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Policy Study No. 9

**THE ROLE OF RESEARCH CONFERENCES IN
DEVELOPING EUROPEAN COLLABORATION
IN SCIENCE AND TECHNOLOGY**



SCIENCE AND ENGINEERING POLICY STUDIES UNIT



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**THE ROLE OF RESEARCH CONFERENCES IN
DEVELOPING EUROPEAN COLLABORATION
IN SCIENCE AND TECHNOLOGY**

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FOREWORD

The Chancellor of the Duchy of Lancaster, in welcoming the recent SEPSU report on the international migration of scientists and engineers, commented that access to the research activities of other countries was 'an important element in ensuring world class standards for UK science'. Migration is one mechanism for giving such access. Research collaboration, the building up of partnerships with research groups in other countries, is another.

SEPSU has published a number of reports on the mechanics and outcomes of international research collaboration. In this report we look at how collaborations begin, and in particular at the role of international conferences in stimulating collaborations. The data are derived mostly from conferences with a European focus, but our findings are likely to be relevant also to the broader international context.

There is nothing to beat personal contact. There are examples of successful collaborations in which the partners have never met, but they are unusual: face-to-face meetings play a large part both in initiating and in sustaining most research collaborations. The 'small world' of international conferences provides an obvious medium for such meetings to occur. This report demonstrates the extensive role of conferences in nurturing international collaboration, and presents evidence about the circumstances that are most conducive to successful collaboration in this context.

This report will be of interest equally to those concerned with organizing conferences, and to their customers: the public and private funding agencies that support conferences on the one hand, and participating researchers on the other. These various groups may have very diverse expectations of what is likely to emerge from any given conference - from the advancement of scientific knowledge to the advancement of greater economic and social cohesion among the Member States of the European Union. As an outcome of a conference, collaborations can contribute to all these varied agendas.

Dr Ian Nussey, O.B.E., F.Eng
Chairman, SEPSU Management Board

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I am very grateful to all those who participated in this study and the two previous studies that led to it, and particularly those who were interviewed, for their time and open discussion of the issues.

Thanks are extended to colleagues in SEPSU and the Royal Society who assisted with the research and the production of the report, especially to Anna Zouga who provided research support.

SUMMARY

1. Collaboration plays a major part in science and technology, particularly international collaboration. This report is concerned with the means by which collaborations are initiated, concentrating on the role of the research conference. The report explores the extent to which the formation of collaborations is an objective of conferences, the nature and impact of those that are formed and the effectiveness of conferences compared to other routes to initiating collaboration. The study was conducted under the ESRC Research Programme on the European Context of UK Science Policy.
2. The report builds on two previous SEPSU studies, an evaluation of the European Research Conferences (ERCs) run by the European Science Foundation and an analysis of the Royal Society (RS) Travel Grant Scheme. These previous studies had shown that conference participants frequently expected a new collaboration to result from their attendance. A new questionnaire survey was conducted of these researchers; the ERC group represented international (mostly European) researchers who had all attended one type of conference, whilst the RS group were all British, but had attended a wide variety of conferences. The questionnaire survey was backed up by interviews with conference chairmen, organizers and funders throughout Europe.
3. All the four suggested objectives of attending conferences were considered important by participants: seeking new collaborations, keeping up with contacts, learning about new areas and keeping up with new developments in their own field. Keeping up with developments was the most important and new collaborations the least important on average, but individual responses varied widely and this order was reversed for women.
4. The clearly stated priority of conference chairmen in organizing conferences was scientific quality. Chairmen generally sought to invite top speakers and bring together a group that would not normally meet to ensure good and novel scientific exchange. It was often felt that such an

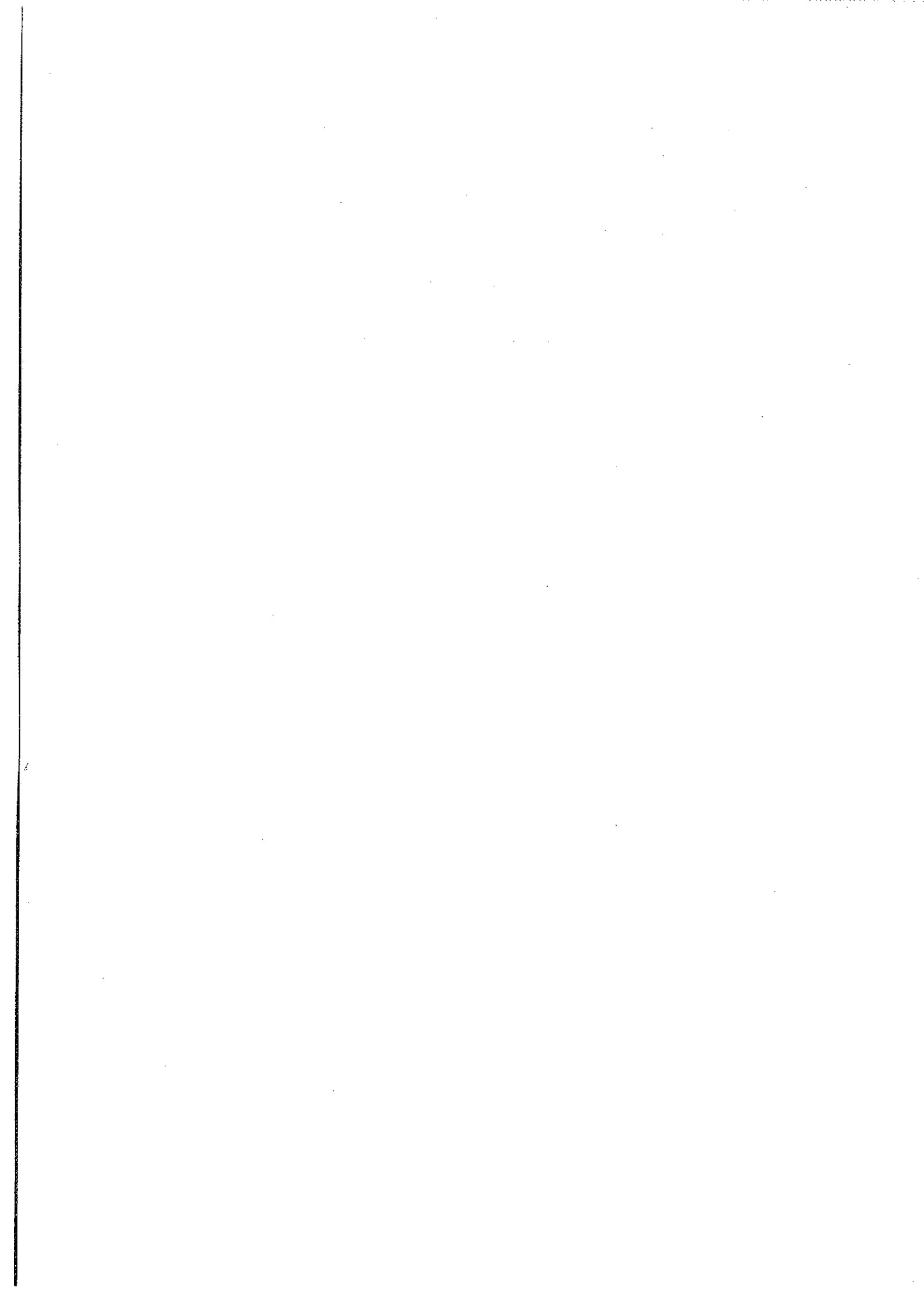
14. Attending conferences and visiting other research groups were seen by researchers as the most important means of developing new collaborations. Meeting potential collaborators speeded up the development and increased the chances of a successful partnership, as it gave better opportunity to assess the scientific and personal priorities of potential partners. A single meeting, however, was generally thought to be insufficient to lead to a collaboration: rather, it would be an important part of the evolution, combined with other mechanisms. Partnerships formed through different routes were not thought to differ fundamentally in nature, although they might be more open, interactive and fruitful if the partners had met. Conferences were also more likely to lead to international or interdisciplinary linkages.

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I INTRODUCTION

(I) RESEARCH COLLABORATION AND ITS INITIATION

Rationale for research collaboration

Research in science and technology is an international activity. The amount of international collaboration is increasing, particularly within the European Community (EC) and greater Europe. For example, of all papers published by EC scientists, the proportion published jointly with a scientist from another country grew from 9.4% in 1977 to 21.9% in 1990*. It is widely, though not universally, believed that there are advantages in being engaged in collaborative research, from the point of view both of the individual researcher and of the nations that encourage collaboration.

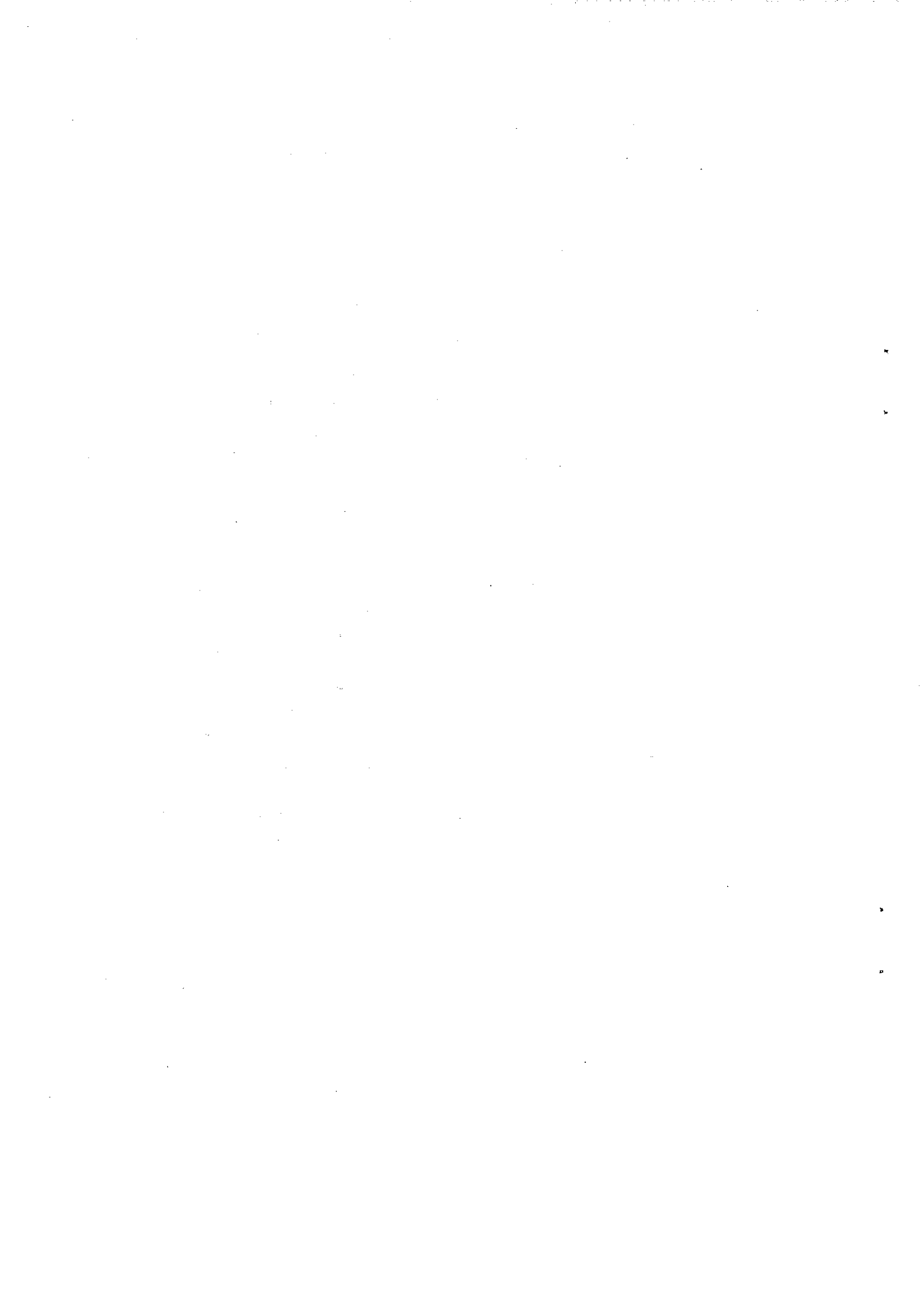
Collaboration is primarily a means of achieving research advantage, not an end in itself. For the researchers, the advantage international collaboration can give is an opportunity to gain or share ideas, technologies and expertise with a wider base of scientists, which can improve the effectiveness of their research. European collaboration may be the most accessible option, geographically, culturally and now economically, as the EC budget for research expands.

