stronger.

(8) Undertaking bigger and riskier projects.

(9) Possibility of future mergers or takeover of other research establishments.

(10) Wider scope for overseas collaborations.

The disadvantages could be outweighed by the advantages. Among the Disadvantages are the disruption; changes in culture; leadership clashes.

IV. Important Turning Points

Late 50s'. Membership limited to British and Commonwealth countries (where grant was concerned). It never had to be commercially minded.

In the 1970's it strove to build up its membership. By 1973, 40% of turnover was from subscriptions. It was also during this period that the automatic grant was stopped. It had to apply through the RB.

It went through a difficult period in 1973/74 caused by the Oil Crisis which caused the first wave of contraction of the Industry. But during the Labour Government, it benefited from the generous govternment support.

In 1980/81, the second oil crisis took place. The Industry suffered, value of pound went up, which resulted in industry not being competitive and consequently cuts in R&D. Furthermore, it was then that the Conservative Government came into power and it adopted a policy of distancing itself from government support of R&D. BNF had to contract its activities leaving out key areas e.g. computing.

Redundancy in 1987, 89 staff left. Merger with Fulmer as of Jan. '91. After the merger, BNF will still retain its Council. A Board of Directors was appointed to run the merged company. It consisted of the chairman of the Council (Mr.Watson); Mr. Bowyer (of Fulmer who was appointed the managing director); Mr. Brightman (Former MD of BNF); the company secretary; and non-

executive directors. There is also talk of a possible investment from staff from time to time.

V.Difficulties faced by BNF

One of the problems it faced was its narrow client membership. Membership subscriptions accounted for only 15% of turnover (1990). The industry it served was cutting its R&D budget further. Most had no in-house R&D but many did carry out their own applied research and product development. Among its members were BP; Cookson and Johnson Matthey. BNF's contract research could be divided into small contracts and a few large ones; few MOD and a small number of multi-client programmes. About 80% of its subscription plus 80% of government support went to core research (the total amounts to £600 - £700k in 1989 prices). Government support amounted to about 14% of turnover. The remainder of 20% of the subscriptions were allocated to membership services.

It had difficulties in planning because it was greatly affected by the environment of the industry it served i.e. it sailed too close to the industry. In order for it to compete, its future strategy would be to diversify into the wider fields of materials i.e. composite and ceramics and be more pro-active rather than reactive.

It did carry out collaborative programmes with Cambridge and Loughborough Universities but no collaboration with GIREs. Its biggest competitors in EC were TNO and FhG. It obtained its first EC programme funding in 1990.

BNF's organisational structure was divided into divisions; it enabled the movement of staff across.

BNF felt that though it served a more specific industry it had less problems with the range of programmes in comparison with an RA that served a wide range of industry.

It had difficulties during recent changes within DTI. But in the long run, it did not plan to move away from government funding.

VI.1992

No sudden impact, changes had been gradual. 1992 will bring more business in legislation and standards work. But the sad thing was that BNF was not accreditated by NAMAS or NATLAS. Once again, it had left out an important area of growth. But the merger would help because FULMER was NAMAS accredited.

VII.Membership

Firms joined BNF because of the following benefits:-

(1)Access to R&D facilities.

(2)Access to core research.

(3)Access to individual contract research.

(4)Access to past research.

(5)Keeping abreast with technology.

(6)Technical information.

(7)Contacts/Broker

(8)Influence on core research programme.

Appendix 1.6.3

Visit to BTTG (merger of SI and WIRA).

Person interviewed:- Dr. David Jones, Busines Manager.

Date of visit: 24/8/90

I.Background Information to SI and WIRA

A.SI

1. Established in 1919. Turnover for 1988 was £3.2mil. Income in 1970 (1988 prices) was £4.5mil. It had a staff number of 180 in 1988.

2. Loss of levy in mid 1970's and it did not recover from it. Most members are SMEs. In 1971, it lost over 1/4 of its income and 1/4 of its staff were made redundant.

3. Introduced Overseas membership in the 1970's.

4. Loss of levy forced SI to :-

   a. Obtain more contract work.

   b. Have a more focused programme ie for membership rather than for the industry as a whole.

   c. Opened its doors to Overseas membership.

   d. Lately, it is trying to diversify into areas like Quality Assurance and Biotech.

B.WIRA

1. Established in 1918. Turnover for 1988 was £2.24mil and a staff number of 100.

2. Its levy for 1970/71 amounted to 50% of its turnover; Government grant amounted to 22%.

II.Develoment since the merger.

A.Background to merger

1. Firstly, SI changed its name to BTTG and then it took over WIRA.

2. Not much resistance from both the Councils with regards to the merger. Membership was at all time low just before the merger, a possible why there were not much resistance.

3. The newly merged organisation was run by an Executive Board. The Director for SI was replaced and the Director of WIRA maintained his post in Leeds.

4. There is a possibility of a management buy out in the near future. This would probably meet resistance from the Council.

5. The merged organisation adopted a matrix style of management.

B.Problems with merger

1. Logistics. It has 4 sites.

2. Leadership.

3. Shifting about during transition brought about a loss of income which is of equivalent to 4 months work.

4. Poor overall management.

5. Problem of staff movement - control of staff.

6. Top heavy organisation. Older staff had to take early retirement.

7. Average age was too high ie at 50. Now with new recruits, it dropped to about 40.

8. Communication and renumeration is still a problem.

C.Staff

1. Present staff number is 230.

D.1st. year's performance of the new organisation

1. It broke even during the first year's trading. Clearly, it was diversifying from the traditional areas of research. The instruction from the director was to work on any job that brought in income.

2. Improved its cash flow by selling off its land in Didsbury. The rest of the site has been rented out which brings in an annual income of over 80k. The proceed from the sales went into a new building and equipment.

3. It cut off non-profitable business and moved into growth area like Biotech. It is also building up its OA services by increasing its staff number from 6 to 40.

4. Overall strategy was to move away from textile to materials.

5. Membership number was maintained. Fees were increased but membership services improved.

E.2nd Year's Performance

1. Performance improved with a surplus of turnover of 120k.

2. Predicted a significant growth next year especially in the areas of :-

a. Quality/Assurance consultancy.

b. Training and conferences.

c. Biotech.

d. Testing and services.

e. Carpeting.

3.Turnover (£5.3mil) :-

(1)Govt £0.9

(2)Sponsor/Club £0.3

(3)Contracts £0.8

(4)Testing /investigation £1.9

(5)Sales of equipment £0.15

(6)Dyeing & process £0.6

(7)Training £0.1

(8)membership £0.4

(9)Rent from properties.

4. Core research still essential.

III.Govt Funding

A. Still essential. The main difficulty has been to formulate programmes that meet the requirements of DTI and at that of industry. It also has faced problems of having to prepare proposal for submissions since DTI insisted on a 3-year rolling plan.

B. Money from DTI comes rather late.

Appendix 1.6.4

Visit to Hydraulics Research Ltd. on 8/8/89

Person interviewed: Dr. Weare, The Managing Director

Historical Background

The Hydraulics Research Ltd. (HR Ltd.) was the outcome of the privatisation of Hydraulics Research Station (HRS). HRS was founded in 1947 to provide a national centre of expertise in civil engineering hydraulics.

On April 1982, HRS was privatised after a number of studies were done to confirm that a sufficient market existed to support a privatised HRS. During the transitionary period, a Board of Directors was set up to negotiate on the financial and legal aspects of the transfer. The Board also negotiated with the staff the issues associated with terms of employment.

The government met the condition set by the board in order for HRS to be successfully privatised. The assets of HRS were transferred free of charge and sufficient working capital was provided to meet the cash flow needs. It was also crucial that the government decided to fund a programme of strategic research for at least 5 years.

Corporate Status of HR Ltd.

The legal constitution of HR Ltd. is that of a company limited by guarantee. The members of the company (guarantors) do not receive any dividends - that is the company is non-profit distributing. The members elect the Board of Directors, appoint auditors and receive the published accounts annually.

HR Ltd. After Privatisation

There was a need to change the culture of the organisation and to replace bureaucracy with modern business management. It had to be more pro-active and conscious of cost and time constraints. It had to let go the inevitable weaknesses of a government research laboratory without losing the best qualities of HRS.

It restructured itself into four main divisions i.e. River Engineering, Tidal Engineering, Maritime Engineering and Overseas Development. Each Division was lead by a manager and within each divisions were units lead by programme managers. It brought new commercial know-how through the appointment of a finance director from the private sector and a marketing manager.

Marketing

HR Ltd. has spent about 3% of its turnover on marketing and publicity annually. This was rather small in comparison with many businesses. It organised courses and seminars to acquaint its clients to the state of the art techniques available through HR Ltd.

It also expanded its range of services and products. It started marketing a combined hydraulics-hydrology consultancy and HR instrumentation equipments in association with other firms. It established its own software house to market and support its software products. It also formed joint ventures with overseas companies e.g. with a Hong Kong based company.

Staffing

During the transition period, over 100 staff left. Since then, the staff number has been increasing steadily from 231 in 1984 to 281 in 1988. The amount of former civil servants dropped from 150 to 120 over the same period. With the decrease in the percentage of former civil servants, it was easier to inculcate a new culture within the organisation.

HR Ltd.'s Turnover

In the first year of trading, it lost £200k and broke even in the following year. In 1984/5, it made a profit of £150k and it increased to £350k in 1987/88. In 1983/84, its turnover was £5m and it increased to £9m in 1987/88. Since privatisation, the amount of contracts from DoE have decreased. This has been the biggest worry of HR Ltd. Ways and means have been created to offset this loss and to stretch as far as possible the science base it generates. But there is a limit to how far this pressure can continue.

Appendix 1.6.5

Visit to Leatherhead Food RA

Date of visit: 7/10/1990

Person Interviewed: - Dr. Holmes; Managing Director.

I.Background to Leatherhead Food RA (LEA)

It was established in 1919. It serves a big industry where most firms have no in-house R&D their own. Looking at its turnover trend over the years, it has been growing consistently. In 1989, it has a turnover of over £6 million out of which 40% was from Overseas. Its strengths lie in its world wide contacts and its unbiased and independent view on R&D. Staff number doubled between 1970 (120) and 1990 (230). The line graph at the end of this report shows the breakdown of its income from 1967 to 1989 (in 1989 prices).

II.Government Support

The government has signalled its intention of withdrawing from near market research. This will be be a problem for LEA because its biggest single client is still MAFF which contributes up to 16% of its turnover.

III.LEA's strategy

It is trying to go into product development; setting up joint consultancy with Peat Marwick, a consultancy firm, but it was not successful in trying to offer consultancy services to SMEs, on training and technology transfer and market research. Over the years,it had built up a very strong data base and it is an area of growth. It is aiming to expand both its confidential

research and collaborative research. It is also moving into legislation work.

A change of status to one that's limited by share may not be appropriate with its present objectives where public interests and not necessary profit come first. It could be possible for LEA to change its management structure i.e. adopting a board of management to run the RA rather than the Council - a very likely move soon.

An important objective of LEA is to maintain the skill base of its staff and to build up its resources. It did try a matrix form of management but it was too complicated and it was given up.

Its nearest rival, though not an immediate threat is CAMPDEN. There is a possibility of a merger in the long run with CAMPDEN. A merger would help to bring down its overheads and bring about synergy of strengths. The possible disadvantages are the fear from members that the newly merged organisation will then have the monopoly of research and the possibility of leadership squabbles.

One of the problems it faced was the problem of recruitment and retaining them. Great emphasis was laid on staff training.

It experienced some coompetition from HIEs with lower overheads. LEA Organised itself in groups i.e. a functional structure. LEA was able to move people across groups. It faced the problem of peaks and troughs.

IV.Needs of Members

LEA is the biggest information centre for the food industry in the UK and it provides a broad range of advice and services.

These are two main reasons why firms in the food industry are members of LEA.

V.Government Support

Government support in 1989 came to about £1mil. Out of this, 100k was used for the support of government policy and 900k was for public safety/ public goods as well as to support collaborative research on a 50/50 basis. When the government income became harder to obtain, it supplemented its income from membership fees from overseas.

It finds that the government policy is erratic with no consistency. This is a problem highlighted by most RAs. Since research is a long term business it needs consistency in government policy. Though recent policy did not affect them much but the recent audit system was felt to be ridiculous i.e. an audit is carried out once a quarter. Another difficulty it faces is the time it takes for the government grant to come through i.e. from submission through to the arrival of the first cheque.

LEA finds that EC money is hard to obtain and the grant does not cover the overheads. LEA did not show much interest in EC funding.

VI.Research Activities

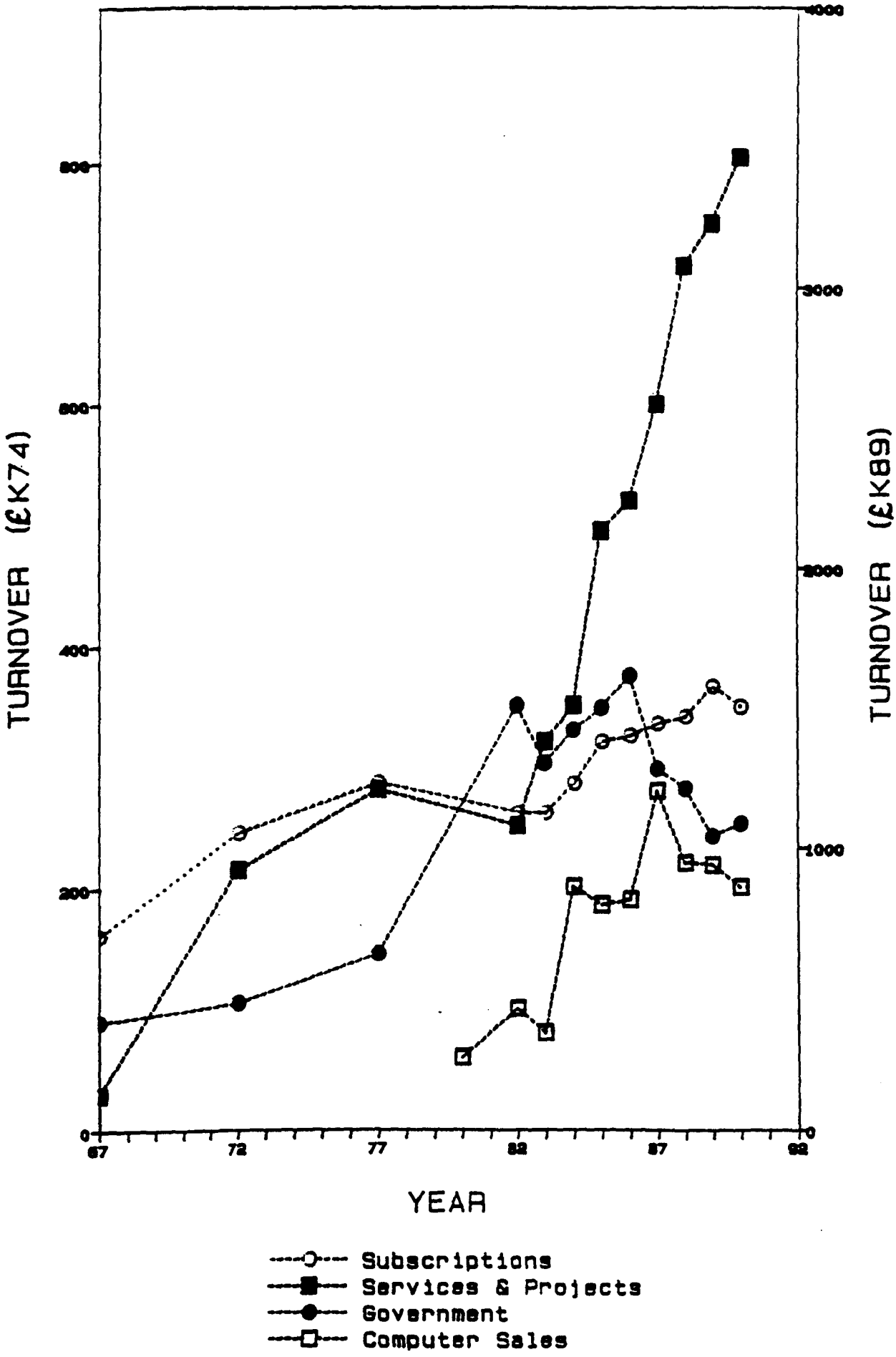
There was a lot of resistance when contract research was introduced in the 1970's because of the fear of confidentiality. Now it is the main stream activity LEA. Sales of information is also a growth area ie its Computer Assisted Information Retrieval Systems (CAIRS). It was a good move to move into database systems in the 1970's especially so when there was an explosion of

information systems. It has one of the most comprehensive information on food in the world. Sales alone on databases for 1989 exceeded £1.5mil. Its broad base research is its strength i.e. being able to tackle anything in the food industry.

It is one RA which has a group of people that deals with the needs of SMEs alone - unique.

VII.Others

Felt that RB was not very effective - nobody took no notice of it. Its members didn't represent the needs of the industry.


TURNOVER (£K74)
TURNOVER (£K89)
YEAR
0
200
400
600
800
1000
2000
3000
4000
67
72
77
82
87
92
Subscriptions
Services & Projects
Government
Computer Sales

Appendix 1.6.6

Visit to MIRA on : 17/8/90

Persons Interviewed:- (1) Mr. Richard Stirley,Head of Business Development.

(2)Miss Geraldine Kent,Strategic Planning Unit.

I.Background To MIRA

Its income in 1970 amounted to £3.6 mil (1988 Prices). In 1988 its turnover was £9mil out of which 70% was from members and 25% of it was from Overseas members. In 1970, it received up to 45% of its income from Trade association (Society of Motor Manufacturers and Traders), another 11% from subscriptions and 20% from repayment work. It received up to 19% from Government Grant. In 1970, MIRA carried out up to 30% of its activities in cooperative research. It is interesting to note that cooperative research has decreased significantly since then. In 1990, the majority of MIRA's income was derived from individual contract research and testing services (About 70% of its turnover ie £7mil) and subscription only accounted for 4% (360k in 1988). The high percentage could be due to the nature of the industry it served i.e. one that was mature and where there was a need to contract out research in order to be more competitive. The industry was not too interested in unproven technology and their R&D budget was too tight to invest too much in cooperative research. MIRA was looked upon as an important centre for "outsourcing" of design and development work by its members.

In the early 1970's, the trade association decided to phase out block grant to MIRA and that trade association members were given the choice of becoming member on an individual basis. It was a difficult period for MIRA because the government was also tightening its financial support for RAs.

MIRA had always operated in an uncertain climate. Most of its members had their own R&D facilities and they would prefer to carry out as much R&D as possible in-house. For the last decade, there has even been competition from its members who were bidding for R&D contract in the market.

MIRA was one of the RAs which resisted overseas membership until the late 1970's. Since then, major overseas motor manufacturers had been encouraged to take up membership. In 1990, MIRA's overseas income constitute a sizeable % of its total income.

II.Problems Facing MIRA

One of the strengths of MIRA was the range of services and facilities it offered. It was able to meet the demand for independent tests, development and validation services. But of late, it was worried about its breadth of services and facilities which was costly to maintain and it may spread its resources too thinly. It was in the process of carrying out a strategic analysis and formulating its business plan.

MIRA faced staffing problems. Old experience staff were leaving and new recruits specialised more in tests rather than research. MIRA had to face difficulty in competing with members for staff. A high turnover of its staff joined member firms. MIRA had to recruit senior and experienced staff rather than fresh graduates.

There was a possible danger of concentrating too much on testing rather research. It was beneficial in the short-term but a disaster in the longer term. In the second half of the 1980's, collaborative research was on the decrease. Core research was ingnored until a conscious effort was made since 1987 to reinvest in core research - DTI as well as EC support was deemed to be important in maintaining core research. UK's motor industry were more interested in short term gain. DTI could help boost its core research by providing funds for feasibility studies and when the probability of success was higher, industry would be attracted to carry out collaborative research. MIRA also felt that the DTI-enterprise policy will not be effective if OGD in particular Dept. of Transport did not have a transport policy. There were also fears that government laboratories e.g. TRRL might be allowed to carry out commercial projects and cosequently coming into direct competition.

Heavy investment by MIRA could upset member companies as they might see it as a threat. MIRA, like most RAs faced problems of peaks and troughs. Members would probably not support a management buy-out. BHRA has been able to proceed along this route because the majority of its members were SMEs whereas MIRA members are large firms. In 1990, a management buy out was difficult because of the high interest rate.

III.Major Changes

The following were some of the major turning points of MIRA in the last two decades:-

- Allowing overseas membership in the mid 1970's.

- Phasing out of trade association's income in early 1970's and withdrawal of government grant forcing MIRA to become more commercially minded.

- Motor industry 'outsourcing' R&D in the early 1980's.

- Leadership change in 1987 - from "academic" type leadership to "commercial"type. Introduction of project management and more aggresive marketing. Management responsibilities shifted from the Council to the Board of Directors bringing about greater focus and accountability.

IV.Others

- The differences between Food RA and MIRA:-

- MIRA has less collaborative research.

- MIRA members have own in-house R&D expertise.

- Leatherhead's research is broader base.

- Motor industry is mature and growth stagnated whereas food industry is mature but growing.

- Both industries need testing, legislative, and testing facilities.

- Most of its Govt funding is from DTp - on legislative work and lesser government support for collaborative research. In 1990, it received about 15-18% of its turnover from government contracts.

-20% of its sales were generated from Business Development Unit and 80% from Operations departments. Each department had a quota to fulfill thereby generating keen competition. Each of them had a cost centre. Over the years, it had improved its project management thrugh networking.

V.Nature of Industry

The following were some of the characteristics of the industry it served:-

- Big auto manufacturers taking over smaller ones (Lotus part of GM) and setting up of links (Honda - Rover).
- Motor industry restructuring world-wide. Problems of peaks and troughs.
- A recession will cause reduction in extramural research.

VI.Competition

MIRA's biggest competitor were its members. It would need to differentiate itself by:-

- Speialising in contract research.
- Being commercially independent.
- Flexibility with a broad base of research and facilities.
- No significant RA competitor in EC though there are parallel organisations e.g. TNO and TUV - but they are not industry based.
- Unfair competition from HIEs but there is scope for collaboration.

Appendix 1.6.7

Visit to PERA - 29/8/90

Person interviewed:- Mr.Bernard Blackwell,Business Manager,PERA

I. PERA's Activities

PERA carrys out multi-disciplinary research, design, development and consultancy. It majors in new materials, manufacturing methods and business management. It manages several DTI iniltiatives including the Enterprise Initiative.

II.PERA:- From 1960 to 1970

PERA was established in 1946 and it was the second largest RA in term of membership. It underwent a tremendous growth record in the 1960's. Its income in 1970 was £11.54million (in 1988 prices). It had a staff number of 550 in 1970. Its main income was from contract work for the government which accounted for 37% and for industry which accounted for 21% in 1970 (see figure 1). The subscriptions plus the government grant accounted for 27% of its income. It had one of the highest percentage of contract work and one of the lowest percentage of government grant (9%) to total income as compared with the rest of the RAs in 1970. In relation to this trend was the fact that PERA's research activities were biased towards consultative work paid for by members and non - members (accounted for 45% of its activities). Cooperative research accounted only for about 25% of its activities and government contracts accounted for 20% of its activities.

III.PERA - In The 1980s'

Figure 2 shows its turnover trend in the 1980's. It reached its peak in the mid 1980's. Its turnover for 1988 was £15.5mil and by the end of 1988, it had a staff number of over 350 in comparison with a figure of 550 in 1970. The contraction in staff number was due to 2 factors:-

(1)The end of government grants in 1978. This factor didn't affect PERA as much as the second factor because it obtained only about 9% of its turnover from government grants then.

