

UK-Brazil Collaborative Research Networks

Evaluation of pilot project

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Executive Summary

1. This report is an evaluation of the Brazil-UK Collaborative Research Networks pilot project which ran from 2000 to 2003. The project arose from discussions between the UK and Brazilian governments during a visit to Brazil in 1998 by the Minister for Education and Employment, Baroness Blackstone. A number of federal- and state-funded research networks with strong links to industry had been established in Brazil, and it was proposed that the UK establish similar networks and that international collaborations might ensue. The principal partner in Brazil was the Carlos Chagas Filho Rio de Janeiro State Foundation for the Endowment of Research (FAPERJ).

2. Three academic networks were established in the UK in the areas of industrial catalysis, corrosion protection and phytopharmaceuticals. The HEFCE's primary interest in funding this pilot project was to pioneer a new form of international research collaboration with a strong applied focus. It specified that each network should have tangible outputs and clearly identified benefits, and should comprise at least three university groups of international repute, with industrial partners who could support individual research projects.

3. Proposals for funding were submitted to the HEFCE and each was considered by an independent assessor. The total funding released to the UK networks over the period of the pilot was £200,070. Including facilitation and annual monitoring workshops, the total amount of HEFCE spending on the project was £225,224.

4. The achievements of the three networks in the UK are variable, but all three have set up websites and many of the individuals in each network have regular contact electronically and face-to-face in the UK. The UK networks report also indicated that the opportunity to work more closely together is a positive gain. At the final evaluation meeting the strong desire to continue to develop the relationships became clear, and plans for joint workshops in Brazil in autumn 2003 are being made.

UK-Brazil pilot project outcomes

| Expected outcomes | Position at end of project |
|--|--|
| Improvement of research and higher education links between Brazil and the UK | Good developments in this area, including spin-offs |
| Positive outcomes of partnerships between higher education institutions and industry in each country | Limited success in UK, good links in Brazil, offering opportunities for UK networks |
| Pioneer a new form of international research collaboration which has a strong applied focus | International research projects have applied focus. Difficulties in obtaining funding experienced by UK networks have led to variable results in this area |
| Encourage UK university groups to establish strategic partnerships | Considerable achievements – UK networks cite this as positive feature |
| Exploitation of university expertise | Limited so far, although potential exists |
| Export potential for associated UK industrial partners. | Phytopharmaceuticals network has been closely linked to industry from the start |

Points for consideration

The following points have emerged from reflection on the project and have led to the conclusions outlined below.

- Establishing and maintaining network communications requires significant effort in the initial stages and needs to take differing cultural expectations and potential language barriers into consideration.
- There is immense value in face-to-face meetings to build trust.
- Dedicated and secure websites can be immensely effective in keeping the networks moving forward after the initial personal relationships have been constructed.
- Regular local meetings and visits overseas are essential, as are the roles of the facilitator and coordinator in ensuring this happens.
- Dialogue with all stakeholders in the initial stages is important, as is maintaining channels of communication throughout the project.

Conclusions

In summary, when establishing an international research network with close links to industry it is suggested that partners:

- Build in sufficient time in the early stages of the project for relationships to be established. This should take account of cultural expectations in both/all countries, language barriers and existing contacts between individuals. Meetings of the coordinators and other network members will assist this phase.
- Ensure that communication between network members is established early.
- Include all stakeholders, such as industrial partners, in discussions at the start of the network, to ensure that its work is focused and relevant. In particular, consider ways to involve industry actively as well as identify and address national research priorities
- Consult with potential funders at an early stage and continue to discuss evolving projects with them.
- Appoint a Project Coordinator early in the project to provide an overview and central liaison.
- Consider using a network facilitator to be the link between network members, industry and other stakeholders.
- Ensure that there are sufficient network members and understanding of the bilateral relationships to maintain momentum in case of loss of the network coordinator

- Make arrangements early in the project for exchanges of research staff or students, and ensure that student registration, where required, is possible.
- Work together to identify areas of mutual research interest and how these might benefit industry, taking into account economic and other factors. In particular, national organisations with an interest should seek to work in partnership to ensure optimum benefit to the whole sector.
- Hold frequent meetings of the in-country network members and plan international workshops to ensure that momentum is maintained and increased.
- Try to establish agreements to address intellectual property rights, or at least agree a framework for them during the initial stages.

Background and Rationale

5. This project grew out of the 1998 ministerial visit to Brazil of Baroness Blackstone, the Minister for Education and Employment, and Professor Sir Brian Fender, the then Chief Executive of the Higher Education Funding Council for England (HEFCE). There was a mutual desire to establish long term collaboration between the two higher education (HE) systems. The visitors met the chief architects of a new federally-sponsored Brazilian University/Industry engineering development project, PRODENGE, devised and run by the federal agency, Financiadora de Estudos e Projetos (FINEP), based in Rio de Janeiro. PRODENGE consists of joint research projects led by several leading University groups working with industrial partners on topics identified by industry as of current importance. The benefit was seen to be in increasing innovation in industry and drawing the university groups in both countries closer to each other and to industry.

6. The initiative for developing PRODENGE followed a nationwide interest and consultation in Brazil to decide broad strategic research and development areas which could contribute to economic development, with the objective of building on existing strengths – not to identify emerging fields. The projects were to be highly focused, and specific applications were to be expected in addition to the less tangible benefits of University groups and industry developing effective ways of working together. The major part of the scheme in Brazil was directed towards a nationwide set of networks, but some Federal funding was set aside to be matched by individual States wishing to create networks to fit their state priorities. The State of Rio de Janeiro – the centre of the internationally important oil and gas industry – set up nine State networks with a budget of US\$4 million over three years. These State networks are run by the university/industry research agency Carlos Chagas Filho Amparo à Pesquisa do Rio de Janeiro (FAPERJ) and have the strong support of CENPES (the research centre of the national oil company, PETROBRAS), which is also based in Rio de Janeiro. Two of the networks were directly related to oil and gas developments, and the remainder were aimed at improving quality of life in this rapidly growing industrial area. The networks included both the Federal University of Rio de Janeiro and the state universities.