From a national perspective, encouragement of researchers to collaborate internationally may give academia and industry access to leading edge research and state of the art facilities across a wider range of fields than available nationally. Within Europe, national support for involvement in collaboration could lead to winning a share of the EC R&D budget, at a time when there are widespread economic constraints on national R&D funding.

Initiation of collaboration

A wide range of programmes and initiatives is supported by the European Commission and other bodies to encourage collaborative research projects, with the general aim of building a stronger and more unified science base in Europe.

* H.F. Moed, R.E. de Bruin & A. Straathof, *Measurement of national scientific output and international scientific cooperation in CEC-related areas of science during 1985-1990* (EUR 14581 EN, CEC, 1992).



II METHODOLOGY

This report is based on four sets of data, which have been integrated to address the key themes of the study.

(I) EUROPEAN RESEARCH CONFERENCES

The ERC evaluation study

A study was conducted by SEPSU between November 1991 and March 1992 to support the evaluation of the European Research Conferences (ERCs) by the European Commission (EC). The report was published as EC Research Evaluation Report No. 51 (November 1992). The ERCs were established by the European Science Foundation (ESF) in 1990, with a high proportion of their funding coming from the EC. They are based on the Gordon Conference model of the USA, with up to 100 participants meeting over about five days with formal presentations plus ample opportunity for informal discussion.

All the participants in five selected conferences, held in 1990 or 1991, were sent a questionnaire concerning their experience; 295 responses (76%) were received. In addition, the chairman of each of the five conferences was interviewed face to face. The chairmen of 12 of the remaining 14 EC-funded conferences responded to a set of broad, written questions. A series of face to face interviews was conducted with those managing the ERCs at the Commission and at ESF, and with the organizers and funders of other European conference programmes.

ERCs and new collaborations

As one of the main objectives of ERCs is to develop a European identity in science and technology, the evaluation study considered the role of ERCs in building contacts and collaborations between European scientists. A key finding of the questionnaire survey was that 42% of conference participants developed a new collaboration as a result of attending, most often with researchers from another European nation. For the present study, we have reanalysed these questionnaire data, in order to investigate the type of researchers most likely to become involved in collaborative research via this route, with respect to age, position, type of organization and nationality.

The interviews with conference chairmen, organizers and funders in the evaluation study also explored the objective of developing research linkages through conferences. The views expressed have been integrated with those from the new series of interviews conducted for the present study (see section (iv)).

(II) ROYAL SOCIETY TRAVEL GRANT SCHEME

Analysis of the RS Travel Grant Scheme

An analysis was conducted by SEPSU between November 1992 to May 1993 of the beneficiaries of the Royal Society (RS) Travel Grant Scheme and the use to which they put their grants. The scheme provides funds for scientists to make short overseas visits, most often to attend conferences. With an annual budget of £900K, supporting around 1800 scientists each year, the RS scheme is an important source of travel funds for UK researchers. The SEPSU study involved the collection of data from RS records, and a questionnaire survey of a random sample of researchers who had benefited from the scheme in 1990/91. The questionnaire, completed by 169 grantees (77% response rate), concentrated on the purpose of their trip and the benefits derived.

RS support and new collaborations

Providing travel grants is one means by which the RS promotes contacts between individual scientists and encourages international research collaboration and knowledge transfer. Indeed, the SEPSU analysis of the scheme showed that 87% of questionnaire respondents, who had attended a conference during their trip, had formed a concrete collaboration as a result of the trip. The proportion of RS supported researchers who formed a collaboration seems high compared to the number who formed one through an ERC (see above). Two factors contribute to this. First, about half of the RS group had combined their attendance at a conference with a visit to a laboratory, which must have greatly increased the chances of a collaboration developing as visiting a laboratory gives a clear indication of wishing to share ideas or techniques. Second, whilst all those who applied to attend an ERC were admitted, not all researchers who applied for RS funding were successful. The selection is on the basis of the quality of the applicant and the likely benefit of the trip to their research. That is, excellent researchers, attending a highly relevant conference will get RS support; exactly the type of situation in which collaboration might be expected to flourish. Of course the two groups also differed greatly in nationality and the nature of the conferences they attended. However, the findings reported in the following chapters do not indicate that these factors account for the large differ-

ence in the number of collaborations formed. The RS and ERC data have therefore generally been considered separately in this report.

As with the ERC data (see above), for the purpose of this study the RS questionnaire survey has been analysed further to examine the type of researchers most likely to become involved in a collaboration. In addition, since researchers attended conferences of a wide range of size and type, we have analysed how these features correlate with whether collaborations were initiated.

(III) FOLLOW-UP QUESTIONNAIRE OF CONFERENCE PARTICIPANTS

The current study aimed to find out more about why researchers attend conferences, the nature and impact of collaborations that develop through attending conferences, and comparisons between conferences and other mechanisms of initiating collaboration. To this end, a follow-up questionnaire (see Annex A) was sent to some of the researchers included in the two studies above.

The questionnaire sample

We sent the new questionnaire to the subset of scientists whom we knew to have attended a research conference, either a ERC or on a trip funded by the RS, and who had, on their return, expected a new collaborative research linkage to develop as a direct result. The ERC group provided a sample of conference participants from a range of countries, whilst the RS group provided a sample of researchers from the UK who had attended a range of types of conference. 89 respondents to the original ERC evaluation questionnaire and 123 respondents to the RS Travel Grant analysis questionnaire received the new questionnaire. Of these, 38 of the ERC group (43%) and 97 of the RS group (79%) responded. The low response from the ERC group was probably because the new questionnaire to this group was sent out 18 months after the first (due to unforeseen delays in the funding for this project), by which time many people would have moved on or have forgotten the details of the conference that they attended.

The respondents from the ERC group came from eight EC nations, USA, Eastern Europe plus a few from other countries. Most of the researchers in each group were academics (97% in the RS group, 91% of ERC participants) and the majority were permanent staff, although the RS group included 8% and the ERC group 9% postdoctoral researchers and 9% of ERC respondents were postgraduates.

Questionnaire analysis

The questionnaire responses were analysed via the Statistical Package for Social Sciences (SPSS). The data from the new questionnaire were input alongside the data from the original questionnaires, so that correlations could be made with background data about the individuals and the type of conference they had attended, in the case of the RS Travel grant holders. Responses to open questions were read carefully and integrated with the opinions expressed by the participants in the interview programme.

(IV) THE INTERVIEW PROGRAMME

In addition to investigation of the views and experiences of participants, an objective of the current study was to explore the rationale and strategy that organizations and individuals have for funding and organizing conferences. This was achieved via a series of face to face interviews. Some of the interviews were conducted as part of the ERC evaluation study and others were conducted specifically for this study, to broaden the range of nationalities and types of conference investigated. However, since the discussions covered similar themes, both sets of interviews have been considered together in this report. All interviews were unstructured in order to allow broad-ranging discussion of research conferences and the formation of research collaborations.

Conference chairmen

Interviews were held with a total of nine researchers who had organized a conference since 1990. Four of the chairmen were based in the UK (although one was Hungarian) and the others were from a spread of European countries (two French, one German, one Irish and one Italian). Three of their conferences were held in the UK, with one each in France, Germany, Hungary, Ireland, Italy and Portugal. All those interviewed had organized a small, international meeting which emphasized discussion (five ERCs, three NATO Advanced Research Workshops and one EUCHEM conference), as these were felt to be the types of conference most conducive to the formation of new contacts and collaborations. The conferences were in a range of research fields (four chemistry, three life sciences, one physics and one information technology/discourse). Conference chairmen were asked about their objectives in running their meeting, whether and how they endeavoured to maximise the development of new contacts between participants and how successful or difficult this proved. As each was an established researcher, they were also asked about their own experiences of

attending conferences and of establishing and maintaining collaborative linkages.

Organizing and funding bodies

Interviews were held with relevant personnel at a total of 11 organizations that actively support research conferences. Five were international bodies that organize and, in most cases, fund international meetings (ESF, NATO, the Ciba Foundation, EUCHEM and the European Molecular Biology Organization (EMBO)) and six were bodies that give financial support to conferences and/or to individuals to attend them (the RS and the Wellcome Trust in the UK, EOLAS and the Health Research Board in Ireland, the DFG in Germany and DGXII of the European Commission). Discussions with the staff of these bodies who are responsible for travel funding and/or conference organization were wide ranging. The main themes were the objectives of the organization in supporting conferences or individuals to attend them, comparisons between this and other forms of research support, the value of collaborative research and the best routes to initiating it.

III RESEARCH COLLABORATION AS AN OBJECTIVE OR AN OUTCOME OF CONFERENCES

The initiation of one or more research collaborations has been shown to be a frequent outcome of attending a research conference in two previous SEPSU studies (see chapter II). In this chapter, we explore the extent to which the establishment of new research linkages is an objective of conferences and how this is balanced with other objectives, from the point of view of participants, organizers and funders. The factors that determine the likelihood of a collaboration emerging from a conference are also explored, in terms of the characteristics of the conference and those who attend. Whilst the report considers the degree to which the objective of forming collaborations is successful, the success of the other objectives of conferences is not considered. The theme of the report is the role of conferences in forming research collaborations, rather than a full exploration of the nature, aims and achievements of conferences.

(I) OBJECTIVES OF RESEARCH CONFERENCES

Objectives of the participants

The two groups of conference participants, the international group who had attended ERCs, and the UK group who had been funded by the RS to attend various conferences, were asked to rank each of the objectives listed in figure 3.1. A maximum score of four indicated a very important objective, whilst zero meant it was of no importance to the researcher; blank responses were discounted. The mean scores for each objective is shown for each respondent group in figure 3.1. All of the objectives gained a fairly high average score, indicating the importance of all of them to both groups of conference participants. Keeping up with developments in one's field appeared to be the primary objective of attending a conference, whilst seeking new collaborations was the least important.

There was considerable variation between individuals' scores for conference objectives, indicating that each researcher has his/her own reasons for participating in meetings. Indeed, one respondent pointed out that the reasons

for attending vary with the nature of the event, as well as the individual. One factor that influenced objectives seemed to be gender. The small number of women respondents (11) in the RS-supported group rated "to seek new collaborations" as the most important objective (mean 3.5) and "to keep up with developments" as the least important objective (mean 3.1). This was the reverse order of the RS group overall, although there were only small differences in the average ratings assigned to the four objectives by women.

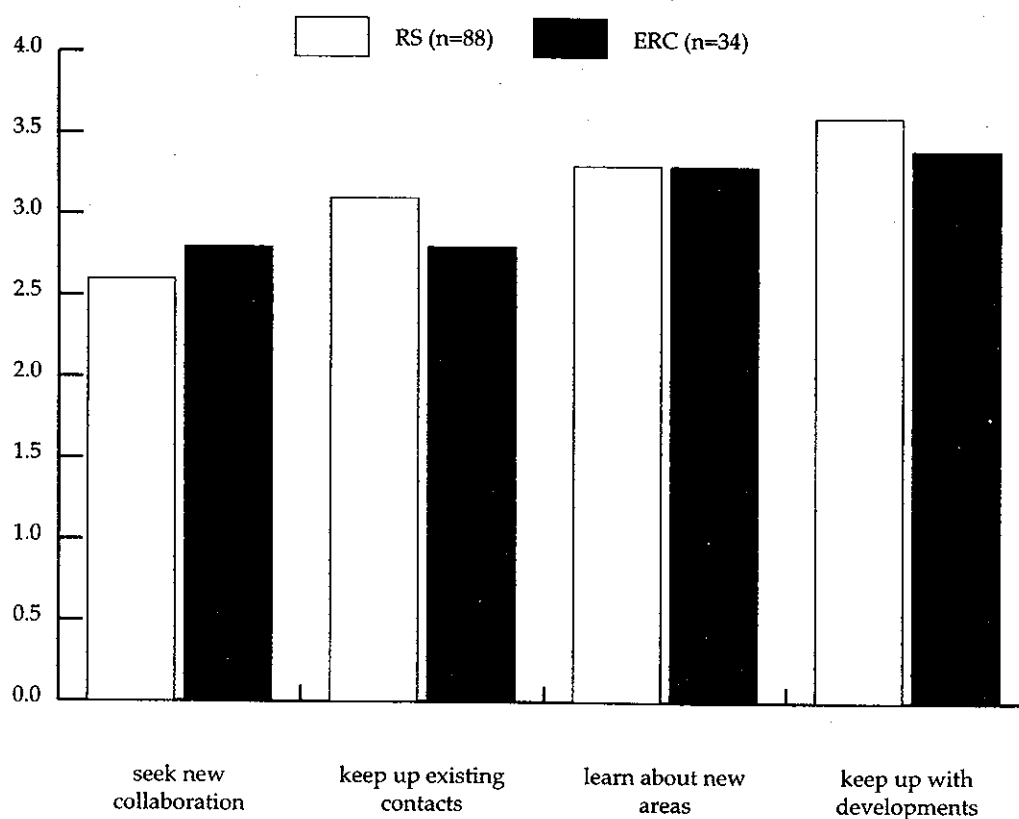


Figure 3.1 Objectives of attending a research conference (mean scores; scale 0=no importance to 4=very important)

In addition to the objectives that we asked conference participants to rate, a number felt that others were of particular importance to them. A few commented that scientific meetings were as valuable for maintaining collaborations and contacts as making them, and others said they attended in order to disseminate their results, particularly prior to publication. One respondent considered the value to be intangible, therefore defying analysis.