(2)The British economy as a whole in the late 1970's and early 1980's affected PERA. During these period, it had to cut down its staff to make itself more competitive.

In the mid 1980's, the British industry recovered and it started to invest in plant, machinery and into systems and information technology. PERA capitalised on this growth and started relying heavily on consultancy work. The appointment of a new Director General was a major factor in causing a significant change towards development of management consultancy services and developing core technologies in the late 1980's. The high interest rate had also benefited PERA because of its high surplus in income (its income from investment alone amounted to £700k per annum in 1989).

In 1989 (see figure 3), its turnover amounted to about £17million. Note that the income from DTI amounted to only about 9% (£1.5mil)of its income. Another £2.5mil or 15% of its income was from subscriptions. About £0.7mil or 4% of its income was from investment and the rest ie about £12.3 million was from contract work-out of which £1mil was from training (PERA turnover on training was one of the highest in comparison to most RAs),

£7mil was from contract work e.g. PERA-OTIS, and £4.3mil came from contract research out of which 25% was from collaborative research (Collaborative research in EC account for about 5 - 10% of its turnover) and the rest from individual members. Its overseas income constitiute about 5% of its turnover. Majority of its clients were from UK and most of them were medium size firms.

In comparison with other RAs, the percentage of collaborative research was relatively lower; its individual contract income was one of the highest (from consultancy) and its R&D activities were skewed towards consultancy services.

IV.Organisational Structure

PERA was run by a Council. The member of Council consisted of the 3 directors; the company secretary of PERA and another 14 were elected by the members. This organisational structure still posed a problem because it was not flexible and it took a long time to implement ideas. There were talks about changing the structure into one where it was governed by a board of directors rather than a Council.

Matrix management was introduced back in 1986 when a new director general was appointed. This form of management structure provided PERA with the flexibility it needed and it improved its effectiveness. The introduction of project management and computer network helped its efficiency.

Marketing was tackled by the following group of people:-

- A small unit that consisted of 3 persons that carried out the selling of the corporate image.

- A highly professional group of 12 persons that specialised in selling membership. Note that its membership had been increasing rapidly for the last five years.
- A lead generating unit whose task was to establish contacts with clients or potential customers.
- Selling was done by every individual.

The present strategy of PERA was getting more and more short termed i.e. it was lop-sided towards consultancy services and very near market. It was trying to obtain greater stability by:
- Going into areas of human resources i.e. training.
- Emphasising on Strategic services especially for bigger clients and phasing out operational management consultancy services. The latter will be built into membership services.
- Development of Key-Technologies to maintain its leading edge and to differentiate itself. It is of importance to PERA in the long term i.e. moving from being too heavily dependent on consultancy services which was short term to R&D which was longer term. A balance needed to be struck.

V.Others

Recruitment was one of its biggest problem which was also a problem faced by practically every RA. PERA had a higher staff turnover in comparison with other RA simply because their career paths were very limited in the latter part of their career. Like most RAs, staff will usually leave the organisation upon better offers from the industry.

Mr.Blackwell felt that the strongest motivation of an RA was still the exemption from being taxed. The surplus income was ploughed back into the organisation. The disadvantage was that being a company limited by guarantee, it could not raise capital. PERA strengths lay in its breath of expertise and it was task oriented rather than skill oriented. Its strengths could turn into its weaknesses in the long run. Being spread too thinly, it could not maintain a leading edge in all fields. It has decided to invest in a few key technologies. Its future strategies would evolve by concentrating on a few key technologies but still maintaining its broad expertise; concentrating on human resources management; building up its quality management services and strengthening its membership base.

There was no talk of merger with another RA (AMTRI). It was not feasible for a very much stronger RA to take over a weaker one.

It ran the following programme for DTI:-

- Manufacturing and Quality.
- PERA-OTIS.
- Com-Centre.

It was proud of its link with DTI and the link was used as a marketing tool. Quite a substantial amount of its income was obtained by carrying out consultancy services for SMEs which were partly being financed by DTI.

PERA differentiated itself from its competitors (one of its competitors was PA technology with its wide range of service) in terms of its:-

- Scope of services and being task oriented. Its competitors were more skill based.

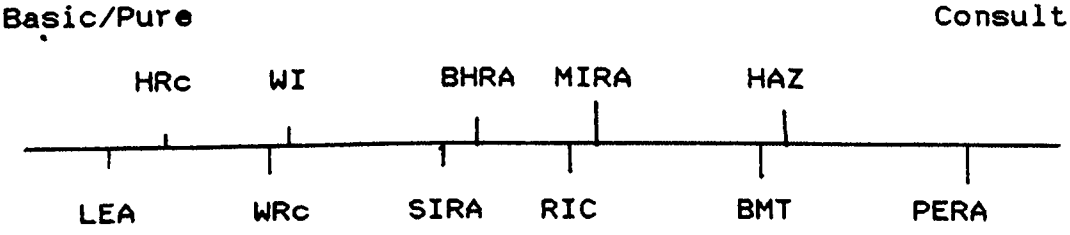
- Non-region based i.e. it is national.
- Non-industry based - horizontal techonology.

PERA was unique in comparison to most RAs because it did not experience as many problems arising from peak demands and slacks. It could be due to the fact that it was skewed towards consultancy services rather than R&D and the wide range of industry it served.

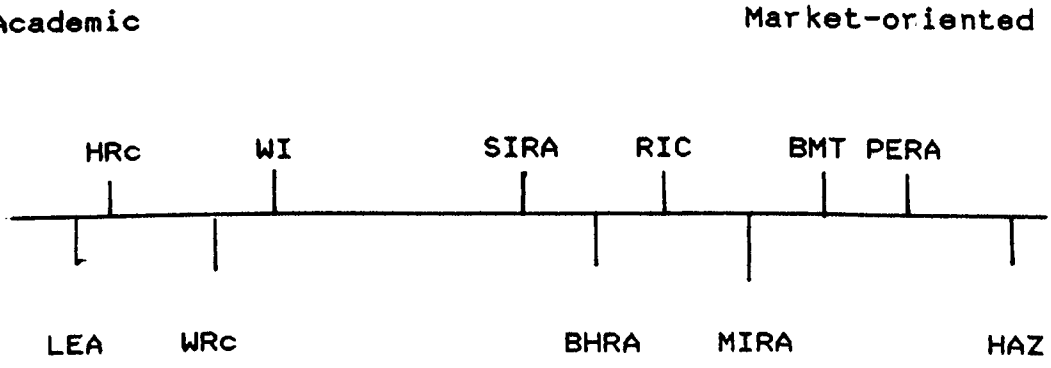
It was interesting to note that the average age of staff was between 36-40 years, which was low in comparison with most RAs. Again, it could be due to the high turnover of staff and its consultancy based services rather than the nature of its R&D.

VI.Summary

The following diagram was an attempt to place PERA on the two extreme spectrum of research in comparison with other RAs.

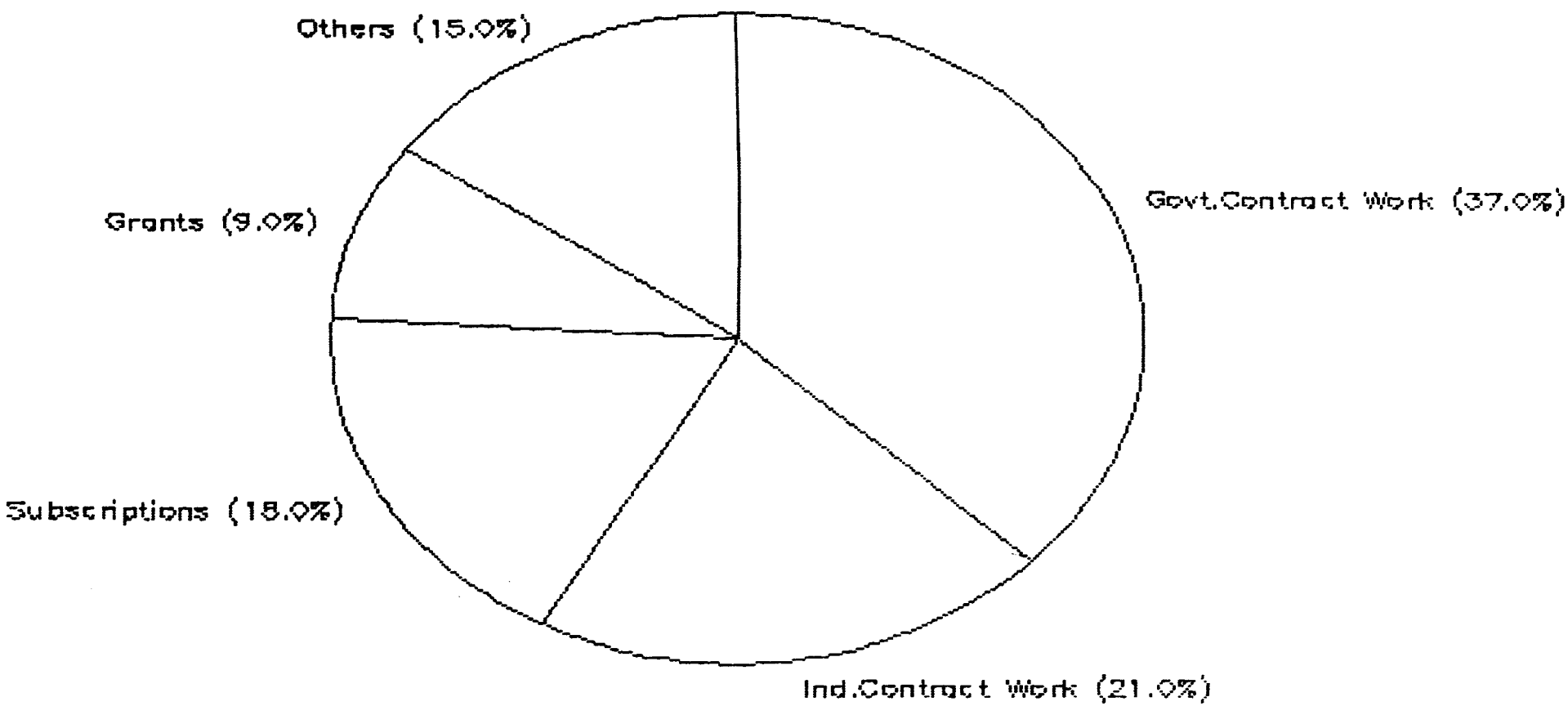


The following diagram was an attempt to try to place the style of leadership in PERA in comparison with other RAs.



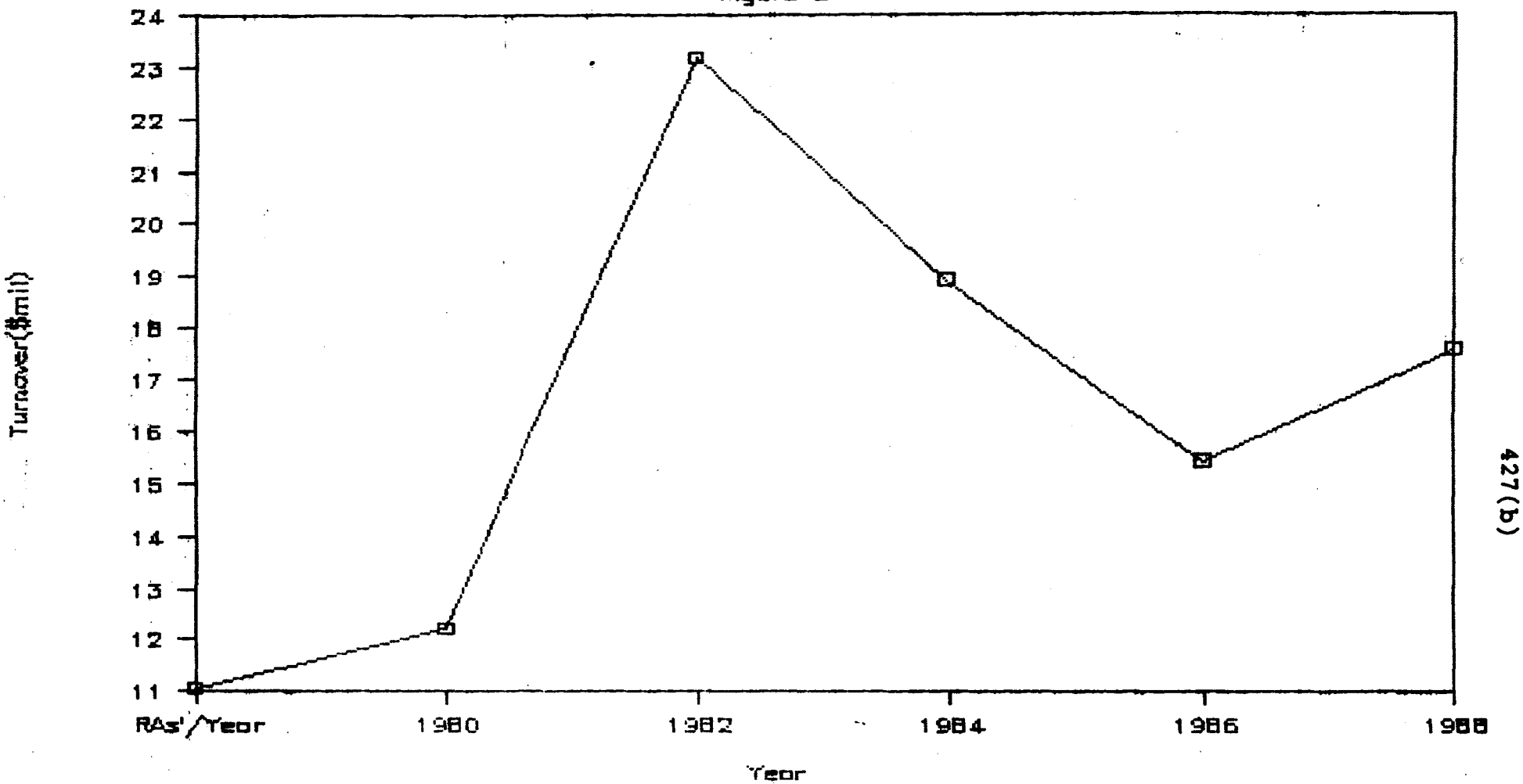
PERA's Income Breakdown(1970)

Fig.1



Turnover Trend of PERA(1980–89)

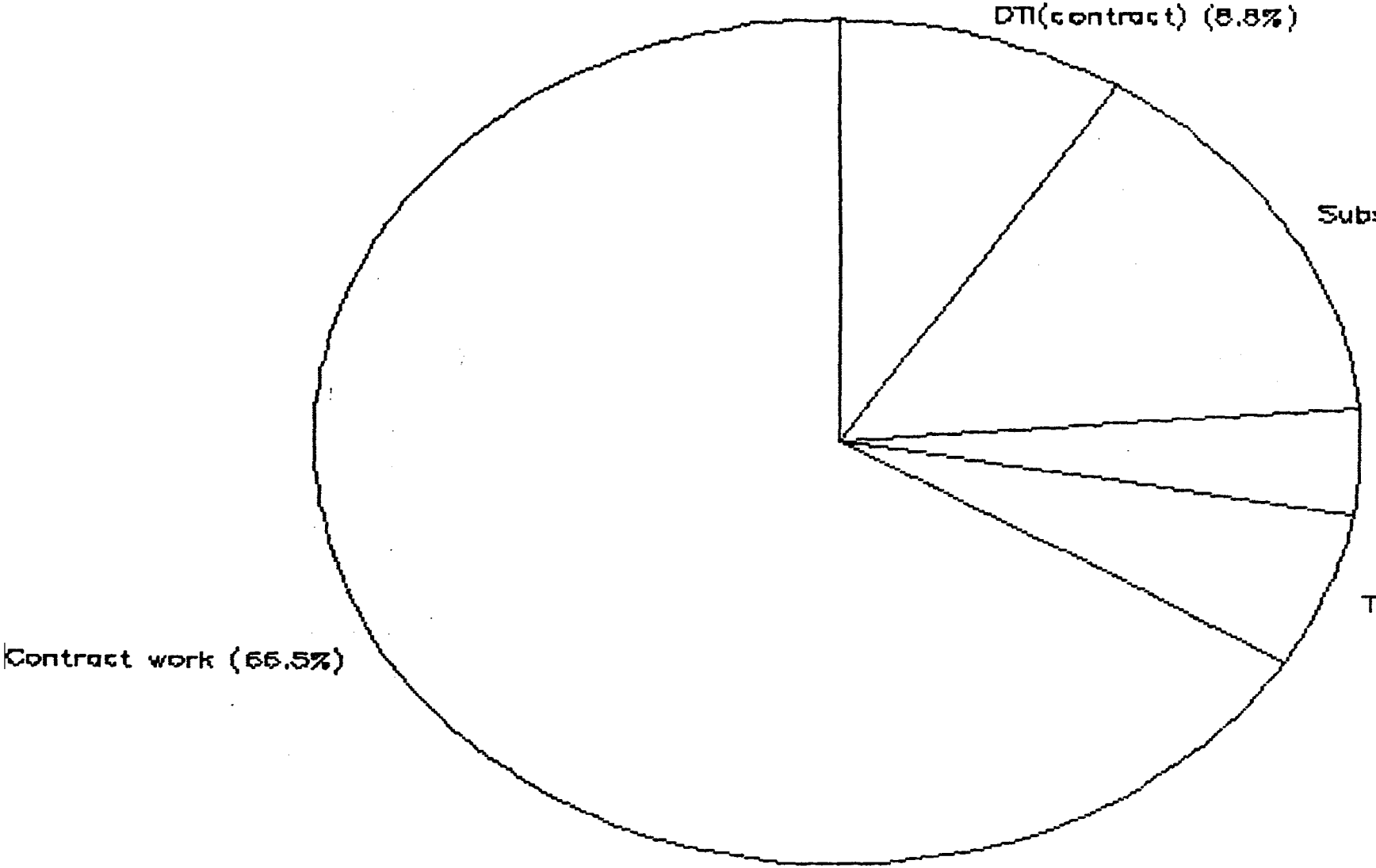
Figure 2



427(b)

PERA's Turnover(%)1989

Figure 3(Total Turnover = $17mil)



Appendix 1.6.8

Visit to PIRA to interview Mr. Blunden, MD of PIRA

Date of visit: 20/1/90

Introduction

It is one of the most progressive RAs that I have visited. It had a balanced portfolio of research and a capable leader. The leadership would like to model it after an organisation like Battelle. In the case of Battelle, it was answerable to the board of trustees whereas in the case of PIRA it was answerable to the Council.

I.Background to PIRA

It was established in 1967 by the merger of the two RAs handling paper and printing. The merger was meant to create a RA with a critical mass and creating synergies. It carried out research for non members as well but at a higher price.

II.Critical Size of an RA

He believed that there was no rigid criterion that defines whether an RA was of a critical size or not but he suggested the following guidelines to test the efficiency of an RA :-

(1) The fixed cost should not above 20% of the turnover. If it were above, then it was below its optimum size.

(2)Minimum size for market credibility. He suggested a minimum staff number of 200.

(3)A need for a minimal size to form a cluster of experts in particular fields. It would also help to boost the morale of the staff-pride of competence.

III.PIRA - Today

It was interesting to note that the appointment of the managing director was from within. Mr. Blunden has been with PIRA for over 28 years. This was also the same case with WI but in the case of MIRA, an outside candidate was brought in together with a new set of middle management.

From Oct'1990 onwards, it restructured itself i.e. it replaced its division form of management with the matrix form management. The reasons for these changes were in the printed leaflets attached. This new struture would enable the staff to be seconded to any project. This would also allow line and task accountability. It would also provide a mixture of acountability and flexibility.

Staff resourcing would be carried out by the Director of Research and the consultancy manager. Their job was to match in-house resources with external demands. The consultancy manager had two graduates to carry out the in house operations and to handle enquiries from clients. This would enable an interchange of staff and resources between consultancy and research.

Marketing responsibility was deemed to be the responsibility of the board of management but selling was the role of everyone. Each director was given a target to achieve and it was up to the director to achieve the target.

It was interesting to note that sales of conferences, training programme and database was done through mail. It was very sophisticated and targeted but cheap form of marketing.

A further point of interest was that PERA recognised two broad categories of staff i.e. those with managerial skills and those with technical skills. On the same rank with the research managers were chief scientists or specialists.

As of next year, it was going to change its name to PIRA International and it would start to offer full membership to overseas members. Even now, up to 50% of its income from paper and board division was from overseas. It organised conferences internationally. At present, total overseas income accounted for 15% of its turnover.

Majority of its members were SMEs (about 70%) but they only accounted for about 30% of its turnover and the rest was from the big firms.

IV.Accountability

20 years ago when the government used to match every pound which the RAs raised, RAs had to be organised in such a way that a council was needed to interface with the government as well as to account to the government. Gradually, the role of the Council changed when the mechanism of funding changed. According to Mr. Blunden, the RAs were forced to the market place to sell its expertise. This was brought about by the Rothschild Principle. Furthermore a ceiling figure of 25% of turnover of support was imposed on RAs. Consequently, RAs had to restructure in order to be able to respond and be accountable to the market needs (in 1989 only 10% of turnover is from subscriptions and 12 % from government). A "Council" type of structure with many committees was not suitable for it to be responsive to the market place. In the case of PIRA a board of management was set up in 1986 because

the success or failure of the RA depended not on the council but on the capability and calibre of the staff. The role of the council now was limited to Policy, Politics, and Public Relations.

The new structure of PIRA is suitable for the present enviroment it operates in. In the future, there could be the possibility of a management buy out which could be a big incentive for the staff.

V.Govt Funding

It viewed government funding as critical because :-

(1) It gave RAs enhanced credibility - a marketing advantage over other non-RA consultancy firms.

(2)Important for high-risk programmes or missionary programmes.

A good ratio of support from government was deemed to be around 12 to 15% of turnover of RAs. It experienced difficulties in obtaining government support last year because of the changes that went on within DTI. The changes in policy regarding multi-client projects and stoppage of SFI scheme affected its income from DTI. He felt that R&D was a long term business and it needed stability of government policy. He felt the changes in policy was to encourage the industry to be more innovative but the short-sightedness of industry was a big stumbling block.

VI.Research Activities

As a policy, it would like to devote about 30% of its turnover to research.

Appendix 1.6.9

Person Interviewed :- Dr. Bryan Lindley,Director of RAPRA

Date of interview: 20/9/90

I.Background to RAPRA

Established in 1919. Its turnover in 1970 was £3mil in 1988 prices. Its turnover for 1988 was £4.5mil. It had a strong leadership in the early 1970's. In 1985, a board of directors was introduced to run the organisation. It was felt that the Council was too cumbersome to run the organisation besides being been static and cumbersome and rigid. It took a long time to introduce the board of management and a lot of lobbying was needed. A leadership change was made in 1986, with the appointment of a new MD. Among his strategies were:-

- Regional dimension - setting up office in London. Research base in Wales, Tee-Side and USA.
- Collaborating with HIEs - value for money.
- Consultancy
- Collaborative research - involving SMEs.
- Own design company.

According to Dr.Lindley, there seem to be a trend whereby the British RAs are moving or converging towards a US style of contract research organisation. The other model which was quite opposite was the FhG model where it obtained a substantial amount of government income. But the two model differs in its objectives i.e. the FhG goal included training whereas the RAs were more of contract research organisation.

When the Rothschild Principal was introduced, it took a long time for the RAs to adapt to it, possibly over a period of ten years.

One problem with the RB was that it did not prioritise the research and there was no long term plan - it merely reacted to proposals. It tried to prioritise research but it was not done systematically. The government tried to devolve the R&D responsibility to the industry but the industry was too near-sighted. The UK needed a more strategic view of carrying out R&D.