7. The UK visitors concluded that a link with PRODENGE offered potential benefits for both countries and that limited collaboration in these areas of research could be undertaken. There was an invitation to the UK to join four of the Rio de Janeiro State projects to form international networks. The history of the origins of the pilot project is given in Appendices 1 and 2). The PRODENGE project is described briefly in the visit report of Professor B L Clarkson, the HEFCE Project Coordinator.

8. The principal aim for the HEFCE was to test the proposition that research programmes led by consortia of UK Universities could be enhanced through international collaboration, and that university expertise could be exploited to the mutual advantage of universities and industry in the two partner countries. The activity was to be focused around themes of direct interest to industry or the public sector in both countries. The project was also intended to support UK Government initiatives to develop links with Brazil. Two important criteria were that there had to be added value from working in this way, and that the project should be sustainable after the initial development funding had ended.

9. Each Brazilian network is organised around a central theme directed towards a specific problem posed by an industrial or public sector partner that commits resources. The research is driven by the application. Some features considered to be essential for success were:

- the network is based on established competence and not on additional staff, equipment or infrastructure
- at least three different institutions must be involved
- the network should be organised so as to work on a well defined problem of strategic importance.

10. In Rio de Janeiro the nine themes were selected out of seventy-nine proposals. To develop the international network it was proposed that the UK mapped research expertise and industrial or public sector interest onto the Brazilian themes to see which was the best fit and hence the most likely to be successful. Four topics were suggested for possible UK participation:

- industrial catalysis
- corrosion protection
- phytopharmaceuticals
- artificial blood.

11. In forming the international network, in the UK it was decided to have at least three linked networks. This created potential for different types of research projects and networking strategies to develop. A typical UK network had the following characteristics:

- based on a theme of current interest to Brazil and the UK
- minimum of three university research groups of international repute working on a topic in a subject area in which they are already national leaders
- industrial or public sector partners who are keen to exploit this topic area and prepared to support it financially.

12. The HEFCE-funded international collaborative projects should include activities that have tangible outputs and clearly identified benefits. In this project the advantages for the partner countries were seen to be:

- improvement of research and higher education links between Brazil and the UK
- positive outcomes of partnerships between higher education institutions and industry in each country
- pioneer a new form of international research collaboration which has a strong applied focus
- encourage UK university groups to establish strategic partnerships
- exploitation of university expertise
- export potential for associated UK industrial partners.

13. The UK networks were set up in February 2000, 18 months after the start of the Brazilian networks. This phasing led to some difficulty later in the project as the UK groups were beginning to develop their programmes just as the Brazilians were finishing their three-year project. However, FAPERJ was eager to continue and arranged continuation funding for the three Brazilian networks which were linked with the UK.

Process and Implementation

Planning and preparation

14. The project milestones are given in Appendix 3. At first sight the time scales for the initial phases seem to be rather extended. This was largely due to the innovative nature of the project and the need to construct the networks and allow UK members sufficient opportunity to identify areas of interest and develop projects in discussion with the Brazilian networks.

15. The Project Coordinator, Professor Brian Clarkson, explored with UK groups the likely take-up of the opportunities presented by joint activity in the four research topics suggested. Initial inquiries amongst leaders of the research community made clear that the UK had strengths internationally in three of the four suggested areas, but had little to offer in the fourth where there were globally-recognised high risks. The HEFCE therefore decided not to pursue collaboration in the field of artificial blood. The importance of this area also declined rapidly in Brazil as PRODENGE progressed.

16. In identifying members of the potential UK networks the selection criteria were:

- high academic standing as evidenced, for example, by the research assessment ratings
- well established activity in the subject area
- enthusiasm to develop joint research with Brazilian partners
- vision to see potential in access to specialist staff, facilities, natural resources or exploitation of research expertise
- established partnerships with an appropriate company or companies
- an application for the output of the research which will be used by the partner industry or public sector body (which is itself prepared to invest in the project).

17. The Chairs of the appropriate Research Assessment Panels, the Chief Executives of the EPSRC and BBSRC and others familiar with UK research were consulted to discuss the project and help identify which groups in the UK should be involved in the project's three networks of Catalysis, Corrosion and Phytopharmaceuticals. The heads of each group were then approached to elicit interest. The groups involved are listed in Appendix 7. Major industrial companies expressed interest in the Corrosion and Catalysis networks, but all tended to adopt a 'wait and see' attitude. In the case of the Phytopharmaceutical network two smaller University spin-off companies and one international company were supportive. In this industry the herbal medicine specialist companies are mostly small although the major pharmaceutical companies are energetic in searching for plants which have active components.

18. The result of this process led to the following initial grouping:

- Catalysis: Leverhulme Centre for Innovative Catalysis at Liverpool University; Chemical Engineering at Universities of Bath and Bradford; Chemistry at University of Wales, Cardiff.
- Corrosion: Corrosion Centre at UMIST, Department of Mechanical Engineering at University College London, Marine Engineering at Glasgow. (Departments at the University of Leeds and University of Wales Swansea joined later.)
- Phytopharmaceuticals: School of Pharmacy at King's College London, Institute of Pharmacy, Kew Gardens, Strathclyde University, University of Bradford plus the companies Molecular Nature Ltd, Oxford Natural Products plc and Phytopharm plc.

The heads of the HEIs were contacted to inform them of the project and to invite them to encourage and support their staff who were joining the networks. Subsequently, contracts were signed between each network coordinator's university and the HEFCE.

19. The FAPERJ coordinator supplied a list of the members of the three Brazilian networks and their coordinators supplied a list of the research themes being followed. The interested UK groups met in summer 1999 and discussed potential synergies with the themes of the now established Brazilian networks. A coordinator was appointed for each UK network and they were given initial funding to prepare a proposal for their network. With the prior knowledge of the Brazilian themes the UK coordinators were able to provide information on promising research topics. The Phytopharmaceutical Group prepared a one page summary of the CV and research interest of each leading individual in their UK network.