Objectives of the organizers

The nine conference chairmen who were interviewed for the study had organized small, European, workshop-type meetings, but they were all

experienced scientists who had been involved in a wide range of conferences throughout their careers. Amongst the questions discussed with them were the general aims of research conferences and the balance and compatibility between the objective of encouraging collaboration and other objectives.

The clearly stated priority of conference chairmen was the scientific quality of their meeting. They sought to achieve this through arranging a programme of those they considered the best possible speakers, in terms of reputation and appropriateness of topic. Usually they invited speakers who were focused on one topic or system, but from differing disciplinary approaches, in order to bring together a group that would not normally meet. Chairmen generally said that if they achieved the correct scientific balance, other objectives would in turn be fulfilled. Good discussion and exchange of ideas were thought to lead on to the emergence of new ways of thinking and new collaborations; this is discussed further below.

The objective of bringing together and therefore encouraging collaboration between scientists of different nationalities and ages was taken into consideration to differing degrees by the chairmen, although it always came second to scientific quality. Some stated that the inherently international nature of their subject made it unnecessary to take particular action in this regard. Others did address this objective, sometimes as much because of the requirements of the funding body (see below) as through their own inclination. Some of the chairmen had made allowances so that younger participants or those from Eastern European or other less scientifically developed European nations could attend, taking into account that they could not expect such researchers to have achieved so much, although they did have to be active in the field. Another strategy was to provide financial assistance for the travel of such participants, or to have a reduced fee, at least for young scientists. In some cases difficulties had to be overcome in communicating with Eastern European scientists, because of poor infrastructure.

Those from the less developed nations who had attended generally participated fully in the meeting, and in some cases the requirement to bring in a speaker from such a country had ended up making a very positive contribution to the scientific programme. Younger scientists tended to be more comfortable in the less formal sessions, such as poster sessions, but on the whole they had contributed to and benefited from the conferences.

Objectives of the funding bodies

Representatives were interviewed from a variety of bodies that provide funding for individuals to attend conferences and/or for the conferences themselves. The organizations were a mixture of national bodies, from several European countries, and European organizations. The degree to which the different bodies were also involved in the organization of the meeting varied considerably, and to some degree related to what their objectives were in supporting conferences.

One aim of all the organizations in supporting conferences or individuals to attend them was to enhance the individuals' research through the exchange of scientific information or to develop the field through the provision of a forum for discussion of leading edge research. In a number of cases this was the only objective, in which case each application for funding was judged on the basis of the scientific quality of the researcher and/or conference, and the likely research benefit. In fact two of the funding organizations felt that dissemination of results through conferences was sufficiently important to have arrangements for all their research grant holders to be eligible for travel funding as part of their grant. Some of the bodies with the general aim of enhancing research favoured small, workshop-type meetings as they thought they were the most valuable. Others were quite flexible in the format of conferences they supported, considering the scientists the best judge of what was appropriate for their field or individual needs.

For some of the organizations an important objective of supporting conferences in Europe was to strengthen the scientific community and develop a European identity in science and technology. Conferences were seen as a cost-effective way of bringing scientists together and allowing new linkages to develop. For some this particularly meant encouraging the participation of young researchers and those from less scientifically developed regions, including, increasingly, Eastern Europe. These people could particularly benefit from exposure to and participation in top scientific discussions.

It was recognized that the scientific organizers did not at the outset always share this objective of strengthening the community. They could usually be persuaded to take action aimed at achieving it, however, if scientific quality did not suffer much, particularly if funding was dependent on it. One EC administrator pointed out that insistence on measures to enhance European cooperation through conferences was not simply pedantic. The EC is a political organization and it was thought important that conference chairmen understood, therefore, that EC funding necessarily came with conditions attached.

The representatives of some bodies felt that a strengthening of the European community in science would be a natural outcome of conferences, without being a primary objective or requiring particular encouragement. Some interviewees went further, suggesting that it was inappropriate, for their organization at least, to have anything other than scientific objectives in supporting conferences, and development of the community was a political rather than a scientific aim. One person was of the opinion that promoting such political aims and targeting "poorer" countries could be damaging to the scientific content of a meeting.

(II) FACTORS THAT DETERMINE WHETHER COLLABORATION ARISES FROM A CONFERENCE

Whether or not the initiation of collaborations was an explicit objective of the researchers attending a conference, or of the organizers or funders, it is certainly a frequent outcome. All those in the earlier ERC and RS evaluations who had expected a collaboration to result from their participation in conferences were sent the new questionnaire and, two or three years after the original conference, more than 90% of respondents in both groups had actually developed at least one concrete collaboration as a result of attending. Chapter IV will discuss the variety of collaborations that arose.

Dependence on personal features

In order to determine the extent to which features of the individual or their employment affect the likelihood of them establishing a concrete collaboration of any type, we re-examined some of the questionnaire data from the RS Travel Grant study and the ERC evaluation. The nationality of the ERC participants seemed to influence the likelihood of a collaboration forming (all RS Travel Grant holders are British). Figure 3.2 shows that, while on average 42% of ERC participants formed new collaborations, this ranged from 31% for French participants to 64% for American. It is likely that the Americans attending these European meetings knew fewer of the other, mostly European participants before arrival, so there was more scope for them to develop a new collaboration.

Age seemed to have more impact on whether collaborations were initiated amongst the international ERC participants than among the RS-funded UK scientists (figure 3.3). Of those who had attended ERCs, researchers aged between 41-50 were most likely to make new linkages (58%), whilst those who were over 50 years old were the least likely (20%). This did not seem to reflect

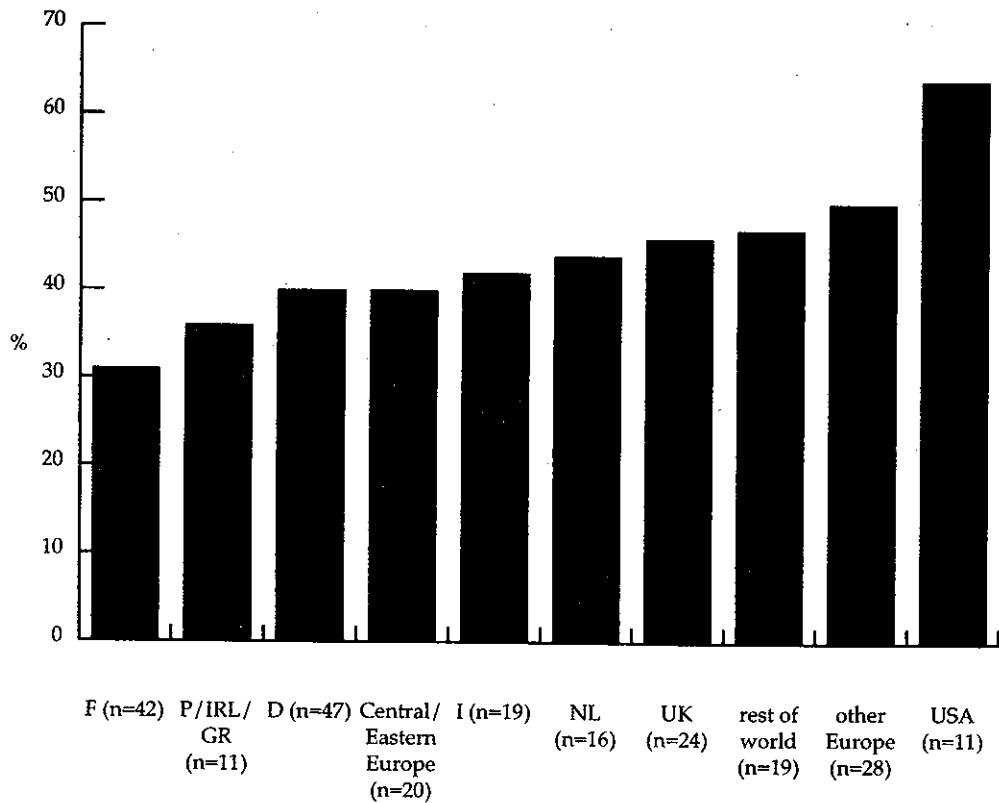


Figure 3.2 Percentage of ERC participants of different nationalities who formed a new collaboration as a result of the conference

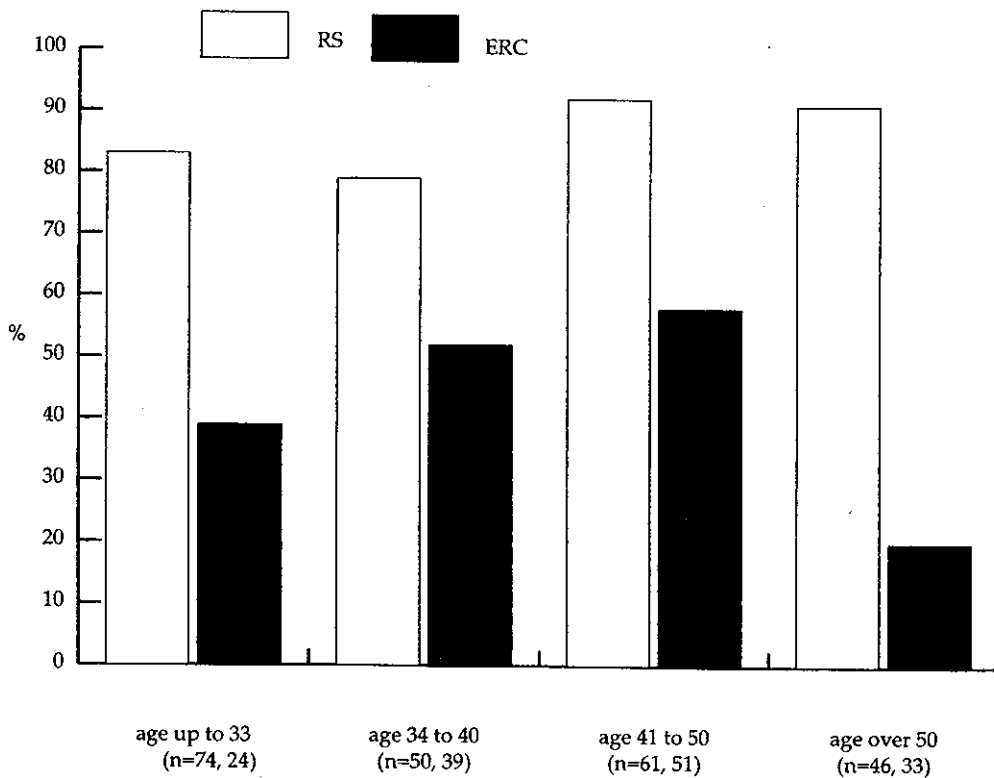


Figure 3.3 Percentage of participants of different ages who formed a new collaboration as a result of the conference

their employment status, as there was little difference between permanent staff and postgraduate or postdoctoral researchers. Nor did it reflect their status at the conference, as speakers and ordinary participants formed collaborations almost equally frequently. It may be that the age ranges from 34 to 50 generally span the most active research years, so scientists in these groups are most open to new linkages. It is not clear why the RS funded group did not show the same age dependence, although far more of them formed collaborations in every age group.