II.A.Change in Status

The latest and most significant move by RAPRA was the decision to change the status of RAPRA i.e. from one that was limited by guarantee to one that would be limited by share. This was going to be a very significant move for RAPRA and one of the main reasons for it was the need to raise capital for expansion. It aimed to become The Centre for Rubber and Plastics Research in Europe. But this idea was to meet strong resistance from its members of which the majority of them were SMEs. The model it was going to adopt was similar to the BHRA model where RAPRA the association remains but the research arm was sold.

RAPRA underwent a difficult spell in the early 1980's due to the recession but research activities picked up from the mid 1980's.

The members remained in RAPRA because they were getting value for money and they were considered preferred customers (a secondary reason). RAPRA still carried out research for non-members but at a higher price. Members had access to information and other services as well as having a R&D resource .

Appendix 1.6.10

Visit To SATRA on 7th.Sep.1990.

Person interviewed:- Mr.Graham Butlin, Director of SATRA as well as the President of AIRTO.

Mr.John Bennet, Secretary of AIRTO.

I.Background to SATRA

It was established in 1919 and it was one of the oldest surviving RA. Even back in the early sixties, it defined its brief very widely to cover areas like process and management; product and processes besides study and testing of materials used in the industry.

Back in 1970, it had a income of £2.16mil (1988 prices) and a staff number of 165. Between 1960 and 1970, its income from government grant dropped rapidly. About 46% of its income in 1970 came from membership subscription. Its turnover in 1990 amounted to £3.5mil. It has been a membership based RA and it has carried out R&D work for members. Around 14% of its income has come from Government Grant.

It is one of the few successful RAs which has been serving a mature industry where most of its members have been SMEs with no in-house R&D of their own.

One of its strengths is no doubt the capability of its director. He has kept a very close rapport with its members and anticipated the needs of its members. The RA itself is looked upon as a centre of expertise and a resource for their activities. He has maintained a high profile in the industry as well as within DTI.

The industry it serves is horizontally organised and fragmented. Its members consisted of shoe manufacturers, material suppliers, machine manufacturers as well as component manufacturers and retailers. Nearly half of its members are shoe manufacturers and the other half consists of retailers and machine suppliers/manufacturers. The majority of its members do not have the size or the over-head capacity to employ in-house R&D facilities. Therefore SATRA has been the first place to seek out R&D capabilities or testing of materials.

SATRA was one of the most progressive RAs in developing links overseas. Its members which consisted of over 1000 came from over 22 countries especially those from high labour cost developed countries. In the past, the council did not allow membership from low labour cost countries. But as of this year, the policy was changed - membership from these countries would be accepted.

In the past, there was talk about a merger with either the British Footwear Manufacturers Federation (BFMF) or British Leather Mnufacturers RA (BLM). SATRA continued to get very strong support from BFMF and it was mandatory that all its members became members of SATRA until the beginning of 1990. SATRA felt that a merger with BFMF would limit its activities within UK and very inhibiting because of its overseas membership (40% of its overseas membership was from EC). A merger with BLM would also limit its activities to one material i.e. leather. It would also lose its credibility as an independent assessor. It would also find itself in conflict with retailers and sythetic materials supplier.

II.Major Government Policy Changes That Affected SATRA

In the first place, SATRA was set up because of the encouragement of the Government after world war one. In the 1930's, it was affected by the depression when it was nearly wound up.

After the 2nd. world war in 1946, a levy was made on industries that didn't carry out in-house training for its staff. The footwear industry didn't want the levy to be applied and when it was decided that all members of British Footwear Manufacturers Federation had to become members of SATRA, the levy was discontinued in 1990. SATRA was helped by the subsequent increase in membership subscriptions. In retrospect, SATRA gained because income generation from levy was not chosen since it would have made SATRA complacent and would not have been able to survive once the levy was withdrawn (this was the case of HATRA).

In the mid 1960's, the government introduced earmarked grants for big projects e.g. 50% grant was given to SATRA to set up a computer centre. This centre has been an important asset for SATRA. The total government grant then amounted to 12% of its turnover.

The next big major change occured when the Rothschild Principle was applied. Government grants were stopped and it had to apply for government support through requirements board (RB). SATRA was quite successful in obtaining government support through the RB until a ceiling figure of 33% of its turnover was imposed (it has been reduced later on to 25%).

And finally, the latest government policy change that affected SATRA was DTI's introduction of its 'Enterprise Initiative'. DTI withdrew support for near market research (it

used to fund up to 50% of SMEs cost for carrying out research projects (SFI schemes) and started promoting collaborative programmes which were of strategic nature. Within the previous 2 years, government support decreased from 50% of the cost of core research progrrammes to 30% (a loss of about £150k). This policy did not benefit SATRA where most of its members were SMEs and that most of SATRA's research programmes were near market. The Enterprise Initiative policy benefits RAs which had large members who were used to research and who were involved in strategic research. The decrease in government income had to be met from income generated from subscriptions.

DTI's support was getting harder and harder to obtain. The reduction of support from DTI would have a wave effect on SATRA. The difficulties were highlighted by the two documents written by Mr.Butlin for the European Commission and Sir.John Collyer (see App. 9.1). Therefore another factor that determined whether or not an RA was affected during a change in government policy was its membership structure i.e. did it consist of SMEs; large or small membership; willingness of members to support collaborative research; research expertise within member firms and the ability of firms to implement the findings.

Mr.John Bennet (who was the former director of Spring research RA) commented that over the last two decades, HIEs had been forced to carry out near market research and consequently they have encroached into the RAs area of research and the RAs have been forced to carry out strategic research which would be better suited to HIEs. These changes have forced the HIEs to change their roles and caused a chaos in the R&D field.

In order for SATRA to survive, it had to have a balance portfolio of activities. It could not concentrate wholly on collaborative research which was funded from subscriptions and DTI. It had to generate income from selling products and services. There was a danger of concentrating too much on selling of products and services and this would be disastrous for an RA if it neglected its core research. SATRA needed to strike an intricate balance.

III. Implication of DTI Enterprise Policy on SMEs

Mr.Butlin felt that the DTI-enterprise policy should not be applied to the whole spectrum of industry i.e. the range from SMEs right to large firms. He felt that the present policy was applicable only to the latter half of the spectrum ie firms which were used to R&D, i.e. those which could afford to capitalise on the results of the research.

He also suggested that one way to encourage SMEs to come together to participate in collaborative research (which was difficult and costly to organise) by changing the structure of government support. He suggested that the overall government support for a project remained the same at 50% but the starting support i.e. say the first year to be at 75% of that year's cost and then it would be tapered down over the remaining duration of the project. MIRA also suggested a similar proposal which was applicable to large firms. MIRA suggested that one way of encouraging collaborative research was for DTI to increase its funding at the exploratory stage of an idea. Once the uncertainties were narrowed down, the firms were more willing to contribute and participate in collaborative research.

Mr. Bennet also suggested that government support could be channeled to RAs in proportion to the subscription income and it was left to the RAs to use the funding as they deem fit. This idea could be applicable to smaller RAs which served a particular industry or where majority of its members were SMEs. This suggestion was useful because some RAs felt that the RB or the various marketing divisions were not aware of the realistic needs of the industry. Nevertheless, this idea was too simplistic and there was always the problem of accountability.

IV.SATRA - Into the 1990s'

The success of SATRA could be due to the fact that:-

(1) it served a mature industry with SATRA growing alongside it.

(2)The capital cost of research was relatively low in the shoe industry. SATRA didn't have to invest too heavily in capital equipment.

(3)It served an industry with no in-house R&D (only Clarks had its own in-house R&D).

(4)Most of its members were SMEs. Therefore, SATRA could play the role of the industry-champion.

A recent business plan (to be implemented beginning of 1991) revealed that SATRA would be removing barriers to membership and that membership fees would be turnover related. It would also be diversfying into clothing. Clothing Technology Centre was set up about a year ago in SATRA by the British Clothing Association (BCA). The R&D needs of the Centre was managed by SATRA. But it was governed by a council set up by BCA (Quite similar to the BHRA model). In 1989, the activities of the centre added up to 10% of SATRA activities and it was anticipated to expand in the

near future. The advantage of setting up that centre was that it helped to broaden the activities of SATRA as well as to attract more recruits (recruitment was also one of its problems). It also helped to create synergy.

V. Staffing

Its staff number didn't change too much over the last two decades. In 1970 it had a staff number of 165 and in 1989 it stood at 170. It had a relativley low turnover of staff especially at the senior level. But over the years, grade of staff increased significantly. About 70 out of 170 of them were scientists/engineers and about 30 of them were lab technicians.

VI.Others

It was interesting to note that within AIRTO there was a clear fundamental difference i.e. the profit making RTO and the non-profit making ones i.e. RAs. There were bound to be a conflict of interests between them.

The Confederation of British Research Association (CBRA) merged with AICRO possibly because of a leadership struggle within CBRA. Furthermore over the years, the differences between them decreased as the RAs were forced to get nearer to the market. One of the reasons why RAs were interested in becoming members of EACRO was the possibility of 100% funding of research by DG13 of the European Commission and the possibility of funding been channeled through EACRO.

The RAs that I visited so far had a negative opinion of the RB. They felt that they were ineffective and that it tried to cover an area that was too wide to be of effect.

Another interesting development was the encouragement given by some marketing divisions in DTI towards RAs to come together and formulate research projects. This would avoid duplication of projects. Another possible reason was that the various divisions did not actually have a research budget - all held by RTP. One way of obtaining a research budget of their own was by obtaining a lump sum from RTP for a loosely defined programme.

Appendix 1.6.11

Visit To SIRA on 23rd.Sep.1990.

Person Interviewed :- Mr.Simon E Cole,Research Director ,SIRA Ltd.

I.Background to SIRA

SIRA was estblished in 1918 i.e. it was one of the oldest RA. Its turnover in 1970 amounted to £3.4mil (1988 Prices). In 1970, its total number of staff was 189.

II.Changes in The Last 2 Decades

Table 1 (at the end of this report) shows the important changes that took place since it was established especially so in the last 2 decades. In 1965, the Industrial Measurement and Control (IMC) programme was started during the term of the Labour Government, when it received special grant (Every pound was matched by 3 pounds from the government). Its role then was to promote the application of scientific instrumentation and automation in industry at large. The achievement of the IMC programme was minimal but it helped to trigger important changes within SIRA. It started shifting its activities from purely scientific and fundamental research towards applied research - and particularly towards engineering applications. In 1966, it introduced an open door policy and membership exclusivity declined.

In the 1960's, the scientific instrument industry began to diversify. SIRA, with its limited resources could not cope with the range of resources needed to meet the needs of the industry. It was also during this period that the industry was becoming

more and more competitive. Towards the end of the 1960's, the industry was going through a recession when the Rothschild Report emerged (seen as a threat to an RA). Consequently, the demand for collaborative research diminished. SIRA decided to abandon collaborative research programmes in 1969 and membership fees was cut drastically. As a result, SIRA moved to a position of financial independence. The small membership numbers did not affect SIRA greatly because of the small fees demanded and the abandonment of collaborative research. Although it was still controlled by a Council, there was a big shift towards business based contract R&D and test services with some group-sponsored projects. SIRA also capitalised on the patent rights that it had. It was a dangerous and risky step to take which meant having to compete with member-firms for research contracts and there was no safety net in the event of failure.

The members felt that they could not manage the RA and furthermore SIRA was in direct competition with some of them. Thus in 1972,the Council set up a committee to look into the running of the RA. The committee recommended that the Council should dissolve itself and be replced by a board of directors. The members of this board need not be members of the SIRA and the persons could be anyone from the industry. This recommendation was accepted. The members became guarantor. This move gave SIRA the independence it needed; greater flexibility and speed in responding to the needs of the market; a shorter line of command with the elimination of the Council; having the ability to plan for the future and having greater control of its destiny. The new organisation had another advantage i.e. it could be acquired by

any company-and the members felt less threatened. By then, membership subscriptions accounted for only less than 1% of turnover.

Throughout the 1970's, SIRA thrived on contract research. It capitalised on its intellectual properties. SIRA started to bid competitively for contracts and developed overseas business.

The UK economy underwent a recession in the early 1980's. The industry began to abandon in-house research but SIRA didn't benefit from this. The research contracts which it obtained were few but of substantial amount. They were risky projects to handle and they were contracted out on fixed cost and the terms were stiffened. It was during this period that SIRA made another decisive move. It made use of its intellectual properties through forward integration into manufacturing hardware. This move was taken after it failed to licence out its intellectual properties. Hence in 1981, the Articles of Association were changed to permit SIRA to hold a majority stake in an external company and the way was made clear for SIRA to form subsidiaries.

Table 2 (at the end of this report) shows the the organisation as it was in 1989. It consisted of SIRA Ltd. which ran SIRA R&D, SIRA membership scheme and SIRA Test and Calibration Centre. The subsidiaries consisted of Ometron Ltd., Image Automation, SIRA Electro-Optics, SIRA Safety Services, SIRA Communications Ltd., SIRA Precision Ltd. and SIRA Holdings Incorporation. Ometron Ltd. and SIRA Safety Services Ltd. were formed in 1981/82. Ometron Inc. was formed in 1983. Image Automation Ltd. was formed in 1986. SIRA Electro-Optics Ltd. and SIRA Precision Ltd. was formed in 1988. SIRA Holdings Inc,SIRA Inc and SIRA Communications Ltd. were formed in 1989. Once these

subsidiaries were set up, they were on their own. They were distanced from each other and each of them became an autonomous profit centre. They themselves had to improve their products or seek to market new products or offer new services. One problem that could arise was the rivalry or friction among the subsidiaries. Another difficulty was the cost involved in getting the accounts of these subsidiaries in order. According to Mr.Cole, the present set-up was diversified enough and there were no future plans to diversify further.

SIRA Ltd., which was the "mother "can be divided into 3 areas :

(1) SIRA R&D was responsible for contract research and development; applications, consultancy, design; and specialist system supply. The subsidiaries of SIRA can contract out research to SIRA Ltd. in the processes of product development. It generated ideas or new products for its subsidiaries.

(2) SIRA membership scheme was responsible for the awareness and promotion of new technology and instrumentation.

(3) SIRA test and calibration centre carried out evaluation, calibration and testing.

SIRA Ltd. accounted for about £4mil of SIRA's turnover in 1989 i.e. £3mil from SIRA R&D and £1mil from SIRA test and calibration centre.

The product line of SIRA was run by 3 of its subsidiaries ie:

(1) Ometron Ltd. which marketed equipments like the Stress Pattern Analysis by Thermal Analysis(SPATE) and Vibration Pattern Imager(VPI).

(2) Image Automation Ltd. It marketed equipments for automatic inspection and process control systems.

(3) SIRA Electro-Optics Ltd. It supplied equipments for optical quality assurance instrumentation.

These 3 subsidiaries contributed about £2m each to SIRA's turnover.

The rest of SIRA can be divided into 2 groups of subsidiaries. The first group consisted of :-

- SIRA Safety Services Ltd. which was bought over from ICI in 1981. It offered services in design and installation of electrical equipment in potentially explosive atmospheres.
- SIRA Communications Ltd. organised conferences and courses and training.
- SIRA Precision Ltd. was responsible for most of the manufacturing and tooling needs of SIRA's manufacturing subsidiaries.

The second group of subsidiaries dealt with the marketing of SIRA's products and expertise in America. This group was controlled by SIRA Holdings Inc. It controls Ometron Inc and SIRA Inc.

III.Others

A the beginning of 1990, the SIRA Group Board structure was introduced whereby the four executive directors of SIRA Group sat on every board of directors of each subsidiary together with each individual CEO.

The product line of SIRA which consisted of 3 subsidiaries were doing well because they had a niche market. They marketed custom built equipment for their clients. They could be termed

as cash cows of SIRA. The profit could be ploughed back to the "mother" company to carry out core research. Though not an explicit policy, SIRA would plough in approximately 10% of its turnover back into its core research (in 1989, it ploughed back about £1mil out of a turnover of £12mil.). The activities at SIRA Ltd. nurtured the rising stars when it carried out research which was risky and which enabled the organisation to maintain a leading edge over its competitors. This was a healthy balance because SIRA didn't have to depend at all on government income to carry out its core research. It was one of the few RAs which ploughed back a substansial amount of its turnover into core research. It didn't experience the uncertainty of government funding and had the freedom to determine its future. In 1989, Government income consisted only of about 6% of its turnover.

The group as a whole would be satisfied if SIRA Ltd. were to break even because of the risky business it was in - carrying out high risk research work at fixed costs.

SIRA didn't opt for a management-buy-out (MBO) because it felt that it could achieve its objectives without one. With its present organisation, it had the flexibility and freedom to determine its own directions. But a major disadvantage was its inability to raise capital.

Like any other RA, it suffered from peaks and troughs. One way to combat this was to have a spread of clients - from different regions of the world and serving a range of industries.

1992 offers many opportunities as well as threats. Areas of growth will be in testing and legislation work. SIRA will also target the sale of its products in EC.

One of the strengths of this organisation is that the activities of each subsidiary are of the complementary.

Marketing was not done centrally but by each subsidiary. It tried to introduce Matrix Management but it experienced conflicts in the allocation of resources among managers. It finally abandoned it.

It did not view HIEs as threats. Quite on the contrary, it viewed them as organisations that carry out complementary research. SIRA has enjoyed a good working rapport with GIREs eg.Harwell and Defence Research Establishments.

The changing environmental circumstances over the years have forced it to change from having a narrow and focused area of research to one where it consisted of staff with multi-disciplinary skills.

MILESTONES IN SIRA EVOLUTION

1918	Established as British Scientific Instrument Research Association [an exclusive collaborative research organisation for the British scientific instrument industry].
circa 1939/45	Non-instrument makers (reluctantly) allowed into membership.
1947	Moved from London to Chislehurst; major staff expansion.
circa 1950	Instrument users form collaborative project at Sira to evaluate process instruments.
1966	Open door policy introduced, membership exclusivity declining.
1969	Collaborative research programme abandoned, membership fees cut. - Sira moves to position of financial independence - Business based on contract R&D and test services with some group-sponsored projects - No safety net in the event of failure.
1970/80	Contract research thrives; Sira starts to bid competitively for contracts and develops overseas business.
1974	Board structure replaces Member Council as ultimate management body; Sira achieves management independence, membership subscription accounts for less than 1% of turnover.
1981	Articles of Association changed to permit Sira to hold a majority stake in an external company; way is clear for formation of subsidiaries.
1981/82	Ometron Ltd and Sira Safety Services Ltd formed.
1983	Ometron Inc formed.
1986	Image Automation Ltd formed.
1988	Sira Electro-optics Ltd and Sira Precision Ltd formed.
1989	Sira Holdings Inc, Sira Inc and Sira Communications Ltd formed.
1990	Sira Group Board structure introduced. Sira R&D and Sira Test & Calibration Centre managed as autonomous enterprises.

SIRA LTD

- Scientific and industrial instrumentation
- Measurement, control and information technology

SIRA R&D

- Contract research and development
- Applications, consultancy, design
- Specialist system supply

SIRA MEMBERSHIP SCHEME

- Awareness and promotion of new technology and instrumentation

SIRA TEST AND CALIBRATION CENTRE

- Evaluation, calibration, testing

OMETRON LTD

- Instrumentation for engineering stress and vibration analysis

SIRA SAFETY SERVICES LTD

- Services in design and installation of electrical equipment in potentially explosive atmospheres

IMAGE AUTOMATION LTD

- Automatic inspection and process control systems

SIRA COMMUNICATIONS LTD

- Conferences & Courses
- Technical Training
- Technical administration services

SIRA ELECTRO-OPTICS LTD

- Optical quality assurance instrumentation

SIRA PRECISION LTD

- Manufacture and assembly
- Optics, electronics, mechanics
- Complete systems

SIRA HOLDINGS INC

OMETRON INC

SIRA INC

Appendix 1.6.12

Introduction :- This is a report on a visit to WRc branch in Beta Centre in Stirling on 13/8/89 followed by a visit to WRc Swindon on 20/8/89. The asst. director, Mr.Ron Fellow was interviewed in Stirling and Mr.David Procter the contract manager, in Swindon.

I.Location of Research

In future, the laboratory in Medmenham would carry out research for NRA works and governmental contracts. The laboratory in Swindon would handle the utility part of research. It was important that the independence of research was safeguarded in the two laboratories as not to affect the image their customers had on WRc.

II.WRc - A Brief History

Prior to 1974, there were three main water research bodies in the UK viz. (1)Water Pollution Research Laboratory (WPRL)
(2)Water Research Association (WRA)
(3)Water Resources Board (WRB)

WPRL was originated in the 1920's and was formally set up in 1952 as a government establishment which dominated water pollution research. It obtained most of its funding through government grants.

WRA was founded in 1953 for the purpose of examining technically all stages of the water supply process, the chemical and biological analysis of water, the design of treatment plant, and leak detection and assessment of new pipeline materials. Membership consisted pricipally of the various water boards and local authorities responsible for water supply, river

authorities, consultants, and a number of industrial suppliers. The bulk of its income came from membership subscriptions.

WRB was set up in 1963 to commission and manage research into conservation. It was a fully funded government body.

III.Reorganisation That Took Place in 1974 - Formation of WRC

In 1971, there were plans to reorganise the water services. The reorganisation paid due heed to the need for R&D in the water supply field and it was proposed that the Government should establish a new industrial research centre. It was felt that this would reduce the fragmentation of R&D in water matters which at that time was spread out between WRA, WRB (technical div.) and WPRL.

In 1974, the WRB was disbanded. Ten regional water authorities were set up. WRPL, WRA and WRB (technical div.) were merged and WRc was formed. WRc would continue to get government grants.

The need for WRc in Swindon was identified in 1977 after a study by Eric Grades of Thames Water Authority which showed the need for a water research centre to look into the needs of the water industry, especially the engineering side and the utility side. On April 1980, the WRc in Swindon which was to be an engineering arm of WRc was established. Its role was to carry out applied research with the water industry's strategic interest and needs in mind.

IV.1984 Onwards

From 1984 onwards, government grants for WRc ceased. Their main source of income now came out of subscriptions from water

authorities and government contracts. In 1980, about 80 % of their income came from subscriptions and in 1988, subscriptions only consisted of 58% of their income and Government contracts amounted to about 9% of total turnover of about £22m. In 1984, WRc set up a branch in USA to try to gain contracts which in 1989, managed to break even.

By the end of 1989, the Government planned to privatise the water industry with The National River Authority (NRA) as a watch-dog within the rationale behind the privatisation plan, the government should not fund the research being done by WRc for the privatised water industry. And if WRc remained in the public sector, the privatised water industry might not fund the research in WRc thinking that the Govenment would finance the research.

In April 1989, WRc was privatised as a staff-management buy-out. About 55% of the shares were bought by the staff and the rest by the water authorities. By October 1989, WRc operated from two centres (Swindon and Medmenham) with a staff of 650.

V.Safety - Net

WRc managed to obtain a guarantee from the Government that for the next 5 years, WRc will continue to secure contracts from Governmnent deapartments.

VI.Share Ownership

About £750k worth of shares were floated among management and staff where the directors holds total share worth £200k and each share was worth £1. The rest were bought by staff. The only incentive for the staff members was the interest free loans of up to £250 for two years. In 1989, the shares were traded within

the company and there was a possibility that they might be traded in the open market in the near future. The response from the staff was overwhelming and it was 45% over subscribed and over 75% of the staff applied for shares. It was believed that the shares may be worth 5-10 times its value if offered later on in the open market.

