COLLABORATIVE RESEARCH & DEVELOPMENT IN THE EUROPEAN COMMUNITY BRITE-EURAM PROGRAMME 1987-1994: FRAMEWORKS OF INNOVATION IN SPAIN AND THE UK

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ABSTRACT

This thesis applies the neo-functionalist theory of integration to a study of the European technology policy, taking the BRITE-EURAM programme as a case study. A three-level mode of analysis is used to examine actor behaviour: actors at the micro-level, national technology systems, and the European-level institutions. The study makes a comparative analysis of participation by two of the European member states, the United Kingdom and Spain, to examine the community building processes that operated in each.

The national institutional system in which economic actors operate influences their behaviour, and the analysis of the European technology collaboration identified the political changes that took place within the context of particular national institutional systems. One variable that is key to the process of integration is the technological capability of the national system. At the supranational level, the ideology and ideas underpinning technology policy created a market-based community, excluding other interests. The effect is to compromise any attempt to upgrade the common interest through directing technology policy towards economic and social cohesion.

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List of abbreviations

ABRC	Advisory Board for Research Councils
ACARD	Advisory Council on Applied Research and Development
ACOST	Advisory Committee on Science and Technology
BERD	Business Expenditure on Research and Development
BETA	Bureau d'Economie Théorique et Appliqué
BMFT	Bundesministerium für Forschung und Technologie
BRITE	Basic Research in Industrial Technologies for Europe
CAD	Computer-aided design
CAM	Computer-aided manufacture
CBI	Confederation of British Industry
CEPYME	Confederación Española de Pequeñas y Medianas Empresas
CICYT	Comisión Interministerial de Ciencia y Tecnología
CDTI	Centro para Desarrollo Tecnológico Industrial
CEOE	Confederación Española de Organizaciones Empresariales
CERN	Centre Européen pour la Recherche Nucléaire
COMETT	Community in Education and Training for Technology
COST	Coopération Scientifique et Technologique (EC)
COST	Council on Science and Technology (UK)
CNRS	Centre Nationale de Recherche Scientifique
CRAFT	Cooperative Research Action for Technology
DC	Developed Countries
DES	Department of Education and Science (UK)
DfEE	Department for Education and Employment (UK)
DFG	Deutsche Forschungsgemeinschaft
DTI	Department of Trade and Industry
EC	European Community
ECJ	European Court of Justice
ECLAIR	European Collaborative Linkage of Agriculture and Industry through Research
ECPE	European Centre for Public Enterprise
ECSC	European Coal and Steel Community
ECU	European Currency Unit
EFTA	European Free Trade Area
ELDO	European Launcher Development Organisation
EP	European Parliament
ESA	European Space Agency
ESPRIT	European Strategic Programme for Research and Development in Information Technology
ESRO	European Space Research Organisation
ETUC	European Trade Union Confederation
EU	European Union
EURAM	European Raw Materials
EURATOM	European Atomic Energy Community
EUREKA	European Research Coordinating Agency
FAST	Forecasting and Assessment in Science and Technology
FEICRO	Federation of European Industrial Cooperative Research Organisations

GDP	Gross Domestic Product
GERD	Gross Expenditure on Research and Development
GOVERD	Government Expenditure on Research and Development
HERD	Higher Education Research and Development
ILO	Industrial Liaison Offices (Spain)
IOD	Institute of Directors (UK)
IRDAC	Industrial Research and Development Advisory Committee
IT	Information Technology
MECU	Million European Currency Unit
MINER	Ministerio de Industria y Energía
MNC	Multinational Corporation
MPTA	Million peseta
OECD	Organization for Economic Cooperation and Development
OTRI	Oficinas de Transferencias de Resultados de Investigación
PATI	Plan de Actuación Tecnológica Industrial
RACE	Research in Advanced Communication Technologies for Europe
R&D	Research and Development
RTD	Research and Technological Development
SEA	Single European Act
SPRU	Science Policy Research Unit
S&T	Science and Technology
STRIDE	Science and Technology for Regional Innovation and Development
TUC	Trades Union Congress
UAEPYME	Union Européene de l'Artisanat et des Petites et Moyennes Enterprises
UNICE	Union of Industrial and Employers Confederations of Europe
VALUE	Valorisation et Utilisation de la R+D pour l'Europe

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CHAPTER 1

INTEGRATION THEORY AND EUROPEAN R&D COLLABORATION

1.1.1 Introduction

Business circles, after initial reactions ranging from cautious support to outright hostility, had accepted the Common Market as a fait accompli and jumped in with almost breathtaking speed to form a network of agreements within the Six. An acceleration of the realisation of the Common Market, far from exceeding the pace desired by business groups, would only catch up with the pace they had already set ... it was from business circles that much of the political pressure for acceleration originated.

(Lindberg, 1963).

Leon Lindberg's description could be almost as appropriate to describe the pace and momentum of the European integration process established during the 1980s, following the Single European Act of 1986. By then, the six had become twelve in a three-stage process of enlargement which spanned two decades. Lindberg's emphasis, however, on the business enthusiasm for the Common Market and its expression through a network of agreements found an echo in the developments within Europe more than two decades later.

The echo was enough to revive integration theory which had for long been buried under the resistance of national governments struggling with the international turmoil of the 1970s, and the burden of balancing domestic economic objectives in the face of inflationary pressures and a slow-down in economic growth. With the announcement of the Single Market Programme, and the enthusiasm which the economic programme to unite Europe generated, analysts returned once more to the neo-functionalist theory of integration as an explanatory tool.[1]

They were encouraged to do so by a clearly observable set of circumstances affecting the institutional structure of the European Community (EC), the attitudes of the national governments, and the behaviour of the economic actors in the Community.[2] Much debate has taken place regarding the source of the initial impetus and the precise point of departure of the integration phase, which has not been finally resolved.[3]

The conflicting arguments regarding how the process began and how best it should be explained have not, however, obscured the central position of the White Paper, Completing the Internal Market, presented by the European Commission in 1985 and which led shortly afterwards to the legislation of the Single European Act (SEA).

The White Paper had set out a series of proposals to be implemented so as to give effect to the internal market envisaged by the Rome Treaty.[4] These included liberalisation measures designed to abolish the physical, technical, and fiscal barriers to the free movement of goods, services, capital, and labour by 1992.

An essentially neo-liberal economic programme, it was given legal effect by the SEA which also made several institutional changes at Community level. For the first time the European Community had responsibility for regional policy, some aspects of social policy, and for research and technology policy. The latter was identified in Article 130f, which stated `the Community's aim shall be to strengthen the scientific and technological base of European industry and to encourage it to become more competitive at the international level.' This thesis is concerned with the operation of technology policy.

European technology policy has developed throughout the 1980s into a series of multi-annual rolling programmes that were directed to the broad objectives of strengthening the European technological base, while creating a technological community.[5] The

Framework Programme comprised a series of constituent programmes directed at either individual sectors or multi-sectoral, and were mainly directed towards the encouragement of research and technology collaboration among European firms, universities and research centres throughout the Community. The current Fourth Framework Programme covers the period 1994-1998, and following the Maastricht Treaty was extended to encompasses all the research activities of the European Union in addition to industrial research with a greatly enlarged budget as a consequence of the treaty agreement.

Specifically, the thesis will examine the implementation of technology policy to determine the extent to which a technological community is created as a result. The examination will identify actors at the micro-level who participated in one of the constituent programmes within the Framework Programme, namely the BRITE-EURAM programme. BRITE-EURAM is, unlike the more well-known ESPRIT programme, multi-sectoral, directed towards the support of cross-border technological research by European manufacturing in general. The general objective of the programme is to increase the competitiveness of manufacturing industry, and to do so by a concerted effort to improve the technological base. What is involved in the programme is, therefore, the active support for the creation of international alliances among economic actors at the European level.

Two other institutional changes were brought about through the SEA - changes to the co-decision procedure and a codified procedure for Political Cooperation on foreign policy. The latter change has no direct relevance for the present research, but has obvious implications for the long-term with regard to creating a common foreign policy and for national sovereignty. The changes to the decision-making procedures gave greater majority voting powers to the European Council (and less opportunity for a member state to use the power of veto) and gave the European Parliament greater say and the formal right to consultation under what was termed the `co-decision procedure'. This change would enable the European Parliament to make an input into the technology policy proposals of the European Commission under the so-called

Framework Programme, and later chapters will consider the role of supranational institutions in creating a technological community.

In addition to the two levels of analysis identified - the micro-level pertaining to the economic actors participating in the programme, and the supranational institution, a third level of analysis is considered in addition. The national level provides a context in which the economic actors operate, and the thesis considers the process of community building as it affected national institutional systems in two of the member states of the European Community, Spain and the United Kingdom.

The analysis of the national institutional system is intended to find an explanation for the behaviour of the economic actors towards integration, and uses a method of analysis located within historical institutionalism. Using the definition given by Steinmo, Thelen and Longstreth, institutions are defined as `the whole range of state and societal institutions that shape how political actors define their interests and that structure their relations of power to other groups.'.[6] Borrowing from institutionalist analysis, the behaviour of micro-level actors is examined in the context of the national socio-economic and political structures, holding to the assumption that political interests are formed by the institutional system in which actors find themselves.

Similar analyses have been made of the policy context of economic policy making in individual countries. Hall (1986) uses this approach to compare economic policy in Britain and France, and uses the same method to look at the spread of Keynesianism throughout the post-war period.[7]

As the thesis is concerned with one functional area, the institutions that are under review in this particular context refer largely to those associated with technology at both the national and the supranational level. Consequently, the institutional system under examination is narrowed down to this functional area, and represents what has been described elsewhere by Nelson (1993) as the national innovation system.[8] Nelson uses the term national innovation system to define `a set of institutions whose interactions determine the innovative performance .... of national firms'. He regards the industrial firms and public laboratories as part of the system. More broadly, `the character and effectiveness of a nation's system of schooling, training, and retraining not only determine the supply of skills from engineer to machine tender, but also influence the attitude of workers towards technical advance'.

Here, industrial firms, research centres, governments, national and supranational technology policies are considered part of the institutional system, together with technological interests at both the national and the supranational level. National innovation systems differ in terms of both the overall structure and the general capability. One of the arguments which the thesis will make is that the different capabilities of the innovation systems will determine the attitudes towards a European technological community, and will affect the progress towards creating such a community. Capability is used, therefore, in the sense of technological intensity and expertise in industry, and at the level of technology policy. It has also a subjective interpretation, especially when comparisons are made with other countries as much as a quantifiable one, although more quantifiable evidence of technological capability will also be provided.

As mentioned above, the research focuses on two of the member states of the European Community, Spain and the UK, and examines through the implementation of the BRITE-EURAM programme the development of a European technological community through the experience of these two member states. The Spanish innovation system is, by comparison with the UK, of relatively recent origin, and partly as a result has a much lower technological capability. It has, however, seen significant changes at the institutional level over the past decade, particularly following a government decree in 1986, and these are examined in chapter five. The changes, which included the introduction of a national technology policy, were initiated partly through the general drive towards European integration managed by the Spanish government and supported a programme of industrial modernisation and restructuring.

The UK's innovation system is a more mature one, and benefited from technical expertise built up since the industrial revolutions of the eighteenth and nineteenth centuries that enabled the country to extend a network of international trade to support the empire. More recently in this century, the post-war period saw a state-directed management of the innovation system, which provided resources for investment in research and development in key areas, often of a strategic and/or military nature, that allowed a spillover into commercial activities. This mission-oriented system, described by Ergas (1986), enabled investment in technology to be turned into innovations by UK manufacturing.[9]

The UK also saw certain changes to the system in the 1980s, which are the subject of examination in chapter four of the thesis. In an ideological shift by the government, the innovation system was subjected to the principles of free enterprise, with the market being given the sole right to decide the allocation and distribution of resources, including technological resources. As part of this shift in government belief, many areas of the institutional system that had formerly received significant public support for research and technological activities were now obliged to find private financing. The more general consequence of this ideological shift was in terms of the effect on the organisation of the innovation system, and the nature of the technological activities undertaken within the innovation system.

The two countries may not seem immediately comparable, and in fact UK government statistics on research and technology invariably include comparisons with other European member states, such as Germany, France, and Italy, and seldom include Spain in the comparisons. Spanish government statistics, on the other hand, invariably provide a comparative picture that includes UK, as well as Germany and France. An international comparative perspective is important for any country in assessing its technological capability, even when the view is essentially a subjective one. Nevertheless, even the European Community has used this comparative perspective to illustrate the region's position in the international technology stakes so as to secure support for the Framework Programme, as we shall see later. But more immediately, the comparative view shows that both the UK and Spanish innovation systems have a number of common problems.

In the two countries there is a heavy, and growing dependence on imported technology, and an internationalisation of the innovation systems through foreign direct investment. However, the manufacturing sectors which are the main target areas for the BRITE-EURAM programme, have large numbers of small- and medium- sized enterprises (SMEs) with limited resources for research and technology. These organisations tend to devote fewer resources to technological development, with the result that both countries have experienced growing problems in terms of innovation through the application of new technology to manufacturing processes and products. At the same time, the internationalisation of technology has implications for the competitive position of domestic industry and created political tensions.

National responses to the deficiencies of the innovation systems have been made at several levels in the two countries, largely corresponding to the nature of the innovation system and to more general attitudes towards policy-making. One response has been through participation in the European Community technology programmes, in the Spanish case with very direct involvement by the government, and in the case of the UK with the government maintaining its customary aloof position on European integration.

The pro-integration position taken by the Spanish state was not adequate alone by itself to counter the institutional weaknesses of the innovation system, while in the UK government foot-dragging did not prevent domestic organisations from taking significant part in European technology collaboration programmes. The thesis will examine the different experiences faced by members of the two national innovation systems, and will evaluate how the processes operated to `europeanise' the technology community.

1.1.2 The European collaborative bandwagon

In extending the scope of Community policy making to the area of research and technology, the SEA gave legal effect to a series of activities to promote collaborative research and development that had been building up for some years. Since the efforts made by Commissioner Davignon towards the end of the 1970s to bring the large information technology firms of Europe together to discuss an industrial technology strategy under the aegis of the European Round Table, the Commission had been extending its efforts to foster research collaboration.

The European Strategic Programme for Research and Development in Information Technology (ESPRIT) was the model for a series of collaborative research and technology programmes, instigated by the European Commission, which brought together firms, universities and research centres throughout the European Community, financed partly by the European authorities and partly by industry.

Following the success of ESPRIT, as measured then by the reception given to the programme by industry and by national governments, there followed other programmes promoting industrial collaborative research. The `collaborative bandwagon' included in the telecommunications sector, the Research and Development in Advanced Communications Technologies (RACE) programme, and the non-sectoral BRITE-EURAM programme, directed at European manufacturing industry in general.[10] This thesis concentrates analysis upon the BRITE-EURAM programme's contribution to the creation of a European technological community, but the findings do have wider relevance to the other programmes.

The first half of the 1980s witnessed a growth in international business alliances that coincided with the initiatives being conducted by the European Community authorities, but which also existed independently of them. In an effort to maintain advantage in an increasingly competitive international market, made even more so by the rapid pace of technological change, business enterprises were pursuing alliance strategies on an international basis to a greater degree than ever before.

The turmoil of the 1970s had not only adversely affected the European integration process, it was also having a gradual and perhaps unrealised impact on Fordist systems of production. New competitive strategies included a greater volume of international alliances, in systems of production that were changing rapidly away from mass-production for a stable market, to smaller volume, differentiated products for a more sophisticated market.

Changing and unstable patterns of demand were combining with the competitive threat from industries in the newly industrialising countries, and new technologies, to force a response from traditional industries in Europe and the United States. Rapid technological change contributed to the instability, but also to the perception that the acquisition of technology was key to maintaining a competitive advantage.

Given the cost of internally-generated technology, and the risks associated with making such an investment under unstable conditions and rapid demand changes, the alternative of international alliances was eagerly seized upon. International alliances were entered into for a whole host of reasons that were not simply related to technology acquisition, such as market expansion, diversification, capital investment, cost reduction.[11] But in any event, the European Commission was able to launch the technology policy initiative at a time when the culture of collaboration was gaining ground in the business community.

The other factor contributing to this permissive climate was the increasing concern of the European member state governments with the competitiveness of domestic industry. Greater international competition, and the structural changes associated with the emerging post-Fordist systems of production had contributed to the pressures for manufacturing industry in particular. Constrained by a variety of factors from giving direct support, European technology programmes were an appealing alternative.

1.2 The lesson of history

The European technology policy that emerged during the 1980s set out to create a technology community in a way that differed significantly to the earlier technology collaboration projects of the 1960s and 1970s. Second time around, the policy that was introduced proved the Commission had learned a valuable lesson, and was prepared to try a new approach to technology collaboration and to integration.

Certain aspects of the context of the 1980s, and of the policy itself, lend themselves to a neo-functionalist analysis. To understand this more clearly it is useful to take a brief look at the earlier experiences in technology collaboration. After this, the following sections will consider how and to what extent neo-functionalist theory can contribute to an analysis and understanding of how technology policy, specifically in the BRITE-EURAM programme, could contribute to the integration process.

The previous experience of European technology collaboration centred upon large-scale projects, where a combination of financial resources, advanced technical knowledge, and a long-term view beyond the resources and capability of any one state made joint activity economically desirable. The political feasibility of collaboration raised other questions, but for a time at least there developed a consensus on joint projects in areas such as the nuclear, space, and aviation sectors.

The European Atomic Energy Community (Euratom) was set up alongside the European Community under the Treaty of Rome, with the intention of creating a European nuclear industry based upon the joint efforts of the member states. Euratom sought to co-ordinate the diverse activities of individual states, and also to provide a regulatory framework for the standards and safety of civil nuclear energy and materials at a time when a variety of civilian uses for nuclear energy was foreseen.

Four research laboratories were set up to co-ordinate activities - at Petten (Holland), Ispra (Italy), Geel (Belgium) and Karlsruhe (Germany) - and to foster collaborative work in areas such as fast breeder reactors, high temperature gas reactors, nuclear applications in medicine and other areas. Gradually the research agenda was broadened by the Euratom authority to take account of societal concerns over reactor safety, radioactive waste disposal, environmental protection, and increasingly the area of industrial standards, and satellites.

In the aviation industry, the Concorde and Airbus projects provided two examples of sectoral collaboration which produced very mixed results. The Concorde project was the result of Anglo-French collaboration to produce a high-technology long-range aircraft that would rival anything produced by US competitors in the aviation industry.

It was a project which exemplified the type of mission-oriented technology projects favoured by both the UK and France to sustain international strategic leadership and where resources were concentrated on a few areas identified by the central governments.[12] The Concorde project produced a small number of technically sophisticated aircraft for the French and British governments, but the experiment was dogged by the adverse market conditions of the 1970s, together with the growing disagreements of the two governments over the escalating financial costs of the project.

The Airbus industrial consortium was the outcome of joint discussions in 1966 by the governments of France, Germany and Britain with aircraft producers and airlines. The consortium, composed of one company from each country, set out to carve a particular market niche in the civilian aircraft sector with the production of the A-300 twin-engined wide-bodied plane, which was intended for medium- to long-range, and capacity up to 270 passengers. Soon afterwards, it followed its US competitor, Boeing, to produce a family of aircraft and by the mid-1980s had made significant inroads into the market. The most recent additions to the fleet, the A-320, the A-330, and the A-340, incorporated state-of-the-art technology.[13]

Collaboration in space exploration and exploitation offers the strongest economic case for international collaboration, even though it is also the area where sovereignty and political prestige is perhaps most valued. However, in Europe pragmatism won out over nationalism, and the conventions for the European Launcher Development organisation (ELDO) and European Space Research Organisation (ESRO) were ratified in 1964. There was some difference between the two in terms of organisation and orientation - ELDO was concerned with applied science to produce a European launcher, and required a two-thirds majority approval for its budget, while ESRO concentrated on basic science and operated with a simple majority vote, each member state holding one vote.

Each organisation experienced a variety of problems during the 1960s - from disagreements over costs, technical failures, to political differences (in the case of ESRO) over whether to concentrate on scientific satellites, or more market-oriented applications satellites. Eventually the two organisations were merged in 1973 to form the European Space Agency (ESA) which became a platform for the national programmes of the members.

ESA proved itself successful in collaboration on a functional basis, bringing together scientists from Europe and beyond to work on advanced technological activities of a non-commercial nature. The prime movers in this collaborative model were the national governments, whose budget contributions were linked to their national income. Apart from the obligation to contribute a certain amount to the mandatory activities of the agency, the national governments could elect what projects to participate in, and were able to secure contracts for their respective national firms from the ever-expanding range of activities.[14]

European technological collaboration of the 1960s and 1970s was essentially sectoral, involving either high-technology industries or mature industries. In many respects, the policy was an extension of the `national champions' approach at the European level, with mixed results across the various experiments.

In some cases, the lack of commitment by national governments and disagreements over priorities, financing, or the management of the ventures hindered collaboration. National strategic considerations and conflict with national programmes proved the stumbling blocks to further collaboration. Nevertheless, these early experiments in technological collaboration provided certain lessons that were to prove useful in the 1980s.[15]

One of the lessons was that European collaboration was possible, but it had to be based on identifiable common interests which could be sustained over the long term. A second and important lesson was that the involvement of industry was key to creating a technological community. The mixed results of the early collaboration projects were partly attributable to the focus of the collaboration - it often centred on areas of activity that governments, during the 1960s and the 1970s at any rate, regarded as the proper responsibility of national authorities, and they were reluctant to cede such authority. Intergovernmentalism could still operate as a force to hinder the integration process as far as some areas of technological collaboration were concerned.

The economic crisis of the 1970s, and the new economic orthodoxy that resulted, forced a reappraisal of the role of government. The view that markets were the most efficient means of allocating resources, including technological resources, came to be widely accepted by the beginning of the 1980s throughout the member states. Substantial public spending on large science and technology projects was no longer feasible, while at the same time greater levels of international competition put increased pressure on industry, and the gains went to those with the superior technological advantage.

1.3 Competitiveness in the 1980s and 1990s

The European Commission presented the case for a European technology policy in political-economic terms that stressed the need to improve the competitiveness of European industry.[16] Through this political goal the interests of industry and of the national governments found a common expression. Competitiveness was presented by the European Commission in a memorandum published in 1985, entitled Towards a European Technological Community, in the general sense of Europe's relative position with the United States and Japan. It did not given any specific quantitative definition, but saw the encouragement of cooperation on research and technology between European industry and the academic community as key to improving the technological base of industry. In so avoiding more specific definitions of competitiveness, the Commission steered clear of any challenge to either national government philosophy and sovereignty, or to particular industrial interests.

A recent report from the Organisation for Economic Cooperation and Development (OECD, 1996) pointed to the fact that there has been no agreement on how to define competitiveness, and noted that contradictory meanings can be found in the same report (p.17). Part of the problem in assessing competitiveness is the tendency to apply the term at different levels - at the level of the firm, the industrial sector, the region, the national and supranational level. Some analyses have tried to examine several levels, for example Porter (1990). However, a key difficulty is that objectives differ depending on the particular level under consideration, and not all objectives will be given similar priorities by different actors. The question then must be, in evaluating outcomes, the extent to which we can or should decide that competitiveness has been achieved if there is a fundamental conflict between differing objectives.

The OECD report summarised the various approaches to the study on competitiveness into four categories, depending on their objectives and methods. In the 'engineering' approach competitiveness depends on the capability of firms to adopt the organisational and technical best practice (Dertouzos, 1989). The country's competitiveness comprises the total competitiveness of its businesses, but in this approach is not measured explicitly. International trade theory would tend to examine differences in productivity and factor incomes as a guide to national competitiveness.

In the second category, the 'environmental/systemic' approach sees competitiveness as a function of the environment in which firms operate, rather than the internal processes and activities of the organisations themselves. This approach therefore focuses on the need to optimise the environment for industry - in terms of the infrastructure, the resources, the efficiency of market structures and the quality of the inputs (Ergas, 1984, Porter, 1990).

In the third category the 'capital development' approach applies at a broader level of analysis, to identify a country's capacity to accumulate human and physical capital as key to its long-term competitiveness (Thurow, 1992, Tyson, 1992). This approach is less quantifiable than the previous two, and includes an element of subjective judgement in making international comparisons. Nonetheless it has the potential to generate a lot of debate, and has been used as a basis for policy proposals in recent years, not least in the United States (Reich, 1991).

In the 'eclectic/academic' approach, subjectivity becomes much more prominent in the analysis, recognising the difficulties of measuring something which may not lend itself to precise quantification in the way that economic variables such as inflation, unemployment, or productivity can be measured. It views competitiveness as an area in which many variables can be contributing factors, not the least being the opinions, attitudes and expectations of economic and political actors (annual competitiveness reports, World Economic Forum). The OECD notes this category as pointing to the need for new research, using new analytical tools.

The European Community technology policy was aimed at improving the competitiveness of European industry, but until 1992 there was no attempt to offer a precise definition of competitiveness. There will inevitably be problems in evaluating the extent to which a programme meets a particular outcome, if the outcome is not defined with some degree of clarity. In the case of European Community technology collaboration programmes where support was confined to 'pre-competitive' collaborative research, the difficulties of evaluating the contribution to competitiveness are increased. In the Commission's evaluation of the Second Framework Programme (SEC (92) 675) it commented 'the transformation of scientific and technological progress into economic advantage is very difficult to measure.... whilst the effect of European collaboration has been clearly demonstrated in many areas, the measurement of direct effects on industrial competitiveness are more problematic, since R&D is only one element contributing to competitive advantage.' Similar views were expressed by CREST, the advisory committee to the Council of Ministers and the Commission in its report on the programme, also published in 1992 - 'the impact of the second Framework Programme on competitiveness is difficult to assess in view of the multi-faceted nature of international competitiveness, of which R&D is only one factor.'

Almost a decade after the European Framework Programme was launched, an attempt was made to provide some workable definition of competitiveness that could be used in the evaluation of the programme's impact on European industry (Metcalfe, 1991). In some respects its findings advocated a form of eclecticism later on identified by the OECD. Competitiveness was viewed as a dynamic rather than a static concept, which could only be understood in its relative context, and could only be measured on a multi-dimensional level. Technological advantage, as a source of competitiveness, must be seen as changing levels of knowledge, skills and artefacts among firms in international competition. An important conclusion of the Metcalfe et al. (1991) study was the emphasis on competitiveness as a process. The report's conclusion, and indeed the findings of the OECD report, suggest that neither have offered the final word on competitiveness, and that it must remain an ever-moving target both for firms and for policy-makers.

What comes out of all of this is the subjectivity that is inherent in the analysis of competitiveness - so that actions and policies are often the result of perceptions and expectations of firms and policy-makers as to what the competitors are doing or might do in the future. This subjective assessment proved a major impetus in establishing the case for European common action on technology - the existence of a European technology gap which had to be closed in order to improve the competitiveness of industry. The political significance of this linkage for the integration process was enormous, both at the immediate level and in the longer term. At the immediate level, the technology policy found support with the diverse sectors of European industry, including those ill-served by earlier European policies that were designed to meet the priorities and security concerns of government more than those of industrial enterprise. In addition to the ESPRIT programme, directed at the information technology industry, and RACE, at the telecommunications sector, the BRITE-EURAM programme singled out manufacturing industry at large.

Through the various collaborative technology programmes that gradually appeared, first as individual initiatives under the direction of the Commission, and from the mid-1980s under the umbrella of the Framework Programme, it seemed that industry was at last being specifically targeted by the supranational authority and brought more directly into the process of policy formulation. To all intents and purposes this was a market-based programme, bringing together economic actors in a network of technological alliances on a cross-border basis.

Under the successive Framework Programmes that emerged during the 1980s and the 1990s, organisations were invited to submit collaborative research projects for support under the formal programme. Both the culture of collaboration, and the particular trend towards technological alliances that had been appearing in the international economy at large were now to be formally supported by the supranational authority. In a sense, the approach to technology policy adopted during the 1980s sought to build the community from the bottom up. The following chapters, and particularly chapter three, will examine how this approach operated in practice.

The market-based approach also found support with the national governments for a number of reasons. In particular, the stated objective of industrial competitiveness struck a chord with member states regardless of their political persuasion or the specific domestic economic policies. As the neo-liberal economic climate spread throughout Europe bringing a convergence of economic policies, it also brought with it a greater focus on macro-economic management aimed at general stability, combined with a set of micro-economic policies to create an enabling environment for economic activity.

Membership of the European Community brought with it the obligation to observe community policies, including competition policy. This meant that national governments were unable to provide aid to domestic industry to the degree that had been done in the past. Even if governments wished to do so, however, the constraints imposed on them by the pursuit of anti-inflationary policies prevented it. The particular form of the policy adopted in the 1980s therefore placed a smaller financial burden on the individual member states than was the case a decade earlier. As such, European policy countered the limits to integration identified by Taylor in respect of the experience of the 1970s.[17]

One of these limits concerned the question of finance. As the experience of technology collaboration in the 1970s, and the British position on budgetary rebates at the beginning of the 1980s showed, the risk of an escalating financial burden for member states acted as a brake on the process. It operated again in the Community negotiations on the overall Framework Programme budget, but this time the technology programmes avoided the type of research projects prone to cost escalation, and most were jointly funded by industry and the Commission. Once the actual Framework programme budget was agreed therefore, member state governments were assured that their financial contribution limit was set.

Another limit to the integration process identified by analysts was the extent of authority and sovereignty transfer. Clearly a problem for integration during the 1970s, and likely to recur in the future given the nature of states, the issue of sovereignty transfer was not addressed directly by the development of European technology policy because of the nature of the programme, and the approach adopted by the European Commission.