Gender had no impact on the probability of forming a new collaboration.

Dependence on conference features

Conference participants, organizers and funders were asked about features of the conferences that particularly encouraged or discouraged the formation of collaborative linkages. It was frequently commented that small conferences were more conducive to the formation of new linkages, whilst at very large ones it was difficult to make contact even with those one already knew. Some pointed out that this did not make large meetings less valuable: their purpose was simply different. However, data from the original questionnaire from the study of the RS Travel Grant Scheme indicated that conference size had a fairly small impact on whether a researcher developed a new collaboration through attending (figure 3.4). Meetings of fewer than 200 people were most likely and those of more than 1000 were least likely to result in collaborations, but the differences were not large.

A very strong message was gained from participants, in particular, that a meeting at which an informal atmosphere was achieved, with plenty of time for informal discussion, was a good environment for new research linkages to emerge. Small size could contribute to such an atmosphere, but social occasions and excursions or preferably eating all meals together and staying in one venue, could also contribute greatly. Informal conversation was thought to allow the interests and priorities of potential partners to be tested. This was considered important as trust and compatibility have to be established if a collaboration is to succeed.

To maximize the chances of collaboration arising, participants and chairmen felt that, in addition to being informal, the atmosphere should be a positive and open one with intensive scientific conversation. Some fields and meetings had a very competitive feel, which was not conducive to collaboration forming.

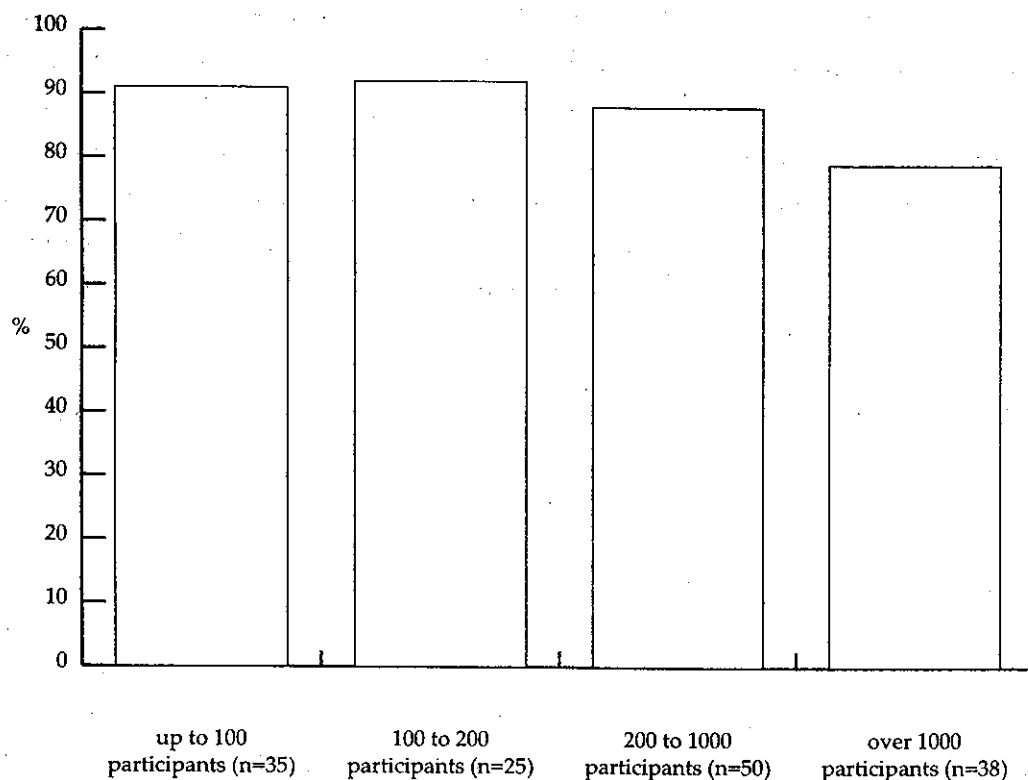


Figure 3.4 Percentage of RS funded participants in conferences of different sizes who formed a new collaboration

In other words, a meeting that was fulfilling the important objective of being a forum for the discussion of leading edge research was also likely to lead to new scientific linkages. A number of people pointed out, however, that meetings with such an atmosphere were, unfortunately, rare. Important features cited as being required to generate such an environment were a good and novel selection of topic and of speakers and ample formal discussion sessions with lively chairmen. Many people, though not all, thought that a good poster session could also contribute a great deal to initiating new linkages by forming a focus for one to one discussion, being particularly valuable for young scientists who might be intimidated by the more formal discussion sessions. Others thought that, whether the meeting was large or small, it should include focused workshop-type discussions, for example on a particular technique or problem.

An appropriate mix of participants was widely thought to be important for a scientifically strong meeting, and for the generation of collaboration. Amongst the requirements were thought to be a balance of scientific interests and backgrounds (including industry and academia), and a mix of nationalities, seniorities and ages of participants. However, there were differing, sometimes conflicting, views on how the optimum mix should be achieved. Some partici-

pants, chairmen and funders felt that if the topic of the meeting was well chosen, the right participants would be there. The theme should be sufficiently focused to bring together people with common interests, yet sufficiently interdisciplinary to attract a group of people that was not predictable, encouraging novel discussion and new alliances. As long as the conference was well advertised, the meeting would be as international as the scientific discipline that it was discussing.

Some participants pointed out that if collaborations were to emerge from a meeting they should be driven only by scientific need or advantage, and not by artificially bringing people together, at a conference or otherwise. However, other participants, as well as some chairmen and funders, thought that efforts should be made to have a balanced mixture of nationalities, ages, seniorities, and background (including industry and academia). Special encouragement, through allowances being made or funding being available for the young and those from scientifically peripheral regions, were suggested as ways of achieving this balance. Researchers who favoured such actions felt that it was these groups who could benefit most from the new linkages formed at conferences. It was generally believed, however, that scientific quality should not be compromised in the process.

IV THE NATURE AND IMPACT OF COLLABORATIONS INITIATED THROUGH RESEARCH CONFERENCES

Research collaborations exist in a multitude of forms, and vary widely in their impact on the research of the partners. Therefore, in this chapter we explore in detail what collaborations initiated at conferences entail, in terms of people, timescale, the benefits sought and derived, and any negative impact. The bulk of the data and views in this chapter are drawn from the follow-up questionnaire to the two groups of conference participants, the international group that had attended an ERC and the group of UK researchers that had been supported by the RS to attend a variety of types of conference. The RS group is also broken down to examine the influence of conference size (and, therefore, type) and of the nationality of their partners on the nature of the collaborations. The statistical information is based on details of 43 collaborations formed by the 38 respondents in the ERC group and 131 collaborations formed by the 97 respondents in the RS funded group, unless otherwise stated. Collaborations were defined as involving at least one researcher or group from outside the respondent's own institution.

(I) COMPOSITION OF THE COLLABORATING GROUPS

Number of groups

Collaboration involved only one partner group from outside the respondent's institution in the case of 79% of the RS funded researchers and 81% of the ERC participants. Three or more partner groups were rare (8% and 2% for the RS and ERC groups respectively); the maximum for a single collaboration in our sample was seven different partner groups. Whilst very few collaborations overall involved three or more partner groups, in the 21 cases where RS funded researchers were collaborating with other EC researchers (see below), they had three or more partners in five (24%) cases. It is likely that these larger than usual teams represent consortia put together in order to comply with the special requirements for EC funding.

Nationality and nature of partners

The breakdown of nationalities of the partner groups is shown in figure 4.1a. It is clear that the RS-supported researchers tended to form their linkages with groups from a very different profile of countries than the scientists who had attended an ERC. Half of the collaborations that had arisen through attending an ERC were with groups from an EC nation other than the respondent's own, whilst for the RS-supported trips the most likely nationality of partners was American (39%).

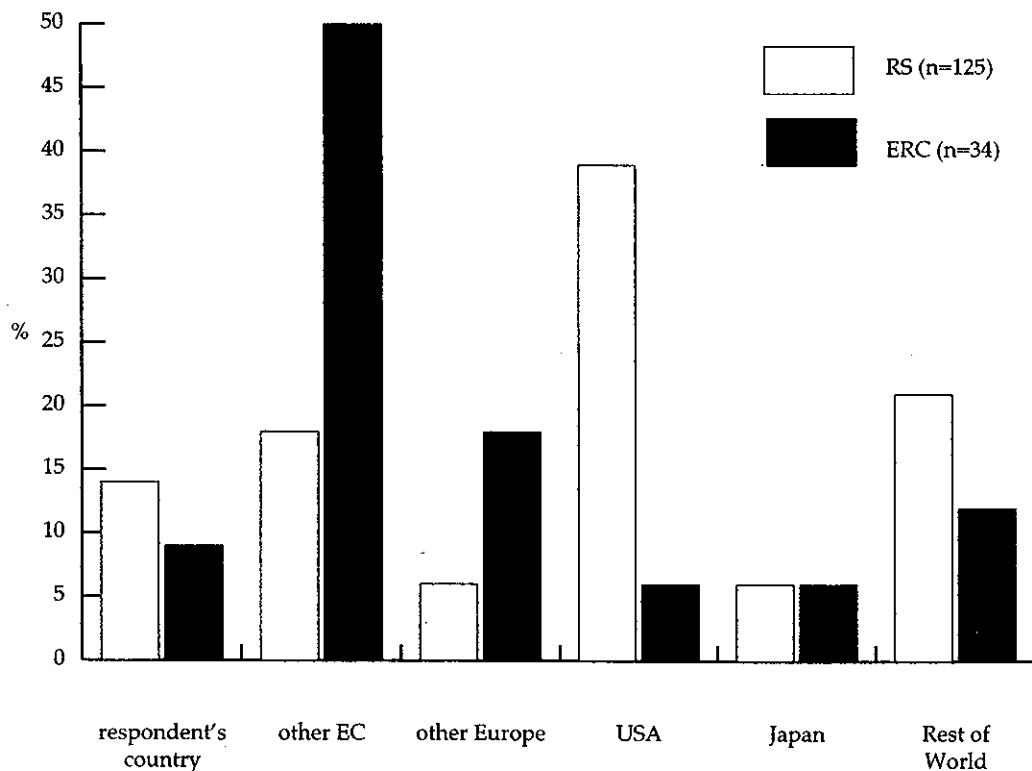


Figure 4.1a Nationality of partners in collaborations formed through attending a conference

Part of the reason that the two groups of respondents tended to form partnerships with different nationalities was related to the nature and size of the meetings that they attended. ERCs are very European meetings: about 67% of participants come from EC nations, with a further 20% from other European countries. This means that if linkages form they are likely to be with European groups. Similarly, as shown in figure 4.1b, in cases where a researcher was supported by the RS to attend a small meeting, more likely to be a national or European rather than an international meeting, any resulting collaborations were more often with partners from the same country or another EC country. In

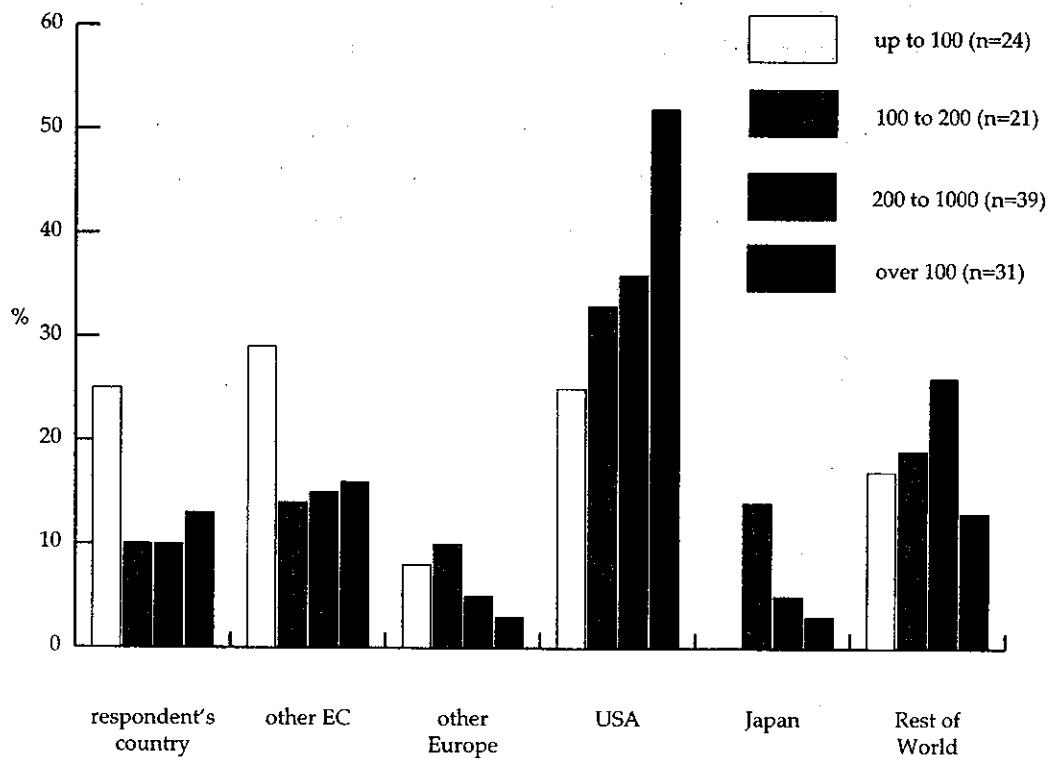


Figure 4.1b Nationality of partners in collaborations formed through different sizes of conference (RS group)

the cases where a researcher attended a large meeting, more likely to include delegates from all over the world, partnerships were more often established with groups from the USA.