About 40% of the shares were bought over by various water authorities with future options for further share purchases.

VII.WRc's Future Customers

After privatisation, WRc's expected customer base would be:

(1) The privatised water industry.

(2) NRA

(3) Contracts from Government departments.

(4) Local government.

WRc's main customer would be the privatised water industry, which might, in due course, set up independent research facilities for competitive reasons.

A possible competitor for WRc post 1992 might be water research associations in Europe especially France.

HIEs were not viewed to be major competitors because none of them were viewed to be capable of handling research covering the whole hydrological cycle. They could however compete in specialised niches.

VIII.WRcs Marketing Strategy

WRc was moving towards being a market-led company i.e. meeting the R&D needs of their clients. With an emphasis on development rather than research. Most probably, it would narrow

down its activities and expand its geographical coverage ie Europe and other overseas markets. For the European Market, it had a function manager who looked after their Europe Market especially with regards to EEC regulations.

The broad strategy envisaged was to move the emphasis from small to large contracts which would eventually come from bigger clients who were perceived as the most likely source of bigger contracts.

WRc has had quite a good rapport with the WHO which has been seen as an important client in the future. In general, WRc's contacts has helped them to spread its coverage to a wider geographical area and to project an image of a reliable and independent assesment body to the public. It say its business boundary expanding from 'water' to 'Enviroment'. It had recently embarked on a quite costly advertising campaign to promote this new image to the public.

Its marketing department consisted of six personnel. Apart from that it had a customer accounts division which implemented the marketing plans.

An activity which WRc failed to do was to publish technical papers or other forms of publications. Consequenly, it was not that well known overseas.

In 1989, WRc had about 10 main customers i.e. all the water authorities. Because it had a small number of customers, it did not need a big marketing force to sell its products. Staff from the operations side were seconded over to handle the technical aspects of sales to the customers.

IX.Pricing Policy and Attitude Towards Customers

WRc has been learning to adjust accordingly its pricing policies even since it was privatised. Its attitude towards customer has changed from one of "We'll tell you what to do " to "How can we help You". The industry too has been coming to term with the fact that it has to pay a competitive rate for research to be done.

X.Reactions Of Staff Members To Buy-Out.

The top management seemed to be enthusiastic about the buy-out and one possible reason was that they had the security of the many years of service. They were willing to take the risks and the next five years were relatively " safe years".

The middle ranking staff were less certain. The newcomers were the ones that had to make real hard decisions as to whether or not to remain in the new orgnisation.

XI.Staff Numbers

The total number of staff in WRc numbered 667 in 1988. The ratio of scientific staff to the other staff in 1989 was 2:1. The income per staff member was £33k.

The staff at Swindon had fewer adjustment difficulties following privatisation as compared to those at Medmenham, a former Government laboratory, which has retained its Civil Service culture.

XII.Staff Recruitment

Some highly specialised staff declined the move from Stevenage to Swindon and therefore created gaps in key areas. Recruitment of best available experienced staff accompanied by

a 'crash' retraining programme was therefore an immediate necessity. Also new graduates recruitment accompanied by a dedicated in-house training was seen as essential to ensure the development of a new middle management.

XIII. Present R&D programme

In the late 1970's and early 1980's WRc developed "products" from its R&D programmes which were sponsored by members through subscriptions. Among the products were softwares, manuals and standards. This research was pre-competitive and aimed to meet the needs of all members.

The new strategy used by WRc was to move into exploitation of their research into products for individual clients. For e.g., WRc implemented a planning document for North West Water Authority which WRc devised for the water authority. The income obtained from services would be expected to increase in the near future as WRc tries to move away from too much dependence on income generated from subscriptions.

WRc's income from services increased from about £100k in 1984 to over £7m in 1989. This form of income would need to increase to compensate for the planned decrease in support by water authorities for collaborative research over the next five years.

XIV.The Effects of Privatisation On WRc's R&D Programmes

Although WRc's chairman has stated that it would remain a R&D firm, the privatisation of the water industry in the near future, might turn it into a consultancy firm. The amount of basic or speculative research will most probably decrease quite

significantly because the privatised water industry will most probably not fund it. But if WRc were not to carry out speculative or basic research, it might lose out in the long run. It needs to have a core research programme.

Especially after the privatisation of the water industry, WRc would have to convince its customers of its independence especially with regard to its research facilities in Swindon (which carries out most of the applied research work for individual water authorities) and its facilities in Medmenham (which carries out collaborative research for all the water authorities).

Before privatisation, WRc used to carry out training or organised seminar where it was possible to disseminate knowledge to a wide audience. After privatisation, this activity would have to be conducted on a commercial basis.

WRc tried to gain income through patenting but was not successful. This form of activities would an unlikely source of income in the future.

XV.Organisational Structure

The organisational structure of WRc Swindon has three main branches i.e. customer accounts, marketing and operations. The role of the customer accounts (4 members plus support staff) was to look into the need of the customers as well as to implement the marketing plans and to obtain feed-back from customers to the marketing section. The role of the marketing department (3 members plus support staff) was to implement the corporate plan and to formulate an appropriate marketing strategy to meet the goals. Their role was to sift through the the market needs and

match them with their internal capabilities. Their role was also to sell the internal capabilities of WRc as well as to prevent the organisation from spreading its resources too thinly and to narrow down its customer base. The operations side chose the contracts (that were vetted through the marketing department) managed the contracts and also bought in services, if needed.

Although WRc used a matrix management structure, not all staff members were involved in the matrix system ie. some staff members had fixed core programmes to work on; some were occasionally in the matrix system; and some who remained in the matrix system all the time.

The staff members in the customer accounts and the marketing had a separate role completely ie they didn't appear in the matrix structure at all. The matrix management system was used more in the operations side.

The role of the marketing and the customer accounts departments decided the directions of the WRc's programmes so that whichever contract to go for, it had to meet the industry's profile.

WRc had a separate department which managed the corporate image of WRc in Swindon and in Medmenham.

XVI.Turnover and Expenditure

According to WRc's annual report for 1987/88, their annual turnover was over £22m. About 67% (£14.8m) of their income was from subscriptions. About 23% (£5m) of their income came from commercial (services) activities. About 10% (£2.2m) came from contracts (sponsored contracts by Dept. of Enviroment).

WRc was trying to reduce its dependence on the income raised from subscriptions. In 1989, 55% of its income came from subscriptions as opposed to 80% in 1986. There was a significant increase in income through contract research and especially through services (commercial services).

WRc has felt that multi-client contracts have been difficult to organise and costly. For example, if a multi client contract were landed but the smaller water authorities were very reluctant to pay the fee that was equally spread among its members and upon paying, they were usually picky and very demanding. Mr Procter felt that a contract alone would take 3 to 4 months to sign. Any multi-client contract which was less than £100k was not worth pursuing because of the high cost involved.

Whereas single client contracts were easier to handle. With the privatisation of the water industry, the various privatised water authorities could negotiate individual research contract with WRc.

In 1987/88, over 95% of their income came from within UK, and the rest came from Europe, USA and Middle and Far East. The short-term strategy was to be more selective in the overseas market. The USA was chosen as a primary target and to this end WRc Incorporation was set up.

XVII.Strategic Move

The decision to privatise WRc at least two years before the privatisation of the water industry was a strategic move by the board of directors. WRc needed at least two years to prepare itself for the major changes that were inevitable.

The decision to privatise WRc received the backing from the various water authorities. They believed that for their own interest, WRc should remain as viable as before. They ensured this through buying of WRc's shares (40%) and agreeing to subscribe to research been done at WRc for the next 5 years.

XVIII.Transition Period

WRc in Swindon had a transition period of about 8 years. It had been moving towards the private sector since its inception in 1980. Its staff members came mostly from the industry. That was one of the main reasons why it had been able to adapt itself to a privatised enviroment.

XIX.Unions

Surprisingly in the new set up ,only about 30%-40 % of its staff were unionised.

XX.Forms of Control

Among the forms of control used was time sheets and it was up dated every week. In implementing the matrix form of management, this form of control was important.

Each contract had a number and each group was given a code. Each staff was also given a number. WRc also had a staff resources and rescheduling programme.

Appendix 1.6.13

Visit to Hazleton UK - 23/1/90

Person interviewed:- Dr.T .Houseman,Head of Business Development.

I.Introduction

Hazleton UK is a part of Hazleton Laboratories Corporation, a wholly owned subsidiary of Corning Glassworks. Hazleton provides a comprehensive product development and safety evaluation service for the pharmaceutical, agrochemical and chemical industries, including toxicology, analytical chemistry, metabolism, clinical studies and regulatory affairs.

It was set up in 1947 by Dr.Hazleton in USA. Hazleton Lab.Corporation has laboratories in USA, Europe and in Japan.

II.Turnover

Its turnover for 1988/89 was £16million. In 1987/88 its turnover was £11.5million and in 1986/87 it was about £8million. Its turnover was increasing rapidly for the last 3 years ever since Corning Glassworks tookover Hazleton Laboratories Corporation. Its turnover increased by 40% between 1986/87 and 1987/88 and an increase of about 39% between 1987/88 and 1988/89.

The majority of its business came from the UK. About 30% of its turnover in 1989 was from UK, 44% from continent europe, 6% from Scandinavian countries, 16% from Japan and 4% from USA.

It had such high percentage of income from the EC (about 70%) and only 6% in USA because Hazleton Europe concentrated on the EEC market. The majority of its customers were from UK because of the strong pharmaceutical and chemical industry. Up to 70% of Hazleton's income came from the pharmaceutical market, 20% from agrochemical and 10% from general chemical industry.

III.Staffing

Hazleton Laboratories Corporation had a staff number of over 2300 in 1989. Hazleton in Harrogate had about 500 staff out of which 300 of them were scientists or engineers. Another subsidiary of Hazleton Laboratory Corporation in Leeds had a staff number of over 200.

Its turnover to staff ratio for 1988/89 was about £50-£60k/scientist or about £30-35k/employee.

IV.R&D Programmes

Hazleton didn't receive any Government funding. Its income came from biological research contracts and carrying out safety evaluation tests.

One of Hazleton's strong points was that it clearly knew what business it was in. It didn't carry out any pure research but concentrated on development right up to licensing the product. It was a capital intensive industry but the advantage was that it didn't need to carry out any core research programmes. Therefore it didn't need to invest in carrying out research but instead investing its money in modernising its equipment and training its workforce. Most RAs needed to plough in investment to carry out their core researach programme and most of the time the investment was too little to achieve significant resuslts. Furthermore, as its development work was 'near market', there was greater value added with a clear cut objective in carrying out the research.

V.Contract Research Market in UK

The pharmaceutical, agrochemical and chemical industry in the UK was one of the biggest in the world. On the average ,these industries spent about 10% of its turnover on R&D.

One of the main reasons why they farmed out their research was to even out peaks and trough in their own R&D laboratory. Another reason was because they might not have the appropriate expertise. Hazleton's clients expected a very high standards of work and that was why Hazleton ploughed back a substantial amount of its turnover back into equipment and training.

One of the main reasons why Corning Glassworks bought over Hazleton Lab. Corporation was because it felt that it was one of the fastest growing sector in which it was serving. Secondly, Corning was then facing stiff competition from the Japanese competitors in the ceramic industry. Whereas in the areas of laboratory sciences, it was an area of growth and less competition.

VI.Management Style

Its management style was typically American. Hazleton had the Total Quality (TQ) performance and it strived to understand who the customer was, what the requirements were, and meeting those requirements, without error, on time, every time.

VII.Competitors

Hazleton's main competitors within UK were LIFE Science Research, Inveresk Research International and Toxicol Lab. Ltd. Competition in Europe came from a Swiss company, RCC, and Battelle in Germany.

It had very little competition from universities because it was in the development side.

VIII.Success Factor

Its success factor lay in :-

-Its international reputation and links as well as technical and resource support from the sister laboratories.

-A clear role i.e. it was in the development business.

-Quality service.

-Prompt service.

Furthermore the pharmaceutical industry was not price sensitive. It was willing to pay for a good service.

IX.Organisational structure

It used the matrix form of management with project teams. In each project, there was a project manager who alone was accountable for the project.

X.Long term planning

Long term planning was carried out on a five year basis and each division was given a growth target.

XI.1992

Hazleton would not feel the impact of 1992 that strongly. It had already been involved in Europe for the last decade.

One possible danger was the need to carry out testing for drugs once the rules were harmonize i.e. instead of having to go through stringent tests as required by each individual country, the need to carry out tests occurred once only. Consequenly there

would be a reduction in the need for carrying out tests. Anyway Dr.Houseman felt that it was not a big threat. On the other hand there would be greater need to carry out more tests on pesticides that have been used for a while but about which there have been much controversy about safety.

XII.Others

The two Hazleton laboratories in the UK complemented each other. In fact all the laboratories of Hazleton complemented each other but they did not tackle projects on a corporate level but at laboratory level.

For example the laboratory in Harrogate tackled problems in toxicology and chemistry and the one in Leeds carried out clinical tests on healthy volunteers and the laboratory in Virginia, USA tackled the regulatory affairs.

It was interesting to note that the negotiation of contracts was done by the marketing people. And once the contract was secured, it was handed over to the project manager who was ultimately responsible for the project. Hazleton's marketing division consisted of 6 persons i.e. 2 support staff and 4 scientists.

Hazleton emphasized a lot on training. It had day releases for courses and specialist courses. About 5% of staffs' time was budgeted for training.

The profit margin which it aimed for was about 20%. If it carried out a development programme that was risky, the contract would be negotiated on a cost plus basis.

Appendix 1.6.14

Visit to Ricardo Consulting Engineer Limited on 15th.Jan '90

Persons interviewed:- Dr.D.H.C.Taylor,Chairman.

-Dr.C.C.J.French ,Vice - Chairman.

I.Introduction

Its basic activities were consulting and contract research (which was the main form of activity), design, development and production engineering in IC engines and transmissions. Industrial design and engineering consultancy in vehicles and general engineering products were also offered. Ricardo had offices in Shoreham, Letchworth, Detroit and Indianapolis, USA.

Figure 1 (at the end of this report) shows the 1989 set-up of Ricardo plc.

II.Historical Background

It was founded in 1915 by Sir Harry Ricardo of whose much early work was concerned with inter-relations between engine performance and fuel quality, an interest which the Company has retained to this day. Sir Harry established Engine Patents Ltd. in 1915 and in 1918, Shell awarded the company a research contract. This was the first major contract for Ricardo and on which the company was built.

Ricardo was involved in combustion chamber designs, the turbulent head side valve engine, various overhead valve petrol engines, the series of Comet diesel combustion chambers and also in industrial diesel engines as well as aircraft engines. It went public in 1962.

Ricardo started offering consultancy services to the motor industry in USA, France and Japan way back in the early 1920s. It has built up this image of being an international company which gave Ricardo worldwide contacts. Its reputation together with its contact worldwide were two of its strong points.

Ricardo continued to receive income from royalties until the early 1970s. The royalties which Shell received were ploughed back into research in Ricardo. Throughout its history, Ricardo received very little Government funding. The only time when it received a substantial amount of Government funding was in the late 1930s and early 1940s when it was involved in the development of aircraft engines for the Ministry of Defence.

III.Sources of Income

Its main source of income (about 80-90%) came from contract research right from design through to prototyping engines for cars, trains and ships.

Income from membership fees constitutes about 10 % of its total income. The size of its membership is over 100 and for a minimal fee, its members are given facilities like access to Ricardo's library, answering technical queries, visits by Ricardo's staff and access to certain technical reports. The main idea of this membership scheme is to establish links and contacts with organisations in the transport industry.

IV.Staffing

In 1952, it had a staff number of 160. In 1989, it had a staff number of 398. This figure excluded those in its subsidiary (about 60 members). At its peak, Ricardo Consulting Engineers had

a staff number of 545 back in 1987. This was because Ricardo decided to sell off one its main subsidiary i.e. G. Cussons in 1988 in form of a management takeover by G.Cussons (G.Cussons had a staff number of over 150 in 1988).

V.R&D Programmes

Its main source of activity has been in the area of contract research. It did very little testing or standards work. Legislation work has been increasing especially in the ares of exhaust and sound.

Every year it has plouged back about 10% of its income ie about £1.5 million into its core research programme and this has been going on for the last 10 years. Every year the research director together with the technical directors from other divisions would decide on the areas on which they would research. This has resulted in a 'rolling programme'. Ricardo's contacts in the transport industry in forms of meetings, visits, and attending conferences which have helped Ricardo to keep abreast in its field of speciality.

Ricardo didn't have a big workshop facility but it has been able to produce prototypes on a small scale basis. For work which it could not handle, it sub-contracted out. It had over a 100 test beds for engines.

VI.Marketing Technique

It went for contracts and not sub-contracts i.e. Ricardo Consulting Engineers was the main contractor and not the sub-contractor. If necessary, it sub-contracted the part which it could not handle.

The membership scheme which consisted of over a hundred members was a very good source of contacts. For a minimal fee, the members got to visit Ricardo to discuss technical problems and likewise Ricardo visited the members at least once a year for technical discussion. It helped the Ricardo's staff to keep abreast with the technology as well as being aware of the market's needs.

Marketing was being done by agents in Eastern Europe, China, Japan, India, Thailand etc. Its two subsidiaries did its marketing effort in the USA plus an agent on a part time basis.

Everyone in Ricardo was expected to do marketing and the main coordinator was the business development manager.

Dr.French felt that cooperative research was cumbersome and took a lot of effort to put together. Most of Ricardo's contracts were with single clients.

VII.Organisational Structure

It had a matrix form of management. Each division was headed by a technical director. Projects were runned by a project manager who headed a project team. He was allowed to sub-contract work to the various division or to draw staff from them. The project manager was acoountable for the project.

It did not seem to have marketing executives. All the various technical directors and managers did the marketing. The business division handled the publicity work.

VIII.Unions

It didn't recognise any union although some of its staff were union members. It formed a Works Council whereby the voice of the staff could be heard. It also had a staff briefing system

IX.Success Factor

Dr.French felt that the success factors for Ricardo have been:

(1) Specialised niches i.e. the engine industry.

(2) Supporting core research programme.

(3) Building up on its international reputation.

(4) Strong loyal customers e.g. Shell which Ricardo had been working with since 1918.

(5) Improvement in project management e.g. usage of computers to check progress of research and cash flow. Especilly useful for smaller projects.

(6) Getting in early ahead of competitors by diagnosing and meeting the needs of customers.

(7) and keeping abreast with technology.

X.Competitiors

Ricardo's main competitior was AVL which was an Austrian firm. The other competitors were its own customers. Companies that prefered to carry out intramural research and those that had excess research facilities were marketing them in the vehicle market e.g. Perkins, Lotus.

XI.Diversification

In 1964, a year after it became a plc, Ricardo decided to divesify into manufacturing of scientific equipment for education. G. Cussons, which became the marketing arm of some of the products of Ricardo, was not a success and it was sold off in 1987.

XII.Profitability

The worst year for Ricardo since it became plc. was in 1986/87 when its turnvoer was over £16 million and its earning per ordinary share was only 6p. Since G.Cussons was sold back in 1987, business had been picking up. Dr.French said that Ricardo's poor performance was due to poor marketing effort.

XIII.1992

Dr.French felt that 1992 will not impact Ricardo as much as other RTOs because it has been involed in R&D activities in Europe for a long time.

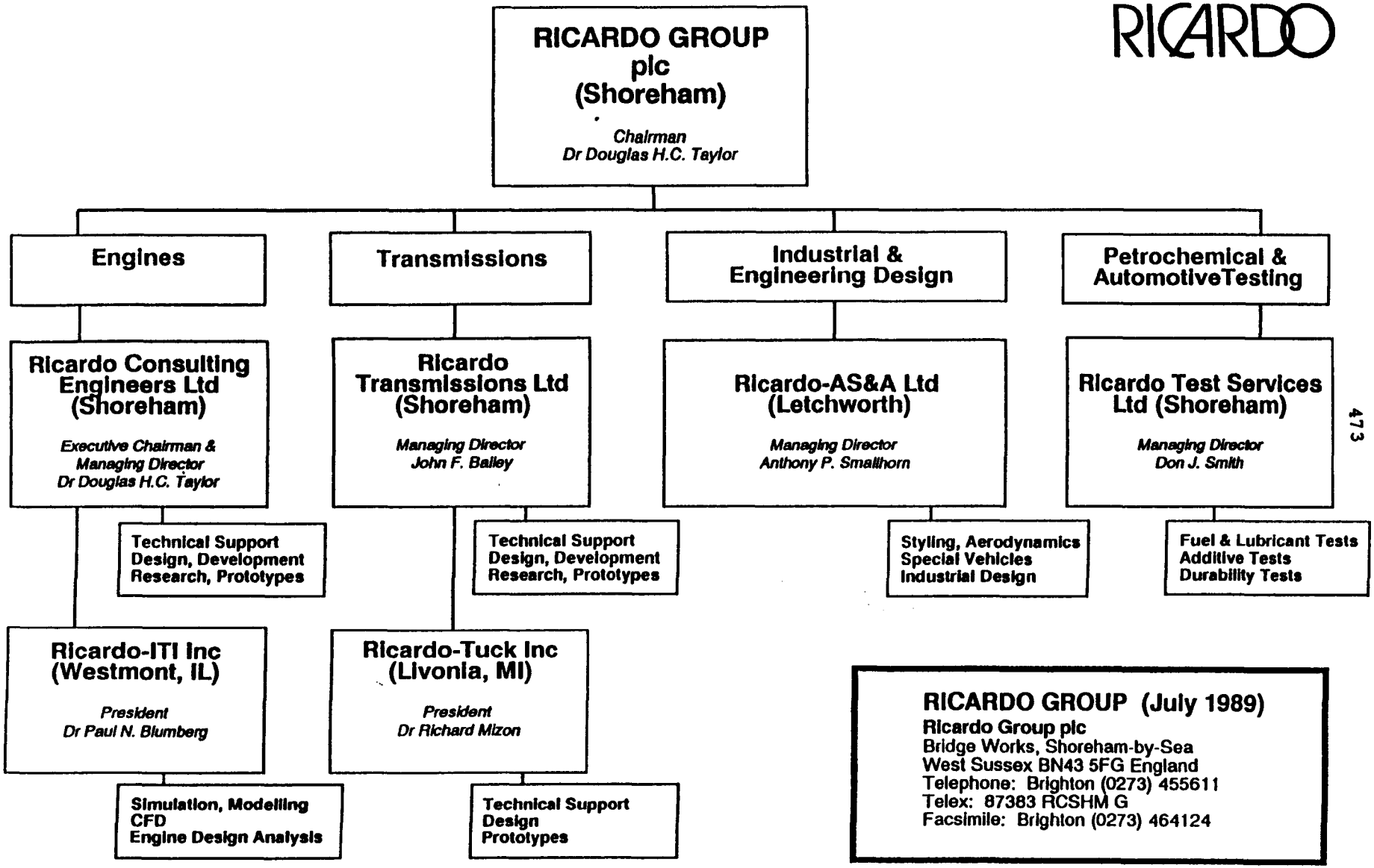
He felt that the biggest threat post 1992 will be the 'poaching' of its staff.

XIV.Others

About 10 years ago, it was heavily involved in the power train design but it has moved now towards vehicles. About 20 years ago, Ricardo got involved in lubricants because it felt that it ought to deal not only in the engines side but also in other parts of the vehicle.

Although it did not organise conferences, it encouraged its staff to present papers at conferences.

It didn't seem to obtain much income from investments. It recently bought another American firm in Illinois which helped to complement Ricardo expertise, in particular to provide engine design capability.


