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EUROPEAN COLLABORATION IN SCIENCE AND TECHNOLOGY:

II. Pointers to the future for policy makers

SCIENCE AND ENGINEERING POLICY STUDIES UNIT

THE ROYAL SOCIETY   THE FELLOWSHIP OF ENGINEERING

The Science and Engineering Policy Studies Unit (SEPSU) is run jointly by the Royal Society and the Fellowship of Engineering. Its staff, based at the Royal Society, assist the Society and the Fellowship in their contributions to policy formulation in science and engineering and, more generally, provide expertise in policy analysis. Much of the Unit's effort is devoted to objective, data-driven studies of policy issues, either of its own choosing or in response to external commissions. The Unit also provides a service to other sections of the Society and Fellowship, and maintains an extensive database of relevant information.

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For further information, please write to:

Dr P.M.D. Collins
Head, The Science and Engineering Policy Studies Unit
6 Carlton House Terrace
London SW1Y 5AG

Tel: 01-839 5561

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FOREWORD

Overseas activities in research, development and the market are having an increasing influence on British science and technology. Knowledge of best practice and pointers for the future are prerequisites for success. Recognizing this, SEPSU is undertaking a research programme on international science and engineering policy. In December 1987, as part of this programme, we published a guide to schemes promoting European collaboration in science and technology for the UK scientist and engineer.

For the current report we have consulted a large number of people with recent first-hand experience of West European collaboration. We are most grateful indeed for all their help. The value of this study has been greatly enhanced by their vigour and candour, and their illuminating evidence underlines the necessity for and benefits from international cooperation. Their experience has provided clear pointers for future initiatives by policy makers in Government, industry, universities, research councils and other research bodies.

We have not sought here to bring forward specific recommendations, but we hope that readers will be able to apply the findings of this report to their own enterprises.

This report has been endorsed by the Councils of the Royal Society and the Fellowship of Engineering.

Sir Roger Elliott, Sec. R.S.
Chairman, SEPSU Steering Group

Professor B. Crossland, F.Eng, F.R.S.
Vice-Chairman, SEPSU Steering Group

October 1988

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SUMMARY: CONCLUSIONS AND POINTERS FOR FUTURE INITIATIVES

(i) Background

This report presents the findings of a study on European collaboration in science and technology, based on case study interviews of participants in a representative set of over 20 cooperative research and development projects. One of the main purposes of the study was to identify good practice and factors that lead to success in collaborative research and development. Thus, an important criterion for selecting almost all the case studies was that they should be perceived by independent observers and/or participants to have been successful.

It was not difficult to find successful projects. Generally speaking, participants in such projects experienced many benefits arising from collaboration, though a few had met major problems. They also identified the critical factors for success, including external stimuli such as official umbrella programmes and public funding. On the basis of their recent experience and current practice we have identified pointers for future initiatives. If these stimulate follow-up action they may help West Europe as a whole, and the UK in particular, to compete more effectively.

(ii) Getting started

The road to getting an approved project with suitable partners was hard, but rarely rocky. For European Community (EC) programmes, European Commission officials in Brussels were very approachable and willingly gave assistance. Regular face-to-face contact with them was deemed to be essential, in accordance with Continental practice of communicating orally whenever possible.

Motives

Industrial collaboration in science and technology was driven by perceptions of future markets and opportunities for marketable products, processes and services. The main commercial reasons for joint research and development were risk sharing, improvement of competitive position, access to the larger international market, access to other organizations' complementary knowledge and expertise, and, more specifically, development of international standards.

Science has always been international, but UK academic interest in collaboration with other European countries was increasingly being driven by financial considerations. Domestic competition for limited academic funds made cooperation within this country comparatively harder and encouraged links abroad, where there was often found to be a better match of specialist interests.

Choice of partner

Companies were more constrained than universities in their choice of partners, owing to business considerations. The prior existence of a national common interest community helped them to find partners and to make the UK a credible participant in international consortia.