Beyond these considerations, however, is the fact that the general geographical distribution of RS travel grant destinations (USA 40%, EC 25%, non-EC 35%) is not very different from the nationality distribution of the RS collaborating partners in our sample.

In addition to the nature of the conference influencing the nationality of collaborators, the two groups of respondents may also favour linkages with different nationalities. Figure 4.1c shows the responses to the question of whether researchers had any collaboration, not only ones formed through the conference, with groups from various countries. The great majority of researchers in both groups had collaborations with groups outside their own institution, but from the same country. However, the international (mostly European) group of ERC participants were more likely to have links with EC or other European nations, besides their own, than the UK group of researchers supported by the RS. In contrast, the RS-supported group were somewhat more

likely to collaborate with Americans than the ERC participants. This is likely to reflect in some measure the common language and historical relationships.

The majority of new collaborations that arose through attending conferences were reported to be with academic research teams: 79% of those formed by RS-funded researchers and 93% of those formed by ERC participants. The

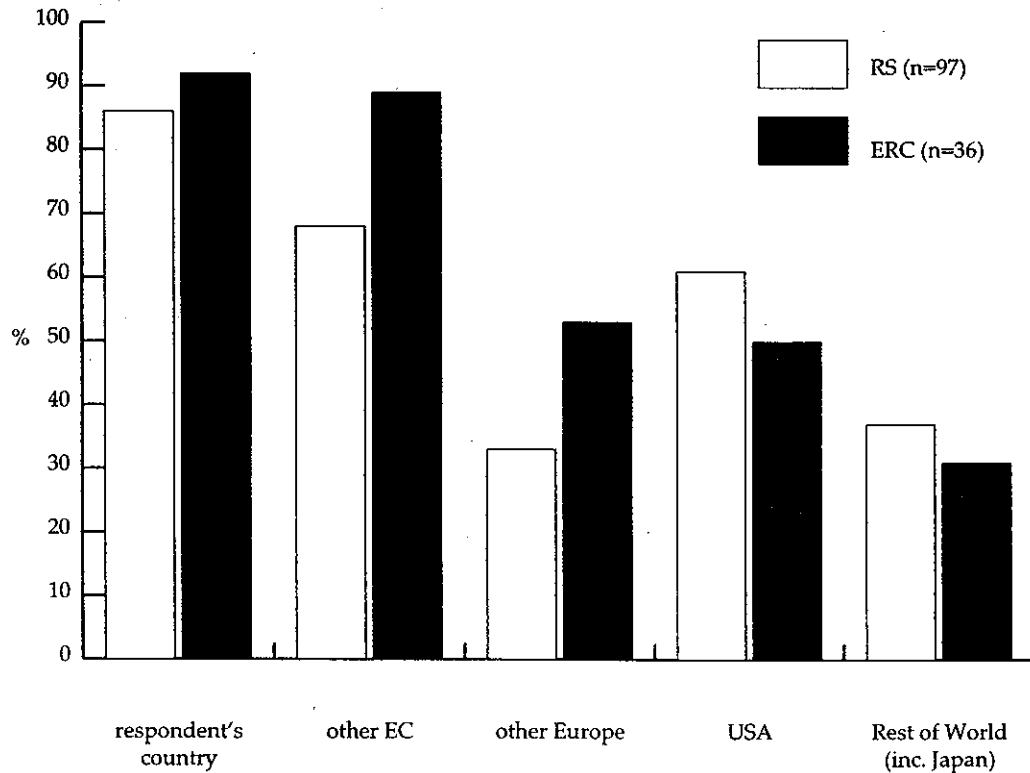


Figure 4.1c Percentage of respondents who have any collaboration with partners of various nationalities

RS-funded group were more likely than the ERC group to collaborate with partners from industry (9% versus 2%) or 'other' organizations (11% versus 5%), probably reflecting the fact that almost all participants in ERCs are from an academic background, whereas this may not be the case for the wider range of meetings attended by the RS-funded group.

Number and status of personnel

The number of people directly involved in a research collaboration varied widely, from one researcher in each of the two institutions, to up to six people being involved from the respondent's group and up to ten from the partner group or groups. On average, the number of participating researchers was almost balanced between the respondent's group and their partners. The RS-funded respondents established collaborations involving a mean of

1.9 people from their side and 2.2 from the other group(s), with more variation in the number from the partners. The collaborations established by ERC participants involved an average of 2.3 scientists from the respondent's side and 2.4 from that of the partner; again there was greater variation in the number of partner scientists.

A breakdown of the status of the personnel involved in the collaborations formed through conferences is shown in figure 4.2. The RS and ERC groups responses have been combined in this case as the average proportions of staff of different grades were very similar in the two groups, though they varied considerably between individual collaborations. On average half of the researchers (ie an average of about one person) from the respondent's group were permanent staff; in most cases this would have been the respondent him/ herself, as most of them were permanent staff. The remaining individuals were postgraduates or postdoctoral researchers. Whilst the numbers of researchers involved from the respondent's and the partner's group were similar in total (see above), a higher proportion of the latter were permanent staff (65%, ie an average of 1.4) and fewer were postgraduates or postdoctoral researchers. The greater average number of permanent staff on the partner side may reflect the cases where there

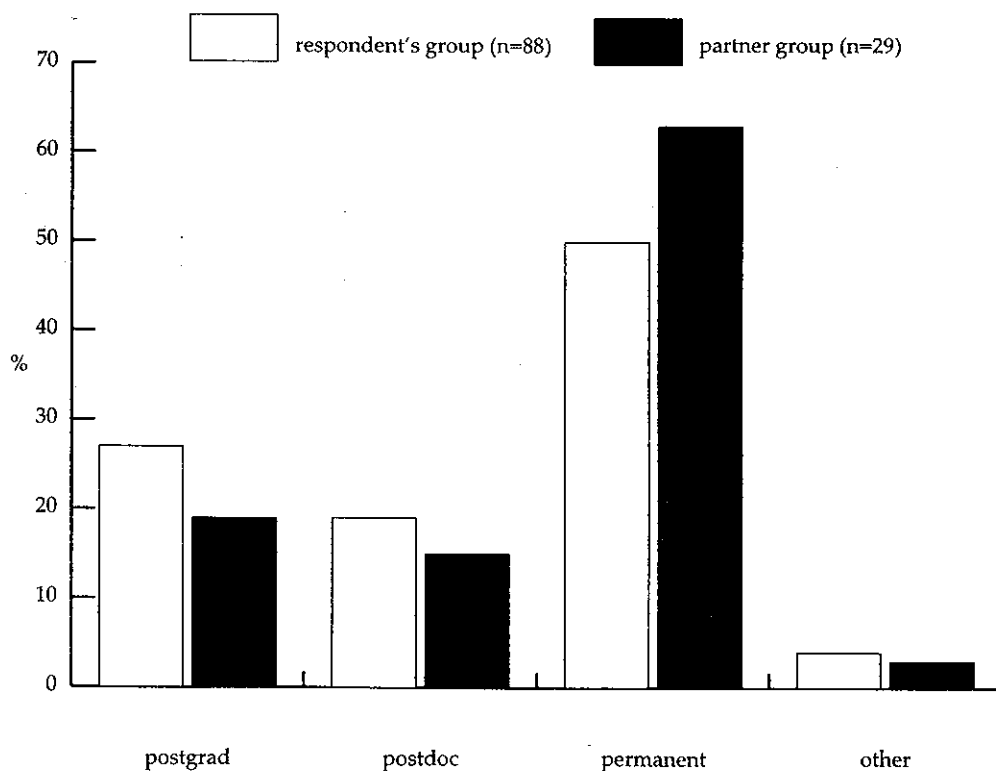


Figure 4.2 The status of staff involved in collaborations formed through conferences (RS and ERC group combined)

was more than one other group, as it is likely that a permanent member of staff was involved from each.

The nationality of the partner group seemed to have some bearing on the number of researchers involved in the collaboration and their status, on the basis of the collaborations formed by the RS-supported group. Figure 4.3 shows the average number of researchers from each side for collaborations with various national groups. It can be seen that linkages that included another UK group tended to be smaller than average although, unusually, the total number of people from the respondent's side was greater on average than from the partner's. In contrast, linkages that involved teams from other EC countries

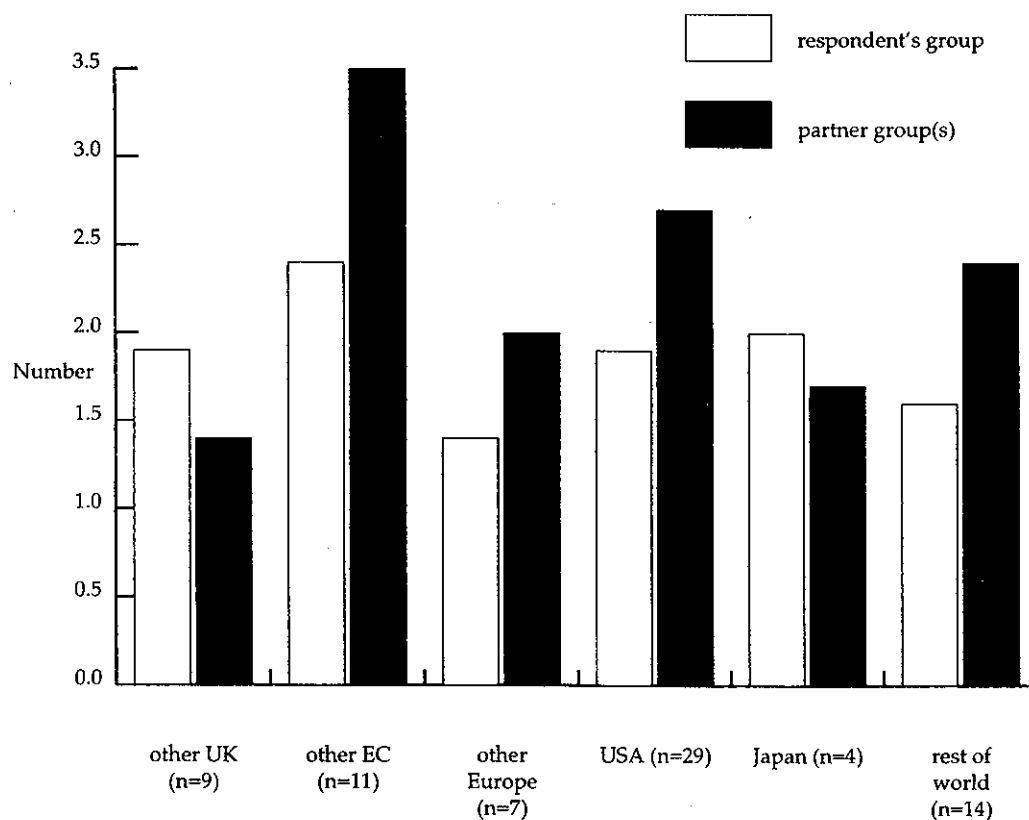


Figure 4.3 The average number of staff involved in collaborations with partners from different countries

were larger, particularly in terms of the number of people from the partner groups, leading to an imbalance in the numbers from each side. This is in keeping with the finding (above) that more of the EC collaborations involve more than one partner group, because of the requirements of EC funding.