20. The UK Project Coordinator was invited to join the first evaluation workshop of the Rio de Janeiro State networks in November 1999. During this visit he met members of the Brazilian networks and the State and Federal Agencies. He developed contacts and saw work in progress in the universities and at Government laboratories and industry. He met the three Brazilian coordinators and their network members, visited their laboratories and discussed the initial list of subject areas that the UK groups had prepared. Lists of names, CVs and details of research interests were exchanged. In addition the Project Coordinator visited the city of Brasilia and met representatives of the Federal Ministry of Science and Technology, Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), FINEP, and CAPES, the agency of the Ministry of Education responsible for university staff development and training and for national and overseas studentships. These meetings helped to place the Research Network project in the national context in Brazil and confirmed the importance that the Federal authorities were placing on its success. It was clear from these meetings that there were many common policy and strategic interests with UK HE, and this supported the HEFCE's decision to engage in the project.

21. Immediately following this visit the UK network coordinators began to communicate directly with their Brazilian counterparts and started drawing together the UK members. The formal start of the HEFCE project in February 2000 provided funds for a start-up phase. Each network was provided with £3,000 to follow up the information received during the Project Coordinator's visit to Brazil, to make initial contact with the Brazil network coordinator, to call the UK network members together, to outline common areas of interest and to work out a full proposal for which the remainder of the first year's funds (up to £30,000) would be available, subject to a strong case being made in the proposal.

22. During the year the networks began to meet and develop ideas for collaborative research programmes for discussion with their counterparts. The coordinators and several members of each network visited Brazil to meet with their Brazilian partners. Agreed programmes of work were defined. In general the Brazilian side was supported by one or more Brazilian research funding agencies, but – as will be seen from the final reports of the UK networks (Appendix 7) – competition in the UK for such funds proved to be more challenging.

23. The Project Coordinator visited Brazil again the following year to attend the final workshop of the Brazilian networks. It was during this visit that a problem with the Phytopharmaceutical Network began to emerge and a proposal to reform the Brazilian network under a new coordinator was proposed by the UK Project Coordinator and accepted. The proposed new Brazilian coordinator was visited together with several members of the reformulated group. The other two Brazilian networks were now well-established and collaborative projects had started. In addition to these contacts with the partner networks, several Brazilian coordinators from other networks inquired about the possibility of links. Although these would be outside the scope of the pilot HEFCE project some approaches were made in the UK and have had positive results (see spin-offs below).

24. After planning and preparation were completed, a formal Memorandum of Understanding (see Appendix 4) was signed between the HEFCE in the UK and FAPERJ in Brazil to provide an umbrella agreement under which university-to-university links could be made. This would be particularly important when questions of transfer of credits for split degrees were considered.

25. The role of the Project Coordinator (the Terms of Reference are at Appendix 6) was to provide initial co-ordination and regular liaison with the networks and to act as a channel of communication with the Brazilian sponsoring departments and network coordinators, plus trouble-shooting as required. Three Independent Assessors (see Terms of Reference at Appendix 6) were appointed to give independent advice to the HEFCE and the Project Coordinator on the progress of the programme. These were:

- Catalysis – Professor Sir John Cadogan, Emeritus Professor, University of Wales Swansea
- Corrosion – Professor John Knott, School of Metallurgy and Materials, University of Birmingham

- Phytopharmaceuticals – Dr John Clements, Secretary of the Royal Pharmaceutical Society

26. Monitoring workshops for the three UK networks were held annually in London. The coordinators produced annual reports to a set format, (which is given in Appendix 5). The Independent Assessors were invited to participate in the workshops and to comment on the value of the work. The first workshop was a purely UK event but two of the three Brazilian coordinators and the Brazilian Embassy Adviser for Science and Technology in London, Dr Paulo Wrobel attended the second. A final evaluation workshop was held in March 2003 when all three Brazilian coordinators, together with Dr Wrobel, attended and contributed to the discussion.

27. The steps taken by the individual networks in the UK were:

- initial meeting of UK members convened by the UK coordinator
- setting up a network website
- communication with the Brazilian coordinator to identify common interests
- workshops/meetings with Brazilian partners to define a common research programme
- search for support for research projects and industrial partners
- extended visits/placements of Brazilian staff and research assistants/students
- participation in jointly organised conferences and workshops/seminars.

Funding

28. The funding from the HEFCE was for initial development, workshops and visits. The three network coordinators had responsibility for setting up their UK network, liaising with the Brazilian coordinator, working with their network members to develop a collaborative research programme and submitting research proposals to the UK Research Councils for support.

29. Mirroring the arrangements in Brazil, the financial support from the HEFCE (£100,000 was available each year for three years) provided no funding for the UK component of the joint research projects themselves. It was always envisaged that this would come from, for example, the UK Research Councils and industrial partners. Thus each network had up to £33,000 per year for three years for development expenditure. This was released on the basis of annual reports and plans for activity. Where activity was low, a small amount, or no funds were released. The Independent Assessor's comments were taken into consideration when decisions about continuation funding were taken. A summary of the actual expenditure on the infrastructure is at Table 1.

Table 1 HEFCE funding of UK-Brazil pilot project

| Item | Amount |
|---|-----------------|
| Paid to networks | |
| Catalysis | £99,000 |
| Corrosion | £93,070 |
| Phytopharmaceuticals | £8,000 |
| Total to networks | £200,070 |
| Facilitation (incl. Project Coordinator's fee and travel, workshops and assessors' honoraria) | £25,154 |
| Total HEFCE funding | £225,224 |

30. It had been anticipated that as soon as collaborative projects were identified the network coordinator would submit one or more research proposals to the appropriate Research Council and industrial partners to fund the UK arm of the research project expenditure. In reality such support was slow to materialise. In Brazil, by contrast, the topics were chosen to be of national strategic importance and so had relatively good support. The priorities in Brazil did not necessarily coincide with the UK Research Councils' priorities. Although EPSRC now has, for example, a small international budget, any request for significant project support is judged on its scientific merit and competes with all other calls on the research support budget, and although the UK Government has identified Brazil as a priority country, no specific research funding is currently available as earmarked collaboration support. The experience of each network is described in paragraph 33 onwards. The position of the EPSRC has changed in recent years and a new procedure for developing international research networks is being developed, which emphasises the need to identify common research themes and appropriate means of developing support.