RICARDO GROUP
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(Shoreham)
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Dr Douglas H.C. Taylor
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Managing Director
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Styling, Aerodynamics
Special Vehicles
Industrial Design
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Additive Tests
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Appendix 1.6.15

Visit to WI on 28/3/89

The Person Interviewed: Mr. A Braithwaite, Chief Executive
Mr. J Kirk-Wilson, Director Finance

The meeting began by the WI extracting every piece of information they could before focusing on the purpose of the visit. If they smell a lead, they would pursue it as far as they could. I found that they were frank with with their opinions and were prepared to face competition from any research establishment. There needed to know the market and therefore took every opportunity to up-date themselves. This became part of its corporate culture and was practised by most senior members of their staff. The leadership style of the institute rubbed off on its staff. Mr. Braithwaite encouraged greater cooperation, coordination and team managemnt and a system for greater accountability.

Competition was getting tougher. It did not secure contracts as easily as it could say 10 yearrs ago. It was prepared to face the changes and it had a sense of commitment and direction. They kept on emphasizing that their business was not only in welding but in joining. Joining has been their focus which encompasses applications of surfacing, and of adhesives and other joioning methods. It was trying to encompass a broader caverage with greater emphasis on the fundamentals of good joining practise.

The institute had a good network of memberships. In 1989, 60% of its membership came from overseas and up to 30% of their subscription came from overseas and the other 30% of their subscription came from Europe. Quite a lot of their members were SMEs but all members paid the same amount of subscription

regardless of size. Over 60% of its membership had less than 500 employees. It had about 6 employees looking into this area of memberships. It therefore established a network through their membership. This helped them tremendously in their marketing and helped to provide a focus on advancement of technology as well as the needs of members. Their subscription plus funding from DTI helped to fund cooperative programmes. Therefore the subscription formed part of the core of WI's business. This would also help them to secure collaborative partners in Europe. There was a relationship established between them. As a result, WI could play the role of an organiser of collaborative programmes which it invites members to take part. Being the organiser had its advantagates but extra cost was incurred in organising. The WI also invested quite a hugh sum of money in Brussels in trying to know its way around. It spent about 1/2 a man year for 4 years to establish itself there. Its a big investment in a way but it will pay off in the long run. At present, their success rate is 1 out of 5. Another problem faces was that most European CROs which were bidding for contracts were subsidised by their government. They could therefore bid at lower price.

About £2m of WI's funding was generated through GSP programmes which were more or less similar to club activities. The programmes did not get much funding from DTI. About £5.9m was generated through single sponsor projects and most of them were small projects and these projects were clinched through active selling. WI claimed that it paid about 180 visits a year to industry and it had a small unit which did basic market research. Marketing was not done centrally but at departmental level.

WI encouraged members and non-members to visit its site and it had close to 7000 visits/year. WI was showing typical characteristics of industrial marketing with very close contacts with their clients. Its customers were loyal customers or repeat buyers who were aware of WI's expertise. Thier guests were well treated and given every assistance possible. This helped to project a good image and impressed their clients to be with their profesionalism.

WI had conference facilities as well as facilities for training and seminar. The centre provided board and lodging. It would be interesting to find out the feasibility of providing this facility and its occupancy rate. The communication and training services helped a great deal to develop guest-client relationship.

The institute had about 7 members of their staff handling contract work. Out of these, 2 of them were front-men who were involved in negotiation and pricing and other legal matters. For e.g. Eureka programme involved a lot of paperwork as compared with Brite because it was nearer market with many patent issues to be solved.

WI kept on emphasizing on its membership which helped to generate a core income and equally important were the contracts for collaborative work and contract research.

Mr. Braithwaite felt that the university should not be brought closer to industry. Their role was to educate and to carry out fundamental research rather than to compete for R&D contracts. He felt that it was a mistake to draw the university nearer as this would create more competition.

The WI's staff members were motivated by fear as well as incentives. Each staff was to account for every hour of their time. If the staff member proved himself, he would be rewarded. As I walked around, there were tags on their doors to say whether they were busy or not. Those who were interested in carrying out fundamental research were encouraged to do so. WI allocated about 5% of their turnovber for fundamental research. This would help motivate those who were interested in research. Through publication of their work, the staff member could increase their esteem and to obrain recognition from their peers. It could also generate income for the writer and the income acts as an incentive to write.

The equipments at WI covered a wide range of welding equipment and it chosed to specialise in certain areas of joining. Some of the equipment were obsolete and as long as they generated income, it would still be utillized. WI optimised the usage of their equipments. WI tried to diversify into areas like robotics; joinings for plactics; and consultancy work (in manufacturing technology). It was thinking of working hand in hand with an established consultancy firm. All in all, WI had a balanced portfolio of programmes.

Appendix 1.6

Visit to BMT on 29/9/89

Person interviewed: Mr. Dennis Jeffrey, Commercial Director

BMT's Activities

It is active in the areas of energy, the environment, defence, manufacturing and transportation. It concentrates on the development, practical application and enhancement of design, safety and technical innocation. With particular skills in fields as fluid mechanics, computer technology and control engineering.

Historical Background

BMT was a merger between NMI (National Maritime Institute) which was a government research institute and BSRA (British Ship Research Association). This move was taken at a time when the shipbuilding industry faced a stagnant markett and many individual yards faced acute economic crises.

In 1982, NMI was privatised and in 1985, NMI merged with BSRA. The merged organisation had to find its role in an industry forced by economic circumstances to view its expenditure on R&D with some reservation.

R&D Programmes

Before the merger, BSRA obtained 50% of its income from the government and the other 50% from the industry. It continued to charge a 10% surcharge for research until 1981 due to intense price competition.

The newly merged organisation, BMT, had to compete in a tough environment for contracts. Consequently, it became customer-driven rather than technology driven. The research programmes that were carried out were of shorter time horizon. It tried to plough back about 5%-6% of its turnover to its core research but this was close to impossible. BMT reduced significantly the areas of specialised research and concentrated more on areas which could generate income.

BMT faced competition from HIEs as the latter were forced to carry out more consultancy work for the industry. This made the competition more acute especially in a depressed industry like shipping.

Turnover

In the first year of trading in 1985, it lost over £1m. This was due to the depressed market for model testings and the high fixed costs inherited from both organisations.

It was interesting to note that the main source of profit for BMT was from its investment i.e. close to £1m. It sold of most of its fixed assets and therefore had a good cash flow. The cash generated had to be used wisely to help BMT divest into new areas. The first few years after the merger was spent on minimising costs and achieving the economies of scale anticipated from the merger.

BMT sold its facilities in Feltham because of the over-capacity of facilities in a world-wide market. A combination of the high fixed costs associated with the provision, operation and maintenance of large intensive operations and the artificaially low prices that was charged lead to very high losses.

BMT developed and successfully marketed its hydrodynamic software products with sales in the UK and abroad. It also developed and marketed software appropriate to the off-shore industry.

BMT moved away from being a heavily dependent on membership subscription. It now has a smaller membership and it carrys out more consultancy work for the membership and less research.

Future Developments

BMT has planned to continue its diversification from its traditional market base. Considerable progress has been made in Offshore Services and Coastal Management and it has intented to acquire suitable business. BMT has decided to restructure into a holding company and subsidiaries. The holding company would focus on the primary role of supporting R&D and the dissemination of the knowledge, whilst each site would become a trading subsidiary with the primay objective of trading at a profit. Each subsidiary would reassess the number of preople employed and other fixed costs to provide a viable economic basis for the operation.

Other Comments

Mr. Jeffrey that EC funding was difficult to obtain due to the bureaucracy involved. BMT had a personnel based permanently in Brussels to look into its affairs in Brussel. It normally took up to 2 years from the point of proposal to the award of contract. Another difficulty was to obtain a suitable partner in the less developed EC countries. Furthermore, the funding of only 50% of the research programmes from EC was not sufficient.

One of its longer term strategy would be to move away from the UK market and focus more on the international market. This was due to the intense home-competition and higher profit margin in the international market.

Appendix 1.6.17 Jute RA

Person interviewed: Dr. Harry Stout, Director, Jute RA

Date of interview: 20.3.90

Historical Background

The manufacture of jute was introduced into Dundee in 1822, when the fibre was processed on the existing flax machinery. The industry reapidly expanded up to the end of the nineteenth century, when competition from India began to make itself felt. The method of production underwent very little change until the decade after the 1939-45 war. In the 1950's and 1960's were there considerable changes in machinery and management methods. Since 1945, the industry changed considerably. There were certain pressurres to progress.

The British Jute Trade RA was established in 1946. Prior to this, the only opportunities for research were in two of the larger firms which set up research departments in the inter-war period. The RA was the the sole source of scientific information which was used by the industry.

Membership of the RA covers 97% of the producing industry. The RA trained people from the smaller firms in the techniques of statistical quality control and advises on quality control in manufacturing processes. At its peak, Jute RA had over 20 scientists. The advent of Jute RA in 1946 offset the shortage of scientists and technologists in the industry.

The Closure of Jute RA

The following were the reasons for the closure for the Jute RAs:-

(1) It was difficult to apply the RA concept in an industry where 2 or 3 companies controlled the whole Jute industry. The smaller companies could not afford to contribute towards the membership subscriptions. The bigger firms monopolised the programmes of the RA.

(2) The industry did not place value on scientific research.

(3) The decision by the bigger firms to divest into polymers. But Jute RA did not diversify into polymers.

(4) The pace of the polymer technology was very fast.

Appendix 4.1

The Customer-Contractor Principle

The Customer-Contractor Principle had a major effect on the RAs over the last 2 decades. With the implementation of this principle, automatic grant-in-aid was stopped and every RA had to submit proposals to the various Requirement Boards to seek funding. The following paragraphs explain briefly the principle and the various reviews that were carried out on it.

Under the Customer-Contractor Principle, substantial amount proportions of the funds previously received by the AFRC, MRC and NERC from the Science Budget were allocated instead to the Departments concerned with research undertaken by the Councils (for MRC, these arrangements were subsequently reversed).

The customer-contractor principle was to apply only to applied R&D; it was recognised that basic research had no analogous customer-contractor basis. No provision was made for strategic research.

However, the Rothschild report recognised that applied R&D laboratories generally needed to engage in some research not directly concerned with commissioned programmes. The report recommended an average surcharge of 10% on R&D contracts to meet the need for general research.

The Government reviewed the changes that flowed from the Rothschild report in 1979. It concluded that:-

(1) The changes appeared to have strengthened the Government's R&D machinery.

(2) If too high a proportion of the income of a Research Council were to come from commissioned research, the viability of the Council as an independent research organisation would begin to

be called in question.

(3) Contractors would vary in degree to which they found a surcharge useful in maintaining a general research capability for meeting future needs.

(4) It had led to additional administrative costs.

Another review was made in 1983 by Sir Ronald Mason for ABRC[1]. The report concluded that:-

(1) The new commissioning arrangements had not provided the dynamic for change that had been intended.

(2) The new arrangements had led to an increase of bureaucracy.

(3) Undue emphasis on short-term research had caused strategic research, which should be integral to commissions, not to be adequately covered[2]. Taken with the failure to implement the general research surcharge, the review considered that this had led to strategic research " being increasingly supported from the science vote, with a consequent reduction in funds available for basic studies."

1. Advisory Board for The Research Councils: A Study of Commissioned Research. London: HMSO Nov. 1983.

2. ibid, paragraph 23.

Appendix 4.2

Support for a Central Structure for R&D

If the support of R&D was regarded, in itself, as an objective of national policy, then it could be argued that there should be a clearer focus within the government on its responsibilities in this field. Sir John Kingman[1] expounded the view that Britain urgently needed a Ministry of Science and Technology to achieve a coherent policy for the public support of science, and that this could not be realised simply through better communications within the existing system: "the issue is not communications but power". Sir John argued that the Ministry should be fairly small and professional. It would have responsibilities for policy making over a broad field of both pure and applied science and would be able to advise the Government as a whole about the balance and the nature of their R&D programmes. The ministry would exercise the function of the research councils collectively, supporting research in research establishments and in universities, and thereby be responsible for the science base and interact with those departments which were running their own applied research programme. Sir John attached much importance both to there being at least one minister who raised scientific issues at Cabinet level when necessary and to the effective presence of science at the top layer of officials in Whitehall.

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[1]Science and the Public Purse;1985 Government and Opposition;Leonard Schapiro public lecture,given by Sir John Kinman at the London School of Economics,7th.Nov,1985.

Appendix 7.1

SPECIMEN MEMORANDUM & ARTICLES OF ASSOCIATION FOR RESEARCH ORGANISATIONS WISHING DEPARTMENT OF INDUSTRY APPROVAL UNDER THE INCOME & CORPORATION TAXES ACT 1970

The Companies Act, 1985

Company limited by Guarantee
and not having a Share Capital

MEMORANDUM OF ASSOCIATION

of

_____

I The name of the Association is.

II The registered office of the Association will be situated in.

III The objects for which the Association is established are:-

(a) To promote and undertake research in the field of and for that purpose to establish, form, equip and maintain laboratories, workshops, or factories, and conduct and carry on experiments, and to obtain and provide funds for such work and for payment to any person or persons engaged in such laboratories, workshops, or factories or elsewhere.

(b) To prepare, edit, print, publish, sell wholesale or retail, issue, acquire and circulate any literary works or matters treating of or bearing on the research of development activities conducted, promoted or financed or which might be conducted, promoted or financed by the Association and to assist, collaborate in or procure any such work; to establish and maintain collections of material, literature and scientific data relating thereto; and to disseminate

information obtained therefrom.

(c) To assist or collaborate with the research work of any persons, associations, institutions, universities and other bodies, incorporated or not incorporated, engaged in scientific research.

(d) To apply for, purchase, or otherwise acquire whether in its own name or otherwise or oppose the application by others for any letters patent or licenses whether exclusive, non-exclusive or limited relating to inventions, improvements, processes, materials or designs whether in the United Kingdom or any other part of the world which the Association may deem to be useful in connection with any of its objects; to acquire and register any designs or standardisation marks; to assign any such letters patent, licences, designs or standardisation marks; and to arrange for the development, perfecting and testing of the value of such inventions, improvements, processes, materials and designs.

(e) To take over, establish, promote, finance or conduct or carry on any undertaking prohibited from distributing any of its profits, income or property amongst its members to an extent at least as great as is imposed on the Association by its Memorandum and Articles of Association with the primary object of promoting the objects of the Association.

(f) To purchase, feu, take on lease or in exchange, hire or otherwise acquire any heritable or moveable, real or personal property and in particular any land, buildings, factories, workshops, laboratories, machinery, plant, apparatus, appliances, ships, boats, vehicles and any rights or privileges necessary or convenient for the purposes of the Association and to construct, erect, alter, improve and maintain any such property from time to time for the purposes of the Institute, and to manage, develop, sell, feu, demise, let, hire, mortgage, dispose of, turn to account or otherwise deal with all or part of the same with a view to the promotion of the objects of the Association.

(g) To employ any person or persons or body in

connection with the objects of the Association and to pay such remuneration as may be thought expedient.

(h) To apply to any Government, public bodies, corporations, companies or persons whether in the United Kingdon or abroad, for any grants of money, and any grants of land, donations, gifts, subscriptions and other assistance with a view to promoting the objects of the Association and to accept the same and to conform to any proper conditions upon which such grants, gifts or other payments may be made.

(i) To undertake and execute any trusts which may be conducive to any of the objects of the Association and to act as Trustees and accept as such specific tasks or responsibilities including advisory functions, provided the same shall be for the advancement of the objects of the Association.

(j) To borrow or raise any money that may be required by the Association on such terms as may be deemed advisable and to grant security by way of bond, mortgage, bond and disposition in security, charge debenture or otherwise over any part of the Association's property.

(k) To raise funds by subscriptions, levies, or in any other way for the promotion of the objects of the Association.

(l) To invest the moneys of the Association not immediately required for its purpose in or upon such investments, securities or property as may be thought fit, subject nevertheless to such conditions (if any) and such consents (if any) as may for the time being be imposed or required by law and subjects also as hereinafter provided.

(m) To provide for the welfare of employees or ex-employees of the Association or their dependants by grants of money, pensions or otherwise and to promote or assist in the promotion of and contribute to any pension or endowment fund or policy of assurance.

(n) To pay all expenses preliminary or incidental to the formation of the Association and its registration.

(o) To procure the Association to be registered or recognised in any part of the British Commonwealth or in any foreign country or place.

(p) To do all or any of the above things as principals, agents, trustees or otherwise and by or through trustees, agents or otherwise.

(q) To do all such other lawful things as may be incidental or conducive to the attainment of the objects specified in this Memorandum.

Provided that:-

(i) In case the Association shall take or hold any property which may be subject to any trusts, the Association shall only deal with or invest the same in such manner as allowed by law, having regard to such trusts.

(ii) The Association shall not support with its funds any object, or endeavour to impose on or procure to be observed by its members or others, any regulation, restriction or condition which if an object of the Association would make it a Trade Union.

(iii) In case the Association shall take or hold any property subject to the jurisdiction of the Charity Commissioners for England and Wales or Minister of Education, or any Authority exercising corresponding jurisdiction outside England and Wales, the Association shall not sell, mortgage, charge or lease the same without such authority, approval or consent as may be required by law, and as regards any such property the Council of Management or Governing Body of the Association shall be chargeable for any such property that may come into their hands and shall be answerable and accountable for their own acts, receipts, neglects and defaults, and for the due administration of such property in the same manner and to the same extent as they would as such Council of Management or Governing Body have been if no incorporation had been effected, and the incorporation of the Association shall not diminish or impair any control or authority exercisable by the Chancery Division, the Charity Commissioners or the Minister of Education or any such other

Authority as aforesaid over such Council of Management or Governing Body but they shall as regards any such property be subject jointly and separately to such control or authority as if the Association were not incorporated.

(iv) The income and property of the Association whencesoever derived, shall be applied solely towards the promotion of the objects of the Association as set forth in this Memorandum of Association, and no portion thereof shall be paid or transferred directly of indirectly by way of dividend, gift, division bonus or otherwise howsoever by way of profit, to the members of the Association.

Provided that nothing herein shall prevent the payment, in good faith, of reasonable and proper remuneration to any officer or servant of the Association, or to any member of the Association, in return for any services actually rendered to the Association, nor prevent the payment of interest at a rate not exceeding six per centum per annum on money lent, or reasonable and proper rent for premises demised or let by any member to the Association: But so that no member of the Council of Management or Governing Body of the Association shall be appointed to any salaried office of the Association or any office of the Association paid by fees, and no remuneration or other benefit in money or money's worth shall be given by the Association to any member of such Council or Governing Body, except repayment of out-of-pocket expenses and interest at the rate aforesaid on money lent, or reasonable and proper rent for premises demised or let to the Association; provided that the provision last aforesaid shall not apply to any payment to any Company of which a member of the Council of Management or Governing Body may be a member, and in which such member shall not hold more than one-hundredth part of the capital, and such members shall not be bound to account for any share of profits he may receive in respect of any such payment. Provided also that nothing herein shall prevent the gratuitous distribution among or sale at less than cost to members of the Association of any books, pamphlets or other publications relating to all or any of its objects. Provided also that nothing herein shall prevent any member of the

Association from exercising any processes, and making, using, acquiring and vending any articles and things in the ordinary course of his business for profit or otherwise under any licence or permission in respect of any discovery, invention or patent resulting from the work of the Association.

(v) The liability of the members is limited.

(vi) Every member of the Association undertakes to contribute to the assets of the Association in the event of the same being wound up while he is a member, or within one year after he ceases to be a member, for payment of the debts and liabilities of the Institute contracted before he ceases to be a member, and of the costs, charges and expenses of winding up, and for the adjustment of the rights of the contributories among themselves, such amount as may be required not exceeding one pound.

(vii) If upon the winding up or dissolution of the Association there remains, after satisfaction of all its debts and liabilities, any property whatsoever, the same shall not be paid to or distributed among the members of the Association, but shall be given or transferred to some other institution or institutions in the United Kingdom having objects similar to the objects of the Association, and which shall prohibit the distribution of its or their income and property among its or their members to an extent at least as great as is imposed on the Association under or by virtue of Clause IV hereof, such institution or institutions to be determinded by the members of the Association at or before the time of dissolution, and if and so far as effect cannot be given to such provision, then to some charitable object.

WE, the several persons whose names and addresses are subscribed, are desirous of being formed into a Company in pursuance of this Memorandum of Association.

NAME, ADDRESSES AND DESCRIPTIONS OF SUBSCRIBERS

The Companies Act, 1985

Company limited by Guarantee
and not having a Share Capital

ARTICLES OF ASSOCIATION

of

INTERPRETATION

1. In these Articles unless inconsistent with the context:-

"The Act" means the Companies Act 1985.

"The Association" means the above mentioned Company.

"The Articles" means the Articles of Association for the time being in force.

"The Memorandum" means the Memorandum of Association of the Association.

"The Seal" means the common seal of the Association.

"Governing Body" means the body established in accordance with Article 5 hereof.

"Governing Member" means a member of the Governing Body.

"Month" means calendar month.

"Year" means year from 1st January to 31st December inclusive.

Words importing the singular include the plural and vice versa.

Word importing the masculine include the feminine.

These Articles shall be construed with reference to the Provisions of the Act, and terms used in these Articles shall be taken as having the same respective meanings as they have when used in that Act.

PURPOSES

2. The Association is established for the purposes expressed in the Memorandum.

MEMBERSHIP AND GOVERNING BODY

3. For the purpose of registration the number of members of the Association is declared not to exceed twenty-five but the Association may from time to time register an increase of members subject to the provisions of Article 6.

4. The members of the Association shall consist of the Governing Members for the time being and accordingly the name of every person who accepts and holds the office of a Governing Member shall be entered on the Register of Members. The signatories to the Memorandum and Articles of Association shall be the first Governing Members. The majority of the Governing Members shall be British subjects resident in the United Kingdom and when necessary the Governing Members shall take immediate action under Article 6 hereof or otherwise to ensure that as far as possible this provision is observed at all times.

5. The affairs of the Association shall be conducted by the Governing Body which may exercise all the powers of the Association not required by the Articles or by the Act to be exercised by the Association in General Meeting. The Governing Body shall consist of the Governing Members for the time being and shall from time to time elect one of their number to be chairman of the Governing Body, and such election shall be for a period of three years. A retiring chairman may be re-elected as Chairman.

6. The Association by resolution of a General Meeting may add to the number of Governing Members and may appoint new Governing Members and may remove from office any existing Governing Member by a resolution duly passed pursuant to Sections 304 and 305 of the Act. The Governing Members shall have power at any time to appoint any person to be a Governing Member either to fill a vacancy or as an addition to the number of existing Governing Members, but any person so appointed shall retain his office only until the next Annual General Meeting and shall then be eligible for re-election but shall not be taken into account in determing

the numbers of Governing Members who are to retire by rotation at such meeting. No person shall be disqualified from being appointed a Governing Member in accordance with the provision of these Articles by reason of having attained the age of seventy or any other age, nor shall special notice be required on that account and no Governing Member shall be required to vacate his office or be ineligible for re-election by reason of his age.

PROCEEDINGS OF THE GOVERNING BODY

7. The Governing Body may meet together for the despatch of business, adjourn and otherwise regulate their meetings as they may think fit. Questions arising at any meeting shall be decided by a majority of votes. In case of an equality of votes the Chairman shall have a second or casting vote. All members of the Governing Body shall be held in the United Kingdom.

8. A member of the Governing Body may, and the Secretary on the requisition of any such member shall at any time summon a meeting of the Governing Body.

9. The quorun necessary for the transaction of the business of the Governing Body shall be three.

10. The Chairman of the Governing Body may at any time instruct the Secretary to send to every Governing Member for his approval a minute and such minute if approved by all of the Governing Members in writing shall be the equivalent for all purposes of a resolution or resolutions of the Governing Body taken at a meeting duly convened and held.