As a market-based programme, it targeted organisations in the private and public sectors so as to foster technology collaboration. But it offered little direct challenge to the national technology policies. Although the Commission had promised in 1985 to coordinate national policies with those of the Community, in fact it did not do so. Instead, it concentrated on establishing the broadest possible base of support for the technology community, at the grass roots level of the market.

The limits imposed on the integration process during the 1970s by the internationalisation of economic activity have been well documented by integration theorists of different persuasion.[18] Ernst Haas spoke of the turbulence in the international economy which could stop the process, while other analysts considered that interdependence would overshadow and ultimately subsume the integration process.[19] At that time, national governments responded to the internationalisation of economic activity by a full-scale retreat en masse on the domestic front, reducing the integration process to a trickle.

In the 1980s, the Community turned internationalisation to its own advantage by working with the trends towards international alliances rather than against them. The collaboration culture became the basis for Community-based activity through the Framework Programme, and more generally through the European Commission's pursuit of technology collaboration agreements with non-member countries. Instead of exerting a divisive influence, internationalisation was used as a basis for uniting the European Community partly by providing the conditions around which the Commission policy was structured.

The longer term political significance of the Community policy is perhaps only now becoming apparent. It stems from the essential nature of the policy which was defined in terms of the competitiveness agenda. In so doing, the supranational authorities determined the type of interests represented, and ultimately the community that would develop as a result. It represented the value system of the market, and was linked to economic interests rather than broader social interests. In effect, a particular path dependency was established that would present problems for policy development in the wake of the Maastricht treaty and the introduction of economic and social cohesion as policy objectives. Moreover, a community created on the basis of the market-related objective of competitiveness does not suggest stability unless it is integrated within a broader institutional framework.

This thesis is concered with the integration process developing through the European Commission's attempts to establish a technological community. As such it is concerned with the subjectivity of the actors involved, and the material presented in the following chapters (particularly the empirical evidence from chapter six) attempts an ex post analysis of community building. The final chapter reviews the evidence, and also offers an ex ante analysis of the technology policy in terms of the potential for contributing to European economic and social cohesion.

1.4 Theorising integration

The methodological approach taken to examine the process of community building through the involvement of actors from two of the member states of the European Community, Spain and the UK, in the BRITE-EURAM programme is borrowed and adapted from the neo-functionalist theory, because it featured a number of elements believed to be useful for the explanatory model. This section provides a brief examination of the various theoretical approaches to integration, examines the renewed attempt to theorise from the second half of the 1980s, and offers a critique of the various approaches.

1.4.1 Functionalism

David Mitrany's exposition of functionalism provided an early explanation for the integration process with its focus on private actors at sub-national and supranational level who saw benefit in cooperation on functional issues.[20] The cooperation would take place through the mechanism of a supranational institution which operated on the basis of the transfer of authority by states over the functional issue. Repeated cooperation would create a learning effect, and the actors would identify the institution as the most effective and appropriate means of carrying out the functional task.

Cooperation was directed at `making use of the present social and scientific opportunities to link together particular activities and interests, one at a time, according to need and acceptability, giving each a joint authority and policy limited to that activity alone.'[21] In this way functionalism was regarded as the best way of meeting the common interest. Mitrany argued that international cooperation would work, since there was `an evident identity of every-day social aims and policy', and `close similarity of ways and means'.[22]

Functionalism minimised the importance of sovereignty, claiming that `the functional approach does not offend against the sentiment of nationality or the pride of sovereignty'.[23] The transfer of authority would not challenge national sovereignty, and it was even considered that states would not be concerned about the possibility of losing sovereignty. In fact, as states came to see the value of the supranational institution's actions in carrying out the functional task, and the ensuing benefits accruing for all, further tasks would be assigned to the supranational institution, with an increasing disregard by states for the loss of authority over the additional tasks assigned. The outcome of the social cooperation was predicted to be the creation of a political community.

A certain idealism may be identified in the functionalist explanation, which was not so readily identifiable through empirical studies.[24] The main criticism of this approach was that it gave insufficient attention to the political aspects of cooperation and sovereignty transfer. Critics argued that the technical could not, as the theory proposed, be separated from the political.[25] Neo-functionalism borrowed certain ideas from functionalism and added a political element to explain the experience of integration.

Three elements were adopted by neo-functionalism - the upgrading of common interests which the supranational institution fostered through its operation, the institutionalised procedures that were necessary for consensus, and the functional tasks around which cooperation was based.[26]

1.4.2 Neo-functionalism

The process of integration began, according to the theory, in pressures within the economic sector to which national interest groups responded by supporting a transfer of authority to a central institution to carry out the necessary assigned tasks. At the national level the interest groups acted on the basis of common interests, and where the success of the initial task prompted further pressures in related areas this gave rise to additional claims and demands on the central authority, in other words a spillover process operated. Where the initial task assigned is inherently expansive, and the integrative success established, a process of task-expansion develops which is marked by a shift of demands, expectations and loyalties to the central authority.

In the neo-functionalist analysis, Ernst Haas stated that the elite groups `have a decisive manipulative role' since they encourage the spillover mechanism, creating what he saw as the `process whereby political actors in several distinct national settings are persuaded to shift their loyalties, expectations and political activities towards a new and larger centre, whose institutions possess or demand jurisdiction over the preexisting national states.'[27]

According to neo-functionalism, the integration process developed through three possible forms of spill-over dynamics. In this apparently simple and ultimately artificial concept lay the key to the process. Functional spill-over stemmed from the assumption of an interdependent economic sector, where integration initiated pressures in related areas and created demands for further integration if only to protect the original gain, leading in turn to further pressures and so on. The neo-functionalist school tended to accept this assumption of interdependence without examination or questioning of the exact nature of this interdependence. Changes in the structures of production and the location of economic activity make it difficult to hold up this assumption.

The second type of spill-over, political spill-over, inevitably followed from the assumption of interdependence and functional integration. It suggested the gradual shifting of expectations, demands and loyalties to the supranational level and to the reformulation and articulation of interests at this level. In addition, it presupposed that the supranational elites would not only work together to establish common interests, but also that they continued to articulate the disaggregated interests of those below the national level. Whether this can in fact be the case is really a matter not simply of debate but requires empirical investigation. The discord that attended the political debates surrounding the Maastricht treaty suggested there were many groups and individuals who felt themselves excluded from the process both at the national and the supranational level.

The third type of spill-over, the upgrading of common interests, resulted from the mediating role of the supranational authority. Under this category, the European

Commission could provide the solution to differing positions and interests of member states, and suggest a compromise in the negotiated positions that in effect represents a common interest while in all probability extends the power and influence of the supranational authority.

The extension of the political agenda of European technology policy beyond industrial competitiveness to economic and social cohesion, which is examined in chapter eight, could be considered in terms of the upgrading of common interests. More generally, the role played by the European Commission under Jacques Delors, from 1984 onwards, suggests such type of spill-over, and it was facilitated further through the legislative impact of the Single European Act and the Maastricht treaty. Yet, the extension of the agenda in European policy by the early 1990s from a concern with competitiveness to economic and social cohesion must inevitably mean a shift in the configuration of interests, and an introduction of a new set of actors, such as public and regional authorities, education bodies and social groups, with non-market based priorities. In effect, there is a whole new set of social relations beyond the narrow base established by the competitiveness agenda.

One of the responsibilities of the supranational institution was to upgrade common interests in order to create consensus and a political community. But a political community was more feasible according to Haas where the task or tasks assigned to it were functionally specific.[28] Hoffman identified greater opportunity for integration in areas of low politics that did not challenge the sovereignty of national governments, rather than high politics.[29] The creation of the political community would, in any eventuality, take place on a gradual basis through a process of incremental decision-making by the supranational institution, a view of the integration process that was shared by economists.[30]

Focusing on economic actors, neo-functionalism attributed the motives behind their behaviour to rational self-interest, thus borrowing from orthodox economic theory to explain and understand the behaviour of economic agents. Similar motives were ascribed to the other actors in the process, the elite groups who represented the interests concerned and additionally the supranational institution. In the context of the latter, the implication is that the supranational institution will seek to expand its own capacity to influence and direct the community.

Neo-functionalist theory considered the main actors in the process to be economic actors, interest groups and elite groups at the national and the supranational level, who represented the economic interests, together with the supranational institution or central authority. The integration process is constituted by the interaction between these groups, with the state being regarded, certainly in the early formulations of the theory, as being secondary. According to Haas, 'integration is conceptualised as resulting from an institutionalised pattern of interest politics played out within existing international organisations.'[31]

This theoretical formulation viewed community building as a process of managing competing interests, and in this sense offered a more detailed view of interests and cooperation than was presented by functionalism. Neo-functionalism acknowledged the possibility of a conflict of interests, and of the need to manage the process to reach a consensus through some agreed framework provided by the supranational institution.

Elite groups became socialised through a learning process associated with greater interaction among other elites at the supranational level, and bound together by the self-interests referred to earlier. As a result of learning, the groups responded to integrative pressures by following up this interaction, provided that the further integrative step did not threaten their interests. In effect, the theory considered the elite group as a rational actor, and capable of recognising the potential of spillover so that 'all political action is purposively linked with individual or group perception of interest.'[32]

Private interest groups were considered to extend their lobbying activity beyond the national level, as the range of activities undertaken by the supranational institution broadened. In addition, the number of interest groups at the supranational level (peak associations) was expected to increase, as groups see that an increasing amount of decisions are made at the European level. In order to ensure that their own interests, demands and expectations were met, more private interest groups were expected to locate in Brussels to become closer to the centre of influence.[33]

A difficulty arises in this view of interest group behaviour where the elites and interest groups cannot channel the expectations and demands of their members, or seriously miscalculate the extent to which they do in fact represent the broader interests of their constituents. Such was the case in the recent experience of the European Community, notably within the individual member states in the conduct of referenda on the Maastricht treaty.[34] Recent research also suggests that in fact elite groups may be less influential at the European level than the theory assumes.[35]

One reason for the limited influence of interest groups may be the fact that groups are smaller in organisation, and operate on a more dispersed basis, with many continuing to articulate interests and seeking to influence policy at the national level.[36] In the economic sector, for instance, internationalisation and the competitive pressures of the market may contribute to division rather than to collective interest representation. The lack of homogeneity in the economic sector does not provide for an easy identification of common interest as the basis for interest group activity.

Weak interest representation need not mean that integration is therefore impossible, but it does highlight the need to find ways of representing such disaggregated interests. In the context of technology policy, there was a very weak representation of interests by the business peak associations, so that the European Commission stepped in to create an industrial interest group in the Industrial Research and Development Advisory Committee (IRDAC).

Neo-functionalism need not fail in the attempt to explain integration simply because of the fact that interest groups are not observed to behave as the theory would suggest. There has been, as was noted above, a change in the structure of interest groups. Technological change has had an enormous impact on communication in general, eliminating distance and facilitating instant, face-to-face communication on an individual basis over a global space. As a consequence, the hierarchical organisation of interests is less evident than a more diffused system of representation.

Even before the introduction of a European technology policy promoting cross-border collaboration, a pattern of international alliances had begun appearing from the late 1970s. So there was less immediate perception of a need to establish additional interest representation channels. There is another side to this point about the relaxed nature of interest representation at the supranational level towards the technology policy, however. International technological alliances involve risks and transaction costs for those involved - finding partners, allocating and distributing resources, protecting the results of collaborative research, and commercialisation of the results.[37] The supranational institution can reduce the transaction costs and cover the information requirements that increase with the level of cross-border activity by economic actors. As chapter three shows, this was an important element in the development of technology policy. The policy in general, and the BRITE-EURAM programme in particular, involved economic actors directly and the Commission often bypassed national governments in the implementation of the policy. Consequently, reducing the transaction costs was a vital aspect to the supranational institution's responsibility towards creating a technological community.

In addition, the internationalisation of economic activity left national governments less able to influence economic actors, while the latter sought more appropriate supranational institutional support for business activity. As the success of the European technology policy depended totally on the direct involvement of economic actors, and on the extent to which they were prepared to participate in collaboration under the various programmes, the `privileged position of business' facilitated their access to the European authority. Charles Lindblom had identified, in 1977, the ability of business to extract benefits and incentives from government in return for merely carrying out market activities, an aspect of firm behaviour not recognised by the neo-classical economic view of the market.[38]

1.5 Contending theoretical perspectives

By the end of the 1980s, integration theory had revived with the renewed activity in the European Community. Following the Single European Act of 1987, which led to institutional changes at Community level, and the Maastricht Treaty of 1992, various contending theories were put forward to explain the processes. It is not the intention here to provide a detailed evaluation of these different approaches, although reference will be made to studies that have done so. Instead, this section will provide a brief sketch of the theoretical areas to highlight areas of difference and to indicate why neo-functionalism remains the most useful approach.

Neo-functionalist theory was criticised for giving a secondary role to the state. By the end of the 1970s states came to be seen as effectively operating a brake on the process of integration.[39] From the mid-1970s interdependence theorists argued that the growing web of economic links among countries had created a dense pattern of interaction, making individual national economies susceptible to external forces that could act as a counterweight to the particular economic policies of the state. Increasing levels of economic transactions need not lead, according to the interdependence school, to pressures for integration.

Keohane and Nye, two of the leading interdependence theorists, argued that the effect could even be to diffuse integration pressures.[40] Undoubtedly, the uncertainty that was a feature of the international economic system throughout the 1970s, following the collapse of the international monetary system and a slowdown in growth together with general stagflation gave a sense of pessimism that left countries unwilling to take risks on the international front, preferring to adopt defensive domestic policies. Haas was forced to conclude that the turbulence in the international economy had led to the obsolescence of regional integration theory.[41] Webb suggested that the best contribution of the interdependence approach had been to show up the incomplete nature of the EC as an integrated regional structure.[42] More generally, interdependence writers were not interested in cooperation or institution-building in the way envisaged by neo-functionalism.

However, interdependence did not go away during the 1980s, while the renewed integration forced some attempt at explanation. Keohane and Nye had suggested that external forces could have an influence in promoting integration, even unwittingly.[43] In 1991 Keohane and Hoffman offered a similar argument, based on the belief that the institutional changes were a response to international challenges and threats.[44] The evidence in chapter three suggests that European technology policy was introduced by the Commission on the basis of the need to strengthen the industrial base and close Europe's technology gap with the United States and Japan. In this sense it was a defensive strategy. But in effect the design of technology policy was more nuanced, recognising that business interests would be directly and actively involved in order to ensure the success of the policy. But it had to be an open policy, with possibilities for European firms to also collaborate with non-European, so as not to foreclose on potential profits.

During the 1980s theorists sought to give the state a much more direct and active role in the way that the integration process was moving.[45] Ultimately, this polarisation of the theoretical views regarding the role of the state is not helpful in that the views adopt contradictory positions that often do not accord with practice. The logical implications of internationalisation and interdependence could be that states are ineffectual, which is to a large extent what the neo-functionalist analysis was saying. Yet, states have also at various times given positive support to the integration process, the Single Market Programme being one of those times.

Relaunching the neo-functionalist debate, Tranholm-Mikkelsen saw in the Single European Act and the resulting programme to create a unified market the re-emergence of the logic of spill-over.[46] The programme extended its pressures into the social space, and to the notion of a single currency. Alongside the extension of the scope of the supranational authority, there was a shift in the institutional balance, with the introduction of the co-decision procedure allowing more involvement by the European Parliament in decision-making. The functional spill-over would be acknowledged by both neo-functionalists and by their neo-realist critics, while disputing the precise nature of the cause-effect relationships involved.

Moravcsik regarded the Single European Act as the outcome of a bargaining process between the powerful member states, with each bargaining from the position of the interests determined within the state.[47] The particular approach which he used inevitably led back to domestic interests, and particularly to state interests. However, there is no guarantee that state interest and society's interest will necessarily coincide.

The eventual outcome of the Single European Act was really the culmination of a convergence of political and economic interests among the major states of the Community, `establishing the essential conditions for reform.'[48] It may be more useful therefore to look at the consequent process in order to establish where or indeed whether there is evidence of community building. Moravcsik's conclusion suggests some unease with the view that `the primary source of integration lies in the interests of the states themselves and the relative power each brings to Brussels' when he goes on to add that `the intergovernmental approach demonstrates that even this explanation is incomplete.' Certainly, focusing on sources of power, and relative power differences can go only some way to clarifying integrative forces and trends, in a world where power sources change with such rapidity and frequency.[49]

In an effort to refine his approach, Moravcsik proposes a liberal intergovernmentalist conception which recognises the role of states, while giving some place to the supranational institution in supporting the inter-state bargains made by sovereign governments.[50] He uses this analysis of inter-state bargains and institutional activity to study the outcome of the Single Market and other major decisions in the Community. The analysis makes much use of relative power, using a strongly neo-realist concept that must inevitably rule out any consideration of smaller and less powerful actors in the process, whether state or non-state actors.

Cameron viewed the Single European Act as the result of a combination of forces, with some of the elements in the outcome explained by the neo-functionalist framework, and others by a neo-realist interpretation of events.[51] In particular, the role of the European Commission was construed as the supranational authority exercising a leadership role following from the grant of initial responsibility for tasks that were inherently expansive. The commitment to create the single market, followed by the commitments made at Maastricht to proceed towards monetary union within the target date, suggested the kind of incremental gradualism of neo-functionalist theory.

However, a review of the part played by the European Council in the few years before the signing of the Single European Act led Cameron to conclude that states still exerted a deal of influence, as neo-realist arguments would conclude.[52] He places the responsibility for the form of the Community `with the air of a forum in which member states pursued their particular national interests and bargaining, negotiating and forming coalitions and alliances with other member states' firstly on the attitude of the British prime minister, and from 1990 on the tensions and pressures within the Community as a result of widening and relations with Eastern Europe.[53]

Cameron, like Moravcsik, identified domestic economic circumstances within the member states as key to the eventual agreement on the single market programme, which created political pressures at national level to which the national governments could not respond. At the supranational level, there was a balance between the European Commission, as policy entrepreneur, and the European Council, as gatekeeper. It was, according to Cameron, the council which `consistently provided the policy leadership in the early 1980s necessary for the development of the internal market, by expressing its alarm over the present state of the market, by continually requesting reports from the Commission, and by occasionally prodding the Commission and the Council of Ministers to work more expeditiously in preparing proposals that would contribute to the creation of a single market.'[54]

Both Cameron and Moravcsik adopt a retrospective view, taking account of the historical circumstances that led to the eventual outcome. This approach is a favoured one among integration analysts. But it tends to give only a partial view, and fails to offer any insight into the actual integration process that follows the initial integrative step. There is no examination of how or to what extent domestic structures are integrated into the supranational structure. Nor is there any examination of the adaptive changes in the social and political relations at the national level. This surely is an important part of the integration process, and a useful indicator of the possibility for further integrative pressures.

Instead, we are left with the focus on either the member states as negotiating and bargaining towards a least threatening outcome, or on the European Commission as an influential policy entrepreneur. In Cameron's analysis, the decision by the member states to push forward with the internal market could be equally seen as a form of upgrading of the common interest, particularly given the increased level of trade between them. And there has never been a suggestion that early Commission proposals for a unified market would lead to a higher level of integration, and greater loss of sovereignty among the member states than that eventually agreed to by the European Council.

Certainly there was a great deal of theoretical debate over the developments in the European Community, but little agreement on the precise causes. A number of studies arrived at different conclusions. Sandholtz and Zysman regarded the SEA as the outcome of elite bargains that were prompted by the changes in the international economy and in the domestic political structure, identifying it as a defensive strategy.[55] In a study of environmental policy, Huelshoff and Pfeiffer concluded that the member states played a gatekeeping role in the political process associated with the development of policy, fighting against any loss of national sovereignty.[56] But they also note that the Commission was determined to achieve the single market at all costs, and that this determination had a detrimental effect on environmental policy.[57]

Even if the Commission had focused more on environmental policy it would have made little difference, as there was little shared concern among the EC members. Their conclusion that the impetus for change in the EC comes from elite groups such as business or from heads of state, and not from nationally-based environmental groups accords with the stance of Sandholtz and Zysman.[58]

A similar pessimistic conclusion regarding the integration process was arrived at by Leibfried and Pierson, in a study of the Social Policy of the Community.[59] The role of the member state continued to determine the pace of policy development, with governments seeing the EC as a mechanism for overcoming their own incapacities, so that only where national solutions fail will supranational options be considered.[60] The authors identify the likelihood of a path dependency stemming from initial social policy choices and that `options chosen - or rejected - now will influence the competencies of EC administrators, the resources and strategies of political actors, and the development of norms governing EC activities.'[61]

With such pessimism being centred upon the theoretical inadequacies of existing theory, some analysts sought to achieve the best of all worlds through combining several existing theories. In efforts to address the perceived inadequacies of existing theory, Cornett and Caporaso applied a mix of neo-classical economic theory, neo-realism, neoliberal institutionalism, and functionalism and neo-functionalism to explain the renewed integration process - using the theoretical combination to explain the observed events rather than to test the theories chosen.[62] This type of approach only serves to illustrate the complexity of the processes that are operating alongside changing domestic and international political and social structures.

The perception of reluctance by the national governments to concede sovereignty has given the centre stage, for now anyway, to theoretical explanations that emphasise the neo-realist view of the state as primary actor. These explanations centre upon relative power and bargaining strategies, with states retaining their domestic goals which are determined on the basis of domestic interests and preferences. Neo-liberal institutionalism starts from these premises and extends the analysis to include the role of international institutions in promoting order.[63]

No doubt, the European Commission has played a key role as a policy entrepreneur which, as Ludlow pointed out, was developed `without any major redefinition of the constitutional role of the Commission, or any fundamental restructuring of the organisation itself.'[64] In his insightful review of the supranational institution's structure and operation, Ludlow refutes the idea of the `adversarial' model of Commission-Council relations. Instead, the Council needs the Commission for the latter's leadership role and to implement policy in the general European interest. The Commission could not carry out these roles without regular interaction with national governments.

This is probably a more accurate, if ultimately less exciting view of the Council-Commission interaction than neo-realists are prepared to credit. In the case of European technology policy, the encouragement and management of cross-border technological alliances could not have been conducted effectively with the remit of the national government. On the other hand, the management role of the European Commission may not be sufficient in itself to deliver the interest group support, and the requisite change in attitudes, expectations, and demands that neo-functionalist theory predicted.

Upgrading the common interest may in practice mean a continuation of the status quo, through a failure of the Commission, with or without the member state governments, to ensure the adequate representation of a diverse range of interests. Again, with reference to technology policy, extending the range of policy objectives to include economic and social cohesion raises the question of creating a whole new set of political and social relations. Unless this can be achieved, the policy merely serves to maintain the existing stage of the integration process.

Some neo-functionalist analyses have begun to address the question of the linkage between the supranational and national structures, beyond the purely supranational-national government level. Burley and Mattli examined the operation of the European Court of Justice (ECJ) from a neo-functionalist perspective, looking at the way in which the operations of the Court created a community encompassing private litigants, lawyers, and the lower national courts, the national law associations and community law professors.[65] Their argument was that the community thus created had strong micro-foundations, with strong self-interest motives binding the national and supranational level actors. Legal integration was observable through `the gradual penetration of EC law into the domestic law of its member states.'[66] In the context of the approach used in this thesis, what Burley and Mattli observed was a gradual integration of the (legal) institutional systems.

In particular, the operation of the ECJ gave individual litigants a personal stake in community law and in doing so strengthened its own legitimacy. The decisions of the Court, nonetheless, always advanced community goals. But crucial to the community-creating role was the `social contract' which the Court established with the citizens of the European Community - that in becoming citizens of the EC, with the duties that such citizenship imposed, they were also entitled to corresponding rights.[67]

In giving actors at the grass roots such a stake in the process, the ECJ on occasion gave judgements that were not in the national interest. Yet, the conflict between national interest and citizen's interest was recognised, and decided on in favour of the citizen. Other analysts from neo-functionalism and from neo-realism have not tended to address this question, and so avoided an examination of the interaction between actors at the micro, national and supranational level.

Yet, if neo-functionalism proposes an integration process that is based on actors interests, and the changes in actors expectations and demands, it is necessary to look at other interests besides those of the member state. The failure of the revised neo-functionalist theory to adequately make use of the full range of its conceptual methodology, including the micro-foundations, has prevented a proper test of the theory and its predictions.

There is a tendency among integration analysts to discard particular theories if the process does not appear to accord with the predictions of the theory.[68] Or to look for one-way flows of sovereignty, expectations, demands and so on, giving again a limited perspective that ignores the multi-level interactions emerging within the European Community.[69] A recent contribution to the theory makes the case for adopting a longer-term perspective in assessing the integration process, so as to take account of the ebbs and flows that are a part of the process, rather than simply discounting the theory with the first ebb of the integrative tide.[70] National political structures have themselves evolved gradually over time. There is no reason to expect otherwise in the context of the European Community.

1.5.1 Applying the theory

Much of the theoretical analyses of integration have as the starting point the state as the primary actor, and concerns are focused largely on the aspects of power, shifts in power between state actors and associated bargaining strategies used to arrive at particular outcomes. These theoretical approaches suffer, therefore, from one of the weaknesses that has been identified in the political unit that is now known as the European Union - that is, the exclusion of large numbers of individuals and groups from the political processes in existence. It is in many respects a static analysis, telling us very little about changes over time. Instead, the focus is upon a particular outcome or outcomes.

None of the analyses referred to in the preceding section was concerned with smaller actors, or with non-state actors. This thesis attempts to redress the balance by choosing a less powerful actor, in the case of Spain, and also organisations outside the frame of supranational interest groups. The aim is to examine a process of integration, to assess whether changes in attitudes, expectations and loyalties occur as a result of the collaborative experience which is here regarded as a form of political process.

Furthermore, outcomes are of less immediate concern than the examination of the on-going process of integration. To focus simply on an outcome has the effect of narrowing the perspective. In studying the implementation of policy rather than the policy outcome, it will be possible to isolate the social relations at the national and the supranational level. Although the behaviour under scrutiny involves a set of economic activities, these activities form part of a broader set of social relations at the national and supranational level. The economic activities of the market are in fact supported, or constrained, by a set of relations which comprise the institutional system.

To illustrate, an organisation's research and technological development is a function of the internal resources, but also of external aspects such as government support for technology and the particular form of that support, the availability and range of outside research and technology organisations, and the state of technological knowledge and the possibility of access to that technological knowledge. Each of these comprise a further set of relations in what is essentially an overlapping, and hierarchical system. Government support for technology, for instance, can be directed at basic research, or applied research, or towards the diffusion of technical knowledge over a wide area of the economy. Financial support can also take various forms, from direct subsidy to capital grant, low-interest loan, training grants and various financial resources on a short or long-term basis covering a variety of purposes.

The state of technological knowledge is a function of the individual, independent efforts in research and development, and of the more general educational system, together with less formal aspects such as international collaboration, conferences, journals and research reports. The increased volume of transactions in an increasingly competitive international economy has been matched by rising flows of international technology. One risk for some economies and organisations is centred upon the loss of new knowledge created, the traditional free-rider problem, with the consequent, rapid erosion of technological and competitive advantage. Under such conditions, it is important to have some system of protection for the owners of new knowledge in its various forms - intellectual property rights and patent law are two aspects of the institutional system that help to guarantee the ownership, and also that encourage the initial efforts in research and development. Where new technological knowledge is created through international collaboration on a cross-border basis, it then becomes necessary to develop supranational institutional systems that provide a framework for these activities.

The risks may not centre upon the possible loss of the ownership of knowledge, but upon an inability of the technological system to create new knowledge, or to access technology to the extent of meeting all the needs of the system. Where organisations engaged in research and technological development, industrial or otherwise, have limited internal technological resources, and limited access to such resources on an external basis either at present or for the foreseeable future, the technological capability of the system is restricted. Like the organisation that secures competitive advantage on the basis of being the sole owner of a particular technology, the institutional system which possesses technological capability can secure advantage and maintain that advantage.

Applying this analysis to the context of European technology policy, and the market-based R&D collaboration programmes that comprise it, the more advanced national technological systems will secure an advantage over those that are less well placed. The result will be an evolving community with uneven and unequal participation by the members. Weak technological capability effectively excludes certain members from an equal position in the community, from securing a greater share of the benefits and the chance to improve the technological capability. The stronger the national institutional system, in terms of technological capability and resources, the better-placed the institutional system is within the integration process and thus more likely to benefit from it.

Moving from the national to the supranational level, certain observations can be made about the nature of the integration process and the form of the evolving community. While the review of theoretical approaches to integration suggests there is little agreement on the form and nature of the political community, generally there is an unwillingness to abandon either the national or supranational as the main level upon which integration processes operate, or to target one level over the other. Taylor's conclusion that what is being observed represents `a paradoxical assertion of separateness at the same time as a determined adhesion to the collectivity', while at the same time acknowledging the reemergence of neo-functionalist dynamics reflects the general uncertainty over the form of the community.[71]

The empirical work carried out on policy developments in areas such as environmental policy and social policy, and referred to in the preceding section on theoretical approaches to integration, indicated the market-bias that affected the type of policy actually implemented, and consequently the form of environmental and social communities that began to emerge. In both cases, the desire to secure the single market at all costs influenced the European Commission and the national actors, to the extent of including some actors and excluding others. The ideology of the market and the idea of a perfectly operating market influenced the eventual form of the community. So long as such ideas, with their underlying ideology, continue to form the views of the political interests at the supranational and national level then the community will include those who hold those ideas and exclude those who do not.