Outcomes

Outcomes are provided in Table 2; progress with each network is given in more detail in paragraphs 33-60)

Table 2 Outcomes of UK-Brazil pilot project

| Expected outcomes | Position at end of project |
|--|--|
| Improvement of research and higher education links between Brazil and the UK | Good developments in this area, including spin-offs |
| Positive outcomes of partnerships between higher education institutions and industry in each country | Limited success in UK, good links in Brazil, offering opportunities for UK networks |
| Pioneer a new form of international research collaboration which has a strong applied focus | International research projects have applied focus. Difficulties in obtaining funding experienced by UK networks have led to variable results in this area |
| Encourage UK university groups to establish strategic partnerships | Considerable achievements – UK networks cite this as positive feature |
| Exploitation of university expertise | Limited so far, although potential exists |
| Export potential for associated UK industrial partners. | Phytopharmaceuticals network has been closely linked to industry from the start |

31. The achievements of the three networks in the UK are variable, as each has faced different problems in moving from the initial stage of enthusiastic response to the Brazilian overture to establishing a lasting relationship. The final reports are in Appendix 7. All three set up websites (see Appendix 8); these have been utilised to varying degrees. Many of the individuals in each network now have regular contact electronically and face-to-face in the UK. It has taken considerably longer than anticipated to establish joint research programmes because little specific project funding has been won to match the infrastructure grant as mentioned earlier. The UK networks report that the opportunity to work more closely together is a positive gain.

32. The hoped-for outcome of this process is an effective sustainable collaborative research programme. This state has not yet been reached, although at the final evaluation meeting the strong desire to continue to develop the relationships became clear, and plans for joint workshops in Brazil in autumn 2003 are being made. FAPERJ is planning to support this with a Fellowship and exchange programme. The separate development of each of the three networks is described below.

Catalysis Network

33. This is a leading edge area of current industrial importance. The international academic community is well defined and closely knit. The Brazilian coordinator is well known to the UK network, and they have met regularly at international seminars and conferences. Several members of the UK network visited Rio de Janeiro and were able to draw up a collaborative programme. Six projects of basic and applied research were developed, and discussions with potential interested groups took place. Following this, three projects are going ahead, funded by FINEP, FAPERJ and PETROBRAS (through CENPES) on the Brazilian side. For the first two, the UK work was limited to what could be achieved by in-house funded postdoctoral workers, because grant applications to EPSRC were not successful. Support from CENPES was obtained for the third project on a prototype catalysis-manufacturing unit at Bradford, which involved joint commissioning and production. Support for a fourth project was available in Brazil, but the UK team has to date been unable to identify objectives that would trigger industrial interest in the UK. Thus, joint research projects are progressing, and networking in the UK will result in interaction between the larger research groups in the UK. The project has strengthened links between some Chemistry and the Chemical Engineering groups in the UK which could be of significant benefit to UK industry.

34. A website was set up and good communication between the UK members established. The public domain of the site advertises the network, its achievements, training and job opportunities whilst the secure domain is used for the exchange of research information between network members.

35. The network also gave considerable thought to intellectual property rights (IPR) and has proposed that the NATO Science for Peace guidelines be adopted (see Appendix 9).

36. Towards the end of the pilot, decisions in some of the universities have had a serious effect on the specialist research groups, such as the Leverhulme Centre for Innovative Catalysis in Liverpool and the Bradford group. The Catalysis coordinator, Professor Derouane and his deputy, Professor Vedrine, resigned to take up posts in other European Universities. The Department of Chemical Engineering at Bradford is being closed. Professor Stuart Taylor at Cardiff has agreed to take over as acting coordinator, and two other university groups are being invited to join the network. Professor Derouane has also expressed his willingness to maintain contact with the network from his new post in Portugal.

37. Thus the enthusiasm and potential for a genuine collaborative programme of work on this industrially important topic could not achieve its full potential within the time available. This is unfortunate as this network, until the last year of the project, seemed to have all the prerequisites for success: groups in both countries already known to each other through international meetings, an important topic in the vital oil and gas industry, excellent facilities and staff. As a result of the initial work, the links will be developed and many of the expected benefits achieved – albeit on a longer time scale.

Brazilian Coordinator's and the Independent Assessor's Comments

38. The Brazilian coordinator outlined the history of the project from the Brazilian side and made the point that collaboration had started on three of the six joint projects originally identified. Only limited progress was made on the first two projects because of lack of funding on the UK side. After an initial period of collaboration with Bradford a third project was discontinued because of lack of support from PETROBRAS. The fourth proceeded to the stage where Bradford provided a ceramic membrane for initial tests in Brazil. Technical difficulties in the matching of experimental facilities and the fear that the membrane would not be adequate for the partial oxidation process halted this work.

39. The Independent Assessor was sympathetic to the difficulties that had emerged on the UK side after a good base for international collaboration had been laid. He considered that the funds had been well spent and complimented the network on bringing together chemists and chemical engineers in working teams, which is the normal situation in industry. He made the point that the failure to attract UK industrial support may have been the result of a lower priority placed on the economic assessment of the UK projects in the planning stage (industry conducted an economic assessment in the Brazil projects). Industry will typically seek to support projects which are economically viable to implement (ie use cheap raw materials) and will avoid spending on innovation which is likely to have a high cost.