DISQUALIFICATION OF GOVERNING MEMBERS

11. The office of a Governing Member shall be vacated if he

(a) becomes bankrupt or makes any arrangement or composition with his creditors, or otherwise becomes publicly insolvent, or

(b) becomes prohibited from being a Governing Member by reason of any Order made under Sections 295 to 299 and Schedule 12 of the Act, or

(c) becomes of unsound mind, or tor any reason becomes incapable of managing his affairs, or

(d) resigns his office by notice in writing to the Association, or

(e) is removed from office by a resolution duly passed pursuant to Sections 304 and 305 of the

Act.

ROTATION OF GOVERNING MEMBERS

12. At the Annual General Meeting in every year one-third of the Governing Members for the time being, or if their number is not three or a multiple of three the number nearest to one-third, shall retire from office.

13. The Governing Members to retire in every year shall be those who have been longest in office since their last election or appointment, but as between persons who became Governing Members on the same day those to retire shall (unless they otherwise agree among themselves) be determined by lot.

14. A retiring Governing Member shall be eligible for re-election.

15. The Association, at the meeting at which a Governing Member retires in manner aforesaid may fill up the vacated office by electing a person thereto, and in default the retiring Governing Member shall, if offering himself for re-election be deemed to have been re-elected unless at such meeting it is expressly resolved not to fill such vacated office or unless a resolution for the re-election of such Governing Member shall have been put to the meeting and lost.

16. No person other than a retiring Governing Member shall be eligible for election to the office of Governing Member unless he is recommended by the Governing Members.

17. A Governing Member who vacates his office under Article 11 or is not re-elected or deemed to have been re-elected on his retirement shall cease to be a member of the Association from the date of such vacation of office or retirement.

GENERAL MEETINGS

18. The first General Meeting of the Association shall be held at such time within not less than one month nor more than three months after the incorporation of the Association and at such place as the Signatories to the Memorandum and Articles shall determine. The Association shall in each year hold a General Meeting as its Annual General Meeting in addition to any other meetings in that year and shall specify the meeting as such in the notices calling it; and not more than fifteen months shall elapse between the date of one Annual General Meeting of the Association and that of the next. Provided, that, so long as the Association holds its first Annual General Meeting within eighteen months of its incorporation, it need not hold it in the year of its

incorporation or in the following year. The Annual General Meeting shall be held at such time and place as the Chairman of the Governing Body shall appoint.

19. All general meetings other than the first General Meeting and Annual General Meetings shall be called Extraordinary General Meetings.

20. The Chairman or the Governing Body may, whatever he or they shall think fit, convene an Extraordinary General Meeting, and Extraordinary General Meetings shall also be convened on such requisition or in default may be convened by such requisitionists as provided by Section 368 of the Act.

NOTICE OF GENERAL MEETINGS

21. Twenty-one days' notice in writing at the least of every Annual General Meeting and of every meeting convened for the passing of a special resolution and fourteen days' notice in writing at the least of every other General Meeting (exclusive in every case of the day on which the notice is served or deemed to be served and of the day for which notice is given) specifying the place, the day and the hour of the meeting and, in case of special business, the general nature of that business shall be given in manner hereinafter mentioned, or in such other manner, if any, as may be prescribed by the Association in General Meeting, to the Auditors and to all members of whose addresses the Association is aware, but with the consent of all the members entitled to receive notice thereof, or of such proportion of such members as is prescribed by the Act in the case of meetings other than Annual General Meetings, a meeting may be convened by such notice as those members may think fit. All General Meetings of the Association shall be held in the United Kingdom.

22. The accidental omission to give notice of a meeting to, or the non-receipt of notice of a meeting by any person entitled to receive the same shall not invalidate the proceedings of that meeting.

PROCEEDINGS AT GENERAL MEETINGS

23. All business shall be deemed special that is transacted at the first General Meeting and at an Extraordinary General Meeting and also all that is transacted at an Annual General Meeting with the exception of the consideration of the income and expenditure account and balance sheet, and the ordinary reports of the Governing Body and of the Auditors, and the appointment of, and the fixing of the remuneration

of the Auditors.

24. No business shall be transacted at any General Meeting unless a quorum of not less than three members is present at the time the meeting proceeds to business.

25. If within half an hour from the time appointed for the meeting a quorum is not present the meeting if convened upon the requisition of members, shall be dissolved; in any other case it shall stand adjourned to the same day in the next week, at the same time and place, or to such other day and at such other time and place as the Chairman of the Governing Body may determine, and if at the adjourned meeting a quorum is not present within half an hour from the time appointed for the meeting the members present shall be aquorun.

26. The Chairman of the Governing Body (if any) shall preside at all General Meetings of the Association. If there be no such Chairman or if at any meeting the Chairman is not present within fifteen minutes after the time appointed for holding the meeting the Members present shall choose one of their number to be Chairman.

27. In case of an equality of votes whether on a show of heads or on a poll the Chairman of a General Meeting shall have a second or casting vote.

28. The Chairman of any General Meeting may, with the consent of a meeting at which a quorun is present (and shall if so directed by the meeting) adjourn the meeting from time to time, and from place to place, but no business shall be transacted at any adjourned meeting other than the business left unfinished at the meeting from which the adjournment took place.

29. Every question submitted to a General Meeting shall be decided in the first instance by a show of hands unless before or on the declaration of the result of the show of hands a poll is demanded by the Chairman or by any other member present in person or by proxy, and unless a poll is so demanded a declaration by the Chairman of the Meeting that a Resolution has been carried, or carried by a particular majority or lost, or not carried by a particular majority, and an entry to that effect in the Minute Book of Proceedings of the Association shall be conclusive evidence of the fact, without proof of the number of proportion of the votes recorded in favour of or against the Resolution.

30. If a poll is duly demanded it shall be taken either at once or after an interval or adjournment in such manner and at such time and place as the Chairman directs, and the result of such poll shall be deemed to be the Resolution of

the meeting at which the same was demanded provided always that a poll on the election of a Chairman or on a question of adjournment shall be taken forthwith. The demand of a poll shall not prevent the continuance of the meeting for the transaction of any business other than the question on which a poll has been demanded.

VOTES OF MEMBERS

31. Subject to the provisions of Article 27 every member shall have one vote at every General Meeting and on a poll that a vote may be given either personally or by proxy. The instrument appointing a proxy shall be in writing under the hand of the appointer or his attorney duly authorised in writing. A proxy need not be a member of the Association and the instrument appointing a proxy shall be deemed to confer authority to demand or join in demanding a poll. The instrument appointing a proxy and the power of attorney or other authority, if any, under which it signed or a notarially certified copy of that power or authority shall be deposited at the registered office of the Association not less than forty-eight hours before the time for holding the meeting, or adjourned meeting, at which the person named in the instrument proposes to vote, or in the case of a poll, not less than twenty-four hours before the time appointed for the taking of the poll, and in default the instrument of proxy shall not be treated as valid. A vote given in accordance with the terms of an instrument of proxy shall be valid notwithstanding the previous death or insanity of the principal or revocation of the proxy or of the authority under which the proxy was executed, provided that no intimation in writing of such death, insanity or revocation as aforesaid, shall have been received by the Association at the office before the commencement of the meeting or adjourned meeting at which the proxy is used.

32. An instrument appointing a proxy shall be in the following form or a form as near thereto as circumstances admit:-

I, of , being a member of the above-named Association, hereby appoint of or failing him of as my proxy to vote for me at the (annual or extraordinary, as the case may be) general meeting of the Association to be held on the day of 19 and at any adjournment thereof.
Signed this day of 19 ."

COMMITTEES

33. The Governing Body may appoint such Committees as it thinks fit to advise it on any matters concerning the work of the Association; and may make such regulations for the conduct of the meetings and proceedings of any Committee so appointed as it may think fit. A Committee so appointed shall have no executive power or authorities other than those delegated to it by the Governing Body and any exercise of such powers shall be subject to confirmation by the Governing Body.

SECRETARY

34. The Governing Body shall appoint some person selected by them to act as the Secretary of the Association with such salary as they consider reasonable. The Governing Body may discuss such Secretary and appoint any other person in his place. The provisions of Sections 283(1)-(3) and 284 of the Act shall apply and be observed.

DIRECTOR

35. The Governing body shall appoint a Director to take charge of the work of the Association subject to the overriding authority of the Governing Body upon such terms as they shall think reasonable and a Deputy Director to act as his deputy.

STAFF

36. The Governing Body may appoint and remunerate such other staff as they may find necessary for the carrying on of the work of the Association.

MINUTES

37. The Secretary shall keep such books, accounts, minutes, and records as are necessary in connection with the business of the Association and as may be directed by the Association. Such minutes shall be made in books provided for that purpose and shall include:-

(a) All appointments of officers.

(b) Names of the members present at each meeting of the Association, the Governing Body and any committees.

(c) All resolutions and proceedings at all meetings specified in (b).

SEAL

38. The Seal of the Association shall not be affixed to any instrument except by the authority of a Resolution of the Governing Body, and every instrument to which the Seal shall be affixed shall be signed by a duly authorised member of the Governing Body, and shall be countersigned by the Secretary or by a second duly authorised member of the Governing Body.

ACCOUNTS

39. The Governing Body shall cause true accounts to be kept of the sums of money received and expended by the Association and the matters in respect of which such receipts and expenditure take place, of all sales and purchases of goods by the Association and of the assets and liabilities of the Association. Proper books of account shall not be deemed to be kept if there are not kept such books of account as are necessary to give a true and fair view of the state of the Association's affairs and to explain its transactions.

40. The books of account shall be kept at the Registered Office of the Association and shall at all times be open to the inspection of the Governing Members.

41. The Governing Body shall from time to time, in accordance with Sections 229, 235, 239, 245, 261(2) and 736 of the Act, cause to be prepared to be laid before the Association in General Meeting such income and expenditure accounts, balance sheets and reports as are referred to in those sections. A copy of every balance sheet which is to be laid before the Association in General Meeting together with copies of the income and expenditure account and reports shall, not less than twenty-one clear days before the date of the meeting, be sent to all persons entitled to receive notices of General Meetings of the Association.

AUDIT

42. Auditors shall be appointed and their duties regulated in accordance with the Act.

NOTICES

43. A notice may be given by the association to any member either personally or by sending it by post to him or to his registered address, or (if he has no registered address within the United Kingdom) to the address, if any, within the United Kingdom supplied by him to the Association for the giving of notice to him. Where a notice is sent by post, service of the notice shall be deemed to be effected by properly addressing, prepaying and posting a letter containing the notice, and to have been effective at the expiration of twenty-four hours after the letter containing the same is posted. A certificate of posting under the hand of one officer of the Association shall be conclusive proof of posting for all purposes.

POWERS OF PUBLICATION

44. Subject to any conditions attached to grants to the Association the whole rights of publication of all information and discoveries made in the course of the Association's work shall be vested in the Association and any decision of the Governing Body in regard thereto shall be binding on all Members of the Association.

INDEMNITY

45. Subject to the provisions of Section 310 of the Act the Governing Members and Office-Bearers of the Association shall be entitled to be indemnified out of the funds and property of the Association for and against all proper outlays and liabilities incurred by them on behalf of the Association, authorised and passed by the Governing Body as proper outlays and liabilities, and against any loss, costs and charges they may incur or be put to in consequence of any act, matter or thing done or permitted by them in or about the execution of the duties of their office.

WINDING UP

46. The provisions of Clause VII of the Memorandum of Association relating to the winding up or dissolution of the Association shall have effect and be observed as if the same were repeated in these Articles.

NAMES, ADDRESSES AND DESCRIPTIONS OF SUBSCRIBERS

Appendix 8.1. Staff numbers in RAs (1980-1989)

RAs	(1980)	(1982)	(1984)	(1986)	(1988)	(1989)
AMTRI	NA	60	56	60	61	70
BCIRA	193	173			137	135
BHRA	230	234	228	220	199	199
BNF	171	162	112	110	90	90
BCR			217	223	225	224
BGI		56	52	48	40	40
BLC					53	54
BMT	NA	NA		456	340	210
BRA	90	85	84	78	85	90
CIRIA			43		39	40
CAT	12	13	11	12	14	14
ERA	298	301	347	388	388	388
FCR			38		33	32
FIR		90	86	83	93	100
HAT					16	19
HRC	NA	255	230	250	281	281
LAM					56	44
MIRA	225	215	230	266	266	287
PR	84	52	50	54	55	56
PERA	439	419	449	370	350	360
PIRA	158	160	166	168	180	NA
RAPRA	195	173			165	170
SAT				151	165	169
SI		197	204	196	187	NA
SIRA	192	158	199	231	250	229
SRA					20	23
SCR					80	55
TRA					125	105
WRc	535	478	571	587	667	650
WI	524	538	548	539	520	530
WIRA					100	NA
BTT	na	NA	NA	NA	N	250
CAMP					152	152
Lea	220	221	219	245	235	240
Total Sta	3566	4040	4140	4735	5667	5306
No.of RAs	30	31	33	33	33	32
No.of dat	15	19	21	21	33	31
Staff/RA	119	130	125	143	172	166
Staff/dat	238	213	197	225	172	171

Appendix 8.2. RAs' turnover from 1980-1989 (£m)

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Appendix 8.2 RAs'/Year	1980	1982	1984	1986	1988	1989
AMTRI			0.978	1.104	1.409	1.131
BCIRA	3.632	3.260	3.316	2.713	2.643	2.483
BHRA	4.384	4.739	4.918	5.614	4.970	4.815
BNF	3.584	2.913	2.702	2.692	2.600	2.778
BCR	3.920	3.928	4.086	4.764	4.609	3.982
BGI	0.986	0.880	0.804	0.701	0.700	0.648
BLC	0.000	0.000	0.000	1.040	0.970	0.926
BMT	0.000	0.000	0.000	11.341	10.024	9.260
BRA	1.603	1.716	1.776	1.831	2.300	1.991
CIRIA	0.194	1.820	1.920	1.690	1.700	1.667
CAT	0.195	0.164	0.172	0.204	0.260	0.278
ERA	6.786	7.051	9.960	11.461	10.500	9.723
FCR	0.418	0.411	0.557	0.000	0.700	0.648
FIR	2.323	2.016	2.111	2.020	2.300	2.408
HAT	1.179	0.000	0.000	0.000	0.400	0.370
HRC	0.000	5.940	6.071	6.863	8.000	7.408
LAM	0.000	0.000	0.000	0.000	0.700	0.648
MIRA	5.120	4.620	6.120	8.936	9.082	8.056
PR	1.259	0.994	0.864	0.928	1.000	0.926
PERA	11.066	12.218	23.179	18.943	15.444	17.594
PIRA	2.987	2.982	3.960	4.668	5.000	6.677
RAPRA	3.245	2.827	3.098	3.150	3.500	4.167
SAT	2.400	2.096	2.160	2.712	2.700	2.593
SI	3.138	2.936	3.438	3.237	3.200	0.000
SIRA	3.818	3.197	5.276	7.195	7.763	7.757
SRA	0.000	0.000	0.000	0.000	0.500	0.648
SCR	0.000	0.000	0.000	0.000	2.800	2.037
TRA	0.000	0.000	0.000	0.000	2.700	2.778
WRc	12.050	14.541	18.854	19.942	22.000	21.298
WI	11.179	11.884	13.013	13.613	15.000	12.964
WIRA	2.720	0.000	0.000	0.000	2.200	0.000
BTT	0.000	0.000	0.000	0.000	0.000	6.019
CAMP	0.000	0.000	0.000	0.000	2.700	2.778
Lea	3.440	3.986	4.800	5.668	6.331	6.204
Total Turnover	91.624	97.120	124.133	143.030	156.705	153.660
No.of RAs	33.000	33.000	33.000	33.000	33.000	32.000
No.of data	22.000	23.000	25.000	25.000	32.000	32.000
Turnover /RA	2.776	2.943	3.762	4.334	4.749	4.802
Turnover/Data	4.165	4.223	4.965	5.721	4.897	4.802

Appendix 8.3 Ranking of RAs' turnover for 1980 and 1982 (£m)

Ranking of RAs' Turnover(1980)(£mil)

RAs'/Year	1980
WRc	7.531
WI	6.987
PERA	6.916
ERA	4.241
MIRA	3.200
BHRA	2.680
BCR	2.450
SIRA	2.386
BCIRA	2.270
BNF	2.240
Lea	2.150
RAPRA	2.028
SI	1.961
PIRA	1.867
WIRA	1.700
SAT	1.500
FIR	1.452
BRA	1.002
PR	0.787
BGI	0.616
FCR	0.261
CAT	0.122
CIRIA	0.121

Ranking of Turnover (1982)(£mil)

RAs	1982
WRc	11.016
PERA	9.256
WI	9.003
ERA	5.342
HRC	4.500
MIRA	3.500
BHRA	3.346
Lea	3.020
BCR	2.976
BCIRA	2.470
SIRA	2.422
PIRA	2.259
SI	2.224
BNF	2.207
RAPRA	2.142
SAT	1.588
FIR	1.527
CIRIA	1.379
BRA	1.300
PR	0.753
BGI	0.667
FCR	0.311
CAT	0.124

Median turnover = 2.259

Appendix 8.3 Ranking of RAs' turnover for 1984 and 1986 (£m)

Ranking of RAs' Turnover (£m)(1984)

RAs	1984
PERA	19.316
WRc	15.712
WI	10.844
ERA	8.300
MIRA	5.100
HRC	5.059
SIRA	4.397
Lea	4.000
BHRA	3.836
BCR	3.405
PIRA	3.300
SI	2.865
BCIRA	2.763
BNF	2.252
SAT	1.800
FIR	1.759
CIRIA	1.600
BRA	1.480
AMTRI	0.815
PR	0.720
BGI	0.670
FCR	0.464
CAT	0.143

Median turnover = 2.865

Ranking of Turnover of RAs'(1986) (£mil)(1988 Prices)

RAs'	1986
WRc	18.295
PERA	17.379
WI	12.489
ERA	10.515
BMT	10.405
MIRA	8.198
SIRA	6.601
HRC	6.296
Lea	5.200
BHRA	5.167
BCR	4.371
PIRA	4.283
SI	2.970
BCIRA	2.489
SAT	2.488
BNF	2.470
FIR	1.853
BRA	1.680
CIRIA	1.550
AMTRI	1.013
BLC	0.954
PR	0.851
BGI	0.643
CAT	0.187

Median turnover = 4.283/2.970 = 3.627

Appendix 8.3 Ranking of RAs' turnover for 1988 (£m)

Ranking of Turnover of RAs(1988)
(£mil)(1988 Prices)

RAs'	(1988)
WRc	22.00
PERA	15.444
WI	15.00
ERA	10.500
BMT	10.024
MIRA	9.082
HRC	8.000
SIRA	7.763
Lea	6.331
BHRA	5.600
PIRA	5.000
BCR	4.609
RAPRA	3.500
SI	3.200
BNF	3.000
SCR	2.80
SAT	2.700
TRA	2.70
BCIRA	2.643
FIR	2.300
BRA	2.300
WIRA	2.20
CIRIA	1.700
AMTRI	1.409
PR	1.000
BLC	0.970
LAM	0.700
FCR	0.700
BGI	0.700
SRA	0.50
HAT	0.400
CAT	0.260

Median of turnover = (2.8+2.7)/2 =2.75

Appendix 8.3 Ranking of RAs' turnover for 1989 (£m)

Ranking of Turnover(1989)(£mil) RAs'	(1989)
WRc	23.000
PERA	19.000
WI	14.000
ERA	10.500
BMT	10.000
MIRA	8.700
SIRA	8.377
HRC	8.000
BTT	6.500
BHRA	5.600
RAPRA	4.500
BCR	4.300
TRA	3.000
BNF	3.000
CAMP	3.000
SAT	2.800
BCIRA	2.681
FIR	2.600
SCR	2.200
BRA	2.150
CIRIA	1.800
AMTRI	1.221
PR	1.000
BLC	1.000
FCR	0.700
LAM	0.700
SRA	0.700
BGI	0.700
HAT	0.400
CAT	0.300

Median = (3+2.8)/2 = 2.9

Appendix 9.1

JGB/RAL

14/09/89

Mr D Miles
Commission of the European Communities
Rue De La Loi 120
B-1049
Brussels
Belgium

Dear David

RESEARCH FUNDING FOR THE CLOTHING AND FOOTWEAR INDUSTRIES

We are looking forward to your visit to SATRA and the Clothing Technology Centre on October 2nd and I felt it may be useful to put some thoughts on paper regarding research for our type of industry. If you feel it would be helpful we could discuss these in more depth during your visit.

The catalyst that prompted me to put pen to paper, was a comment Robin Roach made two weeks ago, that the Commission may be prepared to consider funding a coherent programme of research projects in addition to the present approach of funding single large scale projects. If this is the case it could, in our opinion, make it possible to achieve much more effective research on a broad European basis for our type of industry.

A major inhibitor to our industry's current involvement in BRITE is that clothing or footwear manufacturers normally rely on machine suppliers to to do research and find it difficult to justify substantial investment in a long term, high risk research project aimed at automating a limited number of operations for a limited range of garments. Successful research of this type would result in the requirement for machines to be built and marketed by one of the relatively small number of European machine manufacturers. This inhibition is particularly true of SME's.

It is relevant to quote here the summary from Jeff Hewitts' lecture 'R & D for the European Clothing Industry' given at the EC symposium in Brussels on June 28th this year.

"R & D programmes need to be related to the strategic priorities of the European Industry today

- NOT large scale automated cell type developments such as TC squared/Draper laboratories.

- NOT Super integrated production systems of the MITI type.

In Europe the real need is for pragmatic and (possibly) quite small in scale multiple projects that will enhance flexibility and responsiveness across the broad spectrum of garment makers (and their customers and suppliers)."

I accept Jeff's analysis and hence my enthusiasm for a coherent programme of related projects.

A further motivation for encouraging a move towards research programmes rather than individual projects is the agreement reached last week in Paris for the EEC Clothing Research Institutes to form an Association to encourage closer co-operation. It is hoped to put a proposal to SPRINT to accelerate this co-operation - the initiative certainly gives a more coherent research resource for European Industry. The footwear institutes have been co-operating for several years but the nature of the BRITE project funding has not made it possible for broad co-operation under that initiative.

It may be helpful at this point to identify the fundamental (and often unrecognised) differences between programme based collaborative research involving mainly SME's and project based or contract research involving mainly large, or at least scientifically literate, companies. These are listed in the following table:

	PROGRAMME BASED COLLABORATIVE RESEARCH (NORMALLY MEMBERSHIP OR INDUSTRY SUPPORTED)	PROJECT BASED CONTRACT RESEARCH (CAN BE SINGLE COMPANY OR COLLABORATING 'CLUB')
USUAL CUSTOMER TYPE	90% SME'S	Large companies
NUMBER OF FIRMS SUPPORTING	Can reach several hundred	1 - 10
EXPERTISE AVAILABLE IN COMPANY TO INTERFACE WITH RESEARCH STAFF	Practical factory management	Scientifior strong technical/engineering
DEVELOPMENT STAGE REQUIRED FOR COMMERCIAL ACCEPTANCE	Available for fairly trouble free implementation onto factory floor without major production hold-ups	Can be picked up at working prototype stage or even earlier
IMPLEMENTATION RESOURCES AND SKILL AVAILABLE IN COMPANY	Very limited, usually part time additional responsibility on managers' shoulders	Usually have qualified staff that can be seconded full time to project implementation
COMMERCIAL ASSESSMENT OF ECONOMICS OF A SINGLE R & D PROJECT	Required skills and information not normally available in many SME's. A small group of selected individuals from different companies give balanced judgement on each project and or complete programme	A necessary skill requirement for the funding of any contracted research

Hence programme based collaborative research (often called co-operative research) is a fundamentally different business from project based contract research.