There was also some difference in the status of researchers included in collaborations, according to the country of the partners. In the case of a UK linkage, a low proportion of those from the respondent's teams were permanent

staff (26% compared to a 50% average for all collaborations), whilst a high percentage of those from the partner teams were permanent (86% versus an overall mean of 65%). The reason for this imbalance is unclear. In the case of EC collaborations the proportion of permanent staff from the partner groups was also high (80%); this may reflect the greater number of cases of multiple partners, as it is likely that each partner will involve at least one member of permanent staff.

(II) THE PROCESS OF COLLABORATION

Timescales

The majority of research collaborations established by the scientists who had been funded by the RS to attend a conference, and by those who had attended an ERC, were longer term ventures. Of the 125 RS group collaborations and the 43 ERC group collaborations for which the information was supplied, the highest percentage were open ended, rather than being a single discrete project (62% and 52% for the RS and ERC groups respectively). A considerable number had started as discrete projects, but further collaboration was thought likely (26% of the RS group, 32% of the ERC group). The remaining small proportions (13% and 16%) were divided between projects that had already finished and discrete projects where no continuation was expected.

The nationality of the partner group(s) did not make an appreciable impact on the pattern or timescale of collaborations. There is an indication, however, that the type of meeting which the RS participants attended had some bearing on the duration of the resultant partnership. The smallest meetings attended by the RS group (up to 100 participants) were most likely to lead to short-term liaisons (26%). In contrast, meetings of 100-200 delegates, which would still be considered small, were the most likely to lead to long-term partnerships (80% open ended, 20% discrete but with continuation likely).

Activities involved in collaboration

The questionnaire asked what the respondent's group brought to the collaboration, what the partner group(s) offered and what actions were involved; the results are shown in figure 4.4. In terms of what the respondents were looking for from their partners (figure 4.4a), specialist knowledge followed by methodological expertise were the most important to the RS and the ERC groups. Respondents also thought that what they offered the partner team(s) (figure 4.4b) was most often specialist knowledge, followed by methodological expertise, with research facilities as an important third consideration.

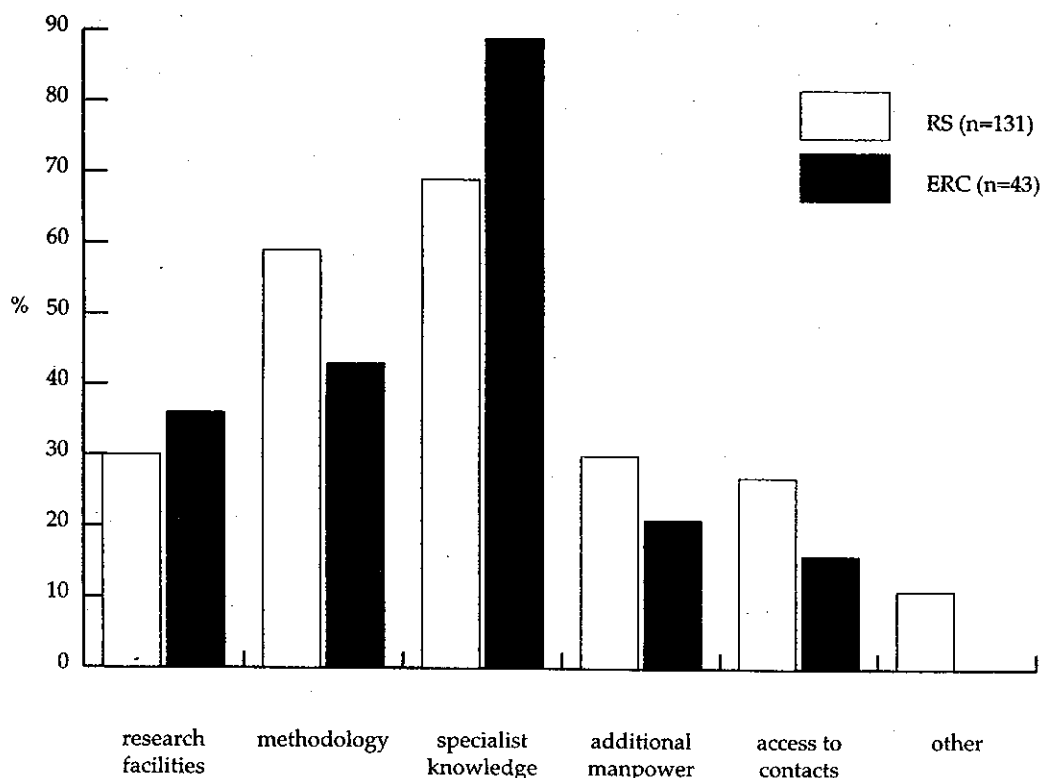


Figure 4.4a Percentage of collaborations in which specified resources were offered by the partner group

On balance (figures 4.4a and 4.4b), the RS-funded respondents more often thought they provided methodological expertise and specialist knowledge than they received it, whilst the ERC group more often thought that they gained specialist knowledge from their partners, but provided facilities. In the cases where the respondent or partner offered something not on the list, it was most often research materials.

Of the activities listed in figure 4.4c, all formed a fairly frequent part of collaborations, with the exception of sharing staff, but no one activity was particularly dominant. Joint papers were produced in fewer than half the collaborations, and in more than half of those cases only one paper had been published to date.

The nature of the collaborations formed by the RS group was dependent to a marked degree on the nationality of the other partner. In particular, collaborations with other EC countries involved use of research facilities, sharing of methodological expertise and access to contacts more frequently than average. They also involved visits to or from the partner group more frequently than average, and more often led to the joint publication of a research paper.

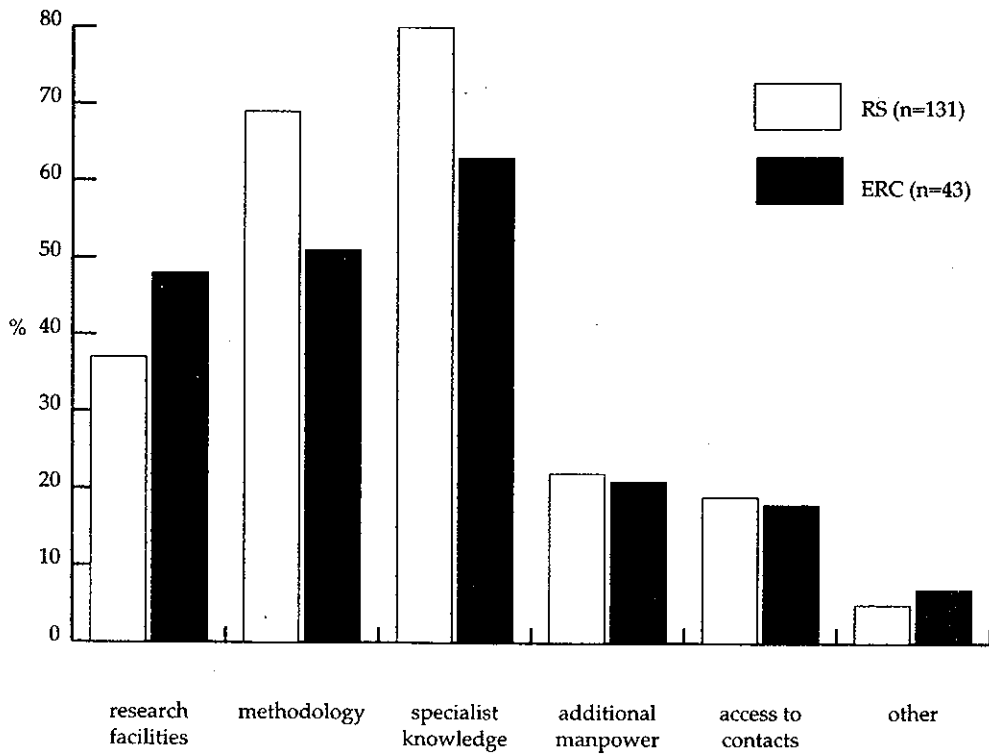


Figure 4.4b Percentage of collaborations in which specified resources were offered by the respondent's group

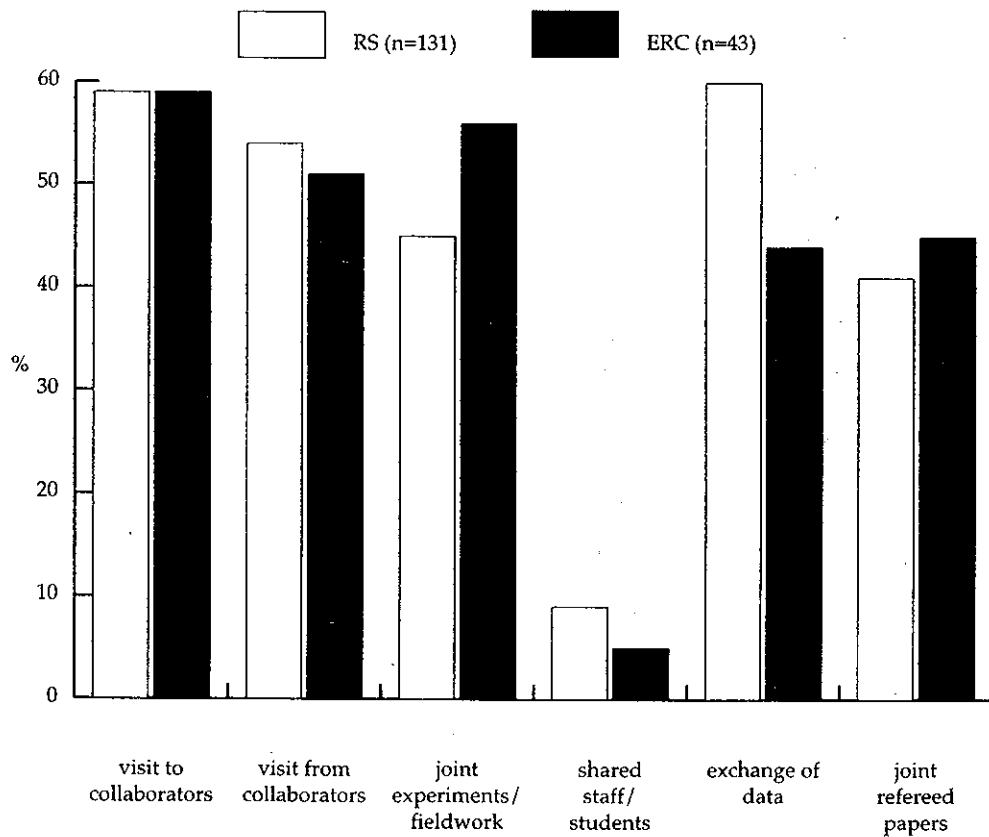


Figure 4.4c Percentage of collaborations that involved specified activities

(III) THE IMPACT OF COLLABORATION

Balance of benefit

The questionnaire asked that each collaboration be ranked according to the benefit/disbenefit to the respondent's group and that of their partner. As figure 4.5 shows, the vast majority of linkages formed by the RS and the ERC groups were considered by the respondents to be beneficial to their partners and themselves. 87% of both RS and ERC groups said that, on balance, the benefits and disbenefits were evenly distributed between partners, although many pointed out that the objectives of collaborating and the nature of the benefit often differed between the partners. Many researchers felt that unless a collaboration was going to be of mutual benefit it would not get off the ground in the first place; the degree of advantage it brought would depend on the commitment of the partners. The exceptions were collaborations involving scientifically less developed countries, which were felt to have more to gain. Some respondents thought that it was important for them to assist researchers from such countries, even if they gained no direct benefit themselves.