Summary of the Catalysis Network

40. In summary:

| | |
|----------------------|---|
| Start-up | Quick, coordinators known to each other from international meetings etc |
| Communications | Good, regular e-mail and meetings at international events |
| Networking in UK | Developing and now changing to bring in other groups |
| Networking in Brazil | Good because of support for both UK and Brazil sides from |

| | |
|--------------------------|--|
| | CENPES |
| Collaboration UK/Brazil | Joint workshops |
| Joint Research Programme | Six joint projects defined, three proceeding |
| Project funding | Brazil projects funded. UK only in-house to date |
| Industrial partnerships | Strong support in Brazil, interest but no direct involvement in UK network although individual members supported by industry |
| Sustainability | Good contacts likely to be maintained and strengthened |
| Website | Active |

Corrosion Network

41. Good communications were quickly built up because the Brazilian coordinator had studied for his PhD degree with the UK coordinator. As a result of the nature of the topic the applications are diverse. A list of names and interests of the relatively large number of Brazilian members of the network was provided, and the Project Coordinator met several members during his first visit. It was necessary to focus on a few areas where the interests and expertise of the two networks coincided – particularly where funding for specific projects might be available. The UK network coordinator joined the Project Coordinator on his second visit to Brazil, and during this time the networks were able to define a list of potential joint activities. The most promising was a group of projects based on the needs of the oil and gas industry, and biomedical applications of titanium.

42. Professor W Dover attended the OMAE oil and gas conference in Rio de Janeiro in June 2001. He met leading figures in the federal ministries, universities and industry. Following these discussions the network articulated a collaborative research programme based around Asset Integrity Management for the oil and gas industry, and drew in additional members to the Brazil network. This gave a focus for a series of joint projects, and Dr Kermani was able to develop proposals around this theme with participation from other members of the UK network.

43. Under the general heading of Multi-phase Hydrocarbon Transmission (MHT) the network identified eight current projects in the UK. Three of these were ultimately identified as suitable for developing into joint network programmes and were linked with the Brazilian network. They are:

- “Probabilistic based inspection scheduling for corrosion” led by UCL
- “Preferential weld corrosion: Prediction, monitoring and inspection” led by University of Wales Swansea
- “The role of microstructure and steel composition on corrosion in carbonic acid environments” led by University of Leeds

44. Funding support for these projects has been sought from EPSRC. The first submissions were unsuccessful, although two received high ratings from referees. Re-submissions will be made after further discussions. This will probably be an integrated

programme. The Brazilian side of the network is being funded from the national oil and gas revenues through FINEP and CENPES.

45. A Corrosion Control and Integrity Management Workshop in Rio de Janeiro followed up this activity in November 2002. The workshop was arranged with the help of the Brazilian coordinator, the British Commercial Attaché and Trade Partners UK. As a result of this, further refinement of the research projects has taken place and details were posted on the website (see Appendix 8). There have been many visits to the website by interested industrialists.

46. The project on titanium implants for dental applications received EPSRC funding for the joint work with Professor Carlos Elias (School of Industrial Engineering of Volta Redonda, Fluminense Federal University). This involves surface studies of dental materials and their performance, and has inputs from the Brazilian Institute of Implantology and the company Conexão Implants.

47. Thus after a slow start it looks as though this network will be able to build effectively on the strong links and the continuing interest in the problem of corrosion in gas and oil pipelines. The other areas will continue, but the main funding is likely to be in the oil and gas area for the coming decade as Brazil continues to develop its deep ocean reserves.

48. The Brazilian coordinator, Professor Cavalcanti, is to be congratulated on his reappointment as a subject area coordinator for FAPERJ and the UMIST Corrosion and Protection Centre on the award of the Queen's Prize for its pioneering work in education, training, research and technology transfer.

Brazilian Coordinator's and Independent Assessor's Comments

49. The Brazilian coordinator described the progress of the Rio based network and emphasised the multi-disciplinary nature of its work. Joint projects were being developed around the UK-articulated theme of Asset Integrity Management for multi-phase hydrocarbon transmission, with particular application to the oil and gas industry. Interest generated by the website should lead to wider activities and support. A second joint project on dental implant materials was proceeding. Several other projects in the Brazil network's inventory would be suitable for UK participation if project funding could be found. To complement future project funding the networks hope to gain support for short term travel grants and visiting fellowships.

50. The Independent Assessor was disappointed at the slow start-up of the network and surprised that greater effort had not been made to involve funding agencies from the beginning. Several suggestions for potential UK partners were made and the idea of an "Industrial Advisory Committee" to nurture the links was put forward (the website is now fulfilling some of this function). The newly developed focus on MHT should allow collaboration to develop from a tentative start.

Summary of the Corrosion Network

51. In summary:

| | |
|--------------------------|--|
| Start-up | Quick as the coordinators knew each other from postgraduate student days |
| Communications | Good, regular e-mail and meetings at international events |
| Networking in UK | Slow to start but developing now with a wider network |
| Networking in Brazil | Difficult initially because of diverse nature of topic and groups involved |
| Collaboration UK/Brazil | Slow to define joint activities because of diversity |
| Joint Research Programme | Implant project on stream, three oil and gas related-projects now defined |
| Project funding | Brazil network funded. UK funding for implant project. Others being resubmitted to EPSRC and industrial support enlisted |
| Industrial partnerships | Strong support in Brazil and growing interest in the UK |
| Sustainability | Looks promising, commitment from UK and Brazil members |
| Website | Very active and is now used to elicit industry interest in new oil and gas projects |

Phytopharmaceutical Network

52. When the project manager attended the evaluation workshop of the Rio de Janeiro Networks he met the coordinator of the Brazilian Phytopharmaceutical network and its members. The UK and Brazil networks then exchanged information on the interests and research projects of their members. Subsequently little communication took place. It transpired that the Brazilian coordinator developed the project into a limited programme related to the refining through tissue culture techniques of a specific plant used by one company and the establishment of a growing programme in a carefully controlled environment. This was a good example of an effective University/Industry link, but it was not a network and there was little scope for other Brazilian members of the network or the UK members to become actively engaged.

53. Several members of the UK network attended a seminar in Rio in the summer of 2000 and were able to build some personal contacts although there was no visit programme organised for them. This was disappointing as this subject had been chosen as one in which the State desired a UK partnership and one where the UK members were keen to collaborate, and where indeed the other Brazilian members of the original network wanted to establish a wider programme of joint interest. During his second visit the Project Coordinator met several other members and proposed that the network in Brazil be reformed with a broader remit under a new Brazilian coordinator. This was agreed by FAPERJ and the new Brazilian coordinator, Professor Antonio da Silva, visited the UK during the following year. A visit was also made to the UK network by Dr Ben Gilbert of the Fiocruz Institute, who is also a member of the network and through his Institute has been a strong supporter of research into native plant materials.