Universities generally found it relatively easy to find academic partners. Many of the academic collaborations we studied were based on pre-established links. In addition, the best UK university departments had an international reputation and were courted by foreign firms as well as

UK firms to join EC industrial R&D programmes. If technology transfer from university to industry in these programmes is to be of direct benefit to the UK, UK organizations should be encouraged to participate as a company-university duo. For the same reason, UK industry, like its competitors overseas, should also be seeking partnerships with the best university departments and research institutes in other countries.

Initiation

Not surprisingly, start-up funding could be a problem. A specific difficulty was lack of funds in universities to support exploratory visits before a collaboration was started. In some cases, however, UK funding agencies had provided pump-priming for emerging science and technology projects on a national level that had later formed the foundation for UK participation in an international project with European funding.

Such a two-stage strategy could provide the necessary national infrastructure to allow the UK both to contribute soundly to, and to benefit effectively from, a wider international initiative. UK initiatives, in schemes like JOERS and Alvey, to establish a national community and competence in key areas of science or technology were perceived by the participants to have been successful. They had provided a springboard not only for credible UK participation in international programmes but also for UK organizations to start to exploit the results competitively in world markets.

(iii) Umbrella programmes

Value of programmes

Brand names were important for marketing and identity. The umbrella European programmes strengthened the credibility of individual initiatives in transfrontier collaboration in R&D. They could be potent and potentially pervasive agents of change. The benefits extended beyond the projects to the market place, with much evidence that association with particular programmes brought favourable international publicity and credibility with customers.

Money was naturally a most powerful stimulus for participation in an umbrella programme, particularly for projects beyond company or national capacity, but it was by no means the only motive. Umbrella schemes provided effective management frameworks and convergence on key initiatives that reduced duplication and accelerated progress.

Regulations

The rules for European and UK publicly funded programmes differed in a number of important respects—level of support, criteria for support and intellectual property arrangements. It would seem that there could usefully be greater openness on, and clarification of, these differences. Similarly, decision timescales in different countries could be synchronized, at the same time removing unnecessary obstacles and differentials.

Science programmes

We studied two of the science programmes—the European Science Foundation (ESF) and the EC Stimulation Programme. Both were perceived by participants to be of great benefit. The ESF provided a useful, low-cost pump-priming mechanism for scientific research, particularly in unfashionable or under-resourced subjects of potential significance. The Stimulation Programme appeared to be particularly effective for a relatively small average unit cost. While we would not urge disproportionate expansion against other programmes of proven value, further extension of the Stimulation Programme would seem to have considerable advantages.

(iv) Problems and constraints

None of the projects was entirely trouble-free, but only two had problems that the participants considered to be severely disabling. The specific problems most commonly met concerned conflicting aspirations, large project management and intellectual property. Other important constraints were bureaucracy, shortage of university funding, recruitment and communication.

Conflicting aspirations

The funding agencies were probably responsible for unsatisfactory situations in three cases, through inept formation of consortia either by merging two or more proposals into one or by introducing inappropriate partners. This led to conflicting aspirations, emphasizing incompatibilities rather than common interests. Conflicts also arose even in successful examples of industry-university collaboration. This was because industry targeted work at a specific end result whereas academics often preferred to investigate interesting new science without direct application.

Large consortia

Despite best intentions management of large consortia was a problem. There was no pool of knowledge on good and bad practice. When management capacity fell short of what was required, the project suffered through inadequate groundwork, lack of overall direction and failure to achieve its original goals. We conclude that succinct guidance for all new consortia, for example a brochure or a short seminar, would be nationally cost-effective. Funding agencies might make funding conditional on attendance at such a seminar.

IPR

The comparative lack of major problems associated with intellectual property was notable. This was probably due partly to the painstaking efforts taken to reach agreement during preliminary negotiations and partly to flexible and positive attitudes shown by the participants. Goodwill went a long way to counteracting the naturally cautious legal background prevalent in joint commercial ventures.