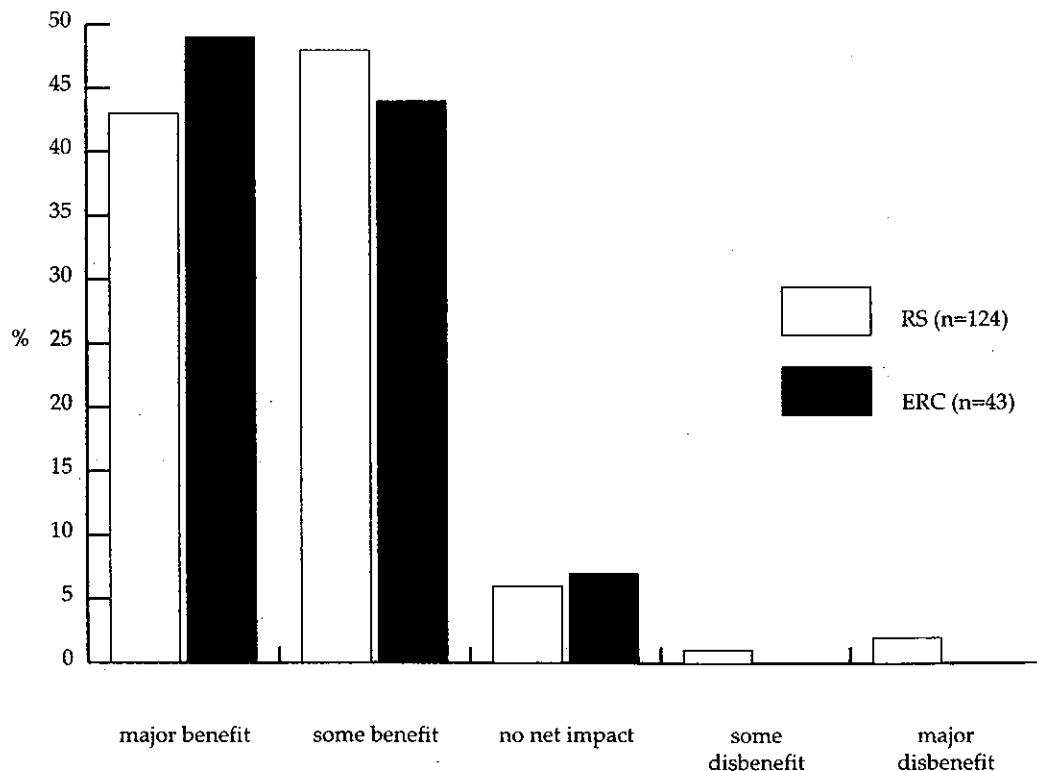


Figure 4.5a Percentage of collaborations that had specified degrees of impact on the respondent's group

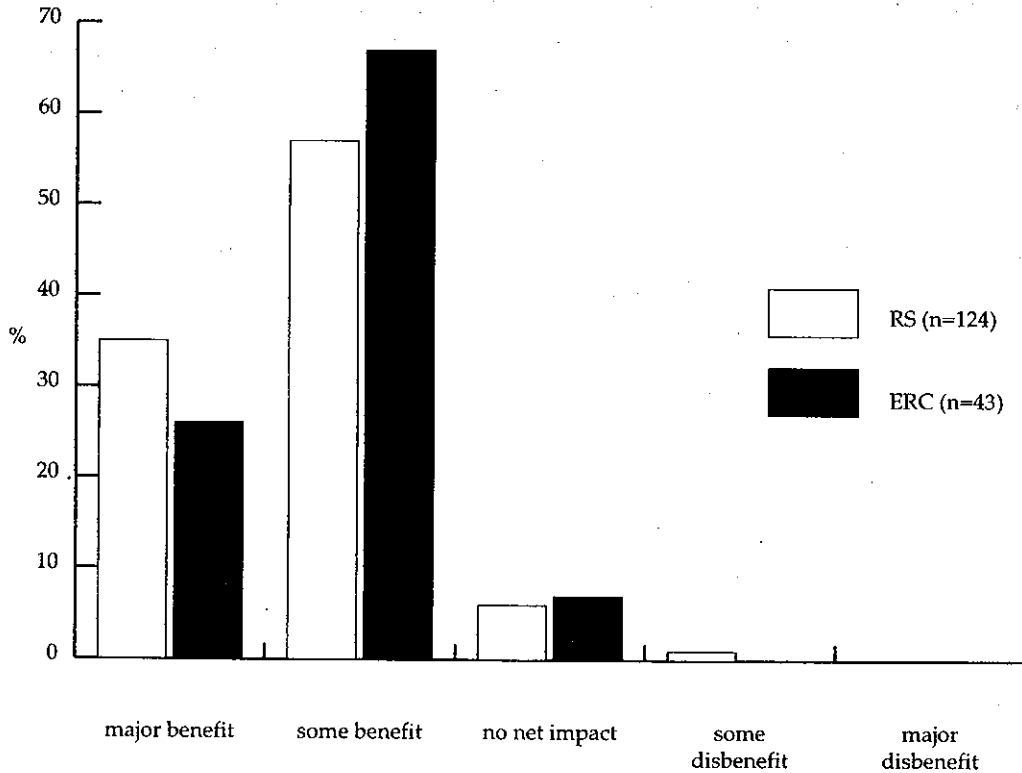


Figure 4.5b Percentage of collaborations that had specified degrees of impact the partner group(s)

Benefits of collaboration

The previous section explored what researchers gained from specific collaborations that was not available in their own group. Comments raised by the respondents' questionnaire and during the interviews with chairmen expanded on how this enhanced their own research and the field in general. Access to specialist knowledge, techniques or materials could allow research activities that would not otherwise have been possible in the researcher's group, or greatly accelerated progress by saving time in the development of know-how or by giving access to information very early. Coordination of effort was also perceived as reducing duplication, improving efficiency and breaking down the barriers of competition. Some researchers and chairmen particularly welcomed coordination within Europe, as this could forge more of a united European approach and lead to a more positive spirit in European science. Collaboration across disciplinary as well as national boundaries was seen as important in cross-fertilization of ideas and stimulating new research directions.

Representatives of funding and/or organizing bodies overall saw similar benefits of research collaboration as the researchers, although some of them placed greater emphasis on the value in building a strong European science base.

Personnel from the Irish funding bodies pointed out the importance of collaboration to peripheral scientific regions, particularly within the EC, in giving access to funding for research and to technologies and facilities not available in their own nation.

Disbenefits of collaboration

Researchers, chairmen and funders were specifically asked about the negative impact that collaboration might have on research. Many people said that there was no negative impact as long as care was taken in the establishment of a partnership, otherwise a collaboration could never get off the ground in the first place (see below). Some specific problems had been encountered, but either these had been overcome or the proposed collaboration had failed (see below). A more general comment, made in some cases, was that the objectives of the agencies funding collaborations could have a detrimental impact on the research. For example, in order to win EC funding, pressure may be applied to encourage acceptance of weaker partners or a technically inappropriate project. One researcher pointed out that the failure of a good grant application to a funding agency could be disappointing and demoralizing to a foreign researcher used to more success. However, any disbenefits cited were rare, and most researchers, chairmen and funders considered collaboration to be a positive part of normal research activity.

(IV) PROBLEMS ENCOUNTERED IN ESTABLISHING COLLABORATIONS

Reasons for failure

Collaborations proposed as a direct result of attending a conference would seem to have a high chance of getting off the ground, since over 90% of respondents (all of whom had originally expected a collaboration to emerge) were able to detail at least one linkage that had developed. Furthermore, some partnerships that had not yet come into fruition were still expected to in time. Of course, those who did not reply could have had a higher incidence of failure, and in some cases fewer collaborations may have materialized than were expected.

A number of researchers gave reasons why expected collaborations failed to materialize. In several cases, once the researchers returned to their own institutions lack of time, other pressures of work or simply inertia prevented one or other partner from acting further on the intended collaboration. In a number of other cases there was a lack of funding for follow-up travel or a specific project grant was rejected, after which the impetus was lost. A change in the circum-

stances also led to the failure of some potential linkages, such as a shifting of scientific priorities, or a loss of manpower or of access to facilities. Finally, the difficulties of communicating with Eastern European scientists had proved too great a barrier to the development of a couple of collaborations.

Difficulties that were overcome

Whilst the number of collaborations proposed as a result of attending a conference that totally failed to materialize was small, others encountered a considerable number of problems before they could be established. Once these had been overcome, most collaborations had a positive outcome, as discussed above. Many of the problems could be avoided on a future occasion with careful planning.

The most common difficulty had been securing funds to pay for further travel or equipment necessary for the collaboration. This was a particular problem if the intended trip was exploratory rather than being tied to a specific project. If there was no money for a follow-up visit a new contact could go 'cold'. It was felt by some that research funding agencies should acknowledge the importance of travel and collaboration by having a flexible element for travel in all project grants, as the Wellcome Trust did, particularly since only small amounts were required. Some thought that it was more difficult for younger researchers who lacked well funded laboratories with the resources to finance potential collaborations, and that they should therefore be favoured in winning travel money. Insufficient funding had frequently restricted the extent of the collaborative activity. To some extent good communications particularly through e-mail, had enabled linkages to be maintained, though this was often not felt to be as fruitful as extensive face-to-face contact with partners, and it was more difficult where the partners were in countries with poor infrastructure.

Lack of time had also led to the scaling down of some plans for collaboration. In some cases this was simply caused by over-enthusiasm when the researchers first proposed to work together, and could be resolved by more realistic planning. Some had found logistics and communication to be more time-consuming than expected, whilst others had found the process of applying for funding long and bureaucratic. In some cases it was felt that the bureaucracy was unnecessarily burdensome, particularly in the case of EC funding, and could seriously inhibit the development of collaboration.

Almost all of the other problems that were encountered in establishing a new collaboration were related to personal and cultural differences. These included

Attending conferences and visiting other researchers were seen as the most important mechanisms, followed by introduction via mutual contacts. Organized networks were more important to the international (mostly European) ERC group than to the all British RS group. Electronic bulletin boards, clubs and expert databases did not appear to be important in forming collaborations, although it might be expected that these mechanisms might develop in importance with time.

The importance of conferences, visits and mutual contacts correlates with the fact that respondents, chairmen and funders frequently commented on the value of face to face contact in encouraging collaboration. By meeting a potential partner, researchers felt they were able to discuss mutual interests in more depth and to establish whether their capabilities, approaches and attitudes were mutually compatible. This meant that collaborations were more likely to succeed, more quickly, and with fewer problems of understanding such as those discussed in Chapter IV. It might be thought that networks would offer many of the advantages of conferences. However, some had found them difficult to break into, although they were thought useful when bidding for EC funds.

A number of respondents pointed out that, although important, a single meeting with a potential collaborator, whether at a conference or elsewhere, usually was not sufficient to establish a new linkage. Collaborations were said by several researchers to evolve, needing time to build up trust and understanding. Several meetings, or a single meeting following some time of communicating by mail, e-mail or being aware of each other's work through literature, may be necessary. Thus, whilst the different mechanisms of communication between researchers differ in their importance in forming collaborations, it may be that a combination of mechanisms is the most valuable.

Some researchers pointed out particular advantages of conferences with respect to new linkages. They combined the possibility of formally presenting one's work with the opportunity to discuss it informally. Conferences were also said to be a good forum for meeting industrial partners or those from different disciplines.