In the context of a European technology policy, which is market-based and operates alongside a well-developed pattern of international alliances among the international business community, similar observations may be made. While it is conceivable for the Commission, and the national authorities to want to establish a market-based technological community at the European level, not all member states and organisations may be able to secure the maximum benefit from it without at the same time having the necessary technological capability. The latter depends on more than market-based activities, instead taking into account broader aspects of the national institutional system discussed above. In effect, national level activity continues to be important, not simply on the basis of the state's desire to protect something as nebulous as sovereignty, but because national level activity remains essential to securing the capability to take full advantage of Community-level developments. National level activity in the area of technology remains important because a market-based technology community cannot secure all the needs of the national innovation system.

1.5.2 The hypotheses

Taking account of the foregoing critique of integration theory, this thesis undertakes an application of the theory to the implementation of one of the European technology programmes - BRITE-EURAM. Neo-functionalism provides a useful framework of analysis, in that it identifies the role of non-state actors and changing interests in the process of integration. As a functional issue which is largely, but not exclusively, located in the realm of low politics technology policy is a very appropriate area for analysis at both the level of the market and the technological institutional system. Again, Burley and Mattli viewed the neo-functionalist theory as having `enduring relevance as a description of the integrative process within a sector', with its theoretical analysis that was based upon `actors, motives, process, and context.'[72]

In the application of the theory, some effort is made to address the omissions and weaknesses already identified. The thesis accepts the leadership role of the European Commission, and goes on to consider how the Commission sought to build a community from the grass roots level. The particular nature of the community that did in fact result through the programme is questioned, as the Commission introduces the concept of economic and social cohesion, with an implicit new value system that is thereby entailed.

The research identifies the inadequate role of interest groups in the representation of diverse interests, and sees the Commission exercise its management skills to fill the resulting vacuum by acting as a policy entrepreneur and cultivating spill-over through the upgrading of common interests.

The assumption underlying this approach is that institutional structures determine the technological capabilities of the micro-level actors, and thus have an important role to play in the process of creating a technological community. At the same time, structures differ across the member states and while community building does not require a full convergence of structures towards a Community model, certain adaptation of the structures are observed.

In particular, some attention is given to the micro-level actors so as to identify changing attitudes and demands associated with the integration process. One of the difficulties that has been associated with integration was the degree to which ordinary individuals did not feel part of the process. In their study of the European Court of Justice, Burley and Mattli offered some indication that it was possible to integrate such actors, just as the Maastricht referenda highlighted the necessity of so doing.[73]

Two hypotheses will be tested against the empirical evidence presented in the following chapters. The first hypothesis is that national institutional capability is a key determinant in the integration process. The second hypothesis centres upon the nature of the supranational community that is envisaged and in the process of formation. It states that the underlying ideology and ideas influence the nature of the community, creating in the case of European technology policy, a market-based community. The effect is to largely exclude other interests from the technology community, and to lock in the community to a particular form. The difficulty then arises when the European Commission attempts to upgrade the common interests. Technology policy may not be able to secure broader objectives such as economic and social cohesion on the basis of a community serving purely market-related goals.

The methodological approach adopted to test these two hypotheses uses a three-level mode of analysis which examines the behaviour of supranational groups, including the European Commission as the supranational authority; the national authorities operating within national technological systems; and at the micro-level, the firms, universities and research centres that participate in the European Community's BRITE-EURAM programme. The three-level analysis is intended to identify patterns of behaviour as a result of the Community initiative to suggest changes in attitudes, expectations, and loyalties on the part of actors, along the lines suggested by the neo-functionalist hypothesis. The micro-level actors, participants in the European Community programme from the United Kingdom and Spain, are surveyed over a three-year period and the results of both surveys are presented in chapter six. A key concern of the inquiry is the nature of actors expectations and attitudes towards the national and the supranational authorities. Additional supporting material relating to the national technological institutions is put forward in chapters four and five.

Supporting evidence for the second hypothesis comes from an examination of the BRITE-EURAM programme, the particular path of its development and the priorities of the actors involved in programme evolution and management. Interviews were conducted with personnel in the European Commission, supranational groups such as UNICE, ETUC, European Parliament, and the Economic and Social Committee. In addition, interviews were conducted at the national level with government officials and various personnel involved in the national technological systems of the two countries under consideration. The concluding chapter will argue on the basis of the evidence that the European Community has developed a market-oriented programme, serving market-led goals, and created in the process a narrow-based technological community unable and unwilling to consider broader goals such as economic and social cohesion.

This first chapter concludes with a brief overview of the organisation of the remainder of the thesis. Chapter two examines the trends in international alliances during the 1980s, which provided a ready made culture of collaboration that the European Commission turned to its advantage in formulating a policy to encourage technological collaboration. As the chapter shows, a variety of motives for alliances were identified that did not rest solely with the technological, so that the Commission had still some way to go to convince the industrial interests of the benefits of a technological community.

Chapter three examines the development of the BRITE-EURAM programme, and the role played by the Commission and other supranational interests in policy formulation. The evidence of the chapter points to the increasing capacity of the supranational authority, and to its desire to build the community from the base. How well it succeeded is examined in chapter seven and eight.

Following the examination in chapter three of the policy developments at the supranational level, the next two chapters return to the national level. Chapter four looks at the development of the UK national technological system, and identifies the major actors within the institutional structure that played a significant part in exerting pressures for changes to this structure over the past decade. Chapter five offers a contrast to the UK technological system, and to European integration generally, in the context of the newly-developing Spanish technological system and in the role played by national elites, including the leadership role adopted by the Spanish government.

Based on the conceptual framework of neo-functionalism, chapter six assesses the extent of changes in the attitudes, expectations and demands of the UK and Spanish participants under the BRITE-EURAM programme from the evidence of a survey conducted over a three-year period. The first survey was carried out in September 1992, just before the re-appearance of tensions within the European Community, and the second one in September 1995, just after the European Union ratified the Fourth Framework Programme. While the time period is not very long in terms of obtaining detail on substantive changes, the preceding chapters four and five adopt a slightly longer time-frame to examine the institutional structures in the United Kingdom and Spain.

The concluding chapters seven and eight evaluate the progress towards the technological community that was envisaged by the European Commission in the early years of the 1980s, and assesses the real nature of the evolving technological community. While the thesis notes some success in terms of what has been achieved, it questions the ultimate stability of a market-based community, held together solely by the members common interest in competitiveness, once the Commission seeks to extend the objectives of the technological community to economic and social cohesion.

Notes to chapter one

1. Lindberg was, with Ernst Haas, among the early exponents of neo-functionalist integration theory - see L. Lindberg (1963) The Political Dynamics of European Economic Integration (Stanford, Stanford University Press); Ernst Haas (1958) The Uniting of Europe: Political, Social and Economic Forces 1950-1957 (Stanford, Stanford University Press); E. Haas (1964) Beyond the Nation State: Functionalism and International Organisation (Stanford University Press).

2. The term European Community will be used throughout most of this thesis as the time period under examination pre-dates the coming into effect of the European Union, although the term European Union is used in the concluding chapter.

3. Some saw it as the result of the European Commission's leadership role and the institutional changes which supported this, others as a bargain between member state governments of the Community, while still other analysts sought explanation through a fusion of approaches - see Tranholm-Mikkelsen (1991), Moravcsik (1991), Cameron (1992), Keohane and Hoffman (1991) for an illustration of the different viewpoints.

4. CEC (1985) Completing the Internal Market, COM (85) 310 final.

5. Previous programmes covered First Framework (1984-1987), Second Framework (1987-1991), Third Framework (1990-1994) - with a gradual increase in the areas covered by the programme, with extra funds to match. The first three programmes were essentially directed to industrial research and technology, and promoted collaboration between industrial organisations and universities.

6. Sven Steinmo, Kathleen Thelen, Frank Longstreth (1992) Structuring Politics. Historical Institutionalism in Comparative Perspective (Cambridge University Press), p. 2.

7. See P. Hall (1986) Governing the Economy. The Politics of State Intervention in Britain and France (London, Polity Press); P. Hall (1989) The Political Power of Economic Ideas. Keynesianism Across Nations (Princeton N.J., Princeton University Press).

8. Richard Nelson uses the term national innovation system to define `a set of institutions whose interactions determine the innovative performance ... of national firms.' He regards the industrial firms and public laboratories as part of the system; and more broadly `the character and effectiveness of a nation's system of schooling, training, and retraining not only determine the supply of skills from engineer to machine tender, but also influence the attitude of workers towards technical advance' - see R. R. Nelson (1993) National Innovation Systems. A Comparative Analysis (Oxford, Oxford University Press).

9. Henry Ergas (1986) Does Technology Policy matter? Paper no. 29, Centre for European Policy Studies (Brussels).

10. The term `collaborative bandwagon' was used by Sharp and Shearman (1987) in one of the first detailed studies of the emerging technology policy of the 1980s - see M. Sharp and C. Shearman (1987) European Technological Collaboration (London, Routledge & Kegan Paul).

11. A vast amount of literature on international alliances appeared during the 1980s, from a variety of disciplines, recognising a range of motives for collaboration - see, for example, F. Contractor and P. Lorange (1988) Cooperative Strategies in International Business (Lexington, Lexington Books); L. Krieger Mytelka (1989) Strategic Partnerships. States, Firms and International Competition (London, Pinter Publishers); G. Hamel, Y. L. Doz, C. K. Prahalad (1989) `Collaborate with your competitors- and win' Harvard Business Review, Jan-Feb; H. I. Fusfeld and C. Haklisch (1985) `Cooperative R&D for Competitors' Harvard Business Review, Nov-Dec.

12. See Henry Ergas (1986) Does Technology Policy Matter? Paper no. 29, Centre for European Policy Studies, for an examination of different technological systems.

13. For a detailed evaluation of international collaboration in this sector, see Keith Hayward (1986) International Collaboration in Civil Aerospace (London, Frances Pinter).

14. The ESA programme expanded from the Spacelab and the Giotto craft to include satellites for earth observation, telecommunications, marine navigation and meteorology, and more recently, the Ariane launcher, the space shuttle Hermes, and elements for the manned space station, Columbus. Commercial applications are not conducted by ESA, but through independent business organisations, or the separate private venture, Arianespace, which is located in France and deals with the production and commercialisation of rockets. Through the management system, ESA sought to deal with the problem of juste retour, leaving national governments free to choose what projects to become involved with, and hence making their own independent decisions on what financial burden to bear.

15. See W. Sandholtz (1992) High-Tech Europe. The Politics of International Cooperation (Oxford, University of California Press); Sharp and Shearman (1987) op. cit.

16. See CEC (1985) Commission memorandum to the Council, Towards a European Technological Community, COM (85) 350 final.

17. The policy appeared, initially, to address the limits to the integration process that were identified by Taylor (1983), regarding the powers of the institutions, national decision-making, and challenges to member states exclusive competence. See Paul Taylor (1983) The Limits of European Integration (New York, Columbia University Press).

18. Ernst Haas (1976) 'Turbulent Fields and the Theory of Regional Integration', *International Organisation*, vol.30, no.2, Spring.

19. Robert Keohane and Joseph Nye (1975) 'Interdependence and Integration' in Fred Greenstein and Nelson Polsby, Handbook of Political Science, vol.8 (Andover, Mass., Addison-Wesley).

20. David Mitrany (1966) A Working Peace System (Chicago, Quadrangle Books).

21. David Mitrany (1965) 'The Prospect of Integration: Federal or Functional', *Journal of Common Market Studies*, 4, 2, p. 135.

22. Mitrany (1965) ibid., pp. 136-137.

23. Mitrany (1965), p. 139.

24. See M. Hodges (1978) 'Integration Theory', in T. Taylor, *Approaches and Theory in International Relations* (London, Longman).

25. Reginald Harrison (1974) Europe in Question (London, Allen & Unwin).

26. Carole Webb (1983) 'Theoretical Perspectives and Problems', in Helen Wallace, William Wallace, Carole Webb, *Policy-Making in the European Community* (Chichester, John Wiley & Sons).

27. Haas (1958) The Uniting of Europe, p.16.

28. Ernst Haas (1973) 'International Integration: The European and the Universal Process' in L. M. Goodrich and D. A. Kay, International Organisation: Politics and Process (Madison, University of Wisconsin), p. 403.

29. S. Hoffman (1966) 'Obstinate or Obsolete: the fate of the nation state and the case of Western Europe', *Daedalus*, 95.

30. J. Pelkmans (1980) 'Economic Theories of Integration Revisited', Journal of Common Market Studies, 18, 4, June.

31. Haas (1964) op cit., p. 55.

32. Haas (1964) op. cit., p. 34.

33. Emil Kirchner and Konrad Schwaiger (1981) The Role of Interest Groups in the European Community (Aldershot, Hampshire, Gower), p. 5.

34. This point was made by Prof. Hjalte Rasmussen during a speech entitled 'Ratifying Maastricht' in the context of the Danish referendum, at the annual meeting of the University Association for Contemporary European Studies, London School of Economics, 7 January 1993.

35. See Sonia Mazey and Jeremy Richardson (1993) 'Policy-making Styles in the European Community: Consultation of Groups and the Process of European Integration', paper presented to the International Studies Association, 34th Annual Convention, Acapulco, 23-27 March.

36. W. Streeck and P. Schmitter (1991) 'From National Corporatism to Transnational Pluralism: Organised Interests in the Single European Market', Politics and Society, 19, 2.

37. R.H. Coase (1960) 'The Problem of Social Cost' Journal of Law and Politics, 3, October.

38. Charles Lindblom (1977) Politics and Markets (New York, Basic Books), p. 173.

39. See Taylor (1983) op. cit.

40. R. O. Keohane and J. Nye (1975) 'International Interdependence and Integration' in F. Greenstein and N. Polsby, Handbook of Political Science, vol. 8 (Reading, Mass., Addison-Wesley).

41. Ernst Haas (1975) The Obsolescence of Regional Integration Theory (Berkeley, CA, Institute of International Studies).

42. Carole Webb (1983) op cit., p. 36.

43. Keohane and Nye (1975) op. cit., p. 385.

44. R. O. Keohane and S. Hoffman (1991) 'Institutional Change in Europe in the 1980s', in R. O. Keohane and S. Hoffman, The New European Community: Decision-making and Institutional Change (Boulder, CO., Westview Press).

45. A. Moravcsik (1991) 'Negotiating the Single European Act: National Interests and Conventional Statecraft in the European Community', International Organisation 45, Winter.

46. Jeppe Tranholm-Mikkelsen (1991) 'Neo-functionalism: Obstinate or Obsolete? A Reappraisal in the Light of the New Dynamism of the EC', Millennium, 20, 1, Spring.

47. A. Moravcsik (1991) 'Negotiating the Single European Act: National Interests and Conventional Statecraft in the European Community', International organisation, 45, 1, Winter.

48. Moravcsik (1991) op cit., p. 21.

49. See M. Newman (1994) 'Sovereignty, Public Power and the Economy' in F. Brouwer et al, Economic Policy Making and the European Union (London, Federal Trust).

50. A. Moravcsik (1993) 'Preferences and Power in the Single European Act: A Liberal Intergovernmentalist Approach', Journal of Common Market Studies, 31, 4 December.

51. D. Cameron (1992) 'The 1992 Initiative: Causes and Consequences', in A. Sbragia, Euro-Politics. Institutions and Policymaking in the New European Community (Washington, DC, The Brookings Institute).

52. Robert O. Keohane (1986) Neo-realism and Its Critics (Columbia University Press).

53. David Cameron (1992) 'The 1992 Initiative: Causes and Consequences', in A. Sbragia, Euro-Politics (Washington, D.C., The Brookings Institute), p. 29.

54. Cameron (1992) ibid., p. 63.

55. Wayne Sandholtz and John Zysman (1989) '1992: Recasting the European Bargain', World Politics, 42, 1 October.

56. Michael G. Huelshoff and Thomas Pfeiffer (1991) 'Environmental Policy in the EC: neo-functionalist sovereignty transfer or neo-realist gate-keeping?', International Journal XLVII, Winter 1991-92.

57. Huelshoff and Pfeiffer (1991), ibid., p.156.

58. Huelshoff and Pfeiffer (1991), ibid., p. 157.

59. Stephan Leibfried and Paul Pierson (1992) 'Prospects for Social Europe', Politics and Society, 20, 3, September.

60. Leibfried and Pierson (1991) ibid., p. 354.

61. Leibfried and Pierson (1992), p. 334.

62. Linda Cornett and James A. Caporaso (1992) ''And still it moves!' State interests and social forces in the European Community', in James N. Rosenau and Ernst-Otto Czempiel, Governance without government: order and change in world politics (Cambridge, Cambridge University Press).

63. R. O. Keohane (1989) 'Neoliberal Institutionalism: A perspective on World Politics', in R. O. Keohane, International Institutions and State Power (Boulder, CO., Westview Press).

64. Peter Ludlow (1991) 'The European Commission' in R. O. Keohane and S. Hoffman, The New European Community. Decisionmaking and Institutional Change (Oxford, Westview Press), p. 85.

65. Anne-Marie Burley and Walter Mattli (1993) 'Europe before the Court: A Political Theory of Legal Integration', International Organisation, 47, 1, Winter.

66. Burley and Mattli (1993) ibid., p. 43.

67. Burley and Mattli (1993), ibid., p.61.

68. A. Moravcsik (1993) 'Preferences and Power in the European Community: A Liberal Intergovernmentalist Approach', Journal of Common Market Studies, vol.31, no.4.

69. Gary Marks (1993) 'Structural Policy and Multilevel Governance in the EC', in A.W. Cafruny and G.G. Rosenthal, The State of the European Community, vol.2 The Maastricht Debates and Beyond (Harlow, Longman).

70. Dorette Corbey (1995) 'Dialectical functionalism : stagnation as a booster of European integration', International Organisation, vol.49, no.2.

71. P. Taylor (1991) 'The European Community and the State: Assumptions, Theories and Propositions', Review of International Studies, 17, p. 121.

72. Burley and Mattli (1993) op. cit., p. 57.

73. Burley and Mattli (1993) ibid., p. 74.

CHAPTER 2

INTERNATIONALISATION OF RESEARCH & DEVELOPMENT

Technology is becoming the leitmotif of the modern world and a linchpin of the international economy. Businesses, governments, community organisations and individuals, seemingly everywhere, are looking to technology as the key to the attainment of their goals.

Willoughby (1990).[1]

From the beginning of the 1980s, the pursuit of technological development was seen as a principal way for firms and governments to achieve a variety of goals, varying from industrial competitiveness, increased and sustained employment creation, to the broader longer-term goal of economic development and growth. Technology became a common theme, bringing together actors with otherwise quite separate, and sometimes conflicting goals. The European Commission recognised the centrality of technology for these diverse groups, and adopted a technology policy that would be the means of unifying the interests of individual governments with their distinct national political concerns and economic actors pursuing a wide range of market-based strategies. A growing trend in international business alliances combined with the ever-present concern of national governments regarding international competitiveness provided the European Commission with a basis upon which to develop a European technology policy, and in so doing to use prevailing conditions to establish some form of policy consensus.

This chapter examines the general conditions prevailing in the international economy, and particularly focuses on the motives of economic actors and of national governments with a view to considering whether there was sufficient converging of interests as far as technological needs were concerned. International alliances, including technological alliances, took place for a variety of reasons. National governments, too, had their individual political preferences, but all held to a belief in the need to sustain the international competitiveness of domestic industry. European Community competition rules constrained the opportunity for national measures to support domestic industry. But even if national governments could give more direct support, they were often unwilling to do so, prompted by pressures to reduce public spending as part of a counter-inflationary strategy, and more recently, by the need to meet convergence criteria for membership to the next stage of European Monetary Union. Indeed, pressures to cut public spending extended as far as trying to shift the burden of financing R&D to the private sector, something all member state governments attempted to do during the 1980s, albeit with mixed results.

2.1 Technology in state relations

The confidence of Willoughby's assertion, at the beginning of this chapter, is at odds with the treatment of technology in international political economy and international relations generally. There was no consistent approach developed to analyse this issue of inter-state relations. Either technology was, like law, a technical matter deserving the attention of experts and not subject to dispute in the same way as foreign policy, security, or even economic policy. Or it attracted the attention of realists, who considered technology as a determinant of national power and position. It was the latter argument that struck a chord with the member state governments of the European Community, and they responded to the argument that Europe needed to take action to counteract the technology gap that existed between the region and its main competitors, the United States and Japan.[2]

The realist argument, put most persuasively by Robert Gilpin, was that technological change and diffusion would have an impact on international comparative advantage, leading to more active forms of economic nationalism as national governments seek to appropriate their own technology. According to Gilpin, `without question, technological issues are becoming among the most important ones in the international political economy'.[3] While inter-firm alliances undoubtedly had a role to play in developing technological advantage, in Gilpin's mind such arrangements worked best through the directed efforts of national governments.

There was a certain inevitability in the ebb and flow of technology throughout the international economy, under the realist perspective, which could be explained by the investment pattern of multinational corporations (MNCs). Gilpin concluded that the increased level of international production, and of research and development had meant also an improvement in communications, enabling the rapid diffusion and innovation of research results. Although the MNCs could play a positive role through their contribution to faster rates of technological innovation and diffusion, their investment decisions were `arbitrary', and any loss of comparative advantage from such investment decisions had to be reversed through national policies.[4]

The response of governments to such arbitrary, and at times capricious behaviour, was to use industrial policies `to make these powerful institutions serve what each perceives to be its own national interest'.[5] Competitive rivalry between governments to attract MNCs, the purveyors of technological advance, could be ultimately damaging, but in any event was increasingly not feasible for member states of the European Community as the EC competition policy gained in strength and credibility from 1984 onwards.

It could, however, be used by the European Community itself, on behalf of the member states, so as to preserve Europe's technological advantage against Japan and the United States. An example of international rivalry may be seen in the context of the European Community's technology policy initiatives within the information and communications technology sectors in the early eighties, in response to the de-regulatory policies being pursued by the US government which saw the break-up of the national monopoly AT&T and the removal of the ban on overseas operations by the US company. As it set about making inroads into the still largely-protected European market, sometimes through establishing alliances with domestic firms, European industrialists were anxious to see a public reponse to the perceived competitive threat. [6] Since technology flows, like capital flows, were less subject to the restraints imposed by national governments, the European Community might be in a better position to co-ordinate flows to the benefit of all.

It was not easy to present a picture of the technology gap that showed the situation with a degree of clarity sufficient to engender support for a common solution, particularly as there were such differences within and between countries, and between industrial sectors in Europe. Such differences within the European Community obviously complicated the task of outlining the comparative position facing Europe.

Inevitably, there was a focus on specific quantitative measures, the proportion of GDP devoted to R&D, the distribution of R&D financing between government and industry, growth in R&D in the business enterprise sector, and similar quantitative measures. In 1981, the gross domestic expenditure on R&D (GERD) as a percentage of GDP for the EC as a whole was 1.7%, while the corresponding figures for the US and Japan were 2.4% and 2.1% respectively. By 1985, the US figure had increased to 2.9%, Japan's to 2.6%, with the EC still lagging behind at 1.9%.

The picture was worse when account was taken of the average annual growth rate of GERD for the period 1981-85, with the US average of 7.3%, Japan at 8.9% and the EC average annual growth rate for the period at a much lower 4.3%. Although there was a general slow-down in the average annual growth rate for GERD in the period 1985-1989, the US average falling to 2.0%, the Japanese to 6.5%, the EC figure remained stable at 4.3%, still lagging behind enough to preserve the image of a gap.[7]

An examination of the trends in industrial R&D during the 1980s showed expenditure rising rapidly in the first half of the decade, with a falling off in the second half. The pattern of expenditure was similar throughout the OECD area, not simply the European Community. In Japan, expenditure on business R&D rose significantly throughout the 1980s to the end of the decade, but fell by 1992. The average annual growth rate in business expenditure for the OECD area as a whole in the first half of the 1980s was 8%, falling to 3.5% a year in the latter half of the decade. In the US, the annual increase in business R&D spending in the first half of the 1980s was just above the OECD average, and just below it towards the end of the decade.

The foregoing description of trends suggests that there was a general increase in business spending on research and development internationally, so that European Community programmes were effectively responding to competitive developments over a wider area. This is confirmed by the average increases in the European Community itself, which were in fact below the OECD average. In the European Community, industrial R&D increased at about 5% a year during the 1980s, showing a falling off towards the close of the decade, and a real decline of 0.3% in 1991.

The national changes in the member states in business R&D also show some divergences (see Table 2.1 below). Interestingly, only the UK showed low real growth in business R&D during the 1980s, and continued poor performance into the 1990s with a fall in real terms in 1990, 1991 and 1992. In Spain, the level of business R&D grew at a rate above the EC average, until falling in real terms in 1992 and 1993.

Table 2.1 Growth in business R&D

	Average annual growth %		% change from previous year	
	1981-85	**1985-89**	**1990**	**1991**
US	8.2	1.4	-1.4	-5.9
Japan	11.2	7.4	10.1	3.0
Belgium	4.8	3.4	3.7	n/a
Denmark	9.9	6.9	10.3	8.8
France	4.9	4.7	6.3	2.5
Germany	5.2	3.8	0.6	n/a
Greece	n/a	n/a	n/a	9.3
Ireland	10.0	8.6	16.6	22.4
Italy	8.5	6.6	5.9	3.7
Holland	5.5	4.9	-5.7	-8.6
Portugal	6.5	4.8	19.6	n/a
Spain	14.1	13.8	20.0	1.9
UK	1.9	1.9	-0.5	-9.9
EC	4.9	4.8	2.6	n/a

Source: OECD (1994) Science and Technology Policy Review and Outlook, p.157
n/a: not available

It would seem that not only was there a competitive spirit which was forcing this general rise in business R&D during the first half of the 1980s, and to which the European Community responded, but also that business R&D responds to recessionary forces in the national and international economy. The slow-down in economic activity in the early 1990s was accompanied by a fall-off in business R&D in a number of the member states of the European Community, and was particularly evident in France, Germany, Holland, Spain and the UK.

By 1991, the European Community as a whole accounted for over a quarter of total OECD business R&D, with Japan having one fifth, and the US the largest share at 43%.[8] Despite the general desire during the 1980s among member state governments to shift much of the financial burden of research and development to the private sector, reflecting the situation that prevailed in Japan, there was mixed success, and by the early 1990s a distinct slowing of the long-term shift. Table 2.2 below shows the changes over the decade, and a couple of explanatory points may be added.

Only a few of the member states had a steady upward move in industrial sourcing for R&D, including Germany, Denmark, Ireland, and the UK. Spain showed a sharp fall by the turn of the decade, but that was counteracted to some extent by an increase in the funding from abroad - from 2.2% in 1981 to 8.6% in 1985, falling back to 8.1% in 1991. The UK also saw increased industrial funding of R&D from abroad - 8.7% in 1981 to 11.1% in 1985, and to 16.0% in 1991.

Table 2.2 Sources of funds for business R&D (%)

	Ind.			Govt.			Over-seas		
	1981	1985	1991	1981	1985	1991	1981	1985	1991
US	68.4	67.7	75.2	31.6	32.3	24.8	n/a	n/a	n/a
Japan	97.9	98.0	98.4	1.9	1.6	1.4	0.1	0.1	0.1
Belgium	91.5	90.8	94.4	8.3	8.4	5.0	0.2	0.8	0.5
Denmark	84.4	87.3	86.0	12.4	9.9	7.9	2.8	2.2	2.5
France	68.2	69.6	66.2	24.6	23.4	22.3	7.0	6.9	11.4
Germany	81.7	83.1	85.8	16.9	15.3	10.7	1.2	1.4	3.1
Greece	95.4	n/a	74.0	4.6	n/a	5.5	n/a	n/a	20.6
Ireland	80.5	81.5	89.6	13.7	12.4	3.7	5.7	5.9	6.6
Italy	86.9	77.0	79.6	8.8	16.9	11.8	4.3	6.1	8.6
Holland	84.3	83.7	89.6	7.5	12.6	7.5	8.2	3.4	2.4
Portugal	92.3	94.3	88.8	3.3	2.2	6.5	4.3	3.6	4.3
Spain	93.6	83.4	80.4	4.1	7.7	11.3	2.2	8.6	8.1
UK	61.3	65.9	69.4	30.0	23.0	14.6	8.7	11.1	16.0
EC	75.1	76.4	78.0	20.0	18.2	13.8	4.8	5.3	8.0

Source: OECD (1994) ibid., p. 160.
n/a: not available

Table 2.3 shows that business kept most of the R&D funds for the industrial sector, although there was a small growth in the share for performance by non-industrial sectors. A principal beneficiary of business-financed R&D during the 1980s was the higher education sector. This was particularly the case in Spain, where the share went up from 0.5% in 1985 to 4.6% in 1991, and even more so in Ireland, where it rose from virtually nothing in 1981 to 9.4% in 1991. In the UK, there was also an increase in the business-financed R&D going to the higher education sector, from 1.6% in 1985 to 2.6% in 1991.