Bureaucracy

Bureaucracy—that is the funding agencies—is an easy target for attack. In fact, the following few shortcomings apart, in neither Brussels nor London did central bureaucracy emerge as a major problem. There was one extremely frequent criticism, however, that concerned delays and inefficiencies in both places in negotiating contracts and paying claims. We also received comments from participants in UK programmes about the inconsistency and variable quality of official interventions. No such comments were made about European Commission interventions.

University funding

Shortage of university funding was a grave constraint. Two perceived needs were paramount. The first was short-term travel grants to attend conferences, which were increasingly being organized on a European rather than a national basis. The second was grants to allow young researchers to be exposed to overseas research exchanges at an early stage in their careers.

These funding constraints had a knock-on effect. Universities were unacceptably affected by the bureaucratic delays mentioned above. There were many instances where such delays exacerbated difficulties in academic recruitment arising because specialists were in short supply or the grant period was not long enough to attract good benchworkers. The result was suboptimal rescheduling and excessive remodelling of project goals because requisite skills were not available.

Communication

Communication between scattered groups and different nationalities was difficult. Nevertheless establishing and maintaining an effective means of communication was crucial for team-building. It was important to define terms unambiguously, especially in contract negotiation, vendor-user collaboration and interdisciplinary work. Intending collaborators should be made aware how difficult communication could be, even within groups for whom English was the mother tongue.

International standards

Remarkable progress had been made technically through European cooperation to develop and demonstrate international standards in a number of areas. Yet we found little political and commercial urgency to introduce them to the market. Other constraints included unhelpful approval procedures for standards, which depended too much on national bodies, and delays in take-up by the public sector.

(v) Management

Investment in management

There was strong agreement that a prudent level of management/administration overhead was close to 10%, typically half as high again as for an in-house project. There was an almost universal expression of the importance of direction-setting at the executive level and of focused preparatory work. Ultimate success of projects depended on substantial investment in management and planning.

Feasibility studies

Large projects carried immense investment. They also had the potential to go badly astray. In the interests of all parties, it may be that every substantial publicly supported project should be required to have a pilot feasibility study with a breakpoint. This pilot study should be eligible for proportionate public support.

Clubs

In certain circumstances the club arrangement was increasingly being used to handle a large number of organizations. In a club a number of companies joined together to sponsor industrial R&D in a single independent laboratory or occasionally a small number of laboratories.

Management structure

Our case studies showed the importance of a framework separating policy and leadership from technical management and from administration. We were able to identify some outstanding best practice in each of these categories.

Large projects required a senior policy committee with a representative from each organization. Success also depended on strong, yet unselfish, leadership from the prime contractor. This leadership was important in obtaining consensus, channelling democracy and avoiding the divisive effect of invoking the voting mechanism.

There was overwhelming evidence that technical success hinged on having a capable project manager, who had to be clear about the strategy and be a good communicator. He or she was responsible to the policy committee for technical progress, a full-time job in large projects. In all but the smallest projects a technical committee was also required, comprising a technical coordinator/project leader from each organization. These project leaders were accountable to the project manager for their team carrying out agreed actions towards clearly defined goals.

In most projects the lead contractor handled the overall administration of financial matters, documentation and report collation. Generally project control seemed to be most successful when kept simple. Only in the very largest projects were computer-based systems essential.

Electronic messaging

Experience at the project level of electronic messaging was positive. We heard about pioneering demonstrations of its power for strengthening inter-site dialogue on project management. We also established its importance for joint text preparation and editing. Nonetheless there were inhibitors: inability to agree communication and equipment standards, and apparently inadequate security in public systems for transmitting commercially confidential information.

(vi) Critical factors for success

Our study examined in depth critical factors for success. Remarkably there was no discernible difference in the views of those participating in successful projects. All readily identified the same few important factors at the corporate, project and personal levels. The more complex a project was, the more critical these success factors became.

Corporate level

At the corporate level, an influential champion was essential, supported by a strong leadership cadre committed to a common goal. The project should fit comfortably with the overall strategy and commercial aspirations of each organization and provide a clear exploitation route for each partner. Thorough preparation was key, as were high calibre management and a high quality science/engineering base. A deliberate and managed process of dovetailing complementary interests and skills invariably accomplished results greater than the sum of the parts.