Co-operative research, by its very nature, is not directed to assisting one company to develop or improve one or more of its specific products. It is mainly 'Enabling Technology' ie its objective is to provide knowledge, products and services to companies to enable them to be more competitive in the market place. As all subscribing companies receive the results of the research at the same time, the research is, by definition, 'pre-competitive'.

A vital part of any business is its Marketing Policy. It is no less important to market 'research' than it is to market shoes or clothes. If a body - be it an Institute or an industrial company - conceives a research project that would give valuable results to other industrial companies it can decide to offer a partnership in the project and make its results available in exchange for a contribution to the costs. So far so good, but much effort is normally required to obtain a signature on any such agreement for a company to spend a significant amount of money on a research project (and what is 'a significant amount of money?'). It is likely to take at least two or three discussions before the decision making hierarchy in a company are willing to sign an agreement. Also several companies need to be approached in order for one to say yes to the proposed project. Such discussions cannot be carried out by junior laboratory staff. In all probability the possible participators will also be spread over a sizable geographic area - particularly if the EEC is the potential market.

The logistics of single project marketing now begin to emerge. A normal minimum of two or three visits to at least four or five companies will be required to obtain one partner. The ECU's add up and it is no surprise that the cost of preparing a full BRITE proposal is often quoted as being in excess of 30,000 ECUs. If the project value is two or three million ECUs and the number of final participants is in the range two to five, the economics are not unreasonable. If, however, we are dealing with a non-scientific, largely SME type of industry, where even large companies are mainly a grouping of disparate small/medium factories, the situation is completely different. Here a 'significant' investment in research (as distinct from product development) would be only hundreds or, at best the low thousands of ECUs. Marketing costs for a single project could, therefore, easily consume all the money that such companies could afford to invest in research.

What then is practicable in developing a 'European' research strategy for industries such as clothing and footwear?

I suggest that the Research Institutes in the different EC countries could play an important role in both the development of a strategy and in its implementation, where appropriate linking with other research bodies. All are (or certainly should be) in fairly regular communication with the large as well as the small and medium sized companies in their domestic industry. Working together as Institutes with selected technologists from the industry, they should be able to evolve a coherent programme of research projects that satisfies the following requirements:-

(i) The topics cover a broad enough spectrum to be of interest and value to a wide cross section of the European Clothing industry.

(ii) Projects are developed to match the expertise of participating research bodies (which could include companies and universities) and normally one project would be the responsibility of one research body. Parts could, of course, be sub-contracted if appropriate.

(iii) Industry funding for the projects would come largely from the normal contribution to the institutes but extra funding and contributions in kind could be sought for individual projects from larger companies or specific industry sectors where this is appropriate.

(iv) Each individual project or sub-group of projects should be vetted and formally endorsed by selected industrialists in the country in which the main contractor was based. The whole programme should then be subject to the approval of the Commission and its technical advisors, augmented, if appropriate, by selected European industrialists.

(v) A critical requirement for effective European research programmes is that the results of each project should be available to all relevant companies in each of the participating countries. It is therefore essential that all bodies involved in the programme are committed to take the results of a project carried out by one body and translate, and where necessary modify, the results to make them applicable to and implementable by the relevant companies. This should particularly include SMEs and hence such means as demonstration sites, general and in-factory awareness presentations and the development of implementation training programmes should be a normal part of the programmes exploitation and funding.

It would be presumptuous to say how best the Commission could develop this approach, if indeed it wished to pursue it at all, but there would appear to be appropriate mechanisms in BRITE, CRAFT and SPRINT.

I hope you have found these comments of interest, the principles outlined have certainly been the foundation on which SATRA's success has been built.

If there is any further background you would like to have before your visit, on SATRA, the Clothing Technology Centre or AIRTO (the UK Association of Independent Research and Technology Organisation) of which I am a Vice President please let me know.

With best wishes.

Yours sincerely

J G Butlin
Director and Chief Executive

Appendix 9.1
FAXED

JGB/KJI

13/05/88

Sir John Collyer
Chairman
United Machinery Group Limited
PO Box No 88, Ross Walk
Belgrave
LEICESTER
LE4 5BX

Dear Sir John

I was very pleased to have our brief discussion in Pirmasens, yet sorry that I had to use such an occasion to comment on Government Policy.

You mentioned that the Welding Institute receive only 2% of its income from the DTI. This surprised me because I had long assumed that the bulk of their income was from either single company contracts or small group collaborative projects with significant DTI input.

I have just been talking to the Director of the Welding Institute, Alan Wells, and now realise how similar in nature SATRA is to Welding Institute (excluding their "Institute Activities"). You may be interested in the comparison shown in the following table :

Comparison of Welding Institute and SATRA Income Sources

	Total Revenue	No of Members	Average Subscription	Subs Income	DTI Income[3]	Other Income[4]	% Subs	% DTI	% Other
Welding Inst [1]	£ 12m	600	£ 5,000	£ 3m	£ 3m	£ 6m	25	25	50
SATRA [2]	£ 3m	1100	£ 820	£ 0.9m	£ 0.6m	£1.4m	33	20	47

(Figures are approximate).

1 Excluding Professional Institute activities.
2 Excluding Clothing Technology Centre (which SATRA manages).
3 From 50% funded research contracts.
4 From contract research and sale of services etc.

You will see that our respective "earnings" from the market place are a similar proportion of turnover (50% vs 47%), although SATRA's are almost totally from member companies. Interestingly, Welding receives a higher proportion of turnover from the DTI than does SATRA (25% vs 20%).

A striking difference between the two organisations is the size of the average subscription - a 6 to 1 difference - which I am confident is a reflection of the average size of member company. This has prompted me to test the validity of my argument that industries such as footwear and clothing have a different structure than many other UK industries. Of firms employing over 50 people in footwear and clothing, only 1 company in 40 employs more than 500. This contrasts with 1 company in 10 for the rest of UK manufacturing industry.

This difference has a direct bearing on the type of research that an RTO can most effectively perform, ie whether the most effective strategy is to major or single company contracts; collaborative projects involving say 2-20 companies; or co-operative research involving up to several hundred or more companies.

Since you are both Chairman of one of our largest member companies and also close to the centre of Government R&D policy thinking, I hope you feel it reasonable for me to enclose a copy of some notes I hurriedly made for a meeting with Peter Corley (Head of the DTI Consumer Markets Division) last March.

In these I try to show what is a large and fundamental difference between co-operative research and collaborative research and to show that for our type of industry the strategy must be aimed at effective co-operative research. In addition I point out the damage that could be caused if the new Enterprise policies for R&D are interpreted in basically the same way when being applied to collaborative and co-operative research - "sauce for the collaborative goose can easily be poison for the co-operative gander".

My concern over the situation has been further heightened since my return to SATRA. I have reports from other Research Organisations who are already suffering the practical effects of the policy changes. If treated similarly, SATRA could lose income from DTI roughly equivalent to losing our five biggest member companies - or about 120 of our "average" sized members!

Because I am convinced of the profound damage which will inevitably be caused to co-operative research, I conclude there are only two possible explanations. Either the Secretary of State is fully aware of the difference between collaborative and co-operative research and is using the new policy as a cleverly disguised means of cutting Government support for R&D in the lower technology SME type industry, or, as I assume is the case, he is not aware of the realities of the difference. This would not be surprising as I suspect some of my RTO colleagues are not either!

I believe that it is feasible to apply the new policies to co-operative research in a constructive rather than a damaging manner. First it would be necessary to distinguish between collaborative and co-operative research. Three criteria could be a) the number of companies involved (eg over 50 for 'co-operative' research), b) the median size of company (eg not to exceed 250 employees) and c) that funding is for a programme of research projects rather than a single project.

Having agreed that a proposal is for co-operative research, the principle of tapered funding could be applied to the individual projects within the programme. Funding at a maximum 75% level for the first phase of high risk projects could taper to 25% in the latter stages with the safeguard (to avoid possible abuse) that overall programme funding should not exceed 50%.

The principle of 'innovation' has always been present in DTI funding decisions - our only concern is that innovation is a concept very dependent on the type of industry concerned. What is highly innovative for a medium size shoe manufacturer could be mundane for British Aerospace. A fair and reasonable judgement of innovative contact has been present in TOMC decisions to date which I hope would continue.

On the 'distance from the market place' concept I have argued that as the results of co-operative research are available simultaneously to all members it is, by definition, "pre-competitive" and hence far from the market place.

If you felt it appropriate I would be pleased to elaborate on any of these points, or to discuss them further with you.

Having "got that off my chèst" could I repeat my warm invitation to you to visit SATRA to see what we do and how we can and do interface with the UMG.

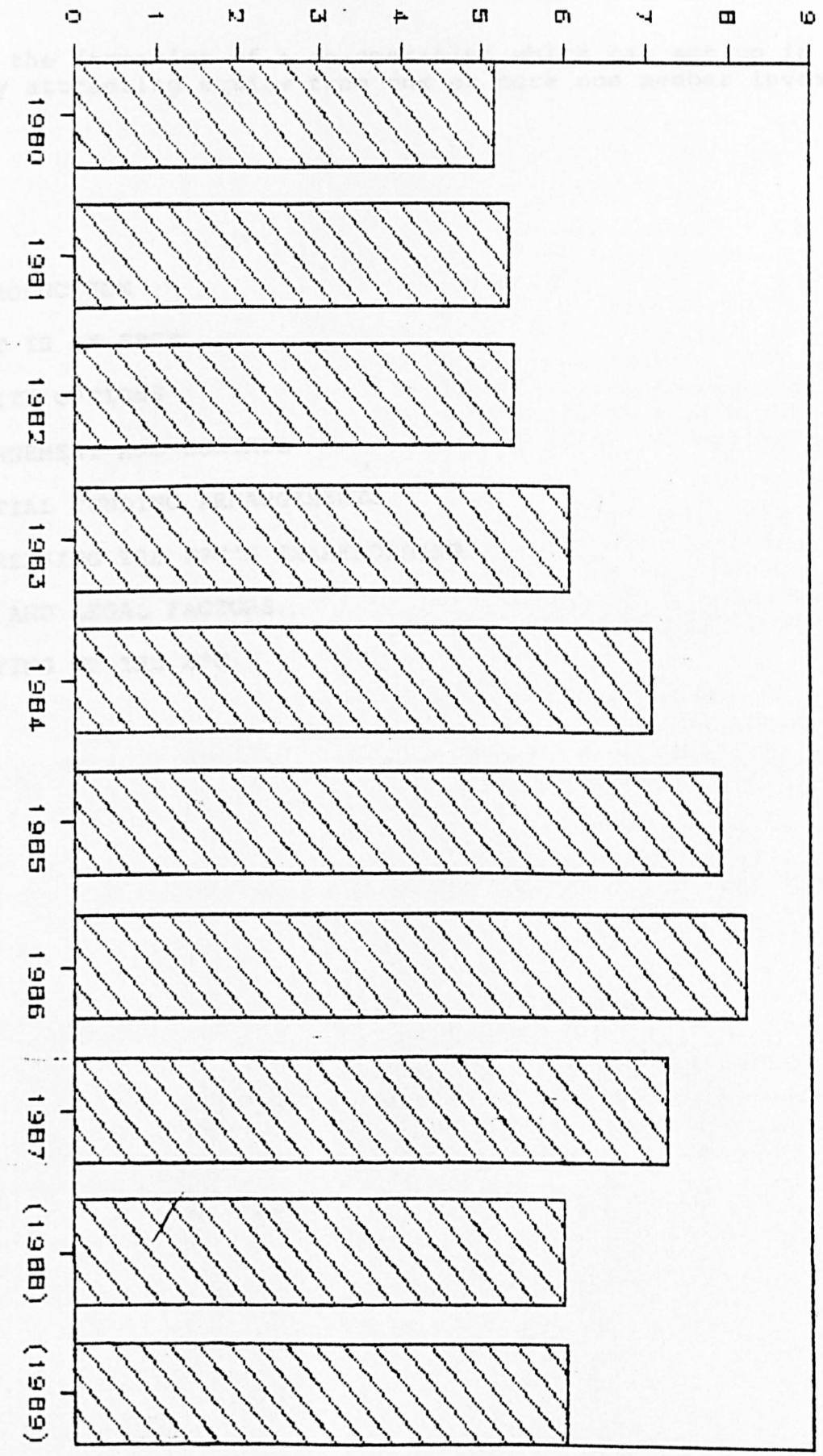
With Kind Regards.

Yours sincerely

J Graham Butlin
Director and Chief Executive

Appendix 10.1

Turnover/RTO $million



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Appendix 12.1

HOW TO FORM AN EQUITY PARTICIPATION CO-OPERATIVE (New Business)

A guide to the formation of a co-operative which can set up in business by attracting equity from one or more non member investors.

HOW TO FORM AN EQUITY PARTICIPATION CO-OPERATIVE

(New Business)

1. INTRODUCTION

1.1 Raising finance is a major hurdle to any group of people setting up in business. In each case there is usually a need to raise external finance as it is unlikely that the group will have sufficient personal resources. If the group wishes to form a worker co-operative the form of finance available is usually limited to loans.

1.2 Due to the members inability to offer adequate security or guarantees many worker co-operatives are at best under capitalised and at worst fail through lack of finance. Any business venture, co-operative or otherwise, carries with it some element of risk and the providers of finance are rarely prepared to inject money at risk unless there is some prospect of a return in excess of the market rate of interest as compensation for the risk of loss. Co-operative shares cannot offer such a return as they do not increase in value and non employee members are usually excluded.

1.3 The vehicle most suitable for raising risk capital is the conventional share company. By using an EPC structure the members will set up a company which is able to offer shares to investors. The remaining shares will be held by an EPC (equity participation co-operative), which will be a company limited by guarantee incorporating co-operative principles.

1.4 The remainder of this guide explains how to go about forming an EPC structure and examines the particular areas which the members need to consider. The CDA is available to be consulted on such matters and will advise the members on the best way of satisfying their requirements.

1.5 The EPC structure, therefore, enables a co-operative to raise risk capital and could mean the difference between forming a viable venture and failure due to the inability to raise sufficient finance.

2. WHAT IS AN EPC?

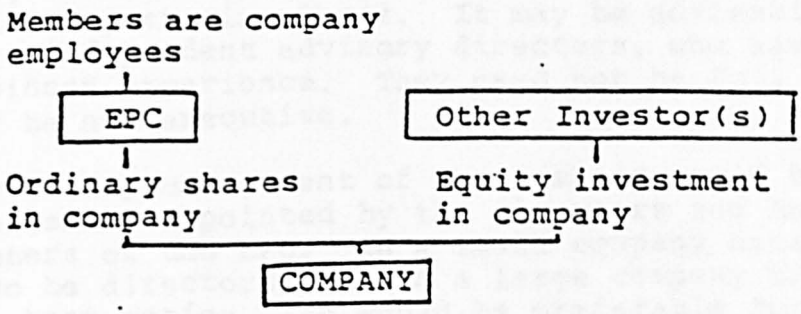
2.1 An EPC is a corporate body, registered with a co-operative constitution, its purpose is the acquisition and mangaement of shares and representation of its members' interests in a conventional company, some or all of whose employees are members of the EPC.

2.2 Membership of the EPC is restricted to employees of the company. Membership of the EPC is not a condition of employment in that company, but it is expected that the majority of employees would choose to join.

3. EQUITY OPTIONS

3.1 The equity of a conventional company consists of shares with various rights. The extent of control over the company will depend upon the proportion and class of shares held by the EPC and outside shareholders. There are various combinations that could be used to satisfy the requirements in each particular circumstance. The EPC would normally acquire ordinary shares with full voting rights. The shares issued to the outside investor will normally be the subject of negotiation but the shares offered can be purchased back at some future date by either the EPC or the company.

3.2 The basic share structure would be as follows:



3.3 The voting rights and powers attached to each class of shares will need to be drawn up in either the company's Articles of Association or a separate Shareholders' Agreement.

The three main equity options cover the issue of ordinary shares, preference shares and redeemable shares.

Ordinary Shares - These may be of the same class as those issued to the EPC. In this case both shareholders will have equal voting rights and powers depending upon the number of shares held by each. The eventual transfer of ownership to the EPC can come about through the shares held by the outside investor being re-purchased by the EPC or re-purchased by the company and cancelled. The value of ordinary shares will fluctuate in line with the value of the business and dividends paid. Ordinary shares may also be issued without voting rights.

Preference Shares - These have preferential rights in the event of winding up the company and in terms of dividend. As such they offer greater protection for the investor. Often issued with or without voting rights or with an intervention vote in the event of unpaid preference dividend. They may or may not participate in profits. Preference shares will not qualify an investor for relief under the "Business Expansion Scheme".

Redeemable Shares - Ordinary and Preference shares may be issued as redeemable. The amount payable upon redemption may be at par or with a specified premium depending upon the terms of issue. If redeemable shares are issued the Company must also have issued shares which cannot be redeemed. Redeemable shares offer a means by which the Company can re-purchase the outside investor's shares, thus facilitating the EPC's final take over o control.

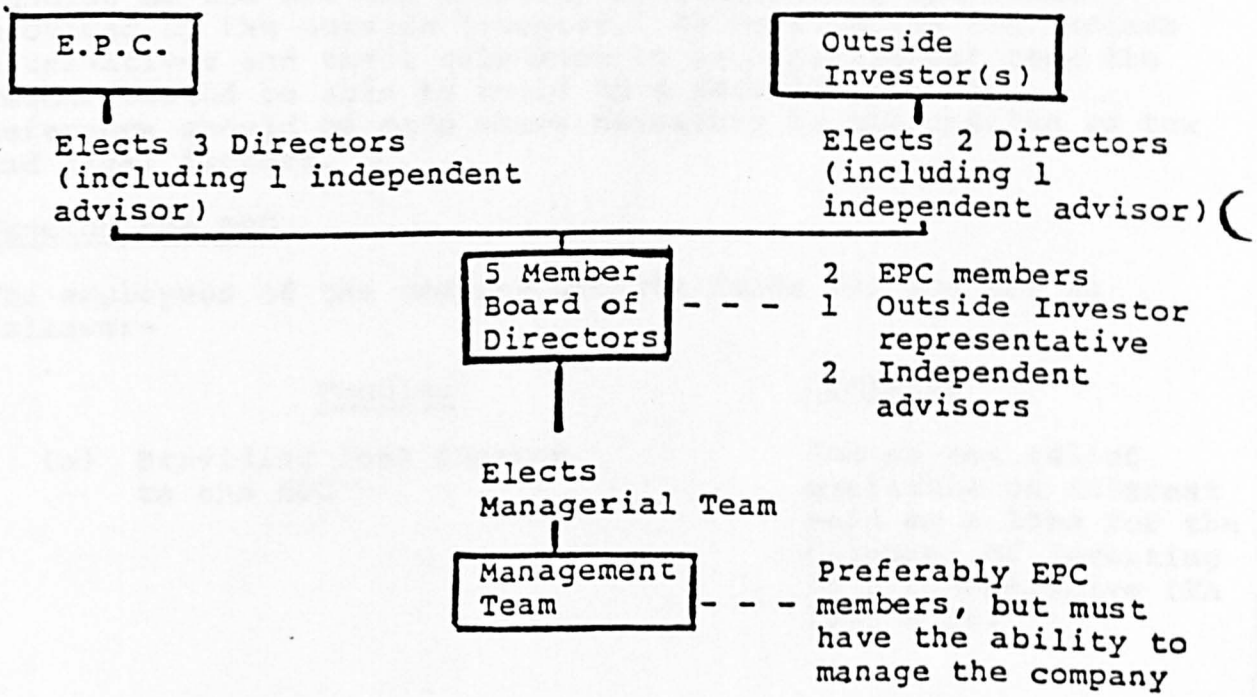
4. MANAGEMENT AND CONTROL

4.1 The effective control of companies is vested by the shareholders in its board of directors, elected at General Meeting. The election of directors may be the subject of negotiation between the co-operative members and the outside investor. Articles of association may provide for the number of directors to be appointed by each class of shareholder. Where the outside investor has non voting shares the articles may allow for the co-operative to appoint all of the directors.

4.2 The appointment of the company directors is in the hands of the management committee which is elected on a one member one vote basis by the EPC members. Management committee members are eligible for appointment as directors of the company, on either a full or part-time basis. It may be advisable to appoint one or more independent advisory directors, who have co-operative and/or business experience. They need not be full time directors and may be non executive.

4.3 Day to day management of the company would be vested in management appointed by the directors and may or may not be members of the EPC. In a small company management may well also be directors, but in a large company this may not be the best option. It would be preferable for management to be drawn from the EPC membership, but if the members do not have managerial ability it may be wise to recruit outside management until the membership can develop their own managerial ability. Outside management, of course, could well be recruited into the EPC.

4.4 The following is a suggested managerial/control stucture:-



Role of Directors - The directors have a responsibility to the shareholders generally. The EPC appointed directors, in particular have a responsibility to the EPC. They are representatives, rather than delegates, of the EPC. They cannot be mandated by the EPC but must obviously take account of its wishes. Their prime objective is running the company in the interest of all the shareholders and will therefore need to balance the overall business interests with those of the EPC. The role of the outside investor(s) representative will be one of ensuring that the interests of the outside investor(s) are safeguarded, and the representative will be unlikely to have executive responsibility. There is a safeguard against business interest being overidden in the above example, by the two independent advisors allying with the outside investor(s) representative to outvote the two EPC appointed directors.

The Directors need to give management clear objectives in order that managements' role, responsibilities and limitations are fully understood. Within such objectives management should be allowed freedom to manage.

It should be pointed out that the above is one managerial structure and members should consider various alternatives.

5. INITIAL FUNDING ARRANGEMENTS

5.1 The acquisition of shares in a company will be funded by the EPC and one or more investors.

This section covers the possible arrangements that may be made to cover the acquisition of shares, firstly, by considering the funding of the EPC and secondly by considering the funding provided by the outside investor. By considering the various alternatives and their relevence to each particular case the reader should be able to build up a suitable package. Reference should be made where necessary to the section on tax and legal factors.

5.2. Funding the EPC

The employees of the company provide funds for the EPC as follows:-

	Funding	Comments
(a)	Providing loan finance to the EPC	Income tax relief available on interest paid on a loan for the purposes of investing in a co-operative (FA 1981 s 25)

The EPC may also be able to obtain funds from other sources

(b) Loan from bank etc., secured where necessry, on (i) assets of EPC i.e. shares in company. (ii) assets of company	Interest on bank loan is relieved against profits of the EPC. If profits in EPC "Group Relief" available. If secured on company assets "Financial Assistance" deemed to have been given and company will need to comply with statutory procedures.
(c) Grant or loan by public or other promotional body	Several bodies may wish to promote the formation of an EPC through grant or loan. If a loan, interest will be relieved against profits of the EPC. If no profits in EPC "Group Relief" available.

5.3 Funding by the outside investor

The outside investor acquires shares directly in the company.

Funding	Comments
(a) Funds provided by a non-connected individual.	Tax relief available to individual under "Business Expansion Scheme" for certain classes of share.
(b) Funds provided by a "Business Expansion Scheme" venture capital fund.	Early days, but requirements of the fund in terms of cost may be prohibitive. May require some managerial involvement e.g. non executive director.
(c) Funds provided by conventional venture capital fund e.g. ICFC.	Requirements as to for of equity and degree o control may vary between funds.