Table 2.3 Distribution of business R&D by sector of performance (%)

	Ind.			Govt.			Educ		
	1981	1985	1991	1981	1985	1991	1981	1985	1991
US	98.6	98.4	97.6	0	0	0	0.8	1.0	1.6
Japan	95.4	95.1	95.8	0.2	0.7	0.2	0.4	0.5	0.6
Belgium	n/a	97.5	97.4	n/a	0	0.1	n/a	2.5	2.5
Denmark	98.7	98.6	98.0	0.8	0.9	1.2	0.4	0.5	0.7
France	98.2	98.6	95.7	1.0	0.4	2.5	0.5	0.7	1.5
Germany	99.1	98.3	97.6	0.2	0.3	0.2	0.5	1.3	2.0
Greece	100	n/a	88.7	0	n/a	1.8	0.0	n/a	9.4
Ireland	93.1	91.5	93.5	3.8	5.4	3.1	3.0	3.0	3.3
Italy	97.9	98.3	97.5	1.2	1.1	0.8	1.0	0.6	1.7
Holland	96.9	90.9	93.0	2.5	8.2	5.6	0.1	0.5	0.7
Portugal	99.5	90.5	85.8	0.0	7	1.3	0.1	0.4	0.9
Spain	99.5	97.5	93.6	0.5	2	1.7	0.0	0.5	4.6
UK	91.8	89.5	90.0	5.4	5.6	3.5	0.9	1.6	2.6
EC	97.1	96.2	95.5	1.6	1.9	1.6	0.7	1.2	2.0

Source: OECD (1994), p. 161 n/a: not available

In concluding this section, two further observations regarding the nature of industrial R&D in the European Community over the 1980s may be made. In the countries where there was a high proportion of foreign direct investment, these companies carried out an increasing amount of R&D. In Spain, it was suggested by the OECD that about 40% of all industrial R&D was performed by multinationals, while UK also benefited through the research activities of foreign-owned subsidiaries, although not nearly to the same extent.

The growth in business R&D also resulted in an increase in the number of researchers. OECD figures reported a marked increase in the number of business researchers in Belgium and Denmark, with an even stronger increase in Spain, Ireland, and Greece. Between 1981-85, the average annual growth rate in the number of business researchers in Spain was 10.7%, and in the following period 1985-89 the average annual rate rose to 18.0%, while the corresponding figures for the UK were a much lower 1.3% and 0.2%.

In the period 1985-89, Spain showed the highest increase of all the member states, reflecting its desire to catch up from a lower starting point.

By 1991, there were two million people (equal to 1.4 million in full-time equivalents) engaged in research and development in the European Union (excluding Luxembourg), with 55% employed in the business sector, 26% in the higher education sector, and the remaining 19% in the government sector.[9] At this time, the situation in the European Community began to stabilise, and in the UK there was a real decrease in the number of researchers in the business sector each year from 1989 through to 1992.

Taking a look at the overall picture in the European Community during the period 1985 to 1991, and comparing it with the position in the US and Japan, there is a certain convergence in the R&D expenditure trends over the period combined with a certain stability (see Table 2.4 below). Both the EC and Japan increased the percentage of gross domestic product devoted to research (GERD), and also the share of the total financed by business (BERD), while the US experienced a decline on both counts. Significantly, in the case of the US the gap in the business R&D was filled by an increase in research and development expenditure in the higher education sector (HERD). Of the three regions, the US invested more in research and development through the higher education sector.

However, in all three regions the business sector played the predominant role in financing research and development and also showed the biggest changes over the period concerned. Again, the Japanese enterprise sector showed the largest increase, from 1.85% in 1985 to 2.16% in 1991. Government sector research and development showed the greatest degree of stability in all three regions (GOVERD), but notably so in the case of the European Community. Clearly, the changes in research and development illustrated in this chapter had the greatest impact at the national level.

What occurred in the European Community was not so much an improvement in the overall position, as a shift in responsibilities which showed up at the sectoral level, and at the national level. In the case of the UK and Spain, the general shift to business financing noted above was also experienced, as was an increase in the number of business researchers. The national level will be considered in more detail in chapters five and six of this thesis.

Table 2.4 R&D expenditure in EC, Japan, and US, 1985-1991, % GDP

	1985	1987	1989	1991
GERD				
EC	1.97	2.03	2.02	1.98
Japan	2.58	2.63	2.80	2.87
US	2.89	2.84	2.76	2.65
BERD				
EC	1.26	1.32	1.32	1.25
Japan	1.85	1.86	2.08	2.16
US	2.10	2.05	1.96	1.81
HERD				
EC	0.31	0.33	0.33	0.35
Japan	0.37	0.37	0.35	0.35
US	0.37	0.41	0.43	0.45
GOVERD				
EC	0.36	0.35	0.35	0.36
Japan	0.25	0.27	0.24	0.23
US	0.34	0.31	0.30	0.31

GERD - gross expenditure on R&D
BERD - business expenditure on R&D
HERD - higher expenditure on R&D
GOVERD - government expendiure on R&D
Source: Eurostat, Research and Development Annual Statistics 1994, p. 127.

While the poor economic climate of the 1990s undoubtedly had an effect on research and development activities, and consequently on the number of business researchers, it may be that a more long-term trend is beginning to show up which reflects a stabilisation in the level of applied research in Europe. One consequence of reaching a saturated market level is the reduced profit potential from further applied research activities. If the business community has indeed reached this conclusion, then it is difficult to see how further economic growth based on technological progress can be achieved.

More optimistically, the distinction between basic and applied research has become less clearcut with the result that technological advance is becoming increasingly incorporated into the techniques and processes of production. Outcomes are the result of a careful combination of research and development activities, application and experiment, and most importantly, learning by individuals and organisations as part of a process of knowledge accumulation that is often tacit rather than codified. Once again, the question of technological progress must be addressed, but this time on the basis of some alternative to industrial and applied research which encompasses learning organisations within a society that is equipped for the challenges which rapid technological change inevitably brings.

2.2 Political context of technology policy

At the beginning of the 1980s, the greater level of international competition which was partly reflected in a higher number of international business alliances, and partly in increased business spending on research and development provided the conditions appropriate for a European technology policy that was market-based. It was easier to develop a policy that supported the research and technology concerns of business, specifically applied and industrial research, in the context of such international pressures.

But, given the fact that industry would have to bear much of the cost, the policy had to be presented in terms of economic objectives such as the pursuit of competitiveness. As industrial competitiveness was also firmly on the agenda of national government policies, regardless of their political persuasion, any policy that would support this objective was to be welcomed, all the more so if it could shift the financial support for R&D to the private sector. The competitive threat from Japanese and US firms, both hungry for an increasing share of the European market, and the freedom of movement of capital, meant that there was a solid case for positive action to improve the competitiveness of European firms if they were to avoid being swamped by external competitors. Since the end of the 1970s governments had become increasingly disenchanted with policies supporting national champions, so that new competitiveness initiatives would have to come very much from the firms themselves.

In effect, the political support of two broad groups for a European technology policy was ensured. If economic prosperity depended on industrial competitiveness and on the level of technology available within and between countries, then decisions on technological resources had a political as much as a scientific basis. But it was a political basis that reflected changes in government priorities, a shift away from basic science to applied and industrial research with the funding coming from the firms rather than from the government. Since firms were increasing their R&D expenditure, and governments wanted to make this switch, there had to be a greater emphasis in technology policy-making on economic priorities like competitiveness and innovation. In other words, technological change and technology would serve the needs of the market, rather than society more generally, or past political goals such as security.

The new political basis for technology policy brought with it a more simplified view as to the nature of technology, a view that was to structure how technology policy should develop. The particular definition and understanding of technology has always determined what form of policy should be used to address technological change. If technology is considered as a stock of knowledge, technological change will necessitate a change in that stock, calling for greater investment in educational and scientific institutions.[10] Or, technology can be seen as another factor of production, alongside traditional factors such as labour and capital.[11] In this case, technological availability is a matter of market exchange although it is recognised that market failure may occur.

Often technology is viewed as a product, or in terms of the application of new knowledge. By the 1980s, the traditional categorisation of activities into science, centred upon basic research activities, and technology, encompassing applied and developmental work, had been dropped. In its place was the notion of a symbiotic relationship among a wide range of activities which give rise to the gradual accumulation of knowledge throughout the many aspects of the organisation. Policy-makers moved inevitably towards policies for technology rather than science, which sought to include knowledge accumulation among a broad range of actors - collaborative technology programmes at both national and supranational level therefore were a good example of this new interpretation.[12] Science, in the sense of efforts to develop new knowledge, was replaced by efforts to apply knowledge across as wide a variety of processes and activities as possible.[13] The new political goal of industrial competitiveness required this particular definition, with its associated policies for innovation and diffusion.

In the European Framework Programme, the goal of industrial competitiveness found its best expression, catering as it did to applied, industrial research more than to basic science and the discovery of new knowledge. The successive BRITE-EURAM programmes exemplified the orientation of policy, the first programme firmly directed to pre-competitive research, but each of the follow-up programmes took on an increasingly commercial orientation although continuing to remain within the confines of broader Community regulations.

Industrial competitiveness and a European technology gap represented a two-sided coin. The rhetoric surrounding the technology debate in Europe had made this inter-connection, regardless of whatever basis it might have in fact. A spirit of rivalry prevailed among technology policy-makers, as much as it did among economic actors, as the battle for international competitiveness intensified.[14] Indeed, it extended beyond industrial technological needs to large science projects.[15]

Policy rivalry and the perception of a technology gap with its principal competitors combined to provide for a climate receptive to the idea of a European technology policy. Time after time, rivalry over technology has led to considerations of new policy that would protect technological interests. It worked in Europe during the 1960s, and again in the 1980s. More recently, in the United States economists and political scientists have argued for policy intervention so as to ensure that the U.S. does not fall behind.[16] The rivalry among states has given rise to a perception of a non-military war, and a race towards technological supremacy.[17]

It has also led to what has been described as an `international policy ricochet among the United States, Japan and Western Europe and has resulted in an increasing convergence of public policies'.[18] But while policy rivalry can lead to a creative and constructive set of policies, there is also the risk that an intensification of political pressures forces an agreement which tries to meet all of the political interests, a lowest common denominator which fails to meet the most important objectives.[19]

While individual states have been engaged in competitive rivalry by introducing national technological programmes that foster collaboration among domestic organisations, economic actors, for whom competitive rivalry has always been present, are engaging in an unprecedented bout of collaboration in the international economy. What has been the cause of this? Does it represent a response to the encouragement given by policy makers, or a new culture developing in international business competition? The following sections will examine the reasons for private technological collaboration, and consider where public policy and business strategy coincide.

2.3 The alliance pattern

This section will examine the pattern of alliances that developed during the 1980s, and will consider whether the conclusions made earlier about business R&D can be explained by the alliance pattern. It should be established at the outset that a wide variety of alliance types were created throughout the decade and, despite the academic attention given to this form of economic behaviour, it has not been possible to classify all of them clearly.[20] This classification problem offers a difficulty when it comes to identifying a particular alliance form, the R&D alliance, for closer examination.

One study which did attempt this classification of cooperation among firms found that agreements were often quite complex, crossing the boundaries of a range of activities.[21] The general objectives covered not only research and technological issues, but also production, marketing and distribution, as the table below shows. The study analysed private agreements, made over a number of years.

Table 2.5 Pattern of inter-firm agreements - range of objectives

	Number	%
Simple Agreements		
1. Technology transfer	1500	79.6
2. R&D integration	251	13.3
3. Production integration	363	19.3
4. Supply integration	370	19.7
5. Marketing	121	6.4
6. Others	84	4.4
Complex agreements of which	383	20.4
2 & 3	100	5.4
2 & 5	59	3.1
3 & 5	72	3.8
2 & 3 & 5	38	2.0
1 & 3	22	1.2
Other combinations	92	4.9

Source: Chesnais (1988), and OECD (1994).

The MERIT-CATI data bank developed at the University of Limburg has become one of the largest and most detailed sources of information on international alliances, in particular strategic technological alliances.[22] In this category of alliance, MERIT reported an increase in the number of technology alliances created during the period 1983 to 1989, with 600 alone being created in 1989. The data did not include those created under the European Community technology programmes.

Under this MERIT survey covering alliances within and between blocs, it was found that intra-bloc alliances were technology related, while inter-bloc were market-related. Out of a total of 4192 strategic technology alliances in the data bank, 37.2% were created in the first half of the decade, and 62.8% in the second half.[23] But, the higher volume of alliances created in this second half was attributable to intra-bloc activity rather than inter-bloc. The distribution of alliances between blocs by 1989 (the total for the two periods) was 19.2% intra-Europe, with 22.4% Europe-USA, 6% Europe-Japan, intra-US 24.4%, US-Japan 13.9%. However, some 24.4% of the total were within the US and 13.9% between US and Japan, with the remainder within Japan, the newly industrialised countries, and less developed countries.[24] An analysis of the sectoral distribution of the alliances in the MERIT-CATI data bank indicated some sectors were more alliance-prone than others, while regionally the pattern of alliances favours the triad - Europe, US, and Japan - very strongly.

Table 2.6 International distribution of strategic technological alliances (DC - developed countries)

Technology area	No.	% in DC	% in Triad
Biotechnology	846	99.1	94.1
New materials	430	96.5	93.5
Computer	199	98.0	96.0
Ind. automation	281	96.1	95.0
Microelectronics	387	95.9	95.1
Software	346	99.1	96.2
Telecomm.	368	97.5	92.1
Misc. IT	148	93.3	92.6
Automotive	205	84.9	82.9
Aviation	228	96.9	94.3
Chemicals	410	87.6	80.0
Food/beverages	42	90.5	76.2
Heavy electronics	141	96.5	92.2
Medical Instruments	95	100.0	100.0
Other	66	90.9	77.3
Total	4192	95.7	91.9

Source: MERIT/CATI, reported in Hagedoorn (1995), p. 44.

From the point of view of the concerns in this thesis, the MERIT/CATI data bank throws some light on the pattern of international alliances that was developing in the 1980s, forming the backdrop to the European Community technology programmes. But it does not elaborate to any great extent on the range of motives behind such alliances, which is also one of the concerns of the thesis. The studies of alliances which MERIT conducted highlighted the role of multinational corporations in this type of strategic activity, and concluded that strategic considerations could also restrict the growth of technology alliances as firms took account of transaction costs, and for the need to retain control over important resources.[25]

2.4 Motives for collaboration

The foregoing section highlighted the growing volume of international collaborative ventures. Given the natural evolution of this pattern, why should economic actors wish to engage in the regulated activities under the European Framework Programme? The question is relevant to assessing the likelihood of further integrative pressures and demands, and to whether the behaviour of economic actors may be extended to transfer loyalty to the central authority. Chapter six of this thesis considers the empirical data regarding participation in the BRITE-EURAM programme, while this section offers a more general analytic framework which will be used later on in chapter six to examine the participants behaviour.

In general, there are a number of overlapping objectives which collaboration can help to achieve:

- risk reduction
- economies of scale and/or rationalisation
- technology exchanges
- co-opting or blocking competition
- overcoming trade barriers
- facilitating initial international expansion of inexperienced firms
- vertical quasi-integration advantages of linking the complementary contributions of the partners in a `value chain'.[26]

One of the more significant risks associated with technology collaboration is that of appropriability of the new knowledge. A large firm considering an alliance with a smaller partner may fear the knowledge gained through the alliance could be used to attack market share, or otherwise gain competitive advantage. More commonly, small firms fear losing their knowledge assets to the acquisitive strategies of large, aggressive partners. Aspects of European Community policy have been directed at alleviating such risks.

Competition policy operates to tackle anti-competitive behaviour. Alliances which are supported by the European Commission's initiatives are set up under certain rules and conditions, with clearly stated terms of reference. There is no change in the existing control structure of the participants' organisations, unless this is the express intention of the participants. SMEs may obtain particular advantages from collaborating under the protective umbrella of the European Framework Programme - where partners are identified, costs shared, and new market contacts created.

Successful collaboration may have other spin-off benefits. Participants may forge deeper understandings of the problems and difficulties, as well as the advantages of international alliances, and learn to operate within national and cultural differences. As a result of the communication involved, other areas of common or potential interests may be identified. National authorities may not have the resources, or the wish to assist in the creation of joint ventures that span national frontiers, to the same extent as the European Commission.

The benefits for organisations that are not major actors in the international economy can be substantial. While one partner may contribute certain critical resources, such as technological skills and assets, another partner may provide financing, complementary technical know-how, or access to the large domestic or international markets for the product of the joint R&D effort. The decision to engage in collaborative R&D is essentially the result of a cost-benefit analysis. Table 2.7 illustrates the factors affecting the joint R&D decision.

Table 2.7 Factors affecting the joint R&D decisions

Potential Benefits	Potential Risks
1. Spreading costs and risks of R&D	1. Risk of sharing proprietary R&D
2. Access to technology and know-how	2. Desire for control
3. Access to markets	3. Agreement on design specifications
4. Competitive positioning	4. Minimum efficient scale in R&D
	5. Government R&D policies

Joint R&D has a further advantage over independent efforts, by allowing access to large domestic and international markets. Given the fixed costs of innovation, the larger the market the higher the joint venture's expected rate of return from R&D activities. Immediate access to a large market is especially useful where the product life cycle is short. The expected sales from an innovation are dependent on both the market size and the length of time over which the produce is sold in these markets.

While the benefits of collaboration may be obvious, the critical success factors needed to ensure success are less easy to quantify. One difficulty in technological collaboration projects is that of reaching agreement on the size of the project, in terms of the financial and technical scale, and hence the design specifications and budget allocations to cover the project activities. Even with careful planning, projects do sometimes go over budget, as the recent examples of the proposed new British Library and the Channel Tunnel exemplify, and the problem then is to maintain consensus among the partners on a favourable path towards project completion.[27] Public support programmes must be directed to the joint interests of partners, and to creating the necessary synergy to meet those interests. An ambiguity of policy outcome may suggest that this synergy has not been achieved. Government programmes to promote technical change often try to reflect the objectives of firms on the one hand, and more general objectives which reflect a societal interpretation of technical change.[28] In this respect, the duality of purpose often results in an ambiguous outcome. However, technology policy itself remains one of the areas of public policy where the outcome of intervention is perhaps least understood.[29]

How well has the European Commission understood the motives for collaboration? The annual Competition Reports monitored the pattern of collaborative agreements within the European Community, including those research agreements under the block Regulation 418/85 that gave exemption from Article 85(3) of the Treaty. Under this regulation, entered into force on 1 March 1985 for a period ending 31 December 1997, agreements between undertakings could include research and development of products and processes, and also joint exploitation of the results of that R&D without infringing Community rules on competition. The exemption also covered the exploitation of the results of prior agreements between the same organisations, and all exempted joint R&D activity had to be carried out in the framework of a defined programme.

Mindful of the central role the Community played in promoting competition, the block regulation was applicable only where all the parties had access to the results, and one party could, if it so wished, go on to exploit the results independently. The ambiguity referred to above was evident in the condition that joint exploitation was allowable `where the know-how resulting from the common R&D contributes substantially to technical or economic progress and constitutes a decisive element for the manufacturing of new or improved products.'[30]

One of the problems with this condition was the difficulty of assessing at such an early stage the likely contribution of R&D results either at the level of the enterprises concerned, or more generally to `technical and economic progress'. Economic and technical progress is a political goal which was not given any clear definition by the European Commission, creating by its failure to do so plenty of opportunity for ambiguity in the policy outcome. Furthermore, political goals may not bear a direct relation with the immediate objectives of firms. The risk therefore is that a policy linked to dual objectives serves none of the relevant interests, and ultimately faces the criticism of all interests.

An instance of the political nature of the block exemptions concerns the restriction to undertakings which together have a market share of less than 20%, thus facilitating the participation of SMEs. Earlier, reference was made to the MERIT study of international alliances which suggested that much of the alliance activity was carried out by large corporations. The Commission policy bias in favour of small and medium sized firms was clearly designed to broaden the alliance pattern within the European Community, and in doing so to widen the collaborative technology net.

The Competition Reports offered an indication of the collaborative activities by European firms within the Community, and with organisations outside. Distinguishing between mergers (including takeovers and acquisitions of minority holdings) and joint ventures, the Commission noted in 1984 that firms motivated by research and development considerations opted for industrial joint ventures as the most preferred form of collaboration.[31]

It also noted that in the high-technology industries there was a tendency to seek collaboration with firms outside the European Community when motivated by research and development considerations. However, it must be said that R&D was not the over-riding concern in seeking collaboration of any type, and tended to be associated with other motives, principally with production and marketing motives. And, while the range of motives identified by the Commission increased over the period 1984 to 1993, research and development continued to hold a subsidiary position as far as organisational strategies were concerned, indicated by Table 2.8.

Table 2.8 (a) Main motives for industrial joint ventures 1985 1992

	1985	1986	1987	1988	1989	1990	1991	1992
Production	8	12	15	19	n/a	n/a	n/a	n/a
Prod/mkt	5	n/a	7	2	n/a	n/a	n/a	n/a
R&D	10	10	7	n/a	n/a	n/a	7	4
R&D/prod	3	6	5	n/a	n/a	n/a	n/a	n/a
R&D/prod/mkt	n/a	n/a	18	27	12	18	n/a	n/a
Rationalisation	14	10	11	n/a	n/a	n/a	n/a	n/a
Specialisation	7	n/a	4	n/a	n/a	n/a	n/a	n/a
Strengthen mkt position		7	3	3	22	38	33	24
Expansion	4	7	4	5	17	15	11	11
Diversification	n/a	n/a	1	2	4	3	1	1
Synergy	n/a	n/a	n/a	n/a	n/a	n/a	18	14
Complementary	n/a	5	3	5	11	3	n/a	n/a
Marketing	n/a	n/a	11	3	n/a	n/a	n/a	n/a
Restructuring	n/a	n/a	n/a	13	5	22	n/a	n/a
Other	4	5	2	13	6	12	14	3
Not specified	12	19	9	17	42	27	36	31
Total	67	81	100	109	119	138	120	88

Source: CEC, Competition Reports for the years 1985 to 1992.

Table 2.8 (b) Main motives for mergers 1985-1992

	1985	1986	1987	1988	1989	1990	1991	1992
Expansion	32	29	50	54	115	126	100	78
Diversification	9	20	13	23	26	14	10	5
Specialisation	12	3	3	5	n/a	n/a	n/a	n/a
Strengthen mkt position	15	18	26	70	55	212	174	107
Synergy	n/a	n/a	n/a	n/a	n/a	n/a	48	14
Integration	2	n/a	3	6	n/a	n/a	n/a	7
Restructuring	n/a	n/a	n/a	41	14	57	n/a	n/a
Complementarity	19	23	28	54	39	26	n/a	n/a
Rationalisation	61	56	67	n/a	n/a	n/a	n/a	9
R&D	3	4	20	2	n/a	n/a	n/a	n/a
R&D/prod/mkt	n/a	n/a	4	2	n/a	3	n/a	n/a
Cooperation	n/a	n/a	3	n/a	n/a	18	4	3
Other	4	7	21	19	18	12	29	3
Not specified	47	66	77	107	125	27	126	31
Total	204	226	315	383	392	495	491	257

Source: CEC, Competition Reports for the years 1985 to 1992.

The above table gives a sense of the motives and objectives that underpinned the different forms of collaborative activity undertaken by European organisations in the 1980s, rather than offering a comprehensive and detailed numerical view of the volume of alliance arrangements. It is clear that the complexity of motives increased considerably, with additional motives being identified as the decade wore on. The rising number in the `not specified' category for both mergers and industrial joint ventures bears out the difficulty of identifying clear objectives in the behaviour of firms. However, one of the more immediately obvious features of the table is the predominance of motives very directly related to market-based concerns.

Merger activity was important for expansionary strategies, as well as to strengthen market position and achieve complementarity in operations, particularly in the second half of the decade when firms were setting strategy in the light of the proposed single market. Diversification strategies accounted for some of the merger activity in the first half of the decade.

Industrial joint ventures allow for cooperation in certain activities, while the partners retain their respective independent units and identities, as is the case with the forms of cooperation under the European Community Framework Programme. Yet here also, market-related strategies were predominant. Industrial joint ventures were undertaken to strengthen market position, or to expand, as well as more general cooperation activities. Research and development strategies were not prominent in either of the general categories considered, although there was a slight increase in the research strategies towards the end of the decade.

While this does not mean R&D was considered unimportant, it is certain that firms engaged in alliances for a variety of motives, combining research with production and marketing. The Framework Programme, and its constituent programmes provided the enabling environment to encourage cooperation for the purposes of R&D. Undoubtedly, there would have been less R&D cooperation without the support of the European programme and the European authorities were convinced that this form of market failure called for a policy to compensate.

In the 23rd Competition Report, issued in 1993, acknowledged this responsibility by saying `policy needs to concentrate on horizontal measures and on areas where there is a failure of the market either to invest enough or to invest quickly enough (notably R&D, the environment, innovation and training)'.[32]

2.5 Sectoral and geographic analysis

The preceding section suggested that firms were not naturally disposed to alliance activity for solely research and development motives. Here, some consideration is given to the question whether this claim can be made in respect of all industrial sectors generally, and whether differences in the geographic pattern has been established or is likely in the future.

Evidence from a number of sources suggests certain differences in the sectoral pattern of alliances, but nevertheless a significant emphasis on market access.[33] In the capital-intensive sectors, however, there is a greater tendency to engage in alliances with a technology motive, as is the case with sectors which exhibit rapid changes in technology. By the early 1990s, there was a stabilisation of alliance activity within Europe, and with the concentration of activities in some sectors firms faced the option of alliances to further globalisation aims. However, many of the industrial sectors in Europe retain lower levels of concentration than US industry, leaving plenty of scope for further alliance activity in the future.

At a sectoral level, future alliances in European sectors such as air transport, food and drink, chemicals, pharmaceuticals, and vehicle assembly are considered either very likely or necessary. The belief that a competitiveness gap persists will support continued alliance activity, but the evidence so far is that such activities are much less focused on R&D than more downstream activities. This was the conclusion of the 1994 Panorama of EU industry, in a review of alliance activity prepared for the European Commission by a group of external consultants.

Table 2.9 Future trends in alliances by sector

	EU	**US**	**Japan**
Air transport	O	X	X
Aerospace equipment		X	X
Computers		X	X
Food and drink	O	X	X
Chemicals excl. pharma.	O	X	X
Pharmaceuticals	O	X	X
Biotechnology		X	X
Telecom equipment	X	X	X
Semi-conductors	X	X	X
Auto components	X		O
Vehicle assembly	O		X

O= very likely/necessary
X= likely
Source: CEC (1994) Panorama of EU industry, p. 26.

The Panorma of EU industry also considered that the level of alliance activity was most likely to continue in Europe, while those European firms looking to gain a foothold in the non-European markets such as the United States and Japan would experience difficulties, partly attributable to market restrictions in those countries, and partly due to their own competitive capability. The report accordingly predicts a continued need for alliances, and particularly for those which focus on technological outcomes. While it could of course be accused of making a case for an extended role for the European Commission in a technology policy which is sustained on the basis of R&D alliances, the evidence presented by the World Competitiveness Table, published jointly until this year by the IMD Business School in Lausanne and the World Economic Forum (see Tables 4.5 and 4.6) suggests that the competitive position of European industry leaves much room for improvement. The tables have been published annually for a number of years and are widely reported in the national press throughout the European Union, with the placings of the individual countries the subject of comment by a variety of interested parties, often disregarding the actual basis of the listings or the possible accuracy.

The sectors targeted by the BRITE-EURAM programme, essentially traditional manufacturing industry, have experienced a continuing decline in competitiveness against competitors in not only the United States and Japan, but increasingly from firms in the newly industrialising countries as well as Eastern Europe.[34]

2.6 Conclusion

2.6.1 Review and analysis

As this chapter has shown, many of the alliances have been sought for reasons other than research and technology acquisition. Alliances were multi-directional, both at the sectoral level and at the geographical level. The common link binding all of these alliances was the pursuit of competitiveness, and the fact that this pattern of international behaviour was developing against the background of policies for the promotion of competitiveness at the national and the European level.

We are left with a situation in need of further analysis. Despite the higher spending on R&D by the European business sector throughout the decade, the higher volume of alliance activity which the European technology programmes fostered was not always directed solely at research and technology. It would seem that, in many respects, the European Commission was imposing a pattern of activity that would not have otherwise developed naturally. But it was able to do so for two reasons. Firstly, there was a developing pattern of alliances, a culture and environment which made its own particular approach seem both reasonable and acceptable. Various forms of collaboration were entering business culture and becoming a normal part of strategy.

Secondly, competitiveness became a political issue in the 1980s, at the national and supranational level. The Commission acted on the basis of this politicisation, and tied technology policy to the pursuit of competitiveness. Alliances would thus be fostered, at the European level, that would both increase technological capability and at the same time strengthen the competitive capability of European industry. It was fortunate that while the alliance pattern was emerging as a natural response to the general threat of increased international competition, governments of the member states were also seeking to combine support for competitiveness policies with a desire to shift the responsibility for research and technology to the private sector.

There has been some degree of success in this, and most of the member states of the European Community saw an increase in business spending on research and development, and also an increase in the number of researchers employed in business over the past decade. Yet, despite the increase in industrial spending on R&D, many European companies did not put as high a priority on research as American and Japanese firms. In 1990, for instance, European industry's share of total R&D spending was 65%, contrasted with 76% in Japan and 69% in the United States.[35]

From the early 1990s, there was a degree of stabilisation and in some cases a decline, in business spending on research, and also in the level of collaborative activity. Much of the stabilisation seen in business spending in 1991 could be attributed to the reunification of Germany, and to the costs and uncertainties associated with the political change in the largest R&D spending member state. These areas of business activity are influenced by the general economic climate and the possibility of high return on investment. Market failure can mean a less than adequate level of business R&D, as the European Commission recognised, making a case for public policy of some kind.