Project level

At the project level, milestone management provided a challenge and focus for a project. A project manager/principal investigator was required to foster the common purpose and to coordinate the technical work.

Teamwork

Trust and teamwork had to be established, and then sustained, at both the management and project level. This required, generally speaking, considerable patience and application and, most particularly, continuity of personnel. In every successful project effective working relationships were built on personal contact and the teams demonstrated group responsibility.

Individual motivation

Finally, and just as important as the other factors, was motivation of every researcher.

(vii) Benefits and achievements

International collaboration

There was copious evidence from our sample that European collaboration was good for the participants, for the UK and for Europe. Many of the benefits were unexpected. Besides numerous examples of direct and tangible achievement—commercial pay-off, academic recognition, improved competitive position, application of other people's knowledge and skills; spin-off science and technology—there was ample evidence of less tangible benefits in almost every project. These included: new project concepts; changes in attitude, such as a less insular approach to overseas developments and a greater awareness of international affairs; improved management experience and practices; and rewards to the individual in terms of enhanced career development and scientific reputation. The majority of those interviewed confidently expected to maintain their links with the same or similar groups.

Intranational collaboration

For comparison we selected a few examples of UK collaboration. These showed that fruitful cooperation bringing similar returns and international success was possible at home. Our small sample suggested that products based on UK-only programmes were particularly appropriate for specialized products aimed at niche markets and for emerging technologies. Public funding and the stimulus of umbrella programmes were crucial start-up factors.

European umbrella programmes

Our observations so far have been about individual projects and their success. Although our remit did not address the enabling European umbrella programmes themselves, our evidence showed that their objectives, although extraordinarily ambitious, were largely being realized at the individual project level. We saw examples of superlative cooperation that our evidence indicated would have been most unlikely before the advent of the umbrella schemes. Studies of projects at or near completion showed that industrial programmes had seeded a strategic competitive advantage for Europe and provided a springboard for a timely, credible and visible entry to the global market. The umbrella science programmes had had similar success. They had, probably not surprisingly, produced high quality science, but they had also generated technical world-firsts that were of strategic relevance to Europe. Participants and the European Commission alike were proud that they had demonstrated good value for money. Our study suggested that their pride was well justified.

Achievements

The last word must be market-related. In this case the audience is widespread—opinion formers, policy makers and prospective participants. The problems and constraints of international collaboration tend to attract wide publicity. The achievements are too rarely reported. This study has shown that, even without the improvements suggested, the benefits can far outweigh the costs.

1. BACKGROUND AND OBJECTIVES OF STUDY

Background

Significant opportunities for many forms of joint research and joint development occur across Western Europe. Although anecdotal evidence of their value is widespread, the Royal Society and the Fellowship of Engineering believe that there is a continuing need in the UK to stimulate further successful international cooperation. The Science and Engineering Policy Studies Unit of the Society and the Fellowship has therefore carried out a two-phase study targeted at a wide audience including Government, industry, universities, research councils and other research bodies.

First phase publication

The first phase entailed publishing a guide* in December 1987 whose purpose is to help the UK scientist and engineer to identify opportunities for collaborating in research and development with partners in Western Europe and to facilitate applications for funding.

Second phase

This report describes the results of the second phase—a critical appraisal of selected policy issues. The intention is to support and stimulate new initiatives. The report is therefore aimed more at policy makers and opinion formers than at practitioners of R&D.

The project was carried out by Dr Malcolm P. McOnie while on secondment to the Unit from ICI. The SEPSU Steering Group appointed a Task Group to guide the project, chaired by Dr I.D. Nussey, F. Eng. The other members of the group were Dr H.H. Atkinson, Dr M.J. Crumpton, F.R.S., Mr J.R. Fryer, Dr A.W.C. Keddie, and Professor A. Ledwith.