54. In this network it is not necessary to have large scale funding for research, but rather there is the need to identify and then refine collaborative projects and exchange research workers. One major difficulty proved to be the previous Brazilian Government's interpretation of the Convention on Biodiversity (CBD) which prohibits movement of plant material out of Brazil. Recent relaxations appear to allow limited movement where this is within an approved international research agreement and is, for example, material brought over by a Brazilian to work with in the UK.

55. Following the visit to the UK of the new Brazilian network coordinator one of his PhD students at the Federal University of Rio (UFRJ) went to work in the King's College group for six months. Travel and living costs are paid by CAPES, and laboratory support and some augmentation of living costs is borne by King's College. Dr Colin Wright has set up an individual link with Professor Israel Felzenszwalb (of the Roberto Alcantara Gomes Department of Biology, State University of Rio de Janeiro). Some joint work has been completed related to potential antimalarials. Further work awaits funding.

56. The academic and industrial community is rather small in the UK. This project, although not yet reaching its potential, has resulted in regular meetings and communications between UK members. The network's website gives the list of all the UK and Brazilian members but has not been updated recently.

57. Against this background it is difficult for the UK network to show much progress in developing an effective collaboration, although the links between UK members is a bonus and the slow progress with staff exchange may yet yield a successful outcome.

Brazilian Coordinator's and the Assessor's Comments

58. The Brazilian coordinator explained the situation of the reformed network and the difficulties from the lack of core funding for international activities. Some collaboration has taken place, with the six month placement of a visiting young researcher in King's College. He mentioned that although in theory it should be possible to work within the CBD to use plant materials in joint research, the authorisation procedures are not yet in place. This has caused difficulties even for well established Brazilian groups. Industrial support is difficult to obtain, largely because the Brazilian companies are mostly small and do not engage in research themselves. The forthcoming legislation to control and register natural products could set up a demand for analysis and assessment of products which the two networks would be in a good position to supply. Spin-off companies may be the best way to meet this requirement. UK experience in this area would be helpful.

59. The Independent Assessor sympathised with the problems which had been encountered and had resulted in a disappointing outcome to date. However the networking development in the UK and the continuing individual collaborations – both in the UK and with Brazilian colleagues – was a positive outcome. He commented that important lessons for the future were the need for clear objectives at the outset and rapid establishment of mutual enthusiasm between the groups. It is not clear whether the problems associated with the CBD could have been foreseen, but the problems with the industrial partners could

presumably have been resolved if clear objectives had been established at the beginning of the link.

Summary of the Phytopharmaceutical Network

60. In summary:

| | |
|--------------------------|--|
| Start-up | Slow as the coordinators did not know each other; initially the Brazilian coordinator responded quickly in exchanging information on members and interests |
| Communications | Poor after initial contacts – improving with new coordinator |
| Networking in UK | Developing |
| Networking in Brazil | Initial network failed. New one being rejuvenated but needs infrastructure funding |
| Collaboration UK/Brazil | Exchange of postgraduates at King's College, Dr Wright and Professor Felzenszwalb working together |
| Joint Research Programme | None defined |
| Project funding | None |
| Industrial partnerships | Strong potential in Brazil from Fiocruz for example, active, personal support in UK |
| Sustainability | Limited networking in UK |
| Website | Full details of UK and Brazilian members and their interests. Not used recently |

Analysis

61. In trying to analyse the results of this pilot project, it should be borne in mind that the UK side entered the collaboration after the Brazilian networks had become established. This has a particular bearing on the themes of the Brazilian research projects that were available for widening into international collaboration. They had been chosen after strong involvement with Brazilian industrial partners and their agreement to provide support. Some difficulty was, therefore, inevitable in enrolling UK industry into something to which it had not been a party in the formative stage. This should not have been a major handicap as the topics chosen were truly international and the majority of the industrial members were international companies. It did, however, have an effect on the ability of the networks to establish active partnerships with UK industry. Thus in the early stages of the development of the UK networks the emphasis was primarily in getting the academic members working together.

Establishing Communications

62. After the initial UK-wide contacts had been established within the networks, the two main challenges were to maintain regular liaison with members of the Brazilian networks and to get support for a major collaborative research programme. Although excellent websites were set up, real collaboration had to be initiated and nurtured by joint meetings, and these usually took place at workshops in Brazil. It was only after such personal contacts and friendships had been created that electronic communications (such as e-mails and the website) were fully effective in keeping up the collaboration. This process of building

confidence took longer than expected and resulted in longer timescales to arrive at the agreed joint activities. Language did not feature as a major impediment, largely because of the scientific nature of the three subject areas selected; English being widely understood amongst scientific circles. Additionally, all three Brazilian network coordinators have some experience of studying or working in the UK and speak excellent English.

Maintaining momentum and interest

63. Because the networking represented only a small part of the daily routine of the UK groups it was difficult to maintain momentum, particularly when problems of communication arose. The different timetable and ethos of the HE systems in the two countries made for difficulties in continuity – although the Brazilian academics working on this programme work in much the same way as their UK partners. As a result, progress in getting things moving was slow – no one senior person in each network was able to spend sufficient time to keep things moving and therefore initial enthusiasm tended to wane. There is tension between the need to involve well-established, internationally recognised, credible researchers as network leaders, and the need for someone to provide proactive leadership with sufficient input in terms of time to develop and maintain interest. There is also a need to make provision for changes in network leadership (as occurred with the Catalysis coordinator) and it may be advisable to have a deputy coordinator or facilitator to ensure continuity.

64. The experience of the Corrosion network suggests that the part-time employment of a senior figure (recently retired for example) who is well connected with the industry and academic groups can be advantageous. This facilitator can act as liaison between the members of the group, draw up research proposals, discuss them with the Research Councils, draw in industrial partners and link with the Brazilians. Such a person can keep up the momentum and do the day-to-day communication and follow-up that is so essential. This takes the main load off the network coordinator. Without such a focus it can be difficult to maintain momentum.