Where, then, can the integrative pressures arise in the European technological community? There are a number of possibilities where public policy and business strategy could coincide, leaving the way open for further integration. We have seen in this chapter that the wide range of motives for alliances do not always extend to cover technological motives. A public policy which supports such motives has an obvious role to play. But there are other aspects to technological collaboration, which require public support or coordinated policy of some kind.

Research and development spending is just one activity in the link between R&D and the market. Innovation of new techniques, diffusion of knowledge and the results of research and development may be the subject of market failure just as much as the required quantity of research spending, and economic actors may be unable to follow-up the results of research activities because of such market failure. At the same time, the competitive pressures building up in the international economy demand that they should be able to use the results of research efforts, and that an economy must sustain competitiveness on the basis of innovation and diffusion. These issues represent, therefore, likely sources of further integrative pressures from the European technological community.

The predicted continued trend in international alliances needs to be considered in the context of the variety of motives behind such behaviour. Increasingly, such motives are likely to be market-related, either those of access or of protection. Economic actors are therefore likely to articulate their demands on the basis of not simply technology creation and exchange but also overcoming trade barriers, co-opting or blocking competition, and more generally risk reduction over a globalised market space, increasing the degree of instablility of the alliances.[36]

2.6.2 Technology collaboration and integration

On the other hand, technological change depends on the level of innovation and diffusion as much as the level of research and development spending. And the connection between R&D spending and innovation and diffusion is not so simple as is often assumed. Indeed, the capacity for innovation and diffusion is related to a broad set of circumstances and relations at the local level, quite distinct from the amount of collaborative research and development being done at the European or international level. Relations between industry and the scientific and technological community, communication networks, technology transfer mechanisms, and levels of educational attainment and skills development all contribute to an institutional structure that influences technological capability.

The institutional structure referred to above has a distinctly national, and local, character. Further integrative pressures are likely, therefore, to be balanced between a focus on the domestic institutional structure which has such an enormous influence on general technological capability, and a more European focus able to contend with the pressures and demands coming from the international and global economy.

The ability of the European Community to provide financial support for industrial R&D at a time when national governments were reducing such support, and to link such support to improving industrial competitiveness was essential to the initial integrative demands directed at the first phase of the European technology policy. But the implementation of policy has highlighted, too, the differences in national institutional structures, which affect the capability to innovate and diffuse new knowledge.

The essential point here is that any study of the integration process must consider not only the flow of demands and expectations to the central authority, but also a reverse flow of expectations and demands, directed to the domestic institutional structure within which economic actors operate. Even in an increasingly international and global climate, the established structure of social and political relations bears its mark on the actors within it. There is a collaborative network already in place, and a set of social relations that structures the interests and expectations of those in the network.

The creation of a collaborative technological network at the European level demands more than bringing together a group of economic actors to work on joint research and technological development projects. We have already seen that economic actors tend to, by themselves, pursue alliances for a whole range of commercial reasons, and in fact alliances of this nature can be extremely unstable. The network has to be built around institutional structures, linking a series of collaborative webs already in place within the national and regional system.

In conclusion, the literature on alliances does provide a concept that could also offer a more appropriate alternative to the notion of loyalty transfer in the process of integration. Trust between the participating interests is crucial to the success of collaboration, and it is established through a process of learning.[37] The social basis of collaboration among economic actors, and the quality of the social relations, give rise to trust in a process of repeated interaction. The result of reiterated action produces learning among the actors, which forms the basis for trust, and the key to future collaboration.[38]

Trust is described as an expectation, built up over time, that a collaborative partner will behave in a certain acceptable way. It has been described by two contributors to the literature on alliances as operating in the following way, `interaction between firms develops over time. It takes time to learn about each others ways of doing and reviewing things and how to interpret each others acts. Relations are built gradually in a social exchange process through which the parties may come to trust each other. ... Over time, as a consequence of interaction, bonds of various kinds are formed by the parties. There may be technical bonds which are related to the technologies employed by the firms, knowledge bonds related to the parties' knowledge about their business, social bonds related to the administrative routines and procedures of the firms, and legal bonds in the form of contracts between the firms'.[39]

Such are the necessary conditions to an integration process built upon the promotion of a European technological collaborative network. But they are not sufficient unless the process also takes account of the already existing set of relations inherent in institutional systems, where social and political relations have been created. The following chapter examines one such attempt by the European Commission to create an institutional system which would facilitate the social relations inherent in cross-border technological collaboration.

Notes to chapter two

1. Kelvin W. Willoughby (1990) Technology Choice. A Critique of the Appropriate Technology Movement [London, Intermediate Technology Publications].

2. There have been a few recent efforts to change this situation. See, for example, Eugene Skolnikoff (1993) The Elusive Transformation. Science, Technology and the Evolution of International Politics [Princeton, NJ., Princeton University Press]; Etel Solingen, ed. (1994) Scientists and the State: Domestic Structures and the International Context [Ann Arbor: University of Michigan Press]. Solingen is especially concerned with the external impact on the domestic politico-scientific structure, while Skolnikoff traces the relationship in reverse order.

3. Robert Gilpin (1987) The Political Economy of International Relations [Princeton, Princeton University Press], pp. 211-212.

4. Ibid., p. 211.

5. Ibid., p. 237.

6. The European Commission, itself, made much of the technology gap between Europe and its main competitors, putting this gap forward as the basis for the establishment of a technological community. See Towards a Technological Community, COM (85) 350 final. See also G. Dang Nguyen (1985) 'Telecommunications: a challenge to the old order', in M. Sharp (ed) Europe and the New Technologies.

7. These figures are taken from OECD (1994) Science and Technology Policy Review and Outlook, pp. 142-143.

8. OECD (1994), p. 136.

9. These figures are taken from Eurostat, Research and Development Annual Statistics 1994, p. 119.

10. P. A. Yotopoulos and J. Nugent (1976) Economics of Development: Empirical Investigation [New york, Harper & Row].

11. P. H. Lindert and C. P. Kindleberger (1982) International Economics, 7th ed., [Homewood, Ill., Richard D. Irwin].

12. OECD publications sometimes include both science and technology in the title, with the implied suggestion of a distinction between the two. However, closer examination shows that the organisation takes a more integrated view of the policy. See OECD (1992) Science and Technology Policy: Review and Outlook 1991 [Paris]. The report includes a discussion of the need to link research to technology and the market place.

13. Dasgupta offers an explanation - `it is not uncommon to be offered the distinction that science deals with the general while technology deals with the particular, that science is concerned with principles, while technology concentrates on applications, that science resides in the abstract plane of ideas while technology is grounded on the development of products and manufacturing processes', - P. Dasgupta (1987) `The Economic Theory of Technology Policy: An Introduction' in P. Dasgupta and P. Stoneman Economic Policy and Technological Performance [Cambridge University Press].

14. B. R. Inman and Daniel F. Burton (1990) Technology and Competitiveness: The New Policy Frontier Foreign Affairs, 69,9, p. 124.

15. `Our decisions on whether or not (or how fast) to proceed with complicated technologies, like SDI, are now determined - by and large - politically rather than scientifically' - Kenneth H. Keller (1990) Science and Technology Foreign Affairs, 69, 4, p.135.

16. See Laura Tyson (1993) Who`s Bashing Whom? Trade Conflict in High-Technology Industries [Washington, Institute for International Economics]; Lester Thurow (1992) Head-to Head: The Coming Economic Battle Among Japan, Europe and America [London, Nicholas Brealey Publishing].

17. David H. Brandin and Michael A. Harrison (1987) The Technology War: A Case for Competitiveness [New York, John Wiley & Sons].

18. Inman and Burton (1990), op. cit., p. 126.

19. Linda Cohen (1991) The Technology Pork Barrel [Washington, The Brookings Institute]. In attempting to meet a variety of political interests, a technology policy may be developed which is based upon the lowest common denominator - being the least likely to generate conflict, without in any way pushing forward the technological frontiers.

20. See, for instance, J. Hagedoorn and J. Schakenraad (1990) Strategic Partnering and Technological Cooperation, in B. Dankbaar and J. Groenewegan, H. Schenk (eds) Perspectives in Industrial Economics [Dordrecht, Kluwer]; Håkan Håkansson (1989) Corporate Technological Behaviour. Co-operation and Networks [London, Routledge].

21. See F. Chesnais (1988) Technical Co-operation Agreements between Firms, STI Review, No. 4 (Paris, OECD).

22. Strategic technology alliances were defined as inter-firm agreements covering joint R&D and/or other innovative activities that were assumed to affect the long-term product market positioning of those firms concerned.

23. See Chris Freeman and John Hagedoorn (1995) `Convergence and Divergence in the Internationalization of Technology', in John Hagedoorn, Technical Change and the World Economy (Aldershot, Edward Elgar), p. 42.

24. Freeman and Hagedoorn (1995), ibid., p. 43.

25. Chris Freeman and John Hagedoorn (1995) `Convergence and Divergence in the Internationalization of Technology', in J. Hagedoorn, Technical Change and the World Economy (Aldershot, Edward Elgar), p. 54.

26. Michael Porter suggests that, where collaboration is pursued, each partner should contribute to the value chain so that the combined efforts add up to a value chain that can produce a more competitive end result. A successful joint venture needs compatibility of partners` strategies - something that may prove difficult where partners have different national backgrounds, corporate strategies, market strategies, etc. Michael Porter (1985) Competitive Advantage: Creating and Sustaining Superior Performance [New York, Free press].

27. Harrigan identifies joint interests as crucial - ventures that are horizontally and closely related are expected to perform better than ventures that are vertically related. It was further suggested that partners from similar cultures, asset sizes and venturing experience, engaged in similar activities, might have more success particularly if they identified their respective competitive needs. K. R. Harrigan (1988) Strategic Alliances and Partner Asymmetries in F. J. Contractor and P. Lorange, Cooperative Strategies in International Business [Lexington, Lexington Books].

28. E. Sciberras (1987) Government sponsored programmes for international technological exchanges and applied collective research R & D Management, 17, 1.

29. The OECD has made some attempt at an analysis of the role of technical change in international competitiveness. While at a micro-level, the costs and prices of the individual firm or industry are key determinants, at the macro-level a complex array of forces have an impact on competitiveness. The current tendency is to take a holistic approach, encompassing the interaction between business strategies, industry structure, and institutional factors (including the interaction between industry and the academic sector, the quality of human capital, and the financial sector. See OECD (1992) Technology and the Economy: The Key Relationships [Paris, OECD], ch. 11.

30. CEC (1984) 14th Competition Report, p. 19.

31. See CEC (1984) 14th Competition Report, p. 201.

32. 23rd Competition Report, 1993, p. 24.

33. This appears to be borne out strongly by Hagedoorn (1995), and from the evidence of the 23rd Competition Report. See also CEC (1994) Panorama of EU industry, which provides an analysis of sectoral patterns of alliances.

34. See Frédérique Sachwald (1994) European Integration and Competitiveness. Acquisitions and Alliances in Industry (Aldershot, Edward Elgar)

35. See OECD (1994) Science and Technology Policy Review and Outlook (Paris).

36. See Turner and Hodges (1992) who argue that the forces of global competition will exacerbate the pressures on many alliances, making them purely temporary arrangements among even the very large firms - p. 72.

37. See, for example, C. Ciborra (1991) Alliances as Learning Experiences: Cooperation, Competition and Change in High-tech Industries, in L. Mytelka, Strategic Partnerships and the World Economy (London, Pinter). Here, alliances are seen as forms of institutional arrangements that facilitate learning by firms upon which are based a variety of innovation strategies.

38. P. J. Buckley and M. Casson (1988) A Theory of Cooperation in International Business, in F. Contractor and P. Lorange, Cooperative Strategies in International Business (Lexington, Lexington Books),

39. H. Hakansson and J. Johanson (1988) Formal and Informal Cooperation Strategies in International Industrial Networks, in Contractor and Lorage, op. cit.

CHAPTER 3

EUROPEAN POLICY - COLLABORATION UNDER BRITE-EURAM

3.1 Introduction

The preceding chapter examined the growth in international alliances during the 1980s. It concluded that a range of motives underpinned this development in international business, factors that were broadly commercial in orientation with technological motives being very much secondary. Yet, the European Commission was able to launch a series of programmes during the decade designed to increase the volume of technological alliances in Europe, and in so doing to create a European technological community. That it was successful at one level, in the number of collaborative links created, is evident, but the assertion that technological motives were secondary raises the question why so many organisations were prepared to participate in these programmes.

The question is addressed in this chapter specifically to one of the programmes, the BRITE-EURAM programme, which fosters cross-border collaborative research and development of a pre-competitive nature among industrial firms, research centres, and universities in the European Community. Introduced in 1985, and designed along similar lines to other collaborative research programmes in the European Framework Programme, it has now been in operation for ten years.

It is targeted at Europe's largely traditional manufacturing sector, which still accounts for a significant amount of employment throughout the region. BRITE-EURAM has developed, therefore as a multi-sectoral programme, and in this respect differed from the two other major programmes, ESPRIT and RACE, which were single-sector initiatives, in the information technology and telecommunications sectors.[1]

BRITE-EURAM was not as prestigious as the other two programmes, and did not receive the extent of financial support for industrial collaborative research allocated to

ESPRIT and RACE under the Framework Programme, but neither did it attract the same degree of attention or opprobrium. Appendix 4, at the end of this thesis, shows a gradually increasing share of the Framework Programme budget over the decade going to industrial and material technologies, while the range of activities and objectives of the BRITE-EURAM programme has also been extended. Although the information and communication technologies continued to attract the largest share of the Fourth Framework Programme budget, its percentage had declined in favour of other areas such as industrial and materials technologies, environment, life sciences, socio-economic research and international cooperation.

Moreover, the BRITE-EURAM programme has succeeded in creating a large collaborative network, a web of alliances that span the member states of what has now become the European Union. By the end of 1994, there were 1577 projects overall running under the programme, compared to an overall total under the ESPRIT programme of 719. In that year alone, 706 new projects were agreed under the BRITE-EURAM programme, involving 1836 participants, while 178 projects with 983 participants were launched under the ESPRIT programme.[2]

This chapter considers how the BRITE-EURAM has managed to build up this web of alliances through an examination of the programme's inception and development. It will consider how the programme was formulated, and the method of implementation, and will give particular attention to the process of interest group involvement at the different levels.

While the fortunes of the programme were determined at a general level by the Framework Programme negotiations, once the overall budget of the latter was concluded the European Commission had quite a degree of freedom to decide the programme direction, content, and participation rate. The explanation for this major role of the European Commission may be found in a memorandum from the Commission to the European Council in 1985, entitled <u>Towards a Technological Community</u>.[3]

3.2 Roots of the Community process

In the memorandum to the European Council, issued in June 1985, the European Commission set out the basis for the creation of a technological community, the means by which the community could be established, and the political, institutional system charged with the management of the community process. By this time, some of the collaborative programmes had already moved beyond the embryonic stage to become fully operational, and provided the models for the proposals outlined in the Commission memorandum.

The basis for the proposed technological community was that common interests called for it. It was in the interests of the whole of the European Community to `strengthen the technological bases of European industry and to develop its international competitiveness', and the challenge facing Europe was that of being able to counter-act the competitive and innovative threat from the rest of the world but particularly, the memorandum suggested, from Japan and the United States.

Europe's comparative technological position was key to the argument, and in the memorandum the European Commission used it as a bench mark against which to detail the various areas in which progress had to be made. The extent of the comparative gap between Europe and its two main competitors was identified right at the beginning of the memorandum, with the effect that the Commission had straight away identified a basis on which common action and political will could be united.[4] The rivalry between international firms over technology flows, and between states over technology policy that was identified in chapter two provided therefore a very important source of consensus among the European member states for the proposal to create a technology community.

Like earlier attempts that were made in the 1960s to develop a European technology policy, the European authorities picked up on one of the issues that would be most likely to attract political support, especially from the member state governments.[5] The memorandum addressed several additional issues that had proved the basis for disagreement in European technology policy two decades earlier.

The first issue concerned national technology policies, and where these fitted in with the European proposals to create a technology community. European programmes would supplement, not supplant, national efforts, and `the European Technology Community would also be required to promote the coordination of national and Community policies, to propose the means of strengthening their complementary aspects.' The Commission memorandum provided the necessary reassurance to national governments that their efforts to deal with domestic circumstances would not be adversely affected by the proposals.

Here again, previous collaborative efforts cast a long shadow. Technological collaboration in the aircraft and aerospace sectors, and other sectors where collaborative technological projects had been attempted, had mixed results stemming partly from continuing efforts of the national governments to pursue firmly national interests.[6] Joint efforts ultimately failed through the unwillingness of national governments to make the large financial commitments, and the perception that joint collaboration represented a zero sum game as far as national interests were concerned.

The Commission memorandum promised to `reconcile unity of vision and strategic coherence at Community level with the greatest possible flexibility in the management and financing of programmes and in the level of participation by Member States and their nationals.' Large and increasing financial demands to support an emerging technology policy were unlikely to meet with the support of European national governments in the early 1980s, or indeed any time afterwards. With this in mind, the memorandum placed emphasis on shared-cost initiatives, and on the `variable geometry' nature of the proposed community. Not all of the financial burden would fall on member state governments, and the actual return to each member would be determined by the level of participation of national organisations.

The memorandum also recognised the fact of international cooperation in science and technology, and proposed that the European technology community should continue this cooperation with international institutions and countries outside the European Community. Although not all technology efforts could, or indeed should be, conducted at the Community level, the Commission document focused on the synergetic effects of national, community and international efforts.

Having clarified national governments' concerns regarding the financial requirements and the position of national technology policies, the Commission then identified the roles and responsibilities of the European institutional system in the formulation and implementation of a European technology policy. The division of responsibilities would effectively reflect what was already in place in the European Community. The Commission would `fulfil its role as the driving force by issuing proposals on its own initiative for the adoption and review of the framework programme and following up its implementation.'[7]

The European Council would maintain its stewardship of Community developments, and consult the European Parliament before fixing the budget limits for technology programmes. Mindful of the European Council's ever cautious approach, the Commission was also anxious to establish its own position as the body which could give impetus to the creation of a technology community - `the council decisions adopting the major specific programmes could conceivably be taken unanimously, but the ways and means of implementation should then be decided by a qualified majority and with considerable delegation of executive powers to the Commission.'[8]

Overall, the Commission memorandum described the context and purpose of the proposed policy, the broad industrial and technological objectives to be met, and the method of implementation. Its significance lay in the fact that it was the first comprehensive communication regarding a European technology policy for over two decades, and one which provided a coherent statement of how the overall policy might develop.

But it was a communication where caution took precedence over any radical policy proposals. There was no challenge to national policies, and no intent to effect a structural technological change in European industry. Although a European dimension to technology policy could have provided the scope for a much more radical proposal, the Commission clearly decided to play safe, and to build a policy and a community on the existing conditions that prevailed in Europe. The conditions were in any event favourable - a growth in the volume of international alliances combined with a concern over the competitiveness of European industry that was shared by both national governments and the business community. Green Cowles (1995) showed that the large corporations were eager for some initiative, using the European Round Table as a very effective vehicle, and giving an overwhelming response to the European Community's ESPRIT programme when it was first launched. Indeed, the success of this early ESPRIT initiative provided the basis for the introduction of the telecommunications programme (RACE) and other programmes, including BRITE-EURAM (Sharp and Shearman, 1987).

One of the over-riding concerns of the memorandum was the creation of the community itself, one that had a broad base, rather than any particular conception as to the precise nature of the community. If anything, the nature of the proposed technological community was economic - it would be established on the basis of the need to avoid waste through the duplication of national research efforts, and of the need to maintain the competitiveness of European industry, and to protect market share. Beyond this, it was value-free.

The case which the Commission memorandum made for technological collaboration in manufacturing industry (and specifically for the BRITE-EURAM programme) is illustrative of this point - `production technologies are passing through a transitional phase. Europe cannot let slip the opportunity it is being given of capitalizing on existing R&D investments. It must make the optimum use of the assets and resources that exist in the Community. The world market in industrial automation will probably be worth something between US$ 65 million and 75 million in 1989, whereas it represented only

US$ 15 million in 1983. A great economic effort needs to be made to support such growth: the European CIM market should double over the next four years.'[9]

The following section traces the development of the BRITE-EURAM programme, and subsequent sections look at the political processes surrounding its development.

3.3 The BRITE-EURAM development

3.3.1 BRITE (1985-1988)

The BRITE-EURAM programme, under the responsibility of the Commission Directorate-General XII, is an amalgamation of two earlier programmes - the BRITE programme which covered the period 1985 to 1988,[10] and the EURAM programme from 1986 to 1989. The joint programme reflected a realisation on the part of the European authorities and industry of the importance of new materials and generic technologies in the modernisation and restructuring of industry.[11]

BRITE-EURAM represented in large measure the acceptance by the European authorities of emerging ideas concerning the nature of technology as applied knowledge, with the blurring of the traditional science/technology divide (see section 2.2 in the previous chapter), and was directed therefore to the application of technologies so as to upgrade the processes and procedures of ordinary manufacturing operations. By contrast, the already-launched ESPRIT programme, in the information technology sector, and RACE, in communication technology, were more focused on the production of new technologies.

European manufacturing accounted for some 30% of Community GDP when the BRITE programme was first introduced, and a workforce of 41 million.[12] BRITE and EURAM were both introduced to coincide with a renewed debate on the importance of manufacturing to economic welfare and employment.[13] But while manufacturing mattered, it would be developed and supported through the market rather than through direct public intervention - in this case through collaborative research and development projects.

The overwhelming response to the first BRITE programme (1984-1987) showed that industry was interested in cooperative research. The Commission made two calls for proposals, in 1985 and in 1987. A total of 559 proposals were received in response to the first call for proposals, involving almost 2000 proposers mainly in groups of 3-4.

With a budget of only 125 million ECUs it was about five times oversubscribed and a further 60 million was made available with the second call for proposals in 1987. A total of 103 proposals with an average size of 1.6 million ECU were selected at the first call. They were evaluated by 63 independent experts from industrial sectors and universities, who reported the majority of proposals of a high standard capable of making important contributions to the competitiveness of European industry.[14] Following the second call for proposals, some 469 proposals were received, with a slightly higher participation by industry. With the extra money made available the Community eventually was able to support 112 projects under the second call, with an average size of project of 2 million ECU.

The programme identified nine priority themes within which collaborative proposals could be made. These were (1) reliability, wear and deterioration (2) laser technology (3) joining techniques (4) new testing methods (5) CAD/CAM, mathematical modelling (6) new materials (7) membranes (8) catalysis and particle technology (9) new production technologies suitable for products made from flexible materials. Themes 1, 5, 6 and 9 attracted the largest share of the BRITE budget, each receiving 17% of the funds on average. The following section 3.4 will consider how the themes were selected. This first BRITE programme allocated some 67% of the budget to industry, 22% to research centres and 11% to universities.[15] The distribution of the budget between the member states benefited the larger countries, with France and the UK receiving 22% each, Germany 20%, Italy 11%, Belgium and Holland each took 7%. Spain received 4% of the total BRITE budget, but in fact was only eligible to apply for funds under the second call following its accession in 1986.

The overall objective of the BRITE programme was to increase the technological level of industry and through this to achieve an increase in its competitiveness. But the specific aims were to widen the collaborative net to include industrial organisations, academic institutions, and SMEs, while the European dimension centred on strengthening the European collaboration in technological R&D.

3.3.2 EURAM 1986-1989

EURAM was a much smaller programme, with a budget of 30 million ECU, introduced in 1986 to fund collaborative research in new materials, including metals, ceramics and composite materials.[16] A total of 84 projects, with 302 participants, were funded under the programme, from an original 300 proposals. The budget was allocated between the three groups - industry, universities and research centres - with industry receiving 44% of the total, universities 36%, a much higher percentage than the sector received under BRITE.[17]

The distribution of the budget between member states also differed to some extent, with France and the UK receiving 29% and 26% respectively. Much smaller shares of the programme budget went to the other member states, reflecting either strong national programmes in this area, for example in Germany, or lower levels of technological development in some of the smaller states. The German share of the budget was 17%, with 7% going to Italy and 5% to Spain.

EURAM differed from the other collaborative programmes in a number of respects, apart from the obvious one of budget size. Although the areas and issues included were generally regarded as of significance for the competitiveness of European industry -the materials sector accounted for almost 10% of industrial activity, and formed the basis of developments in major industrial sectors such as automotive, aeronautics, building, electronics, nuclear - the evaluation committee noted the omissions in certain areas.

There were overlaps in the areas supported with other programmes, such as BRITE and the ECSC programmes, and like the case of the BRITE programme many of the participants had already established European collaborative links. Nevertheless, the evaluation report found that the level of industrial applications was low and that much of the research work conducted under the programme was categorised as basic research, a fact which may be explained by the high involvement among the university sector.

The industrial response to the programme, although favourable, was somewhat mixed. In particular, many of the industrial participants found it difficult to accept the long-term nature of the research work balanced against short-term commercialisation needs. In this respect, the programme highlighted the different priorities and approaches of the two research communities, the industrial and the academic.

A more serious observation centred on the belief that the programme lacked strategic priorities, and that research themes were selected on a very arbitrary basis rather than being based on a techno-economic analysis which would enable priorities to be defined.[18] The evaluation committee reported `there is a tendency for Europe to reproduce what it knows of American and Japanese research', and identified a lack of insight in the Community that extended from policy makers to industrialists. The lack of clarity and focus was not helped by the limited consultation with other areas of the Commission in the formulation of the programme.

EURAM, it would appear, was a rather hasty attempt by the Commission to counteract the competitive pressures which it saw facing the European materials sector, in a programme that lacked adequate consultation among those groups to which it was directed. It suggested as well a further attempt to construct the collaborative network, regardless of any consideration of the strategic direction that it should take.

The evaluation report on the BRITE programme had recommended that the two programmes be merged, a recommendation that was endorsed by the EURAM evaluation committee.

3.3.3. BRITE-EURAM 1989-1992

The combined BRITE/EURAM had a budget of 500 million ECU from the Commission for the years 1989-1992. Under the first round of proposals in May 1989, 186 million ECU was made available to support 163 projects under BRITE/EURAM out of a total of 645 proposals covering a wide range of industrial technologies and advanced materials applications. A second call for proposals in the following year resulted in an eventual total of 368 projects, from 1304 proposals, receiving support under the programme - with 55% industrial participants (including 22% SMEs, 24% universities and 21% research centres.[19]

Table 3.1 BRITE-EURAM 1989-1992 Distribution of participants

Type of organisation	Number of coordinators	Number of participant groups
Large firms	165	670
SMEs	76	436
Research centres	60	355
Universities	67	473
Total	368	1934

Source: CEC (1993) Evaluation of BRITE-EURAM programme 1989-1992, EUR 15070.

The programme continued to be dominated by larger industrial firms, although the objectives included technology transfer between sectors with a high number of SMEs. The principal objective of the programme was to enhance the competitive position of European manufacturing industry, and additionally to foster trans-frontier collaboration in strategic industrial research, and to transfer technology across Community frontiers. Specifically, the programme was aimed at a small number of identified technical areas, with the budget allocations divided between the different areas (given here in brackets) - the development of advanced materials technologies (28%), design and quality assurance methods for products and processes (19%), applications of manufacturing technologies (19%), and technologies for manufacturing processes (20%). Of the remainder of the budget indicated in the Council Decision of 14 March 1989, 7% was allocated to aeronautics and the other 7% to management costs associated with the implementation of the programme (OJ L 98/18).

As the table below shows, there was a heavy representation among French, German and UK participant groups, with the smaller countries being less well represented.

Table 3.2 BRITE-EURAM National representation 1989-1992

Member states	B	DK	F	D	G	IR	I	L	NL	P	E	UK
Coordinators	21	16	71	67	6	8	40	3	27	7	16	86
Participant groups	118	67	379	377	65	49	198	5	102	78	132	364

Source: CEC (1993) Evaluation of BRITE-EURAM programme 1989-1992, EUR 15070

The merged BRITE-EURAM incorporated a number of amendments in its implementation.[20] Projects were required to include two industrial participants so as to improve the industrial bias, although in fact most of the earlier projects which did receive aid under the first programme included two. Organisations, both industrial and academic, from the EFTA countries could participate in the programme, but they had to fund the general administrative costs of running BRITE as well as a general charge towards the basic administrative overheads of running the Commission generally. The question of EFTA participation had cropped up in the first programme, but then it was considered unacceptable to allow their participation when so many Community firms were rejected.

The BRITE-EURAM programme comprised a number of elements; industrial applied research, focused fundamental research, feasibility awards for SMEs, and coordinated activities. Under the industrial applied research, support was given to pre-competitive collaborative research on a shared-cost basis. Each participant was expected to make a significant contribution to the project, with the contracting parties bearing up to 50% of the costs and the remainder to be borne by the Community.

Research centres and universities were eligible for support for up to 100% of the additional costs of collaboration. Projects were required to include up to 10 man-years of activity, regarded as the realistic minimum for an effective collaborative project.

The focused fundamental research projects involved at least two partners established in different Member States. Where the partners were universities or research centres, the project was required to have at least two legally independent industrial enterprises. Here, the Commission was aiming to maintain the industrial bias of the BRITE-EURAM programme. Industrial participation was designed to ensure that the research matched industry needs, while also maintaining close cooperation between industry and the universities. The project costs in this focused research were expected to fall in the region of 0.4-1 million ECU under BRITE-EURAM I.

The feasibility awards were designed to assist SMEs that were interested in collaborative research, but were as yet uncertain of the degree of commitment which their resources allowed. Here the Commission supported up to 75% (maximum 25000 ECU) of the cost of research lasting up to six months, in order to assist small and medium-sized firms to demonstrate their capability to undertake future collaborative research to potential partners. Research proposals had to conform to the technical areas already identified by the Commission in the BRITE-EURAM programme. Funds were provided to support R&D necessary to establish the feasibility of an innovative device, process or concept within the fields of industrial technologies and the development and application of advanced materials.