Aims

The appraisal was carried out as an in-depth analysis based on case studies. The purpose was:

- to identify positive benefits and achievements from collaboration: tangible and direct, less tangible and indirect, and unintended additional benefits;
- to understand problems and constraints, and hence to identify aspects for improvement;
- to examine the value of external stimuli, such as umbrella schemes and public funding;
- to determine critical factors for success;
- to propose pointers for follow-up action that would help West Europe as a whole, and the UK in particular, to compete more effectively.

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* *European Collaboration in Science and Technology: A Guide for the UK Scientist and Engineer* (ISBN 0 85403 342 4). Available from SEPSU, price £25.00 (UK addresses), £27.00 (overseas addresses).

2. DESIGN OF STUDY

Case study approach

The subject was examined through case studies of individual projects, a bottom-up approach complementing numerous previous top-down studies by others generally evaluating entire programmes. Each of our case studies was conducted by direct interview with one or more partners in the project, often at different levels within each organization.

Using a standard framework of questions (Appendix 1), we asked the interviewees to select and concentrate on those issues that they considered were most important and relevant. They all made frank and instructive responses and, for related reasons of confidentiality, asked that their remarks should not be attributed.

In the interests of speed and cost-effectiveness the number of case studies was limited (to 22), but carefully chosen to form as representative a set as possible, covering different types of R&D activity, fields, types of partnership, scales of project and modes of collaboration, as shown in Table 1.

The study covered a broad spread of scientific and technological fields and ranged over all types of R&D activity, including basic research and the exchange of people and ideas, strategic and precompetitive research, and market-led R&D aimed at wealth creation through products, processes and services. Joint business ventures in the market place were excluded. So too were large dedicated organizations, like CERN and the European Molecular Biology Laboratory, and 'big' science, such as space science and astronomy.

Case studies were fairly evenly divided between academic, industrial, and joint academic-industrial partnerships, with costs ranging from under £100k to over £10m. A balance was also sought between programmes to which the UK had contributed substantial public funds, programmes that included many teams with relatively modest public or private funding, and other types of collaboration, e.g. club or private arrangements for the duration of a project. Many of the important European umbrella programmes for collaboration (EC, EUREKA, ESF) were represented. Two national schemes—the Alvey Programme and JOERS—were included for comparison.

One of the main purposes of the study was to identify good practice and factors that lead to success in cooperative research and development. Thus, almost all the case studies were chosen because independent observers and/or participants perceived them to be successful. This criterion notwithstanding, none was entirely trouble-free, but only two had problems that the participants considered to be severely disabling.

Headings of analysis

The discussion following is based exclusively on the evidence presented and the findings have been summarized under six main themes:

Getting started	Management
Umbrella programmes	Critical factors for success
Problems and constraints	Benefits and achievements

The Task Group has drawn certain conclusions of its own from the evidence and, where appropriate, these are identified.

TABLE 1 : MATRIX OF CASE STUDY CHARACTERISTICS

Type of research	Type of partnership			Scale of project					Arrangement for collaboration			
	Industry/ Industry	Industry/ University	University/ University	Under £100k	£100k to £900k	£1m to £9m	£10m and over	Confid-ential	European Umbrella Programme	UK Umbrella Programme	Club	Other
Basic Research			6	4	1	1			3 Stimulation 2 ESF			2
Strategic/ Precompetitive Research	4	5	1		4	4	2		2 ESPRIT 1 RACE 2 BRITE 1 Stimulation	3 Alvey 1 JOERS	1	
Market-led Research and Product Development	4	3			3	1	1	2	1 EUREKA		2	4
TOTAL	8	8	6	4	8	5	3	2	11	4	3	6

The figures give the number of case studies with the relevant blend of characteristics. Since a small number of case studies fall into more than one category, the totals do not always cross-check.

For each type of research, there are examples of group sizes from 2 or 3 partners to nearly 20 partners.

Fields represented

Advanced materials
Aerospace
Artificial intelligence
Biology
Biotechnology
Chemistry
Clinical medicine
Computer science
Consumer market
Design
Electronics & optoelectronics
Engineering
Environmental science
Information technology
Manufacture
Materials science
Mathematics
Medical research
Pharmaceuticals
Physics
Process industry
Standards formation
Telecommunications