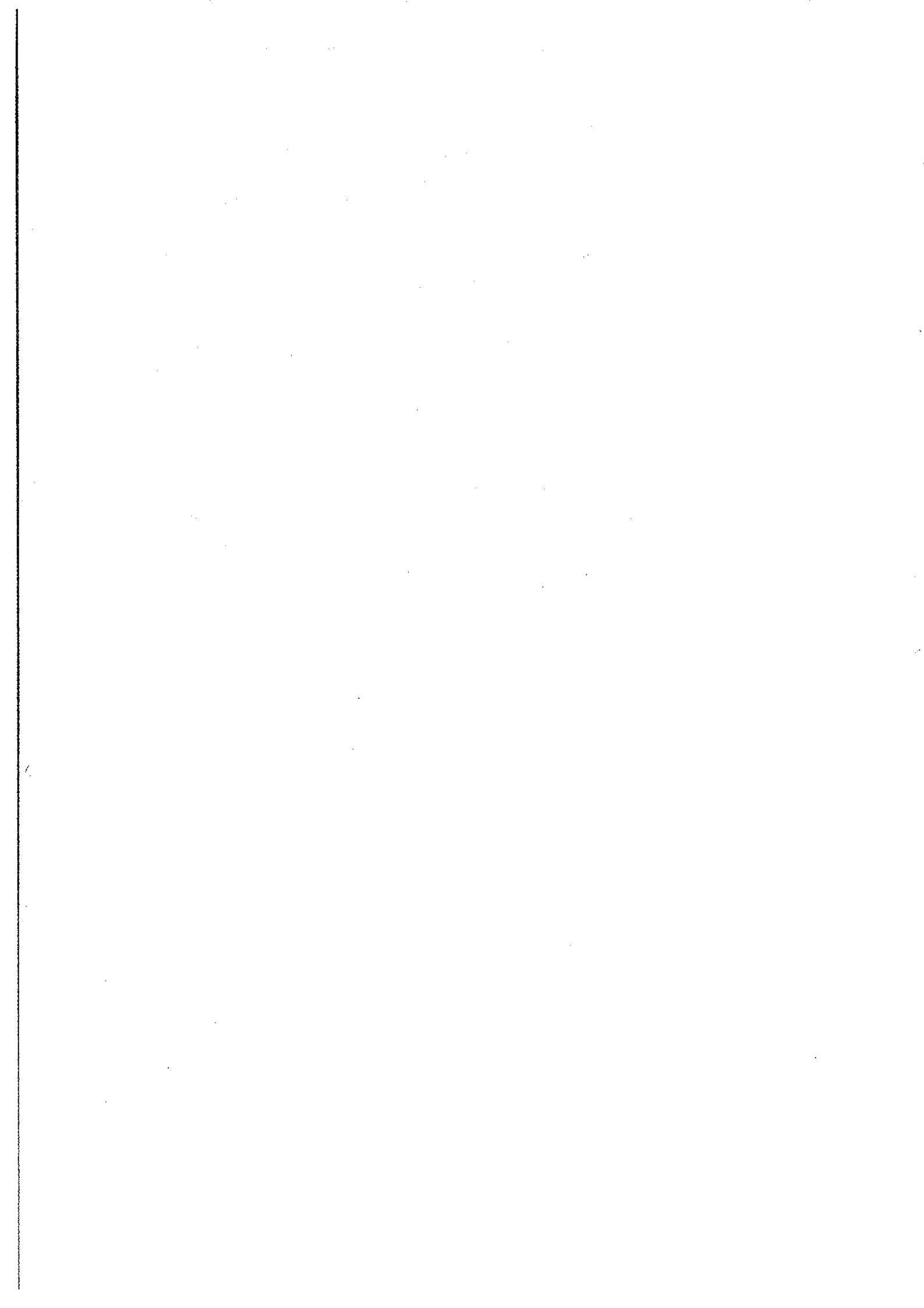
(II) THE NATURE OF COLLABORATIONS ARISING FROM DIFFERENT MECHANISMS

This study provides a detailed analysis of the nature and impact only of collaborations initiated through conferences (chapter IV), though we asked researchers,

chairmen and funders to comment generally on the linkages that emerge via different routes. Many people saw no fundamental or generalized difference in the types of collaborations arising by various routes; rather it was that the particular field of research and the needs and attitudes of the individuals involved would determine the course and impact of the partnership. Indeed, a number of the comments about the different routes to collaboration seemed simply to reflect the individual experiences of the researchers rather than being general observation.

Collaborations that had arisen via face to face contact, at a conference, laboratory visit or via a mutual contact, were shown above to have a greater chance getting off the ground. It was also felt by a number of researchers that they were more interactive and informal, making them more fruitful and long-lasting once they did get under way. Some researchers, nevertheless, had had very fruitful partnerships with people whom they had never met, exchanging data, ideas and materials. However, it was thought that collaborations initiated and continued through the literature and written communication were more formal and often involved a finite activity rather than ongoing and evolving interaction.

It was pointed out that collaborations initiated through conferences were more likely to be international and/or interdisciplinary. Collaboration with researchers in one's own field and country was easier to initiate and maintain, whilst conferences gave access to a greater variety of scientists outside the immediate community. Conferences may also be of particular value for meeting bright young researchers, particularly from the host country.



VI DISCUSSION

Scope of the study

The focus of this study is how research collaborations, particularly between European partners, are initiated and develop. A collaboration is defined in terms of the partnership, very frequently ongoing, between two or more research groups rather than the cooperation of two or more groups on a particular project, which has been the subject of a previous SEPSU study.* We have taken research conferences as one of the possible triggers to forming collaborations, and explored the evolution of collaborations from this point, rather than starting from collaboration on a particular task and asking how the point was reached. Therefore the nature of the activity involved in the collaborations in this study was determined by the researchers themselves.

The choice of research conferences as the starting point for collaborations to be studied means that the bias is towards academic partnerships. The emphasis is on European collaboration, since most of those surveyed were in Europe, but comparisons have been made of partnerships between the UK and other European nations and between the UK and other non-European nations.

Collaboration as an objective of conferences

From the point of view of participants, chairmen and many funding bodies, the most important objective of research conferences is the exchange of scientific information. The formation of collaborations is a secondary function. Nevertheless, collaborations are frequently formed, and indeed conferences are considered to be one of the most important means of initiating collaborations. In other words, from the point of view of the academic community collaborations are a major outcome of conferences but not a major objective. In contrast, for some of the organizations, notably the EC, ESF and NATO, encouraging collaboration and building a stronger scientific community is a major objective of supporting conferences, so their funding comes with conditions or recommendations about the balance of participants. The scientists conform to these

* Malcolm McOnie, *European collaboration in science and technology: pointers to the future for policy makers* (SEPSU Policy Study No. 3, 1989).

specifications in a way that avoids compromising their scientific objectives, inviting speakers and funding participants from less developed regions, but only if they are active in the field. A possible outcome of this is that the strong scientists in a peripheral region have access to wider contacts and funding, but it is difficult for others, particularly the young, to break into the circle, and the benefits to the region as a whole may be limited.

We identified a number of features of conferences that enhanced the chances of new collaborative linkages developing. Small conferences were somewhat more likely to result in collaborations. More importantly, strong and open presentation and discussion of research, with a group of people who would not normally come together, yet had common interests, and plenty of free time for informal discussion, were considered important stimuli for new collaborations.

This, of course, is also a stimulating environment for the exchange of scientific information, and a number of people pointed out that one would lead to the other in any case. This type of format may not be appropriate in all cases, however, depending on the other objectives of the organizers and the audience that they hope to reach.

The nationality of partners established through a conference at least in part relates to the nationality of the participants, as might be expected. European conferences are more likely to lead to European collaborations.

The nature and development of collaboration

We have looked at one of the triggers of collaboration, the research conference, and explored what develops from there. What emerged is a picture of collaboration as a part of every day scientific activity, very varied in nature to suit the scientific needs of the researchers. From the point of view of the academic scientist at least, collaboration is a highly successful means of improving research effectiveness, by sharing ideas, methodology and resources. It is not an end in itself. A fruitful collaboration must be driven by scientific advantage, and must be allowed to build up over time to allow the priorities and attitudes of potential partners to be established. Face to face contact is considered to be a very important part of this process. Thus the development of collaborative linkages is a slow process, but it seems that once established, a collaborative relationship between research groups lasts for a long time.

The activities involved in a collaboration vary considerably, and probably change in the course of time depending on the needs and interests of the partners, since most relationships last once established. Most collaborations in our sample were between two groups and involved the exchange of specialist knowledge and methodological expertise, through visits, joint experiments/fieldwork and exchange of data.

Collaboration between UK researchers and other EC groups tended to be on a larger scale, with several groups participating. They were more likely to involve exchange of methodology and access to facilities and visits between the groups. It is likely that the difference in size is the direct result of EC funding of research projects, where consortia of groups tend to be encouraged. The difference in nature may relate to the fact that EC funding will be for a specific project, rather than the ongoing sharing of ideas, therefore involving methodology and facilities and including money for travel between the groups. EC collaborations were more productive, in the sense that they were more likely to lead to the publication of papers. However, they were not felt any more intrinsically beneficial to the researchers, and the greater production of papers is again likely to relate to the collaboration being based on a discrete task.

	1	2	3
5. Number of partner groups			
6. Countries of partner groups			
7. Nature of collaborators' organizations (one tick per partner group):			
EC industry	()	()	()
EC academia	()	()	()
non-EC industry	()	()	()
non-EC academia	()	()	()
other (specify)			
8. How many researchers of each grade from <u>your</u> research group (including yourself) are directly involved in the collaboration:			
postgraduate			
postdoctoral			
permanent staff			
other (specify)			
9. How many researchers of each grade from the <u>partner</u> research groups are directly involved in the collaboration:			
postgraduate			
postdoctoral			
permanent staff			
other (specify)			
10. What did the <u>partner</u> groups offer that was not available in your own institution (tick where appropriate):			
research facilities	()	()	()
methodological expertise	()	()	()
specialist knowledge	()	()	()
additional manpower	()	()	()
access to further contacts	()	()	()
other (specify)			
11. What did <u>your</u> group offer that was not available in the partner group's own institution (tick where appropriate):			
research facilities	()	()	()
methodological expertise	()	()	()
specialist knowledge	()	()	()
additional manpower	()	()	()
access to further contacts	()	()	()
other (specify)			
12. Which of the following has the collaboration involved (tick where appropriate):			
visit <u>to</u> collaborators	()	()	()
visit <u>from</u> collaborators	()	()	()

joint experiments/fieldwork	()	()	()
shared staff/students	()	()	()
exchange of data	()	()	()
joint refereed papers-			
give number	.....	.....	.....

13. **How much funding has been won from organizations other than your own or that of your partners specifically to support the collaboration in total, and from each source (specify currency):**

TOTAL VALUE	.....	.....	.....
European Commission	.....	.....	.....
other international body	.....	.....	.....
public funds from:			
- your country	.....	.....	.....
- collaborators country	.....	.....	.....
private funds from:			
- your country	.....	.....	.....
- collaborators country	.....	.....	.....
other (specify)	.....	.....	.....

14. **What is the timescale of the collaboration (tick one):**

already finished	()	()	()
discrete project, no	()	()	()
continuation likely	()	()	()
discrete project, further	()	()	()
collaboration likely	()	()	()
open ended, not a single	()	()	()
discrete project	()	()	()

IMPACT OF COLLABORATIONS ARISING FROM ATTENDING CONFERENCE

15. **What impact have the collaborations had on your research group:**

major benefit	()	()	()
some benefit	()	()	()
no net impact	()	()	()
some disbenefit	()	()	()
major disbenefit	()	()	()

16. **What impact have the collaborations had on partner groups:**

major benefit	()	()	()
some benefit	()	()	()
no net impact	()	()	()
some disbenefit	()	()	()
major disbenefit	()	()	()

17. **To what extent were the benefits and disbenefits evenly distributed between the groups involved in the collaboration?**

.....

18. If any collaborations had a net negative impact on your research, how was this manifest and how would you avoid this happening again in future?

.....
.....
.....

19. Even if collaborations have been beneficial on balance, were there any problems in establishing them, and how might problems be avoided in future?

.....
.....
.....

20. If any collaborations expected to develop as a result of attending the conference failed to do so, please give the reasons:

.....
.....
.....

MECHANISMS OF FORMING RESEARCH COLLABORATIONS

21. What features of the conference that you attended particularly a) encouraged or b) discouraged the formation of collaborative linkages?

.....
.....
.....

22. Please rate the following objectives of attending a research conference on a scale of 0 to 4 (where 0=no importance and 4=a very important objective):

- to seek new collaborations
- to keep up with existing contacts
- to learn about new areas of research
- to keep up with developments in own field

23. A number of mechanisms exist via which research collaborations may be initiated; please rate the importance of each to your research on a scale of 0 to 4 (where 0=no importance and 4=very important):

- attending conferences
- visiting other research groups
- via research literature
- via electronic bulletin boards/ clubs
- via mutual contacts
- databases of experts
- organized networks
- other (specify)

24. Do the nature of the collaborators and the collaborations formed via each mechanism differ in any way?

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.....

25. Please make any other comments of relevance to this study that have not been covered in preceding questions:

.....
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.....

Thank you very much for your time in completing this questionnaire.

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