The intention was that the results of this research should then become the basis for the firm to participate in the BRITE-EURAM programme. Eligibility for a feasibility award was open to SMEs, defined as those firms employing less than 500 with capitalisation less than 75 million ECU and not more than one third owned by a parent company or any other organisation. The feasibility awards scheme was only open to businesses located within the Community, unlike the main BRITE programme which allowed participation to non-Community partners under certain conditions.

The final component of the programme involved the coordinated activities. In cases where work was already going on and funded by national authorities or privately, the Commission's role was confined to organising the coordination of the work, and Community funding covered the cost of the coordination activities. This component took the smallest share of the programme budget, some 10% while the largest share went to the first group of activities mentioned earlier, the industrial applied research.

By the time the Third Framework Programme (1990-1994) was introduced, BRITE-EURAM had become a well-established programme under its umbrella structure with a much larger share of the total budget (see Table 3.3). BRITE-EURAM II was approved in September 1991 by the Council of Ministers, with a budget of 848 million ECU. It also introduced the CRAFT initiative, specifically to assist SMEs to engage in cooperative research, directly responding to the criticism of the earlier programme regarding low representation of this group.

Table 3.3 Framework programmes - distribution of funds

	%	%	%
	I	II	III
	'84-'87	'87-'91	'90-'94
Information/communications technologies	25	42	39
Industrial/materials technologies	11	16	16
Environment	7	6	9
Life sciences/technologies	5	9	13
Energy	50	23	14
Human capital and mobility	2	4	9
Total (million ECU)	3750	5396	5700

Source: European Report on Science and Technology Indicators, 1994 (CEC, Brussels).

The expansion of the programme occurred through larger budgets, a greater number of projects being supported with larger numbers of participants. But, although more effort went into programme implementation with the intent of extending the collaborative net, it is hard to escape the conclusion that the overall Framework Programme budget distribution between the different areas still retained a clear objective of challenging Europe's main competitors, and principally Japan, in information technology.

So far, this chapter has concentrated upon setting out the development of the BRITE-EURAM programme chronologically, and providing a brief indication of the sectoral and national representation. But there is a broader concern here, which is to examine the extent of economic and political integration achieved through a programme that set out to build a network of collaborative technological alliances spanning European manufacturing industry.

At the beginning of this chapter, it was suggested that the number of alliances created under the BRITE-EURAM programme had increased significantly to a level that exceeded those created under the other initiatives of the Framework Programme. But the degree of economic integration cannot be assessed simply by the number of alliances created, and the volume of alliances created offers no guarantee of political integration. Undoubtedly, the existence of a network of collaborative technological alliances constitutes a technological community of some form.

The progress made in this area seems to suggest that the vision set out in the 1985 Commission memorandum may be in the course of being realised. However, we have yet to ascertain the nature of the political community that was created in the process.

3.4 Political processes in BRITE-EURAM

Political integration in the technological area succeeded on the basis of several favourable conditions co-existing in Europe throughout the decade of the 1980s and into the 1990s. These conditions operated at the national level, through a general desire on the part of all the national governments to see an improvement in industrial competitiveness, secured through a macro-economic policy environment that focused on the market while retaining a facilitative role for government.

The member state governments were therefore in favour of a European technology policy that was represented with the stated objective of tackling European industrial competitiveness, but that did not demand large-scale financial resources. Attitudes towards European technology policy were essentially benign, if at times cautious. Caution was directed, however, less at the proposed programmes content and direction than at the overall Framework Programme budget.[21]

At the international level, the growing trend in international alliances created a culture of cooperation among the business community. Although not in itself a new phenomenon, industrial alliances provided a general framework against which technology policy could be developed. In the context of European integration, these developments had potentially an important role to play, in sowing the seeds for greater economic integration. The European Single Market was the political goal of integrationists throughout this period, and any policy that fostered European economic cooperation could also be regarded as facilitating political cooperation.

The third condition referred to the European institutional structure, and particularly the part played by the European Commission within that structure. The leadership of the European Commission was a vital element in the development of policy, playing the role which it had identified for itself in the 1985 memorandum Towards a Technological Community. But the actions were more than those of co-ordination, it was also a strongly political role.[22]

The notion of the European Commission as a political actor is widely accepted.[23] And it has long been represented as such in studies of technological policy development.[24] The development of the Framework Programme throughout the 1980s under the Delors Commissions was essentially a continuation of earlier strategy begun by the Industry Commissioner, Etienne Davignon, at the turn of the decade when he brought the large

European IT firms into the political frame with the European Roundtable (Green Cowles, 1995).

The political process associated with technology policy has been broadened to include industrial interests through the Industrial Research and Development Advisory Committee (IRDAC), the European Parliament through the co-decision procedure introduced in the Single European Act of 1987, the member state governments still mainly through the European Council, and at the grass-roots level, the myriad of participants in the European technology programmes through the implementation procedures.

In essence, a multi-level political process has been developed around the technology programmes, and which was extended to the BRITE-EURAM programme. It becomes necessary to examine each level in the process, to identify what influence and input that particular level had on the development of the technological community. The political interests that were included had an obvious influence. But in fact if we also identify those that were excluded from having a more direct and more immediate input it may be possible to determine the ultimate limitations of the technological community.

This section, therefore, examines each of the levels in the political process that have been identified above, beginning at the apex of the structure. Some of the aspects which will be looked at here relate to more general developments in the integration process, but which nevertheless had an impact on technology programmes overall as well as on the BRITE-EURAM programme. It is in this sense that the development of the programme has been subject to the fortunes of the broader integration process.

3.4.1 The Commission's role

As far as the broader integration process is concerned two developments had a particular impact - the Single European Act in 1987, and the Maastricht Treaty on European Union which came into force on 1 November 1993. The latter brought all the diverse research activities of the Community together under the umbrella of the Fourth

Framework programme, and with a much larger budget as a consequence (see Table 3.4 at the end of this chapter). However, the Maastricht Treaty has further implications for European technology policy which will be considered in the concluding chapter.

Under the Single European Act (1987) a new Title VI to the Treaty of Rome covered research and development, giving legal status to a practice that had already been in place for some time. Article 130f of the title set out the legal basis and intention of collaborative programmes such as the BRITE-EURAM programme. It is worthwhile to set out the detail of Art. 130f here:

1. The Community's aim shall be to strengthen the scientific and technological base of European industry and to encourage it to become more competitive at the international level.

2. In order to achieve this it shall encourage undertakings, including small and medim-sized undertakings, research centres and universities in their research and technological development activities; it shall support their efforts to co-operate with one another, aiming notably at enabling undertakings to exploit the Community's internal market potential to the full, in particular through the opening up of national public contracts, the definition of common standards and the removal of legal and fiscal barriers to that co-operation.

3. In the achievement of these aims, special account shall be taken of the connection between the common research and technological development effort, the establishment and the implementation of common policies, particularly as regards competition and trade.

There is a strong echo in these three points of the proposals made in the 1985 memorandum. What is common to both is the emphasis on creating a community that encompasses the widest possible range of actors, together with a market bias that is linked to the objective of international competitiveness. To create this community, and to bring in as many participants to the Community technology programme, the European Commission undertook a major coordination role.

Coordination of the emerging web of technological alliances involved closer contact and growing involvement with participants and potential partners. It meant, too, finding ways of facilitating collaboration, of removing the obstacles to cross-border collaboration, and offering inducements to encourage higher levels of participation.

The extent of success in establishing a technological community would be gauged, in some respects at least, by the strength and size of the community. Conversely, success would also build the prestige and influence of the European Commission. Hence, it was logical that more economic actors had to be brought into the community. The process developed then through the direct interest representation of economic actors, and the European Commission responded through various means to facilitate their participation in the collaborative programmes.

Setting up and managing a collaborative venture throughout the lifetime of the agreement presents many problems for the firm. There is the problem of identifying the appropriate partner, or partners, establishing the financial contributions to be made by each one, the responsibilities and duties of each participant, and the protection of the intellectual property rights.

To the small and medium sized firm, such problems may present almost insurmountable difficulties to participating in a collaborative venture. Even large firms find it necessary to generate technology internally for this reason.[25] A firm will only enter an alliance if the benefits in doing so exceed the costs associated with setting up a venture between independent firms.

These problems were anticipated by the Commission and a system was developed to support participants and to encourage potential collaborators. The Commission set up a data base of potential participants by inviting firms, and research organisations to submit `expressions of interest' to Brussels. These expressions of interest offered details of research proposals under consideration but did not constitute, at the stage of making the expression, an actual proposal under BRITE-EURAM. The data base was classified by research tasks and types of action, and potential participants could access it through the Commission, or through national contact persons in each Member State.

In addition, the Commission organised public events in different Member States to promote participation in the programme, and to publicise a new programme, or a call for proposals, or to offer help on submitting proposals. Like any bureaucratic organisation, the Commission experienced administrative delays in its work and was conscious of criticism among the participants. The first BRITE programme which came into operation in 1985 was dogged to some extent by the complexity of the applications procedure, and the slowness of the decision-making by the Council on the eligibility of participants for Community support under the programme.[26]

Following the BRITE evaluation report these issues were tackled in the Second Framework (1987-1991), which also had a greater level of funding and made annual calls for proposals rather than the intermittent calls that were a source of uncertainty in the first programme. It also included new standards and procedural rules, such as those relating to the environment and safety considerations. Application was made easier through a simplified information package. In addition there was to be close coordination of this programme with EUREKA projects, with ECSC research, the COMETT programme and the ESPRIT programme particularly in the areas of expert systems, situation monitoring systems and preventive maintenance and quality control.[27]

Regular workshops were organised throughout the Community to provide support, or information to proposers, or to the individual coordinators who had to make regular progress reports to the Commission. Such events offered an opportunity for potential collaborative partners to meet, and helped to create an informal community with an increasingly European identity. Since the average length of collaborative project supported under BRITE-EURAM was 3-4 years, co-ordination was an important part of the management of collaboration.

3.4.2 Industrial representation

The Commission was anxious, from the beginning, to promote the programme as market-led.[28] It considered that the initiative should reflect the needs of industry, and that industry should be involved in the formulation of what the supranational authority termed a `bottom-up' programme. Moving away from the previous experience of collaboration on centrally planned, large-scale projects during the 1960s and 1970s, the new policy sought to involve a much broader range of industrial and research actors on smaller projects with a distinct industrial bias.[29]

The Industrial Research and Development Advisory Committee (IRDAC) was appointed by the Commission in 1984 to ensure that the industrial interests were represented in the formulation and implementation of technology programmes, to advise on industrial research policy, and to act as the general voice of industry.

It was composed initially of 12 members chosen for their `substantial experience in research and development work in industrial undertakings, research institutes or other organisations involved in work related to industrial research and development who shall be appointed by the Commission in a personal capacity'.[30] Membership was increased to 14 in 1986,[31] and currently stands at 24.

The term of membership is in principle limited to three years, except in the case of the members coming from European organisations: the Union of Industries of the European Community (UNICE), the European Centre for Public Enterprise (ECPE), the Federation of European Industrial Cooperative Research Organisations (FEICRO), the European Trade Union Confederation (ETUC), and the European Union of Crafts and Small and Medium-sized Enterprises (UAEPME). The individual members came from large corporations in the European Community - there were no individual representatives of small and medium sized firms.

IRDAC operated through plenary sessions, working parties and round tables, and established over the years a communication network throughout the Community made up of over 500 high level managers. These helped to form a pool of expertise to which the Commission turned for proposals regarding areas of research which BRITE-EURAM should target. Many of them were also invited to evaluate research proposals submitted under the programme, and to assist with mid-term reviews of the collaboration projects. The Commission also used experts not directly involved with IRDAC to assist in a similar way, from industrial organisations and universities throughout the Community.

Although IRDAC was set up to represent an independent voice of European industry, its work has tended to be organised by the Commission, and representatives of the Commission can take part in the meetings of the committee.[32] The areas of work have been extended beyond industrial research, to include environmental research, marine sciences, bio-technology, pre-normative research, and skills shortages throughout Europe. In effect, the agenda has widened to match the interests of the Commission, and to reflect the development of the Commission agenda on research and technology.[33]

To a large extent, IRDAC has been co-opted by the Commission to identify the needs and interests of industry certainly, but also to build the political support for Community policy among industry representatives, and to widen the base of that support as much as possible.[34]

Despite its supposed independent status, IRDAC offered very cautious opinions on the Framework Programme. It has tended to offer little challenge to Commission proposals or the rationale for such proposals, and tended to respond more in a reactive mode to the proposals of the European Commission. The Opinion on the Framework Programme 1987-1991 approved the purpose of the programme to stimulate cooperation at the European level both for the generation of new technology and for its implementation,[35] and in doing so re-echoed the stated aims of the Commission to create a European technological community.[36]

IRDAC has consistently taken the side of the European Commission in seeking a higher budget for the Framework Programme, and for both the Second and Third Framework

Programmes the committee found itself in opposition to the European Council, when the latter succeeded in forcing through lower budgets than those originally proposed by the Commission.

IRDAC aligned itself with the Commission in other areas besides the Framework budget. As the debate on what factors affected industrial competitiveness broadened, the contribution made by IRDAC to the debate was extended to a consideration of issues such as skills.[37] The committee supported the Community's Human Capital and Mobility programme, introduced under the Third Framework Programme to increase the mobility and training of researchers and the formation of research networks within the Community.[38] IRDAC`s view, expressed in a report published in 1990, was that `the output of education and training systems (including in particular Higher Education) in terms of both quantity and quality of skills at all levels is the prime determinant of a country's level of industrial productivity and hence competitiveness.'[39]

The committee argued that investment in research and technology could not be increased without giving due regard to the level of qualified people. At the European level, the IRDAC recommended that all European R&D efforts should be accompanied by related training measures,[40] and concluded that education and training must be part of the European strategy for dealing with competitiveness. The universities and research centres, already part of the integration process through existing programmes, could be the vehicle through which such a plan might be implemented.

IRDAC's most consistent influence has been through its insistence that technology policy should start from the needs of the market and the user. As a result, from the Second Framework Programme onwards the BRITE-EURAM projects were encouraged to include a potential user of the research results in the collaborative project. This became central in the pronouncements of the Commission as the BRITE-EURAM programme developed.

More recently, as the committee extended its brief into the area of skills, training and education, it has moved to the view that the research supported under the European technology programmes should be confined to pre-competitive activities.[41] It opposed the support for near-market activities. In an opinion on the EC White Paper, Growth, Competitiveness and Employment[42], delivered to the Commission in March 1994, the committee welcomed the special place that the White Paper gave to research and technological development. It agreed that research aimed at industry, including basic technological research, should be substantially increased, but it warned that while RTD was necessary it was not in itself sufficient for industrial competitiveness.[43] The committee did, however, recommend that traditional industrial sectors should be boosted through the application of new technologies.

3.4.3 The European Parliament's role

The European Parliament supported the Framework Programme from its earliest stages, and the parliamentary Committee on Energy, Research and Technology conducted rigorous debate on each successive Framework Programme and on the constituent programmes. The Committee was sometimes hampered in its examination of the latter by a scarcity of specialist technical advisors, but this problem was significantly reduced from the early 1990s. By contrast, the Committee has provided diligent comment on more general aspects of proposed policy issues, and particularly focused on strategic directions for the evolving European technology policy.

Parliament supported the European-wide initiatives on the basis of the need for a European-wide initiative to defend economic security. Its position was best summarised by the chairman of the Committee on Energy, Research and Technology in the European Parliament, Mr. Poniatowski, who concluded that Europe `has neither the political and economic power for its strength is dispersed and divided by petty national frontiers, nor the aggressive scientific and marketing approach of the Japanese. Very few European firms have the international stature to act alone without political support...'[44] In this statement lay an endorsement of the sentiments expressed by the European Commission in its 1985 memorandum on the creation of a technological community.

But Parliament found difficulty in making a real impact on the policy process. A report by the Energy, Research and Technology Committee, produced in 1985, put forward a set of criteria to be used in the selection of technologies. The criteria included broad socio-economic concerns that were rejected at the time by the European Commission on the basis that they had nothing to do with research, and would eclipse the scientific and technological quality requirements.[45]

In a speech to the Parliament in 1987, the vice-President of the Commission, Karl-Heinz Narjes, emphasised the essential industrial nature of the BRITE-EURAM programme - `It is essential for there to be inter-sectoral technological research in the European Community, with industry, technology and research centres and universities in the various Member States cooperating with one another. Even though this research takes place at a pre-competitive stage, it has a clear-cut industrial purpose. It lays the foundations for the development of new products and processes. In this way it strengthens our innovating potential, enabling us to participate in the race to manufacture the best products with the prospect of succeeding in the world's markets.'[46]

Until the Single European Act introduced the co-decision procedure, which gave the Parliament the formal right to consultation, this body had a limited role in the decision-making on European technology policy. Up to that point, Parliament played an indirect role, acting as a buffer between the Commission and a European Council which tended to take a more cautious approach to research and technology proposals. It was not until 1987 that the Chairman of the European Parliament's Energy, Research and Technology Committee was invited to address the Council of Research Ministers.

While Parliament supported the Framework Programme from the beginning it found itself in conflict with the European Council over the level of funding for the programme. The ECU 5400 million eventually adopted in the Second Framework Programme had been stipulated by Parliament as a sine qua non of approval, without which the programme would not have been adopted.

When it came to the Third Framework Programme, the Energy, Research and Technology Committee of the European Parliament sought, unsuccessfully, to have the programme budget increased from the Commission's proposed ECU 7700 million to ECU 8230 million. It also called for more attention to be given to renewable energies, energy efficiency, the training of researchers, and the needs of SMEs.[47]

However, it was also a platform for member state views on technology programmes. The more pronounced concern of the European Commission in recent years to conduct programme evaluations perhaps owes something to Parliamentary debates. Delegates from the United Kingdom stressed the need for programmes to be subject to strict evaluation, citing the national practice where strict appraisal of national programmes was a permanent feature of the system.[48]

Spanish delegates favoured a stronger focus on supporting small and medium-sized firms through the technology programmes. A Spanish MEP, Robles Piquer, suggested that the BRITE-EURAM programme had the potential to make a substantial contribution to modernisation of industry.[49] More recently, in May 1994, the same view was expressed by J.D. Javier Solana, the then Spanish Minister of Education and Science, at a BRITE-EURAM workshop organised by the European Commission in Seville.[50]

The European Parliamentary debates on technology policy often tended to reflect the national practice and approach, and reiterated the view that European technology programmes should not challenge national efforts.

The Single European Act not only established the legal basis to EC technology policy, it also changed the institutional decision-making structure, giving the Parliament the potential to have a greater say in such policy through a co-operation procedure giving it limited power of co-decision in certain areas and a formalised right to consultation.[51] Before this, the Commission drafted proposals for legislation and the Council made the final decisions on legislation. The European Parliament had no real say in the legislation process, although it could delay proposals. Now it had the opportunity to influence policy development.[52]

In practice, it had more chance of doing so through individual programmes rather than the overall Framework Programme where financial considerations of the member states found expression in the deliberations of the European Council.[53]

Parliament tabled several amendments to the BRITE programme (1985-1988), regarding the inclusion of an explicit reference to solidarity and cohesion in the Community, the requirement that the programme should increase jobs, and that more detailed terms governing the involvement of non-Community participants should be inserted.[54] The European Parliament tabled some 53 amendments to the Commission's proposal for a new BRITE-EURAM II, and the Commission incorporated 34 of these into its amended proposal.[55] Increasingly, in the aftermath of the Single European Act the Parliament began to adopt views on the broader role of technology in serving the needs of society.[56] It considered that the Framework Programme did not have a well-defined strategy in this regard, although ESPRIT, RACE and BRITE-EURAM represented small steps in the strategic direction.[57]

While the Second Framework Programme proclaimed that technology policy should be `placed at the service of social development through the pursuit of ad hoc aims (health, nuclear safety, working conditions, training, etc., and in more general terms, the environment),'[58] these remained general philosophies rather than being fundamental and specific to the implementation of the programmes. It was not until the debate of the Third Framework Programme (1990-94) that a more conscious attempt to relate the Commission policy to economic and social cohesion was made, and to consider the human and environmental impact of research proposals.[59]

By the end of the 1980s, the European Parliament was trying to redefine the influential role which the Commission had created for itself through technology policy, while not launching an outright challenge to the Commission. Each still depended to a significant extent on the other, but the Parliament was, nevertheless, willing to flex its muscles by suggesting that the Commission propose the setting up of a European scientific high authority.[60] The proposed body, according to the Parliament, would involve all the institutions equally in evaluation.

3.5 Integration through the market

In point of fact, the Commission's position was unassailable. The BRITE-EURAM programme was presented by the Commission as being a `bottom-up' programme, industry-driven and meeting the needs of the market. The involvement of IRDAC seemed to confirm this, and to affirm the legitimacy of the supranational authority's position.

Moreover, IRDAC combined with the Commission to establish a network of independent advisors and consultants among the industrial and scientific communities in Europe to advise on programme content. It was through this network that the BRITE-EURAM programme found its identity and structure. Although becoming ever larger and more dense by the beginning of the 1990s, the network operated at a disaggregated level as far as industrial interests were concerned, leaving a much more obvious leadership role for the European Commission. For a lot of the time, the Commission took it to extend the technological community.

Under BRITE-EURAM, the Commission made sure smaller enterprises were made aware of the opportunities available, and could receive assistance with finding partners in other countries as well as dealing with the administrative and bureaucratic processes.[61] This proved to be more difficult than anticipated, and the provision of institutional support alone could not guarantee either participation in collaborative programmes or that the objectives of SMEs were being met.[62]

The findings of an independent evaluation of the first BRITE-EURAM programme were that smaller firms were under-represented.[63] And the Commission reiterated its intention to focus continued efforts on bringing in the SMEs.[64] The Euro Information Centres, set up around the Community, were a direct result of the action programme.[65]

So too was the offer to SMEs to collaborate in related programmes such as SPRINT, for technology transfer, and COMETT for education and training. The majority of the participants in the BRITE-EURAM programme surveyed for this thesis take part in one or both of these initiatives.

It was envisaged that BRITE-EURAM projects would become self-supporting and that cooperation would become a natural and accepted procedure without support from the Community funds. But the programme would, in the Commission's view, be needed well into the 1990s.[66] It could also be said that the reassurance given by the Commission, that the programme would continue over the long term, acted as encouragement to economic actors in their search for collaborative partners.

So too did the provisions covering the new knowledge and patents directly obtained through Community research. The industrial property rights belonged to the firm or contractor carrying out the research. Preferential access to the information and patents directly obtained through the contracts with the Community, was granted in decreasing order of priority, to other contractors on the project, other participants in the BRITE-EURAM programme working in the same field, and other firms established in the Community. Exploitation of the results of research was facilitated by the Commission setting up the VALUE programme,[67] and the following chapter will show that many of the participants surveyed are also part of this network.

Although BRITE-EURAM was intended to support pre-competitive research, the notion of pre-competitive remained poorly defined, and open to liberal and individual interpretation among individuals within the Commission. European competition policy precluded collusive behaviour among industrial firms that could be considered to infringe market competition, so that some provision had to be made for cooperative practices emerging under the Framework Programme. The block exemptions under Regulation 418/85 covered joint activities conducted under the Framework Programme. In adition, the European Commission insisted that collaborative research activities should be confined to the pre-competitive stage. The greatest difficulty was in establishing a clear definition of the term ‘pre-competitive’.

When pushed, as for example by participants at the Seville workshop organised by the Commission in May 1992, the supranational authority identified pre-competitive as being activities that were upstream and 'away from the market'. The lack of a clear-cut definition, or a quantitative indicator, meant that a range of activities of varying proximity to the marketplace, were regarded as eligible by Commission officials. Sandholtz (1992) pointed out that the emphasis on pre-competitive research existed from the beginning of the ESPRIT programme, partly since the Treaty of Rome did not provide the European Commission with authority for industrial policy, and partly because the Commission itself argued for a concerted effort to be made in the area of long-term industrial research. He considered that the definition was 'intentionally left vague' (p. 167).

Deliberate or not, the vague definition given to the type of research activities that would be supported under the Framework Programme meant that the European Commission could launch the programme within the limits of the authority that actually existed at that point in time. In the first BRITE-EURAM, and successor programmes, the notion of pre-competitive research was again highlighted. But the political convenience attached to the use of this term managed to obscure for a while the essential contradiction behind it.

BRITE-EURAM is a good example of this contradiction. In this programme, the Commission sought to extend the amount of applied research in European manufacturing industry, including SMEs. It stressed the need for greater innovation, and from the Second Framework Programme stipulated that users should be involved in collaborative projects. For these objectives to be met there would have to be a move downstream in the activities undertaken. During the second Framework Programme, there was a downward shift in the research activities supported, to include activities closer to the market.[68] Pre-competitive research was not so compatible with the simultaneous emphasis also being placed on innovation and application, particularly for small- and medium-sized firms that were actively encouraged by the Commission to take part in the programme. How could firms jointly cooperate on research activities away from the market, and at the same time co-operate to improve the level of applied research, which by implication takes them closer to the market?

The position taken by the supranational authority appeared more sympathetic with the needs of market agents, and so gave greater appeal to EC policies as relevant and appropriate to their commercial needs. The Commission maintained this position, seeing co-operation projects as a learning process for the participants, where the preconditions have to be built by a supranational institution.[69]

An evaluation study of 207 finished projects, half of which involved SMEs, carried out in 1991 showed that a substantial impact on their innovation potential was expected as a result of participation in the programme.[70] BRITE-EURAM II, approved by the Council of Ministers on 9 September 1991 for the period 1990-1994, included a sub-programme which was specifically intended to assist co-operative research by SMEs - the CRAFT programme. By the end of 1991 the BRITE-EURAM had been responsible for setting up an industrial R&D network in Europe, involving 3000 organisations participating in 750 research projects among 17 countries. One out of four partners in the network was an SME, with 29% from industry, 27% from universities, and 17% comprising research centres.[71] As the opening paragraphs of this chapter suggested, the community of technological alliances has increased in size since then.

3.6 The integration pattern

The preceding remarks have a strong resonance in the context of any evaluation of the BRITE-EURAM programme. Although this specific programme has attracted an increasing share of the overall Framework Programme budget (see Appendix 4), and an increasing number of participants, the pattern of participation reflects the uneven technological capability that exists within and between the member states. At no point has either the programme, or more general policy pronouncements indicated either the desire or the intention to tackle such differences in technological capability.

Under the Second Framework Programme, BRITE-EURAM supported 375 collaborative projects in the shared-cost actions, with a total of 1871 participants and an average of five participants in each project. The successor programme supported 463 projects with 1847 participants, and a smaller average of four participants to each project. The average number of member states had also fallen, from 6.0 to 2.5, while the average European Commission funding per project also declined from 1240 (000 ECU) to 1091 (000 ECU).[72]

These figures do not include the aeronautics section five of the BRITE-EURAM programme.[73] In this area, 28 projects with 295 participants were supported under the Second Framework Programme, with an average Commission funding of 1240 (000 ECU). The average number of participants per project was 10.5, with some six member states to each project. By the Third Framework Programme, the number of projects supported had fallen to 22 but with more participants in each project. Both the average number of participants and the average number of member states had risen, respectively to 14.0 and 6.5, and a significant increase in the average Commission funding per project, to 2156 (000 ECU).[74]

The evidence of the programme's popularity with European industry was shown by the overwhelming responses given to the Commission's calls for proposals, as each new programme was introduced. The early programmes had a particularly high proposal rejection rate, often because the funds had run out as much as because of the technological quality of the proposals.[75] However, the evidence presented above would suggest that the Commission was trying to involve as many participants as possible by spreading the net wide.

This type of approach carries with it certain risks which could have the effect of mitigating the positive results intended. For one thing, spreading the resources widely could mean such dispersion has little real impact which a more focused, strategic approach might achieve. If organisations are not certain of receiving the appropriate level of funding to do the requisite amount of research that is necessary, then they may be discouraged from applying for support and hence from doing the research. In any event, there is no guarantee that the most deserving will receive the support that is available. The most deserving, of course, will be determined by the political or economic criteria being used.

That observation regarding the most deserving recipients of support is a useful introduction to the next aspect of the participation pattern. BRITE-EURAM, intended to support multi-sectoral collaboration in manufacturing, was dominated under the Second Framework Programme by large enterprises. Following a concerted attempt by the European Commission to broaden the spread of membership, the number of small- and medium-sized enterprises involved in the programme increased during the Third Framework Programme. Nevertheless, the White Paper on industrial competitiveness, published by the European Commission in 1994, suggested that there is still a long way to go in incorporating the SMEs in industrial cooperation.

Of the total 1871 participants under the Second Framework Programme, some 522 were large organisations, with 493 SMEs, 402 research centres and 441 universities. The corresponding figures in the follow-up programme were 480 large organisations, 569 SMEs, 373 research centres and 368, showing a more industrial bias. The dominance of the large organisations was also apparent with the other industrial research programmes, ESPRIT and RACE, although the former showed an increase under the Third Framework Programme in the number of SME participants.