(d) Grant or loan by public or other promotional body.	May be more supportive of long term objectives rather than a sole interest in capital gain.
(e) Member with capital to invest may invest in company shares rather than loan to EPC.	Loan to EPC preferable as this maximises EPC shareholding. Individuals may not be prepared to invest sums larger than other members directly as loan to EPC and may want potential capital growth. Shares should be non voting.

6 INCREASING THE EPC's SHAREHOLDING

6.1 Whatever the intentions of the EPC members the option is open to increase the proportion of the EPC's shareholding. This section considers the possible arrangements by which this can come about. In many cases sacrifices will have to be made by the members i.e. by forsaking the distribution of dividend as bonus and in others help may be available from the other shareholders. Such sacrifices will be more readily made when the objective of forming a fully co-operative business is firmly established in the minds of the members. The options are broadly classified under the following headings:-

- EPC purchases shares from outside investor.
- Conversion of outside shareholdings.
- Company buys back its own shares.
- Company issues bonus shares.

6.2 EPC Purchases Shares from Outside Investor

With shares in the company held by the EPC and one or more outside investors, the obvious route for increasing the EPC's shareholding is for it to purchase shares from the outside investor. To do this the EPC needs funds, these can be obtained as follows:-

Funding	Comments
(a) EPC members plough back a percentage of earnings or bonus to EPC on loan account.	Interest may be paid tc members on loan account, this will need to be financed or accumulated on loan. Interest relieved against profits of EPC - if no profits "Group Relief" available.

	Benefits of using a savings related share option scheme to acquire company shares should be considered. Shares could be sold to EPC on loan account.
(b) Loan from company.	"Financial Assistance" deemed to have been given and company will need to comply with statutory procedures.
(c) Loan from bank etc., secured, where necessary on (i) assets of EPC (ii) assets of company	Interest on bank loan is relieved against profits of the EPC - if no profits "Group Relief" available. If secured on company assets, "Financial Assistance" deemed to have been given and company will need to comply with statutory procedures.
(d) EPC receives dividend from the company and does not distribute it to members as bonus	Only possible where company has profits available for distribution. Dividend may be paid gross using "Group Relief".
(e) More employees join EPC.	Income Tax relief available to an individual on interest paid on a loan for purpose of investing in a co-operative (F.A. 1981 s. 25).

6.3 Conversion of Outside Shareholdings

In the initial stages of forming the company, the outside investor may have insisted on certain rights regarding dividend and control attaching to his or her shares. This may have been retained to prove the abilities of the employees, once proven the outside investor may be prepared to convert his or her shares to non voting equity or loan stock.

There are advantages to the ouside investor or residual shareholder in having redeemable equity or loan stock on agreed terms as the ordinary shares themselves may have limited marketability.

6.4 Company Buys Back its Own Shares

The Companies Act 1981 gives companies the ability to buy back their own shares. The company should consider this facility to purchase the shares back from the outside investors or residual shareholders. The legislation comprises three main elements, namely:-

- Power of a company to issue redeemable shares of any class, thus permitting short term equity investment;
- Power of a company to purchase its own shares through the media of a recognised stock market, private contract or a contingent purchase contract (future option);
- Power of a private company to purchase or redeem its shares out of capital.

Except in the last case, purchase or redemption monies must be satisfied by the company's distributable profits (as defined by s 62 (1) Companies Act 1981) together with the proceeds of a fresh issue (if any) made for the purpose of purchase or redemption.

The company therefore may buy in some or all of the shares of outgoing shareholders thus leaving the EPC in control of the company. Such an option , however, should never overide the need to maintain sufficient working capital in the company.

Various statutory procedures will need to be complied with.

6.5 Company issues Bonus Shares

It is open to the company to issue bonus shares out of profits to either the EPC or individual employees through an approved profit sharing scheme. In the case of an "approved profit sharing scheme" funds applied may be offset against the company's profit for corporation tax purposes and the employee obtains some relief against income and capital gains tax. Once in the ownership of the employees the shares could be sold to the EPC on loan account.

7. TAX AND LEGAL FACTORS

7.1 In the previous sections various legal and taxation considerations were referred to. This section explains in further detail some of the main considerations which are:-

- Profit sharing schemes;
- Relief for loan interest;
- Share buy back;
- Financial assistance;
- Business expansion scheme;
- Group relief;

7.2 Profit Sharing Scheme

The 1978 Finance Act introduced certain reliefs for participants in profit sharing schemes which have been approved by the Board of the Inland Revenue. The scheme must be administered by a trust constituted for that purpose. Out of monies paid to them by the company which has established the trust, the trustees must purchase or subscribe for qualifying shares. The shares so purchased or subscribed must be formally appropriated to named individuals who are eligible to participate.

Under an approved scheme the company can offset payments to the trustees against corporation tax and the individual employee will not be subject to income tax on either the original grant of the shares or their growth in value. For sums appropriated on or after 6th April, 1983, the maximum sum eligible to be contributed by the company in respect of each employee is £1,250 or 10% of the employee's earnings, whichever is the greater, subject to a ceiling of £5,000.

The following are the main conditions necessary for Inland Revenue approval:-

(a) The employer must establish a UK trust and the trustees will appoint shares to the beneficiaries, account for any income tax and generally administer the scheme;

(b) Participation in the scheme must be open to all full time working directors and employees of the company;

(c) The shares acquired under the scheme must form part of the ordinary share capital of the company, be of a class quoted on a recognised stock exchange or be in a company which is not under the control of another company;

(d) The shares must be fully paid up, not redeemable and not subject to any restrictions other than those which attach to all shares of the same class;

(e) The scheme must be open to employees with five or more years service although the scheme may allow those with a lesser service to join;

(f) The employees must agree to leave their shares in the scheme with the trustees for at least two years, if the shares are sold within seven years some income tax may be payable on a reducing scale.

The scheme as it stands is simply a method of extending share ownership to employees. The scheme can be used, however, to pass shares to employees who may then sell the shares to an EPC on loan account after seven years. The CDA is pressing for relief under the scheme to be extended to enable the shares to be held by an EPC.

7.3 Relief for Loan Interest

Under section 25 of the Finance Act, 1981 interest is eligible for relief against an employee's income tax if it is interest on a loan to defray money applied:-

(a) In acquiring a share or shares in a body which is a co-operative, or

(b) In lending money to any such body which is used wholly and exclusively for the purposes of the business of that body or of a subsidiary of that body, or

(c) In paying off another loan, interest on which would have been eligible for such relief.

The conditions on which such relief is given are:-

(a) That when the interest is paid the body continues to be a co-operative, and

(b) That in the period from the application of the proceeds of the loan to the payment of interest, the individual has worked for the greater part of his or her time as an employee of the body or of a subsidiary of the body, and

(c) That he or she shows that in that period he or she has not recovered any capital from the body.

This provision, therefore, considerably assists employees who raise a loan in order to finance an EPC.

7.4 Share Buy Back

Sections 45 to 62 of the Companies Act, 1981 grant companies the power to purchase their own shares. This power will be of considerable help in enabling the company to buy back the shares held by an outside investor, thus leaving the EPC in control of the company. Any class of shares may be purchased by the company including redeemable shares.

The legislation comprises three main elements:-

(a) Power of a company to issue redeemable shares of any class, thus permitting short term equity investment;

(b) Power of a company to purchase its own shares through the media of a recognised share market, private contract or a contingent purchase contract (future option);

(c) Power of a private company to purchase or redeem its shares out of capital.

Except in (c) purchase or redemption monies must be satisfied by the company's distributable profits together with the proceeds o a fresh issue (if any) made for the purpose of the purchase or redemption. The main features of the legislation which will nee to be considered by a company considering buying back its own shares are:

REDEEMABLE SHARES

The company's articles of association must authorise the issue o redeemable shares and provide for the manner of redemption, subject to the following statutory requirements:-

(a) they may only be issued if there are also non-redeemable shares in issue;

(b) redemption may be at the option of the shareholder or the company;

(c) only fully paid shares can be redeemed;

(d) the redemption terms must provide for payment on redemption;

(e) on redemption the shares are treated as cancelled and the share capital reduced accordingly;

(f) an appropriate transfer to capital redemption reserve must be made to maintain the company's capital.

PURCHASE OUT OF RESERVES

(a) The company's articles of association must contain general authority;

(b) Authority of a special resolution must be obtained for an off-market purchase or contingent purchase contract (i.e. option), and authority of an ordinary resolution must be obtained for a market purchase;

(c) At least one member (e.g. the EPC), must hold non redeemable shares following the purchase.

PURCHASE OUT OF CAPITAL

(a) The articles of association must contain general authority and this power may only be exercised by private companies with the authority of a special resolution passed within one week of a statutory declaration by the directors;

(b) Any available profits or proceeds of a fresh issue (if any) must first be used for the purpose of redemption or purchase before any depletion of capital can take place;

(c) Where there is an excess of the payment out of capital plus the proceeds of a fresh issue (if any) over the nominal value of the shares redeemed or purchased then the excess may be applied in reducing:-

(i) capital redemption reserve, share premium account, or fully paid share capital; and

(ii) the revaluation reserve.

If there is a deficiency the difference is added to the capital redemption reserve.

(d) The following statutory procedures must be complied with:

- statutory declaration by the directors,
- auditors' report on the declaration;
- notice in the Gazette and appropriate national newspaper (or to each individual creditor) within one week of the resolution;
- declaration and auditors' report filed with registrar of companies;
- payment out of capital must be made within five and seven weeks of the resolution.

7.5 Financial Assistance

Sections 42 to 44 of the Companies Act 1981 considerably relax previous restrictions applying to private companies which wish to use their own resources to enable or facilitate the acquisition of shares in themselves or in their holding company. This relaxation will considerably assist the company to help the EPC obtain finance to acquire the company's shares.

Financial assistance may be by gift, guarantee or security, loan etc. The company can now give security over its assets for the purpose of assisting the EPC raise long term finance and it may make loans to the EPC, provided that any provision required against such loans is covered by the company's distributable profits. The company may need to make loans to the EPC to enable the EPC to make loan repayments to its financiers, such loans constitute financial assistance since they are made for the purpose of enabling the employees, through the EPC, acquire the company's shares.

The company, if it is to provide the financial assistance, must pass a special resolution to approve the arrangement. The directors of the company must make a statutory declaration in the prescribed form. Copies of the declaration must be delivered to the registrar of companies together with the relevant special resolution within 15 days of the resolution. The statutory declarations by directors will contain:-

- Prescribed particulars of the assistance to be given;
- Prescribed particulars of the business of the company;
- Identification of to whom the assistance is to be given;
- A statement that the directors have formed the opinion that immediately following the date assistance is proposed to be given there will be no ground on which the company could be found unable to pay its debts;
- A statement that the directors have formed the opinion either that:

  (a) if it is intended to commence winding up the company within 12 months, the company will be able to pay its debts within 12 months of the commencement of winding up or,

  (b) in any case, the company will be able to pay its debts as they fall due during the following year.

In forming these opinions prospective and contingent liabilities must be accounted for according to their likelihood of crystallisation.

An auditors report must be annexed to each declaration stating that they have enquired into the state of affairs of the company and are not aware of anything which would indicate that the directors' expressed opinions are unreasonable in all the circumstances.

The special resolution must be passed on the date of the statutory declaration or within the following week and is only effective if the statutory declaration is open for inspection at the meeting and has not been cancelled by the court. Financial assistance may then only be given after the expiry of four weeks from the date of the last relevant resolution unless every member voted in favour of the resolution. Financial assistance must be given within eight weeks of the date of the earliest statutory declaration made by the directors.

The court has powers to cancel or confirm the resoluton, arrange for the purchase of the interest of dissenting members, provide for the purchase by the company of shares of any members, or make alterations in the company's memorandum or articles. An application for cancellation may be made within 28 days of the resolution by the holders of not less than 10 per cent of the nominal value of company's issued share capital.

The company is likely to be making loans to the EPC at regular intervals to cover the EPC's loan repayments and it would be best to include as many quanta of loans as possible to be ratified by the required procedures. It is advisable in any circumstance to obtain professional advice to ensure that the procedures are followed in accordance with the law as the above are simply guidelines to the necessary procedures.

7.6 Business Expansion Scheme

The Finance Act 1983 introduced the Business Expansion Scheme (BES) as a successor to the Business Start-Up Scheme. Under BES qualifying individuals are eligible for income tax relief on sums, up to a maximum of £40,000 per year, invested in the eligible shares of qualifying companies. The scheme has made available substantial funds for investment in new and existing businesses. The EPC structure enables co-operatives to tap this source of funding which may be available directly from individual investors or from funds set up to administer such investment on behalf of individuals. An individual must subscribe at least £500 in each year if the investment is made on his or her own behalf, although where a BES Approved Fund subscribes on his or her behalf there is no lower limit.

Eligible shares under the scheme means new ordinary shares which throughout a period of five years from the date on which they are issued carry no present or preferential right to dividend or to the company's assets on its winding up and no present or future preferential right to be redeemed. The shares are effectively, therefore, locked into the company for five years. After five years, however, the rights may be changed to enable the shares to be purchased by the EPC, converted to loan stock or repurchased by the company. Voting rights, however, do not necessarily have to be attributed to the shares when they are issued and it is possible for the EPC to retain the voting shares, but allow the BES investor to participate in asset growth and continue to receive dividends.

The income tax relief is given to the individual at the highest marginal rate ie up to 60%. The relief is given in respect of the amount subscribed for any eligible shares. In practice, these shares may be offered at a premium, and it is the entire amount paid for each share that will qualify, rather than the par value of the share.

To qualify the investor must live in the UK, not own more than 30 per cent of the ordinary shares, nor be a paid director or employee of the company. The investor may be an unpaid director and receive payments from the company so long as they relate solely to travelling or other expenses that have been wholly, exclusively, and necessarily incurred in performing his or her duties as an unpaid director of the company.

Most unquoted trading companies will qualify provided that they are incorporated in the UK. Throughout the period of three years after the issue of the eligible shares or the commencement of trade, whichever is the latter, the company must:-

(a) Be resident in the UK only for tax purposes;

(b) Be an unquoted company. This means that none of its capital can be dealt with on the Unlisted Securities market or be listed on the Official List of the Stock Exchange;

(c) Exist wholly, or substantially wholly, for the purposes of carrying on one or more qualifying trades in the UK. Non qualifying trades include: dealing in commodities, shares, securities, land or futures, conducting banking, insurance, debt-factoring, hire purchase or other financial services, leasing, or letting, providing legal or accountancy services, and farming;

(d) Not be itself a 51% subsidiary of another company. There must also be no arrangement in existence whereby the company could become controlled by another company. Whether, this provision excludes a 51% holding by an EPC, registered as a Company limited by guarantee, is as yet untested;

(e) Have only fully paid issued share capital.

The attractions to a business in seeking BES finance are several. There are now substantial amounts of BES money looking for a suitable home. Investors go into these investments on the basis of risk, and so the criteria are very different from those the banks apply when lending money. The money is, on the face of it, provided in perpetuity as the company receives cash in exchange for an issue of shares and the individual investors are required to hold their shares for a minimum of five years in order to obtain BES relief. This period will allow the company ample opportunity to plan the use of the money, and also to make provision for it to be repaid where appropriate.

A further attraction is that the finance carries little cost. Because BES shareholders are likely to be higher rate taxpayers they would prefer capital growth rather than dividend income. Many of them would not wish to receive dividends at all, and this factor may compliment the company's own wishes that the profits should be retained in the business, rather than be paid out by way of dividends.

The exit route ought to be discussed in any initial negotiations and the preferred route may be for the company to buy back the shares in five years time. The situation is similar to a five year loan except that repayment does not have to be made until after the end of five years. The other methods referred to in section 6 are all possibilities worth considering.

7.7 Group Relief

To obtain the benefit of group relief the company would have to be a 75% subsidiary of the EPC and, in this case, losses could be surrendered by either company to the other.

One particular area that may need clarification by the revenue for a particular case is that of the surrender of losses made by the EPC occasioned by the payment of interest on its loan stock.

It would seem that this interest on loan stock, if it produced a loss in the EPC, could then be offset against the taxable profits of the company. If the company is 100% owned this has the same effect on the amount of profits liable to tax as if the trade were carried on by the EPC.

Where the company is a 51% subsidiary of the EPC it would seem that, so long as both the company and the EPC jointly elect, then ACT is not payable on any dividend paid to the EPC. Such dividends then constitute "group income" which is exempt from corporation tax.

8. SETTING UP THE EPC

8.1 A group of people want to start a co-opertive but find that they need to obtain outside equity investment in order to fund the new venture. They can do this by forming an EPC to hold shares in a conventional limited company in conjunction with an outside investor.

8.2 Step 1: Business Plan

Before embarking on any business venture it is essential that a detailed business plan has been prepared to assess the viability of the venture and to calculate the financial requirements. Before embarking on the formation of an EPC the members should first try to obtain funding from members, supporters, grants or loans from local authorities or banks etc. without resort to equity investment. This will enable them to commence as a conventional co-operative.

If equity funding is required then proceed to step 2.

8.3 Step 2: Funding the EPC

The members of the EPC will usually invest in loan stock in the EPC, rather than in the company, in order to maximise the EPC's shareholding. The EPC may also be able to obtain funds directly from other sources. A bank loan may be obtained, possibly secured with a cross debenture over the assets of both the EPC and the company. Funds may also be available as grant or loan from public or other promotional bodies. (see section 5.2).

8.4 Step 3: Equity options and equity partners

The equity partner(s) may be an individual, whether a member of the co-operative or not, a venture capital fund or a public or other promotional body (see section 5.3). The members will need to consider the suitability of such investors, particularly if they are going to have voting rights or the power to appoint directors. The type of equity option (see section 3) will effect the overall level of control the EPC has over the company (see section 4) and its share of the company's profits. The members will also need to consider how the equity option may effect the EPC's ability to eventually acquire full control of the company.

The object of allowing equity investment is mainly to obtain funds whilst retaining control in the hands of the employee co-operators. Such an option will involve issuing the investor with non voting shares. A member with surplus funds to invest, a public sector agency or private venture capital group may all be willing to consider taking non voting shares. An alternative may be to offer shares with voting rights only where dividends/ or profits fall below a certain level.

A venture capital fund will be looking for capital growth and will require a share that participates in profits. The public agency, however, may be happy with a fixed interest share repayable at par at some time in the future on agreed terms.

Provision ought to be made for the outside shares to be redeemable although the ordinary shares held by the EPC ought not to be if the EPC is to take advantage of the share buy back legislation.

8.5 Step 4: Registration Proceedures

The following agreements will need to be drawn up and agreed.

(a) EPC memorandum and articles
(b) Company memorandum and articles
(c) Shareholders agreement.

The CDA has models available for (a) and (b) which can assist the process of registration (see section on registration).

The company model is widely drawn to allow it flexibility in the shares it may issue. The exact terms attached to the shares issued will need to be set out in a separate Shareholders Agreement. We strongly recommend that an experience solicitor or accountant is employed to draw up this agreement as, whilst the CDA can advise, professional legal expertise will be required.

Appendix 12.2

TAXATION RELIEF FOR SCIENTIFIC RESEARCH ORGANISATIONS

Note for Applicants Seeking the Approval of the Department of Trade & Industry

1. Application for approval may be made under one or both of the following Acts of Parliament:

> Income and Corporation Taxes Act 1988 (ICTA), Section 508(1)(a)(b), and Section 90 Capital Allowances Act 1968 (CAA), Section 90.

The former Act (ICTA) provides for (a) exemption from tax on an approved association's income from rents, profits, interest, dividends etc, such as is currently afforded to charities under Section 508 and (b) exemption from tax in respect of chargeable gains, eg capital gains tax. The latter Act (CAA) allows any contribution to an approved association from a trader to be counted as an expense, and consequently only benefits the trader.

2. The Department has to be satisfied on two main counts before granting approval:-

i. that constitutionally, both in theory and in practice, the organisation is an "Association" of which the Department can approve.

ii. that the organisation is devoting a major proportion of its effort to the undertaking of scientific research which may lead to or facilitate an extension of any class or classes of trade, which should be an object of the organisation.

The Inland Revenue has subsequently to decide, in the case of new applicants for Section 508 approval, whether "the

memorandum of association or other similar instrument regulating the functions of the Association precludes the direct or indirect payment or transfer to any of its members of any of its income or property by way of dividend, gift, division, bonus or otherwise howsoever by way of profit" (Section 508(1)(a)(b)). An example of a typical Memorandum and Articles of Association may be obtained from RTP Divison of the Department of Trade and Industry.

It is up to the applicant to decide, or seek professional advice if necessary, on whether it is worth his while to obtain approval but applicants should always feel free to contact the Department for help in preparing an application.

3. "Scientific research" is defined in the two Acts as "any activities in the fields of natural or applied science for the extension of knowledge". The latter has previously been interpreted as meaning the uncovering of new knowledge, not the dissemination of already existing knowledge nor any work based on the results of research.

In practice, however, in view of the crucial need to encourage the industrial application of research results, the Department accepts that where dissemination and exploitation activities, including design and development, are associated with scientific research, wherever and by whomsoever that research may have been carried out, the relevant dissemination and exploitation may, within reason, be included as an admissible overhead. Activities preliminary to a research project, like a literature search, are similarly admissible. On the other hand, certain activities never qualify, such as training and education, routine testing and manufacture of goods for sale. It is important to note that, for approval, co-ordination of other people's research or general promotion of research does not usually qualify.

To qualify for approval under the Acts, an association's effort on scientific research, as described above and including admissible overheads, should be a major part of its overall gross annual expenditure. A low figure in one particular year would not formally disqualify a previously approved body, but the Department would want to be assured that there was the intention to rectify matters in the future. We would like to see Associations have at least seven financially independent ordinary (voting) members. If two or more members are inter-connected bodies corporate or individuals carrying on business in partnership, or have an employer-employee relationship, then they should be treated for this purpose as a single member.

4. With the first application we require two copies of the Memorandum and Articles of Association, one is for retention by the Department and the other is sent to Inland Revenue.

Once an association is approved any proposed significant changes to the M&A should be submitted to this Division before the change. As a reminder to associations with approval under Section 25 of the Companies Act 1981 Companies Division of the Department of Trade and Industry should also be notified prior to the change.

With the initial application and thereafter annually the following documents are required:

For the previous year:

i. the Annual Report

ii. the Audited Statement of Income and Expenditure

iii. a list of technical staff, showing qualifications.

for the year for which approval is sought:

iv. the Research Programme

v. an Estimate of Expenditure

and for both years

vi. a breakdown of the gross expenditure showing the effort on "scientific research" and on other major activities of the Association.

Normally, these documents should be submitted within 3 months of the commencement of the year for which approval is sought. The Department is prepared to accept draft accounts on the understanding that the Audited Accounts will not materially differ and that a copy of the latter will be provided as soon as possible.

Item (vi) is an important document and it is suggested that the following information is tabulated in columns:

In Column (1) all the main items in the R&D programme and other major non-research activities;

In Column (2) the relevant expenditure on each item or activity specified in column (1) including its share of the normal overheads such as administration and accommodation expenses; the total sum of column (2) should equal the <u>gross</u> expenditure of the Association;

In Column (3) the estimated "scientific research" content (%) of each item, or for non-research activities, the degree (%) to which they could be regarded as an "admissible overhead"

on the scientific research undertaken;

(It is recommended that the Director of Research completes this column);

In Column (4) the resultant expenditure that can be credited to "scientific research" (obtained by multiplying the figures in columns (2) and (3); and

In Column (5) (or as a footnote) any necessary explanation or justification for the figures given in Column (3).

Enquiries regarding these notes should be made to:-

Research and Technology Policy Division
Department of Trade and Industry
Room 212
Ashdown House
London
SW1E 6RB