Establishing Joint Research Projects

65. Once initial contacts had been established the Catalysis and Corrosion networks were able to agree on a portfolio of joint projects and set about the task of securing funding for the research staff and materials. Six projects of joint interest on catalysis were rapidly agreed, and starts on three with in-house support were made. More intensive work would depend on Research Council or other support for research staff and equipment. In the case of Corrosion the large number of potential projects mentioned earlier took some time to reduce to a group that could be linked to national priorities and thus have a chance of success. Here the facilitator played a vital role in defining the oil and gas related projects.

66. As mentioned earlier, the Phytopharmaceutical network had difficulty in defining joint activities because of communication problems, which arose after the first spate of enthusiasm. A person-to-person contact between the two coordinators has now resulted in some joint activity based on a postgraduate student from Brazil working on secondment to King's College.

Research Council Support

67. In the Catalysis and Corrosion networks it is believed essential to have financial support from the Research Councils to support research staff and equipment/materials. This would then normally be supplemented by industrial support in cash and in kind. Proposals were submitted. However, in hindsight, not enough effort was made to ensure that these joint applications could fit into priority areas and be of sufficient quality scientifically to compete successfully with those from single, highly focused groups. Some success was achieved, and revised applications addressing referees' comments have high hopes of success. A facilitator active at the start may have been able to overcome this problem.

Establishing Industrial Support

68. The most notable feature of the project was the high level of industrial support that was forthcoming for the research themes of the Brazil networks. They were involved at the beginning in drawing up priorities. PETROBRAS was a strong supporter from the inception of the programme (largely due to the enthusiasm and leadership of the Director of CENPES).

69. The highly focused strategic nature of the project gave rise to problems where the perceived priorities of the two countries were not the same. In this case the UK was invited to join with topics which were initially chosen from the Brazil perspective. Active UK industrial interest and support was difficult to maintain because there was no funded project to commit to and industry did not have a say in setting the agenda. In spite of this situation considerable interest has been shown by some large international companies in oil and gas, and latterly the Corrosion facilitator has had success in getting interest through the website.

70. In the case of the Phytopharmaceutical network the smaller companies have been very supportive from the project's inception.

Intellectual Property Rights (IPR)

71. IPR issues have been discussed, but as no industrially applicable product has yet been produced there has been no reason to reach an IPR agreement. The proposed route is to adopt the NATO Science for Peace guidelines, but each case will have to be determined on its own merits.

Exchanges of Staff

72. There have been some exchanges of staff but the potential for this means of strengthening collaboration has not been fully realised. The opportunity to assign several Brazilian split PhD students (see paragraph 76) to each network, with periods of study at different UK network universities, has not been taken. This seems to have been because of an assumption that different regulations in each UK university in a network would not permit this, although it is not clear whether any attempt was made by the networks to investigate the possibility. A network facilitator could probably have helped to clarify this.

Sustainability

73. After a slow start, each of the members of the UK networks has found some benefit in the joint consultations and workshops on topics of common interest. They propose to develop these contacts even if no specific joint research project is continuing. This is a positive outcome that is likely to have benefits in the long term. At the final evaluation workshop, all those present were keen to stress their continuing commitment to the international networks. All have plans for the future. It would be valuable to review the situation in, say, two years' time to see what has turned out to be of lasting benefit.

Additional Opportunities: wider links, split PhDs and spin-offs

74. Wider links: during the Project Coordinator's first visit to Brazil he met the coordinator of the Brazilian Federal Network on Materials. This is a large network and includes the most active groups drawn from across the whole of the Brazilian academic sector – federal, state and private universities. Its subject area is also wide and hence would appeal to a wide group of universities in the UK. It was arranged for the Brazilian coordinator to visit some of the leading groups in the UK and also industry. There was interest in following up this contact but as there was no central mechanism in place no coordinated action has taken place. Such collaboration could possibly take place under the umbrella of a new bilateral agreement on science which is being developed by the two governments.

75. The high profile of the activity alerted other bodies to the possibilities of collaborative work with UK groups. The British Council and FAPERJ had been considering this possibility, so during the second visit the Project Coordinator visited the Rio State Departments of Education, Health, Science and Technology and of Energy, Shipbuilding, Industry and Petroleum to look into possible joint activities. News of these potential opportunities was passed to the appropriate UK bodies.

76. Split PhD degrees: The two Federal bodies involved in sponsoring students overseas (CAPES and CNPq) were keen to increase the proportion of students sent abroad on a split degree basis (ie. jointly registered with Brazilian and UK HEIs). In this way they would be able to support more students and encourage collaboration with receiving universities. Such a scheme would have been an ideal way to establish a close working relationship between research groups. Perceived difficulties in registration were regarded as an impediment to such an arrangement, but the Memorandum of Understanding between the two countries should have made it possible. Given the national-level enthusiasm and interest, it is unfortunate that it did not materialise.

77. Spin-offs: Any successful academic venture comes to the attention of a wider audience, and other groups begin to see advantage in setting up such arrangements. When the Project Coordinator attended the evaluation workshops in Brazil the coordinators of several other Rio networks enquired about similar links in their area. As this would have been outside the present pilot scheme it was not possible to suggest another set of formal networks but it was agreed to let the interests be known to the appropriate UK groups. One

in particular, the Groundwater Geotechnology Network, RESUB, has been very successful in the State. It has a high political profile, and good relations have been established with local communities and their local government, as well as industrial support and applications of hydrodynamic research. The active groups in the UK (Professor Paul Younger in Newcastle and Professor David Lerner in Sheffield) were very interested and have followed up the contacts. Professor Younger visited the network and was impressed by its members. He identified potential areas that are now developing naturally. His contact with a leading member of the network led to a week's consultancy with the largest mining company in Brazil – to assess the hydrogeology of a potash mine working beneath a carbonate aquifer. This has been followed by hydrogeotechnic research sponsored by the company. He is planning to include a case study in his new groundwater text book on RESUB's major aquifer modelling study of the Paraná Aquifer; one of the largest in the world, which underlies Brazil, Argentina and Uruguay.