Apart from their numerical strength within the programme, the large organisations also appropriated the largest share of the programme budget. Under the Second Framework programme, the large corporations received 30.6%, while SMEs received 25.1%, with public research centres and universities receiving 19.4% and 24.3% respectively. This did not change under the Third Framework Programme, and in fact the large corporations received an even larger slice, 32.8%, with 26% to SMEs and universities losing out to the public research centres, 19.6% to the latter's 20.9%.[76]

A similar pattern was evident in the sectoral distribution of funds under the ESPRIT and RACE programmes, in both the Second and the Third Framework Programmes. RACE had a particularly strong bias in funding large organisations under the Second Framework Programme, although this was reduced slightly in the successor programme.

The third evaluation study of the BRITE-EURAM programme, based on interviews with the leaders of 84 projects completed in 1992, reported favourable results from the programme. Out of the total, some 71% of the participants believed they had fully met their objectives, while the majority considered the results of collaboration were either level with (28%), beyond (45%) or strongly beyond (18%), the current state of the art in the particular field of endeavour. The evaluation looked at the economic effects, measured either directly by sales or by cost reductions, and indirect effects as measured by technology transfers, improved networks, or improved organisational processes. The conclusion was that most projects show economic effects in the following five years, with the average for these 84 projects being 12 MECU per project. At a more general level, the conclusion based on this report and the BETA (CEC, 1993) report is that every ECU invested in these research programmes yields at least 7 ECU in potential economic impact within five years.

The evaluation also looked at the strength and cohesiveness of the partnership created, seeing this as a significant factor in the successful completion of the project. In the BRITE-EURAM evaluation, it was found that 90% of the partnerships continued after the project was completed, with high or very high efficiency of cooperation between partners in 67% of the cases. Chapter six of this study also finds a generally high level of satisfaction among the participants with their existing partners, with many expressing the intention to continue collaboration beyond the life of the project.

However, the bias towards large organisations mitigated the modernising impact of the programme, all the more so since much of the European manufacturing sector is characterised by small- and medium-sized firms. This is true of Spain, and to a significant extent in the United Kingdom also. Despite more recent efforts by the European Commission to include smaller enterprises within the widening collaborative net, and IRDAC's proposal to set up the CRAFT initiative specifically for SMEs, there is still a perception among this group that large obstacles hinder their participation in the programme. This was supported by the results of the survey, reported in chapter six.

Inevitably, this type of sectoral bias was reflected in the national participation pattern. It is difficult to obtain precise figures on the distribution of programme funds between the member states, particularly as the Commission does not tend to publicise this type of information which it regards as having potentially adverse political consequences if some member states see themselves as receiving less than their fair share. The UK's dispute over the agriculture budget had taught the European Commission a lesson in caution, and highlighted the political wisdom of avoiding the appearance of being too bountiful with some member states compared to others.[77]

Nevertheless, the evidence pointed to the dominance of the larger member states within the programme. In this chapter, table 3.2 highlighted the leading positions of France, Germany and the United Kingdom in the BRITE-EURAM programme (under the Second Framework). The 1992 Annual Report of Government-Funded R&D, published by the Cabinet Office in the United Kingdom, ranked France, UK, and Germany (in that order) as the member states with the largest volume of participation in the overall Second Framework Programme. It also indicated a rising participation rate for each of these countries over the five years of the programme, from 1987 to 1991.[78]

Italy, Netherlands, Spain and Belgium formed a second group, again in that particular order. The smaller member states showed significantly smaller participation rates, although these were rising over the period. Chapter five suggests that Spanish participation and the return from the BRITE-EURAM programme increased towards the end of the 1980s, but that the return was coming under increasing scrutiny from the Spanish authorities and also the technological community. The UK has been a net beneficiary under the BRITE-EURAM programme almost from the beginning, so has avoided this particular form of criticism. Additionally, the policy of cutting public support for research and development activities placed the European programmes in a position to act as replacement for national policy.

One other related point concerning the national pattern of participation will be made here. It concerns the appearance of collaborative networks within the European Community, linking the different member states in relation to the volume of participation by each one. Among the countries with the largest participation rates, there has developed a very dense pattern of collaborative research and development links, with a much less dense pattern appearing for the smaller countries.

Under the Second Framework Programme, Spain had the highest number of collaborative links with France, United Kingdom, and Germany, a pattern that was repeated under the Third Framework Programme.[79] The survey results presented in chapter six of this thesis suggest a slightly different order in respect of the BRITE-EURAM programme, with Spanish organisations collaborating most frequently with partners in Holland, France and Germany. The United Kingdom created most collaborative links under the Second Framework Programme with France and Germany, with a less dense collaborative linkage with Italian and Dutch partners. The same pattern was repeated under the Third Framework Programme, although there was a slight shift away from France and Germany, in favour of Italy and Holland. There was also a slight fall in the number of collaborative links between the UK and Spain.

The United Kingdom had a higher rate of collaboration under the European programmes with domestic partners than was the case for Spain, which is also noted in chapter six. However, a comparison of the Second and Third Framework Programmes showed an increase in the volume of Spanish domestic collaboration, as well as a slight increase in the collaboration with smaller countries such as Ireland and Greece. These two countries were recipients under the Cohesion Funds announced at the Edinburgh summit in 1992, as was Portugal.

Spain's collaborative links with Portugal, however, declined under the Third Framework Programme. Like Spain, Portuguese domestic collaboration also increased, as did its collaboration with another Cohesion partner, Ireland. The conclusion is that there appears to be an emerging pattern of alliances under a core-periphery scenario, reflecting in particular the technological capability of the member states and hence their dominance within the different programmes.

The conclusion is, therefore, disturbing for two reasons. Firstly, the appearance of a collaborative pattern that exhibits a core-periphery nature does not suggest a community that is fairly and evenly balanced. Such a community must inevitably be unstable, with low levels of trust and the expectation of continued divergence in the pattern of alliances, and in the consequent technological benefits to be derived from such alliances. If there is widespread support for the technological community, then pressures and demands for change are likely to arise.

Secondly, this emerging pattern of core-periphery technology alliances challenges the notion of economic and social cohesion, the objectives that were identified in the Single European Act and further endorsed under the Maastricht Treaty. European technology policy has certainly not addressed the issue of competitiveness, which was identified as one of the key objectives of the policy, and set out as such in the 1985 Commission memorandum, Towards a Technological Community. It is questionable, therefore, whether the policy can have any greater success in dealing with the issues of economic and social cohesion under the context and set of circumstances in which the policy is presently situated. Chapter eight will return to this question in assessing the possibility for the Framework Programme, and specifically the BRITE-EURAM programme, of being capable of meeting the goals of competitiveness and economic and social cohesion.

3.7 Conclusion

The emergence of European technology policy has brought with it a European technological community, one that is both hierarchical in structure and diverse in membership and commitment. With the adoption of the Fourth Framework Programme on 26 April 1994, and of the specific programmes later on that year, European technology policy has become a stable feature of the EU's activities.

From the first initiatives of the early 1980s through to the most recent Framework Programme, technology policy has attracted the interest and involvement of an increasing range of political actors - from the grassroots level of the participants to national governments, the European Council and the Parliament, and European-level organisations.

In addition to the actors referred to in the preceding paragraph, the programmes have also seen participants from EFTA countries, many of which are now members of the EU. Their involvement at the time reflected a degree of openness on the part of the European Commission as far as international technology flows were concerned, in recognition that `a technology community, open and uninhibited, cannot isolate itself within its geographical or institutional boundaries without the risk of suffocation or decline.[80]

Returning to the specific case of the BRITE-EURAM programme, two general questions arise which this concluding section will address. The first question, identified at the beginning of this chapter, was why so many participated in the programme. And the second issue revolves around the consideration as to whether a political community has been created. Although in many respects the questions are inter-related, here they will be treated independently.

To answer the first question one can turn to a consideration of the individual motives for cross-border technological alliances, and to more general factors associated with the environment within which collaboration must occur. The next two chapters examine the national context within which actors must operate, and which shapes the approach to cross-border collaboration for all actors. In chapter six, the analysis takes a step further by examining the individual motives, and the supporting empirical evidence.

As to the environment, the Commission effectively created a European-level institutional system which fostered cooperation and was directed towards reducing the risks and difficulties associated with cross-border technological alliances. As one of the primary political actors, the supranational authority responded to the demands and interests of those groups that it wanted to see in the collaborative net. It did so through the implementation of the programme, by providing support in finding partners, information about the programme, management of project collaboration, more near-market activities, and help with using the results of the collaboration.

In order that collaboration among industrial firms would not conflict with Community competition policy, a linchpin of the integration process, certain exemptions to Article 85 of the treaty had been granted in March 1985. Regulation 418/85 allowed for collaborative agreements in pre-competitive R&D under the Framework Programme.Several years later, a system of regular programme evaluations was introduced, the results of which formed the basis for renewing the follow-up programme.[81]

Evaluations were conducted by panels of independent experts from industry and the scientific community at the invitation of the Commission, and centred upon examination of the quality of the research results, programme management, and more generally the contribution of the programme to the social and economic development of the Community, as well as the benefits of implementing the programme at the Community level.

In practice, this system of evaluation was part of the broader approach which involved the European Commission coopting IRDAC into the political decision-making process. The chair of the first evaluation of BRITE was Yves Farge, vice-president of research and development with the French firm, Pechiney, who was also chairman of IRDAC for a number of years. Bringing in the industrial elites in this manner helped to secure greater legitimacy for the Commission strategy.

It worked well enough in that evaluation panels tended to report favourably, and their recommendations on programme management and implementation were acted upon by the Commission.[82] The evaluation of the BRITE-EURAM programme 1989-1992 noted the positive contribution to competitiveness and cohesion, and concluded that the programme had been a `substantial success'. But it also raised concern over the shift to near-market research and the increasing level of proposals, which could bring the BRITE-EURAM programme more into competition with EUREKA, and warned `development along these lines without a substantial increase in funds would result in a very high rejection rate - perhaps in excess of 95% - which could have undesirable consequences.[83]

The problem, as the panel saw it, was that the Commission was engaged in a balancing act, trying to encourage pre-competitive research but facing political pressure to show immediate economic benefits. It was also trying to involve more SMEs, organisations primarily interested in the near-market activities. In addition, the programme sought to contribute to cohesion, while promoting projects of scientific and technical merit.

More broadly, the Commission was having to respond to pressure from some member states for juste retour, which could have an impact on project selection possibly at the expense of technical merit of the future projects. The balancing act was, however, an inevitable result of the political process instituted by the Commission with its over-riding objective of creating the technological community.

Despite such difficulties, the political process gave singular prominence to the Commission as political actor. Industrial representation did not challenge this to any great extent in that IRDAC was created by Commission decree, with members appointed in their personal capacity while continuing to hold positions in the major corporations throughout Europe.[84] Certainly, it was not greatly representative of broader industrial interests, of SMEs, or of the scientific community at large. On the other hand, there was a benefit for the committee members in having the ear of the Commission, which could be potentially beneficial when it came to other areas of proposed Community policy.

The effect of the key position of the European Commission, combined with the industrial-bias and the increasingly near-market emphasis of the research was to leave the scientific community on the periphery in the political process. There was a degree of exclusion as far as the academic technological community was concerned, in that although the Commission consulted scientific experts, it did so on an ad hoc and decentralised basis. The result was an extremely disaggregated level of interest representation, making it difficult to reflect more organised scientific interests in the policy.

Some have identified a `scientific deficit' similar to the democratic deficit. As one commentator has noted, `the decision to tackle certain problems and the decisions subsequently taken basically reflect conflicts of interest - or lack of interest which produces a slide away from the scientific towards the economic. Procedures do not really allow organised, properly thought-out and transparent scientific confrontation .... there is insufficient connection between decision-making processes and European research programmes, and a closed character in the expert networks linked to the Commission'.[85]

The European Parliament has displayed interest in European technology policy from the beginning, and an increasing desire to secure greater involvement in the formulation and implementation of programmes. It has emphasised the importance of technology policy in general adopting a more strategic focus, and indeed some of its recommendations are beginning to appear in the policy objectives, notably economic and social cohesion, employment, environmental, and health and safety concerns. The annual report by the Commission on research activities, the first of which was issued in 1995, is a direct result of pressure by the Parliament.[86]

What part did the member states play in this political process? National governments were broadly in support of the programme and its objectives, particularly that of international competitiveness. The BRITE-EURAM programme did not conflict with national government policy. Instead, there was a degree of symmetry between the objectives of the EC technology policy - international competitiveness and the attainment of all the objectives laid down in the Single Act[87] - and those of the national governments.

The Commission did not claim to substitute for national policy, confining itself to suggesting its competence in allocating certain resources and in coordinating national activities, `to introduce efficiency, transparency and compatibility with national policies'.[88] The idea of national economic security was thus assured, particularly since the promise made in the 1985 memorandum, Towards a Technological Community, to co-ordinate national policies showed no sign of being fulfilled.

In fact, it was not until July 1995 that the first debate on the coordination of member states' science and technology policies began - and even then it was conducted in an informal meeting of the Council of Research Ministers.

The BRITE-EURAM programme was launched amidst a general concern with the relative competitiveness of European industry. Both the political and economic case were obvious, while the Commission's presentation of the programme as market-led made it more acceptable to national governments, many of whom followed non-interventionist policies at the time.[89] However, it was clear that approaching the mid-1990s competitiveness remains a major concern that is likely to give rise to additional pressures, expectations and demands and possibly require more forthright and as yet untried solutions.

The European Commission instituted a structure for the implementation of the BRITE-EURAM programme, which enabled it to go directly to firms, and to bypass national governments. While the latter have exerted their voices in European technology, through the Council, opposition has been voiced on the overall budget for Framework, rather than the specific strategy inherent in specific initiatives.

For many of the economic actors, the system of access and support provided by the Commission, and the growing ease of access, made the Commission appear as approachable as national governments. The Commission acted like the national government - it provided information, finance, support and management of research and technology within a supranational institutional structure. Chapter six will consider to what extent the participants did in fact regard the Community initiative as a substitute for national support.

But before this, the next chapter returns to the national level, to examine the nature of the UK technological system and the context in which UK actors operate.

Table 3.4 Fourth framework Programme 1994-1998 - breakdown of finances (MECU)

ACTIVITY 1 - RTD and Demonstration Programmes	10696
Information/Communications technologies	3405
1. Telematics	843
2. Communications technologies	630
3. Information technologies	1932
Industrial technologies	1995
4. Industrial/materials technologies	1707
5. Standardization/measurement	288
Environment	1080
6. Environment/climate	852
7. Marine sciences/technologies	228
Life sciences/technologies	1572
8. Biotechnology	552
9. Biomedicine/health	336
10. Agriculture/agro-industry	684
Energy	2256
11. Non-nuclear energy	1002
12. Nuclear fission safety	414
13. Controlled nuclear fusion	840
Transport	240
14. Transport	240
Targeted socio-economic research	138
15. Targeted socio-economic research	138
ACTIVITY 2 - Cooperation with third countries and International Organisations	540
ACTIVITY 3 - Dissemination and exploitation of results	330
ACTIVITY 4 - Stimulation of the training and mobility of researchers	744
	12300

(In April 1995 the European Commission proposed a 7% increase in the funds allocated above to cover the recent enlargement of the EU).

Notes to chapter three

1. In this chapter, comparisons are made with the programmes that encourage industrial collaborative research, ESPRIT and RACE, but of course the Framework Programme deals with other collaborative research in addition.

2. CEC (1995) Research and Technological Development Activities of the European Union Annual Report, COM (95) 443, Brussels. This is the first one of the annual reports on the research and technological activities of the EU, a requirement that was introduced under Article 130p of the Treaty on European Union. The European Parliament had, however, been pressing for a comprehensive review of Community research activities for some time.

3. CEC (1985) Towards a European Technology Community, COM (85) 350 final.

4. The memorandum intimated that Europe's annual production rate of high technology goods was lower than either of its competitors, and had been since 1972 - the annual rate for Europe being 5%, while that of the US was 7.6% and Japan 14%. Furthermore, `Europe's mediocre industrial performance has eroded its trade surplus in high technology products. Over a 20-year period the export cover of high technology imports into the Community fell from 190% to 110%.'(p.5).

5. See Jean-Jacques Servan-Schreiber (1968) The American Challenge (New York, Atheneum), transl. R. Steel. Servan-Schreiber's thesis of a growing gap between European technological development and the progress of the US gave rise to much debate in Europe, and the concerns expressed in this debate helped to gather support for the European collaborative technology initiatives of the period. For further detail on technology collaboration during the 1960s and 1970s, see M. Sharp and C. Shearman (1987) European Technological Collaboration (London, Routledge and Kegan Paul).

6. See Keith Hayward (1986) International Collaboration in Civil Aerospace (London, Frances Pinter).

7. See CEC (1985) Towards a Technological Community, section 5.1.

8. CEC (1985) ibid., 5.1.

9. Ibid., p. 33.

10. OJ, L 83/8, 25 March 1985.

11. See W.J. Abernathy, K. Clark and A.M. Kantrow (1983) Industrial Renaissance: Producing a Competitive future for America (New York, Basic Books). An OECD report published in 1988 on the revival of industry through new technology was an important contribution to the debate on the importance of manufacturing - OECD (1988) Industrial Revival through Technology (Paris).

12. CEC (1986) The Science and Technology Community: Guidelines for a New Community Framework of Technological Research and Development 1987-1991, COM (86) 129 final.

13. See S. Cohen and J. Zysman (1987) Manufacturing Matters. The Myth of the Post-Industrial Economy (New York, Basic Books).

14. CEC (1986) Communication from the Commission to the Council on the review of the multi-annual research and development programme in the fields of basic technological research and the applications of new technologies (1985-1988) COM (86) 271, p. 2.

15. CEC (1988) Evaluation of the first BRITE programme (1985-1988), Research Evaluation Report no. 25, p. 6.

16. The distribution of the EURAM budget between the various areas was made on the following basis: structural materials (including coatings) 26.5%, magnetic materials 15.5%, composites 32%, and ceramics 26%.

17. CEC (1988) Evaluation of the European Advanced Materials Research Programme EURAM, Research Evaluation report no. 33.

18. See Evaluation of the European Advanced Materials Research Programme, ch. 4, p. 25.

19. CEC (1993) Evaluation of the BRITE-EURAM programme (1989-1992) areas 1-4, Research Evaluation report no. 53.

20. COUNCIL DECISION of 14 March 1989 on a specific research and technological development programme in the field of industrial manufacturing technologies and advanced materials applications (BRITE-EURAM) 1989-1992, 89/237.

21. See Hugh Ward and Geoffrey Edwards (1990) Chicken and Technology: the politics of the European Community's budget for research and development, Review of International Studies, 16.

22. See Wayne Sandholtz (1992) High-Tech Europe. The Politics of International Cooperation (Oxford, University of California Press). Sandholtz offers a persuasive argument that the demand of national governments for cooperation combined with the supply of political leadership and a desire to obtain a solution to the problem of juste retour explain the emergence of international cooperation under the European technology programmes. However, it may not be appropriate to reduce political processes to the all-embracing single categories of demand and supply. In particular, he gives insufficient attention to the national institutional system within which the demand for cooperation is derived.

23. See, for example, P. Ludlow (1991) 'The European Commission' in R.O. Keohane and S. Hoffman, The New European Commission, (Oxford, Westview Press); Neill Nugent (1995) 'The Leadership Role of the European Commission:Explanatory Factors', paper presented at UACES Research Conference, University of Birmingham, 18-19 September 1995.

24. See M. Sharp and C. Shearman (1987) European Technological Collaboration (London, Routledge and Kegan Paul).

25. David Teece (1976) The Multinational Corporation and the Resource Cost of International Technology Transfer [Cambridge, Ballinger].

26. See Evaluation of the first BRITE programme (1985-1988).

27. See COM (88) 385, p.15.

28. CEC (1985) Implementation of the Commission's memorandum 'Towards a European Technological Community' COM (85) 530 final, p.11.

29. Margaret Sharp and Claire Shearman (1987) European Technological Collaboration [Chatham House Papers. 36, Routledge, London]

30. CEC (1984) Commission Decision of 29 February 1984 on establishing an Industrial Research and Development Advisory Committee (IRDAC) - Official Journal, No L 66/30. IRDAC was set up by Commissioner Davignon partly with the idea of avoiding too many lobbyists. Each year there are two plenary sessions of the Committee, while a steering committee (comprising the president and two or three members) meet each month. There are also ten to twelve working groups, chaired by the president of IRDAC or another industrialist, set up for one year with a clear mandate to work on a specific task. IRDAC both reacts to Commission proposals and proposes its own initiatives.

31. CEC (1986) Commission Decision of 7 January, Official Journal, No L 25/26.

32. O.J. No L 66/30, 8 March 1984.

33. With its industrial membership, IRDAC is similar to the European Round Table of industrialists invited by Davignon to consider proposals for collaborative research in the field of information technology that were later to form the basis of the ESPRIT programme. However, IRDAC has been formally constituted by Commission decision, and since then has operated an institutionalised form of consultation and decision-making. As a group it works closely with the European Commission, and has operated from Commission offices, with its small secretariat being employed by the Commission.

34. The vice-chairman of IRDAC, Dr David Giachardi, Research Director of Courtaulds described the committee as a `sort of old boys club' organised by the Commission, which had the effect of `europeanising' its members through the ongoing interaction and concerns of the committee - concerns which had an inherent European bias. Interview held in London, 11 June 1992.

35. IRDAC (1986) Opinion on the Framework Programme, Brussels, October.

36. CEC (1985) Towards a European Technology Community, COM (85) 350 final.

37. See, for example, Robert Reich (1991) The Work of Nations. Preparing Ourselves for 21st Century Capitalism [London, Simon & Schuster]; more recently a report prepared for UNICE embraced similar views regarding the contribution of skills levels to industrial competitiveness - Torger Reve and Lars Mathiesen (1994) European Industrial Competitiveness, SNF Report 35/1994 [Foundation for research in Economics and Business Administration, Norwegian School of Economics and Business Administration, Bergen].

38. See Official Journal C 188, 19 July 1991.

39. IRDAC (1990) Opinion on Skills shortages in Europe [Brussels], p. iii.

40. Ibid., p. 45.

41. IRDAC (1992) IRDAC Strategy Paper on Future Community RTD Policy - opinion requested by Vice-President Pandolfi discussed at IRDAC's Plenum/Seminar on 6/7 March 1992 and approved on 31 March 1992, p. 2.

42. CEC (1993) Growth, Competitiveness, Employment. The challenges and ways forward into the 21st century (Brussels).

43. See IRDAC News, No. 2, Spring 1994.

44. M. Poniatowski (1988) Europe's technological challenge: a view from the European Parliament, Science and Public Policy, December, p. 392.

45. European Parliament (1985) Report of the Energy Research and Technology Committee on SDI and Eureka, raporteur Glyn Ford.
The criteria included impact on employment, on the environment, on health and safety, on living and working conditions, and on the third world.

46. Debates of the European Parliament, Official Journal No 2 -358/64.

47. EP debate 135. 596, 5 December 1989.

48. Debates of the European Parliament, No. 2/341/138, 9 July 1986.

49. Debates of the European Parliament, Official Journal No. 2/ 358, 177 November 1987.

50. CEC (1992) 4th BRITE-EURAM conference, 25-27 May, EUR 14576.

51. B. Guy Peters (1992) Bureaucratic Politics and the Institutions of the European Community, in Alberta M. Sbragia (ed) Euro-Politics [Washington, The Brookings Institute].

52. Following the SEA, Community legislation required two parliamentary readings before Council decisions were final. Parliament could review the 'common position' of the Council, with three possible options - the position could be approved within three months; it could be rejected, and the legislation fails unless the Council acts unanimously within three months; or the Parliament could propose amendments that, if supported by the Commission, could only be overturned by a unanimous Council vote. Rejection or amendment of Council positions required a simple majority of the European Parliament, while amendments rejected by the Commission require unanimity on the part of the Council.

53. Interview with Frances Morgan, UK representative of COREPER, 8 August 1994.

54. See European Parliament Session Documents, Document A 2-269/87, 27 January 1988.

55. European Parliament Session Documents, A3-0183/91, 27 June 1991.

56. Glyn Ford (1988) European Technological Choices, Science and Public Policy, December. The author was a United Kingdom MEP at the time of writing the article.

57. Glyn Ford (1988) op.cit.

58. CEC (1986) Proposal for a Council regulation concerning the framework programme of Community activities in the field of research and technological development (1987-1991) COM (86) 430 final, p. 3.

59. Debates of the European Parliament, No 3-384, 12 December 1989.

60. European Parliament Session Documents - Report drawn up on behalf of the Committee on Energy, Research and Technology on the proposal from the Commission to the Council for a decision concerning the framework programme of Community activities in the field of research and technological development (1990-1994), M. Chiabrando, 1 December 1989.

61. CEC (1987) Report by the Commission to the Council on the realisation of the objectives of the Community action programme for small and medium-sized enterprises COM (87) 238.

62. In August 1986, the Commission proposed an Action Programme for Small- and Medium-Sized businesses which was adopted by the Council in October of that year. It contained two objectives designed to foster the community generally - to create a favourable climate for business, and to provide services to help SMEs in the light of the single market.

63. CEC (1988) Evaluation of the first BRITE programme (1985-1988), Research Evaluation report 25. [Brussels].

64. CEC (1988) Second Report by the Commission on the realisation of the objectives of the Community action programme for small and medium sized enterprises, COM (88) 64 final.

65. CEC (1988) COM (88) 64, ibid.

66. CEC (1986) The Science and Technology: Guidelines for a New Community Framework Programme of Technological Research and Development COM (86) 129 final, Annex II, 3.5-2.

67. CEC (1990) Official Journal, 1 June, 1990 [CEC, Brussels].

68. One report suggested the downstream shift was such that programmes could not continue to claim support for pre-competitive research, and quoted BRITE-EURAM as an example. See CEC (1991) Analysis of the key factors; how prime partners choose appropriate collaborators for successful R&D co-operation, Harald Linne (submitted to the MONITOR/SPEAR unit, DG XII, February).

69. 4th BRITE-EURAM conference, op. cit.

70. CEC (1992) BRITE-EURAM Evaluation study of finished projects: projects completed by December 1991 [DG XII].

71. CEC (1992) A universe of possibilities: BRITE-EURAM II [DG XII, Brussels].

72 . See European report on Science and Technology indicators, 1994 (Brussels).

73. The programme was divided into five areas: Areas 1-4 covering work on advanced materials technologies, design methodology and assurance for products and processes, application of manufacturing technologies, technologies of manufacturing processes; area 5 covered aeronautics.

74. See European Report on Science and Technology Indicators, 1994.

75. See evaluation of the first BRITE programme, 1988 (Brussels).

76. CEC (1994) An Industrial Competitiveness Policy for the European Union, COM (94) 319 fiinal.

77. See Stephen George (1990) An Awkward Partner. Britain in the European Community (Oxford University Press) for a discussion of the dispute and its eventual settlement.

78. HMSO (1992) Annual Review of Government-Funded R&D, p. 71, Figure 34.

79. European Report on Science and Technology Indicators, (1994)

80. CEC (1986) Proposal for a Council regulation concerning the framework programme of Community activities in the field of research and technological development (1987-1991), COM (86) 430.

81. See Commission communication to the Council `A community plan of action relating to the evaluation of Community research and development', OJ C.14, 20 February 1987.

82. See CEC (1993) BRITE-EURAM. A Measurable Impact, EUR 15276.

83. CEC (1993) Evaluation of the BRITE-EURAM programme 1989-1992, EUR 15070, p. 13.

84. A decision of the European Commission, on 7 September 1995, outlined a new role for IRDAC to look at more strategic issues beyond those of industrial research and development.

85. Jacques Theys (1994) `Decision-making at the European level', paper presented at conference in London School of Economics, 14-15 September 1994 on Scientific Expertise in European Public Policy Debate.

86. See Research and Technological Development Activities of the European Union Annual Report 1995, COM (95) 443.

87. CEC (1986) Proposal for a Council regulation concerning the framework programme of Community activities in the field of research and technological development (1987-1991) Submitted to the Council by the Commission, 5.8.1986 - COM (86) 430.

88. Ibid., p.2.

89. The EC provided an alternative source of funding, putting cash into key technologies for European competitiveness when national policies stressed other priorities. It was deliberately used to build research collaboration, especially in areas where industrial and academic teams can work together - see Times Higher Education Supplement (1993) Many resources make labs work, 30 April.

CHAPTER 4

UNITED KINGDOM - SQUARING THE TECHNOLOGICAL CIRCLE

4.1 Introduction

The preceding chapter's analysis of the BRITE-EURAM programme suggested differences in the pattern of participation between the different member states, with the highest volume of participants among the larger countries. Many reasons can be put forward for this, but not the least is the capacity of firms, universities and research institutes to engage in cross-border technological collaboration. Another important factor is the support given to European technological collaboration by the national authorities. More broadly, the varied pattern of participation reflects differences in the national institutional systems which structures the relations of actors and determines how they see their role in relation to others in the process of technological development.

Institutional systems are not an immutable force. They change gradually in response to internal and external pressures - from economic, political, and financial pressures to those influences emanating from the international level. In the Spanish case (examined in more detail in the next chapter) the programme for the modernisation of industry (1983-84) called for changes in industrial organisation, in government-industry relations and in the focus of public policy - to a large degree such changes were prompted by the ultimate goal of European Community membership, and perceived as a necessary prerequisite to it.

The Conservative government in the UK, prompted partly by ideological conviction and the pursuit of a neo-liberal economic programme, sought to reverse the government-industry relations built up over the preceding decades. In matters of research and technology, this meant shifting the burden of financing to the private sector, and encouraging a more market-oriented approach to the research activities being conducted.