Points to consider

78. Following our experience to date we can begin to suggest some enhancements of the original scheme which we believe would make it easier to get a real sustainable collaboration going. The two greatest obstacles were:

- for the HEFCE, the time taken for the initial planning and preparation phase (partly a product of the need to take account of appropriate public spending safeguards)
- for the networks, the difficulty in finding support for the UK side of a significant collaborative research project.

More rapid success may have been achieved by early provision of sufficient seedcorn funding to kick-start one key project, and inspired more initial commitment from the network members and wider industry/academia interactions.

Establishing and maintaining communications

79. Much effort is needed initially to make personal contact with overseas partners. Face-to-face meetings are essential to generate confidence and trust. This will involve reciprocal visits and regular electronic communication. Websites with public and secure domains are valuable for exchange and dissemination of information amongst members and enlisting wider interest. Care should be taken by both sides to ensure that sufficient attention is given to the cultural expectations and assumptions of each partner country. Where, for example, there is an expectation that professional relationships are strengthened by social interaction, as in Brazil, it is important to build this into bilateral plans. Some of the relatively slow start in this project might be attributed to the UK partners being unaware of the need to plan adequately for the need for social interaction. The HEFCE was also conscious of the need to ensure sufficient consideration had been given to public accountability requirements. However, it is also fair to say that when planning such collaboration, it is important to allow for evolution to occur over a long period of time.

Maintaining the momentum

80. Regular meetings of the UK network members and visits to overseas partners are necessary. The contribution of the Project Coordinator – a retired university vice-chancellor with substantial experience of industry-related research – in establishing the links between the networks and funders in both countries was critical. He was actively involved from the beginning and thus alive to potential difficulties and able to negotiate solutions at all levels. A part-time network facilitator, such as that appointed by the UK Corrosion network, can also be invaluable in maintaining contact between the UK members, preparing funding applications and liaising with overseas partners. There is particular value in appointing such a person early in the development stages; to encourage contact and ensure that essential planning discussions with all relevant stakeholders take place.

Defining a joint programme and getting support

81. Much discussion is required with all possible stakeholders at the initiation stage of the project definition. There is a need for national organisations in the UK to work together in partnership to facilitate bilateral engagement, and identify national research priorities. This would engender confidence in national-level initiatives and encourage participation from the sector. It is also important at network level to identify where there is common academic interest and then hold detailed discussions with potential funders and industrial partners about the form of a project which is likely to be attractive for them. There also would seem to be a need for the UK to develop a stronger academic/industry vision, working together to recognise and develop potential areas of collaboration. The UK has much to learn from the PRODENGE experience in this regard. For the networks, continued close liaison with funding bodies throughout the development of a project is required. The Brazilian networks have worked with industry on the economic assessment of projects, to ensure that there is a specific need for the research and that it will have industrial appeal. This consultation seems to be critical when designing applied research projects.

Sustainability

82. Once joint projects are proceeding, regular workshops to assess progress and plan future development will be required. Where a network coordinator or facilitator moves university, this can lead to a hiatus (as happened with Catalysis), so it is important that there is another network member, in another of the network's universities, who is conversant with the coordination arrangements and can help to maintain momentum. It would therefore be wise to consider in a risk assessment what the minimum number of member institutions in a network should be. The experience of the Corrosion network, in terms of the need to redefine the scope, demonstrates the value of being prepared to reevaluate the focus and change direction if circumstances dictate.

Website

83. A good website is invaluable in keeping in touch with members of the network. A secure area can be used for exchanging the latest research ideas and results, and the public

domain for more general publicity and to generate interest in others who might help to exploit the achievements.

The Role of the Facilitator

84. Experience has shown that several of the points made above can be effectively addressed by the appointment of an appropriate part-time facilitator. This would only represent a small proportion of the overall cost and would represent good value for money.

Final Evaluation Workshop

85. From discussions at the final evaluation workshop, and ones between the UK and Brazilian coordinators, it became apparent that there is a strong desire to build on the collaboration that has been established through this pilot programme. New possibilities for joint activities and staff exchange are being identified. It is proposed that as a next step in establishing a sustainable joint programme each of the three networks hold a workshop in Brazil in the autumn to plan their continuing collaboration. The new President of FAPERJ sent a letter to the Chief Executive of the HEFCE offering continuing support in the form of travel grants and visiting fellowships.

Conclusions

86. There is much interest in establishing international networks of research in many fields. The experience of setting up collaboration with Brazil has shown some of the advantages that can accrue and also points up many of the difficulties. It is recommended that this experience be shared with the sector to help others who are trying to set up fruitful long term relationships with other countries. Specific recommendations to those seeking to set up international research networks with industrial relevance are:

- Build in sufficient time in the early stages of the project for relationships to be established. This should take account of cultural expectations in both/all countries, language barriers and existing contacts between individuals. Meetings of coordinators and other network members will assist this phase.
- Ensure that communication between network members is established early.
- Include all stakeholders, such as industrial partners, in discussions at the start of the network, to ensure that its work is focused and relevant. In particular, consider ways to involve industry actively as well as identify and address national research priorities.
- Consult with potential funders at an early stage and continue to discuss evolving projects with them.
- Appoint a Project Coordinator early in the project to provide an overview and central liaison.

- Consider using a network facilitator to be the link between network members, industry and other stakeholders.
- Ensure that there are sufficient network members and understanding of the bilateral relationships to maintain momentum in case of loss of the coordinator.
- Make arrangements early in the project for exchanges of research staff or students, and ensure that student registration, where required, is possible.
- Work together to identify areas of mutual research interest and how these might benefit industry, taking into account economic and other factors. In particular, national organisations with an interest should seek to work in partnership to ensure optimum benefit to the whole sector.
- Hold frequent meetings of the in-country network members and plan international workshops to ensure that momentum is maintained and increased.
- Try to establish IPR agreements or at least agree a framework for them during the initial stages.