However, the changes made in both countries suggest that even with the `europeanising' of the system fundamental elements of the original structure remain. What both this chapter and the succeeding one will try to bring out is the essential stability of the domestic technological systems in both countries, which neither ideological shifts nor international influences could change.

This chapter examines the structure within which the UK participants of the European technology programmes operated, and considers the principal actors, the sources of the `europeanising' influences, and recent policy changes. One consistent element of public policy throughout the 1980s and the 1990s has been the pursuit of competitiveness, and the government welcomed the European Framework Programme on that basis. The Department of Trade and Industry (DTI) view was that

> *European collaborative research can help both by encouraging industry to carry out more research leading to innovative products and by developing through standards more open markets which increase competition in Europe and hence industry's own competitiveness.*[1]

Less consistent has been the view as to the government's role in maintaining competitiveness, the most appropriate policy and the necessary structure to sustain industrial research and technology - moving from the excessive managerialism of the 1960s to the non-intervention of the 1980s, the government's approach seemed to present a picture of reaction to pressures rather than a co-ordinated plan offering a strategic approach to the problems of British industry. As one commentator observed `In no other advanced country has the government department responsible for industrial policy so frequently changed its name, its internal organisation, or its Minister (six times in the 1980s alone, against twice in the Treasury). In no other country has it set itself such ambitious tasks in one decade (the Ministry of Technology under Wedgewood Benn in the late 1960s), or willed its own disbandment in another (DTI under Ridley in the 1980s)'.[2]

The chapter thus begins by taking a look at the interventionist approach of the 1960s, and the policy and technology structure that resulted from it.

4.2 Historical roots of technology policy

The technological system that developed in the UK over the post-war period was characterised as mission-oriented, with an emphasis on the selection of large projects in areas such as civilian aircraft, electrical and mechanical engineering, shipbuilding.[3] Policy centred upon limited, selective intervention in industries with high growth potential, where concentrated production in a few large firms with close ties to the Ministry of Defence would generate technological advance, and a `trickle-down' to the smaller firms. At best, the belief of government was that as far as industrial prosperity was concerned `bigger is better and that productivity is related to the percentage of wealth invested in research and development.'[4]

Both before and after the Second World War, the Ministry of Defence had established a leading role in science and technology. In the decades after the war the bulk of government spending on science and technology in Britain continued to be devoted to defence.[5] Ample resources and government support contributed to a long and successful record for the Defence Ministry in research and technology, with a spill-over into the private industrial sector for big industrial projects.

The mission-oriented system was in many ways dominated by the needs of defence and security, rather than broader societal concerns - and the particular sectors that grew out of it, computers, aerospace, nuclear power, reflected this. `Big science' projects rather than technological innovation and broader industrial applications were the order of the day. In a study by Mowery and Rosenberg (1989), the authors concluded that very little Britih government-supported R&D was conducted within industrial firms, during the period 1900 up to 1950 (p.102).

One effect of the mission-oriented system was to lock in policy makers to a mind set which regarded science and technology as properly the responsibility of the defence sector or the universities. Some concern with the direct technological needs of industry and the problem of linking basic research to applied research underpinned the activities of the Department of Scientific and Industrial Research (DSIR), set up in 1916, which provided financial support for industrial research associations (RAs). The industrial research associations operated as cooperative organisations open to membership by firms within an industry. Although the RAs gained widespread membership, by the beginning of the 1940s the impact on industrial research was limited - fundamentally because the limited in-house capability of firms hindered them from making the most effective use of the research results.

The idea broached by the UK scientist, J D Bernal, in the 1930s that science and technology could go beyond serving defence needs to meet broader social and economic goals met with little consideration until the 1960s.[6] This meant that the UK technological system was essentially decentralised in the two decades after the Second World War, although taking into account the activities of the DSIR and the MoD. While the government was unwilling to set up a central mechanism to co-ordinate technological activities, it was also not eager to leave the responsibility for science and technology policy in the hands of the Royal Society or the two research councils - ARC and MRC.

Eventually, it was agreed that responsibility at ministerial level be split between a non-departmental coordinating minister and departmental ministers, with an Advisory Council on Scientific Policy to advise on civil matters and a Defence Research Policy Committee on defence matters. But science and technology did not have the degree of wide political concern which it has attracted in recent years, nor did it attract the interest and debate of academics.

A report published by the OECD in 1961, the so-called Piganiol report, renewed interest and debate on technology.[7] The report coincided with inquiries into the relations between technology, national economic welfare and economic growth generally. It emphasised the importance for all OECD states to develop technology policies, and argued that government policies in practically every field could be assisted by the application of new knowledge discovered through scientific research.

The OECD report re-introduced the view put forward earlier in the 1930s by J D Bernal that science policy could help in the formulation of a wide range of government policies, and not simply defence. It also suggested the need for some coordinating mechanism for science policy, a suggestion that was to prompt many of the OECD member governments to appoint ministers with responsibility for science.[8]

Further reinforcement of the need for science and technology policy, if any was needed, came with the publication of a book by the French writer, Jean-Jacques Servan Schreiber, warning that Europe was losing out in competitive and welfare terms to the technological capacity of America.[9] It was an argument that was used with equal conviction at the beginning of the 1980s to secure support for a European technology policy. In the 1960s, a concern with the gradual slow-down of the post-war growth experience made governments take a closer look at science and technology as a means to reverse the process. But the most appropriate technological structure or the role of government within this structure was not at all clear, and countries adopted varying models.

The Harold Wilson government, in an apparently more interventionist frame of mind, set up the Ministry of Technology in 1964, undeterred by brief term of the former Ministry of Science set up under Hailsham in the 1962-4 period. From its inception, the new Ministry of Technology had a wide ranging brief, covering industrial support, technological change, co-existing with the Department of Economic Affairs for the first couple of years with the latter taking responsibility for planning. The Ministry of Technology had responsibility for the government's activities in DSIR, and from 1967 it also took responsibility for aviation research. In addition, a number of academic establishments were set up, which focused attention on the study of science and technology policy. These included the Science Policy Research Unit (SPRU), set up in 1966 by Asa Briggs, at the University of Sussex, the Department of Liberal Studies in

Science (later Department of Science and Technology Policy) at the University of Manchester.

Despite these developments, there was no agreement on the role of government in science and technology. Opinion extended between giving responsibility for science to the research councils and the Royal Society, to favouring a stronger role for government in the formulation of policy, with a Minister to oversee the planning of public and privately funded research in the civil, military and industrial areas. Partly as a result of the lack of agreement, partly because of the entrenched position of the Ministry of Defence, the newly created Ministry of Technology took some time to find a role for itself and was forced to steer a course between defence and other ministries dealing with aspects of industrial affairs.

Inter-ministerial rivalry was somewhat inevitable, also, given the wide-ranging brief of the new department, which saw overlap with activities of other departments besides Defence, such as Education, and the Foreign and Commonwealth Office. The inclusion of aviation research in 1967 to the Ministry of Technology's list of activities, an area long held to be the responsibility of the aviation ministry, added to this rivalry.

The Ministry of Technology grew in size through merger with other departments and an extension of its responsibilities, including the control of the Industrial Reorganisation Corporation, to attain a staffing level of 40000 by 1969, compared with 6000 in 1964. But uncertainty was also created through several departmental re-organisations, in 1968 and in 1970. On the latter occasion, following the general election win by the Conservatives under Ted Heath, a superministry was created to form what is now the Ministry for Trade and Industry - with a preference for a less interventionist style of management. The UK's Ministry of Technology lasted just six years.[10]

The creation of the Ministry of Technology presented an opportunity to develop the institutional structure so as to direct the technological needs of industry and of society, but it was an opportunity that was not seized. Its failure is difficult to explain, particularly in the context of years of post-war policy making and a demand management structured on the basis of consensus.

The appointment of Frank Cousins, a senior trade union official, to be the first Technology minister in 1964 represented this consensus-building in practice.[11] But it did not work out as planned and he was replaced by Tony Benn in 1966. Already, the cracks in the consensus were beginning to show up. Several reasons may be put forward to explain this, although none provides an adequate reason for the inability of the government to develop the institutional structure.

One commentator has suggested that the post war consensus was breaking down by the early 1960s, even though government continued to act on the basis that strong consensus still prevailed.[12] The gap between the perceptions and aspirations of decision makers, and the practice of politics prevented a coherent, strategic technology policy from being introduced. More directly, the nature of `mission-oriented' technology policy did not lend itself to sustained consensus, even within the system of interest representation that the government had fostered in order to achieve that consensus.

The `mission-oriented' approach was characterised by selectivity, focusing upon a narrow range of industrial sectors containing a few large corporations. The possibility for `trickle-down' upon which the policy was based would become increasingly unlikely with structural change and greater international competition. Government policy hinged upon the belief that large corporations were more efficient and technologically dynamic, a premise that drove the activities of the Industrial Reorganisation Corporation which was created amidst this short wave of public institutional innovation to rationalise the industrial structure. The outcome of its activities - examples such as ICL, Leyland and GEC - proved the falsity of the assumptions behind the organisation.

This was the context in which Tony Benn made a speech to the Cabinet on 22 October 1964, calling for a `technologically united Europe.'[13]
But Benn's vision, and that of the rest of Europe did not translate immediately into a broad-based industrial technology policy. Instead, the mission-oriented approach

brought forth projects such as Concorde, polaris, and nuclear research.[14] In the absence of a more strategic attempt to harness the combined efforts of industrial firms, research centres and universities, these projects probably did more to exacerbate the rivalry among government departments than to engender a spirit of co-operation among the main actors in the technological system.

In 1970 the new government, under Edward Heath, reorganised the Ministry of Technology into the enlarged Department of Trade and Industry, under the direction of John Davies, a former Director General of the CBI. It set out a programme of support for industry - business incentives, lower taxes, cuts in public spending, and at the same time tried to encourage greater competition. However, it was unable to maintain the programme in its entirety, as the decline in manufacturing and discontent of the trade unions forced the government to continue with subsidies to private industry. The 1972 Industry Act was a turn-around from the non-interventionist style that the government had preferred in 1970, giving significant powers of intervention to the DTI that were later to be used by the Labour government throughout its term of office in implementing the industrial policy of the period 1974-79.

One of its earliest efforts centred upon a report on the nature of government support for research and development, the so-called Rothschild report.[15] This signified a shift in thinking on mission-oriented research, and was in fact the beginning of a more widespread re-appraisal of the role of government in economic management that was to spread throughout Europe as the decade wore on.[16] The Rothschild report was based upon the view that science policy should be aimed at more specific objectives than simply the general idea of promoting economic growth.

It was commissioned by the Heath government, which was already convinced that large science projects were a drain on public funds and better ways were needed to allocate scarce resources. The conclusions and recommendations, made over two decades ago, find an echo in more recent directions of government policy. Rothschild made a distinction between basic and applied research, with the recommendation that applied research should only be carried out at the instigation of government ministers, on a `customer-contractor' basis.

The report marked a move away from the science-driven attitude of public policy makers to technology-pull, with social responsiveness as being secondary to industrial innovation. By the end of the 1970s, the term `science policy' was replaced by `science and technology policy', with a greater emphasis on the technological dimension. Technical change, it was believed, came about through the direct efforts of firms, as well as being the result of scientific findings.[17] New technologies did not come about, as originally supposed, solely from scientific effort and the radical new technologies ensuing, but also through the internal processes of firms which generated incremental technological change as these firms responded to the market pressures. The rapid encroachment of a neo-liberal economic agenda, in the UK and elsewhere, allowed for the ready acceptance of this new approach to technology policy.

The preference for less government intervention, which was the basis of neo-liberalism, extended to technology management. Unlike Spain with its National Technology Plan, the UK did not have a formal technology policy throughout the 1970s or 1980s. There was no individual government department or Minister with responsibility for research and technology.

By the 1980s, the national technological system had all the appearance of a loosely organised system, with a fair degree of independence allowed to the different parts. But in shifting the responsibility for research away from the public purse so as to decentralise the system even further, the effect was to strengthen the control of government over the public areas of research and technological activities that remained. This became apparent with the changes that took place after 1993, and which will be considered later in this chapter.

4.3 UK technological system - actors and resources

The neo-liberalist doctrine permeating economic policy throughout the 1980s also affected technological policy, essentially through a concerted shift of spending, and to a lesser extent a change in the priorities of R&D coupled with a gradual change in the institutional structure.

It began with an attempt at coordinating the range of technological activities conducted throughout the public sector by the Cabinet Office Scientific Officer, a post linked to the Prime Minister's office. From 1983 the Cabinet Office Chief Science Advisor produced an annual review of government-funded R&D, which gave a comprehensive examination to previous years activities, the sources and providers of funds, and the technological areas attracting funds. Increasingly the review began to pay more attention to international programmes, including European programmes, and aimed to establish some coordination with regard to international programmes. In 1986 the Cabinet Office set up a Science and Technology Assessment Office to assist in the evaluation of R&D programmes.

The Advisory Board for Research Councils (ABRC) advised the Secretary for Education and Science, while the Advisory Council on Applied Research and Development (ACARD), set up in 1978 by Jim Callaghan to advise on new technologies and to identify emerging areas of commercial importance.[18] ACARD was replaced by ACOST in 1987, a year which marked a change in Conservative policy when it dropped any remaining vestiges of the Labour government's system from the 1970s. However, each government department continued to have responsibility for its technological activities, and set its own research budget. Science activities in higher education and the Research Councils continued to be the responsibility of the Department of Education and Science (DES) until 1992 when the Office of Science and Technology was set up, when the latter took over responsibilities for the Research Councils and government research strategy. The Higher Education Funding Council eventually came under the responsibility of the new Department for Education and Employment (DfEE) in 1995.

The Advisory Committee on Science and Technology (ACOST) was set up in 1987 to advise the government on the nature and extent of the UK participation in international collaboration in science and technology, and issues in science and technology generally. The Chairman and members of the committee were appointed by the Prime Minister, who initiated some of the work, with the remainder undertaken by ACOST itself. It occupied a somewhat unusual position in that, although closely connected to the government through the Prime Minister's office, the government did not always heed its recommendations.

ACOST proved, however, to be more in tune with developments in technology policy at the international level than the government was prepared to consider in practice. It criticised government departments and research councils, arguing that 'greater European collaboration could increase cost effectiveness. UK government needs to be more proactive in developing cost effective R&D programmes on a European basis.' [19]

It also criticised the policy of attribution (where funds received from Brussels were attributed to a particular department and in effect substituted for central government funds), suggesting that such a policy acted as a disincentive to more active participation. ACOST's acknowledgement that issues of pollution control, harmonisation of standards, competition policy and industrial competitiveness would increasingly need to be tackled at a European level,[20] did not meet with the full acceptance of the government.

The system differed in several respects from the French one, where a more dirigiste approach underpinned a system containing many structural elements dating back to the 1950s. In France five year R&D plans were issued by the government, and co-ordination took place through the Ministry for Research and Technology.

In addition, the French government provided a higher proportion of funds to R&D than any other member state (see Tables 5.2 and 5.3), whilst the National Centre for Scientific Research (CNRS), under the Ministry for Research and Technology, provided one-third of this. Much of the French science research is carried out through government- funded research institutes, grouped under the CNRS, rather than university departments. Whilst efforts have been made in France to develop close links between the research centres and industry, the Mitterrand government also encouraged greater decentralisation of research activities to local authorities and regional organisations.[21]

The UK's other main European competitor, Germany, had developed a technological system which reflected the federal system of government. The Ministry for Research and Technology (BMFT) works with the authorities at federal and Lander level to develop technological activities. BMFT provides most of the funds, with additional sources coming from the ministries of defence, economics, and education.

In addition, several independent organisations, jointly funded by Federal and Lander governments, allocate funds for research -the German Research Society (DFG) to academia, the Max Planck and Fraunhofer societies run research institutes that are funded partly by industry. The major national laboratories are largely funded by federal funds, while the regional applied research institutes receive funds from the Lander. The Ministry for Research and Technology has the primary responsibility for planning technology over six-year periods, and other ministries assist in the review of national plans.

Support for research in the UK, particularly industrial research, was identified on the basis of the general thinking of the time. Macro-economic policy centred upon a fairly strict counter-inflationary strategy, allied to supply side initiatives to improve competitiveness. The latter tended towards the pursuit of enabling policies that did not impinge on the general intent to reduce public spending.

Shifting the financing of research activities in general to the private sector was part of this enabling strategy, with government's role being largely one of facilitating and coordinating whatever activities were designated by the actors, without actually setting priorities for these actors. The overall result was to give primary position to the Treasury, making all the other government departments subject to its direction. This strategy was carried out fairly consistently throughout the 1980s and into the 1990 until, with the advent of Michael Heseltine to the DTI, there was a renewed emphasis on competitiveness, with pressure on firms to increase their R&D efforts, increase the level of training, and promote greater organisational efficiency.

The Department of Trade and Industry followed the enabling role which government had set for itself in its dealings with industry, pursuing a series of `soft policies' to encourage the development of the enterprise culture. In a White Paper published in 1988, the Enterprise Initiative set out the department's vision for industrial and sectoral growth based on the entrepreneurial efforts of individuals and small firms.[22]

The White Paper signalled a renewed interest in supporting small firms, and individuals who wanted to set up their own businesses. The DTI set about advertising the Initiative, and launched consultancy schemes to help small enterprises, seeking financial support for them through the encouragement of the venture capital sector. However, the White Paper was criticised for idolising the market and enterprise 'but the entrepreneur was not necessarily, or even primarily, a creative force generating or exploiting new scientific and technical knowledge - the essential qualification was that the entrepreneur should operate a new or expandiing business, whether it be a sweatshop, a software house, or a property company.'[23] Instead, it lauded the benefits of the free market, setting out the `value-for-money' approach that was to determine the future decisions on government spending.

Collaborative R&D was supported by the DTI through the LINK programme, EUREKA, the Advanced Technology Programme, and Club R&D. The LINK programme encouraged collaboration with universities on pre-competitive research relevant to industrial needs. Although in fact a government-wide programme, the DTI has played a major part, contributing £106 million of the total allocation of £194 million.

Many of the areas involved under LINK overlap with those supported under the European BRITE-EURAM programme - advanced materials and chemicals, advanced manufacturing and engineering, electronics and communications, and measurement and sensing. At the end of 1992 there were 350 collaborative projects in progress or completed, and a further 110 approved.[24] By contrast, UK companies were participating in one quarter of the 600 projects approved under EUREKA, and the DTI had committed £85 million to 106 EUREKA projects.[25]

Under the Advanced Technology Programme the DTI had allocated, by 1993, £185 million to 22 programmes to assist pre-competitive research in advanced information technology, manufacturing technology, advanced robotics, and superconductivity. The Club R&D operated on a slightly different basis, although still with the aim of encouraging industrial collaborative research, with the work being carried out by a host organisation on behalf of a group of companies.

Based on a principle which was adopted for firms interested in collaborating under the European programmes, but without sufficient internal facilities, the DTI had approved £3 million for 13 projects under the Club R&D programme.[26] By the time of publication of the 1993 Annual Review of Government-Funded R&D, UK firms were very actively involved in the European collaborative programmes participating, according to the review, in `almost 80 percent of the Framework II projects in some areas and receiving 18-20 per cent of the funding'.[27]

In terms of the specific programmes, the ESPRIT, RACE and BRITE-EURAM attracted the major interest of UK participants. Under ESPRIT II, UK firms were involved in 291 of the 420 projects. The BRITE-EURAM II programme was second in terms of the number of UK participants attracted, with involvement in 157 of the initial 271 projects approved. A later evaluation study conducted by the European Commission indicated that a total of 368 projects were approved, and the UK profile was 364 participants from a total of 1934. The largest number of coordinators of the projects approved were of UK origin.[28] RACE 11 (1990-1994) attracted UK organisations to 75 of the 95 projects initially approved.[29]

This `europeanisation' of UK industrial collaborative research was not created by the direct intervention and support of the government. The national authorities did not play the same role as their counterparts in Spain to push for domestic engagement in European technology programmes. While the drive for industrial modernisation was linked to European integration of Spanish industry, in the UK economic liberalism was a primary force in keeping government, and the Department of Trade and Industry, from taking a more prominent position. As the next section will argue, the europeanising influences came from other areas of the changing technological system that had emerged.

Throughout most of the 1980s and the early 1990s the central government avoided direct consideration of a national technology policy. Technological priorities were absent from government pronouncements, and no real attempt was made to coordinate the various institutions, both private and public, engaged in technological activities. As far as the European Framework Programme was concerned, the UK government brought its most vociferous opposition to the overall budget.

The lengthy debate on the budget for the Second Framework Programme (1987-1991) exemplified its stance. The original budget proposal made by the Commission set a figure of 7.7 billion ECU, which the UK government regarded as being too high. While holding the Community presidency in 1986, when the budget negotiations were under way, the government proposed 3.1 billion ECU with the suggestion that it was adequate for any country's aspirations and accused the Commission of not being willing to compromise.[30] The eventual settlement was 5.3 billion ECU.[31]

4.4 `Europeanisation'- the public level

The liberal inclination characteristic of the 1980s policy towards industry created a vacuum, and UK manufacturing looked to European initiatives for financial support. In the context of a loosely structured technological system with a high degree of permeability it was a simple matter for economic actors to bypass the national government, and articulate their interests directly at the European level.

But at the domestic level there were a number of voices and influences that were taking a strongly European orientation from the early 1980s. One that proved particularly influential was the House of Lords Select Committee on Science and Technology which issued a number of reports on research and technology during the 1980s, with the intention of promoting strategic thinking on science and technology.[32]

Apart from its impact on the technology strategy, the House of Lords Select Committee also offered a platform for a whole range of interested parties to voice their concerns, or set out ideas for the improvement of the technological system.[33] It drew attention, through its various enquiries and reports, to aspects of socio-economic activity that were largely neglected by the government, and many of the reports' conclusions have subsequently been incorporated into policy.[34]

The Select Committee's perspective was a broad one, covering matters relating to the domestic technological system and also aspects of international technology programmes. The Annual Review of Government-Funded R&D, first published in 1983, was the government's response to the Select Committee's report on Science and Government.

The 1986 report of the Select Committee, Civil Research and Development, made a number of recommendations regarding industrial R&D.[35] These included greater financial support from the DTI for industrial research, which it had called for three years before,[36] and also the improvement of information about public and private R&D. It also recommended that the government should do more to help the small firms with regard to their research needs, and that more effort should go into increasing the knowledge of R&D results from overseas. There was also a recommendation that a process for funding strategic research to support the economic future be introduced.

Following the recommendations of the Select Committee's 1986 Report on Civil Research and Development, the government set up ACOST, with a brief to prepare a strategic review of public and private S&T every three years for submission to the Prime Minister's office. Apart from setting up ACOST, the government's response to the 1986

House of Lords report was mixed, and conformed entirely to the prevailing spirit of laissez-faire being pursued so vigorously.

In a subsequent government White Paper published in 1987, Civil Research and Development, certain aspects of agreement with the Lords Committee were clear.[37] Support for small firms was one area of common ground, and the government was to set out a clearer position on such support in the Enterprise Initiative White Paper of 1988. However, the nature of support was different, with the government being unwilling to commit further spending on applied research. In particular, public support for programmes such as the Alvey programme of the early 1980s, which supported industrial/academic resarch in IT, were ruled out.

Instead, government held firm to the view that finance should come from the private sector, on the basis that research and technology is market-driven. The government would confine itself to granting financial support to basic research, and expressed very general encouragement for greater collaboration and technology transfer.

In the absence of a concerted attempt by the government to further European technological collaboration, the House of Lords Select Committee turned its attention to an examination of international scientific programmes, and the UK's position as participant and beneficiary. The resultant report, International Scientific Programmes, published in 1991, urged a higher level of participation in international collaboration.[38]

Since only 5% of the world's research is carried out in the UK, and earlier reports had indicated a lag in UK research efforts which had not been filled, the Committee urged the necessity to participate in international research programmes. The Lords Select Committee made a further recommendation that the Annual Review of Government Funded R&D should identify the amounts contributed by research councils and government to international scientific programmes, and to include a separate section drawing together UK participation in these programmes.

However, the fact that the UK was a net beneficiary to many of the European technology programmes, including the BRITE-EURAM programme, meant that there was little need for concern over juste retour.[39] It is fair to say that much of the subsequent co-ordination of technological activities by the government, evident after the 1993 White Paper on Science and Technology,[40] owes a lot to the efforts of the Lords Committee to highlight deficiencies in the system.

The unhesitating support of the House of Lords Committee for a greater international dimension to UK technological activity was not mirrored to the same degree by that of the House of Commons Education, Science and Art Committee. In a report entitled Science Policy and the European Dimension, published at the end of 1990, the Commons Committee expressed reservations concerning the European dimension, particularly if it reduced the autonomy of the national scientific effort. Indeed, the stance taken by the Commons Committee was closely aligned with the general ambivalence to issues of European integration which the UK government expressed throughout much of the 1980s.[41]

While it did not oppose the European dimension, the Committee preferred to take a broad view of Europe, beyond the area of the European Community to include wider international ties. It commented that `while it is and will continue to be appropriate for the greater part of the United Kingdom`s scientific research to be organised and funded at national level, the evidence we received recognised the increasingly international character of scientific endeavour and strongly supported the United Kingdom`s continuing to develop and strengthen her international links in order to retain her place in world science.'[42]

The Commons Committee strongly endorsed the principle of subsidiarity, rejecting the idea that the European Commission should play a predominant role in determining the priorities for, and funding of scientific research in Europe, declaring that `it would be inappropriate for the Community to seek to extend its competence in science and technology beyond its present objectives.'[43]

Instead, the Commons Committee view was that the Commission should be one of many players. It accepted the Community support in such areas as information technology, but also that other forms of research organisation should continue, for example, specialised collaborative laboratories, informal networks of research teams, decentralised coordination of national research activities.

Essentially two distinct views were represented by these committees, one of which found favour with the scientific community and the research councils, and to some degree the industrial community, the other representing the underlying philosophy of the government. It is difficult to identify a convergence of views such as occurred in Spain, and which formed the basis of that country's consensus on European integration. One position was represented by the House of Lords Select Committee on Science and Technology where the view was that `the government has .... a general responsibility to support science and technology because this is fundamental to the social and economic well-being of the country'.[44]

On the other hand, the government's position stemmed from its view of the purpose of technology, and was firmly set in the prevailing philosophy which regarded the market as the most efficient allocator of resources. In the words of the DTI, `Firms themselves are best able to assess their own markets and to balance the commercial risks and rewards of financing R&D and innovation. The Government should not take on responsibilities which are principally those of industry'.[45]

Technological development and innovation was accepted as a means to improved competitive capability, but relative costs particularly associated with the labour market and the general price level also determined the country's position in the international competitiveness table. The objective of the European technology policy to improve competitiveness of industry made it generally acceptable to the government, even when the government's preferred domestic technology policy was strictly non-interventionist.

4.5 `Europeanisation - the private level

UK industrial and academic support for European technology programmes grew steadily through the second half of the 1980s and the early 1990s, despite the absence of an organised and coherent campaign directed at the technology programmes. The major representative groups, although building up a lobbying presence at the European level, tended to confine themselves to regulatory matters and more directly competition-related issues. In the period under study here two features stand out in stark relief -the general shift of financing research and development to the private sector, and the greater proportion of that financing coming from abroad.

The foreign sources of R&D financing included European Community resources as well as the financial resources provided by the multinationals resident in the United Kingdom. This section does not argue that the European sources were predominant and a primary factor in the `europeanisation' of the domestic R&D effort, but undoubtedly both sources indicated a greater internationalisation of the technological activities conducted in the country.

Table 4.1 shows a notable increase in the share of research funds coming from overseas, over the period 1983-1993, rising from 7% in 1983 to 15% in 1993, a clear outcome of the government's very active encouragement of foreign direct investment during this period. By the end of the 1980s the government's policy of shifting the burden of research funding to the private sector appeared to be showing some signs of success, but it was clear that a significant proportion of the burden was being carried by the foreign firms in the United Kingdom.

Table 4.1 Sources of funds for industrially performed R&D (% cash terms) 1983-1993

	1983	1986	1987	1988	1989	1990	1991	1992	1993
Govt.	30	23	20	17	17	17	15	14	12
Overseas	7	12	12	12	13	15	16	15	15
Own resources	63	64	68	71	69	68	69	71	72
Total (£m)	4163	59951	6335	6922	7650	8318	8135	8489	9069

Source: Forward Look of Government-funded Science, Engineering and Technology, 1995, vol. 3 (London, HMSO)

Large firms, employing more than 1000 employees, spent nearly 70% of the total, with firms employing 1000-4999 accounting for 30% of industrial R&D expenditure.[46] Companies employing under 200 workers spent 15%, confirming a long-held view that local firms were slow to assume the burden of research funding alone.[47] Findings from the research carried out by Patel and Pavitt showed that UK managers were less willing than their international competitors to commit their own funds to technology creation, general economic conditions not withstanding. With the general shift of financing away from government to the private sector, shown in Tables 4.2 and 4.3, some small and medium-sized UK enterprises inevitably turned to the European Community as a source of support.

Table 4.2 Gross expenditure on R&D by performing sector 1986-1993, £m cash terms

Performed by:	1986	1987	1988	1989	1990	1991	1992	1993
Govt.	1212	1264	1360	1534	1566	1757	1846	1893
Higher ed.	1288	1460	1575	1689	1837	2020	2129	2266
Business	5951	6335	6922	7650	8318	8135	8489	9069
Private non-profit	317	324	370	415	480	494	516	524

Source: Forward Look, 1995, vol. 3, ch.4.

Table 4.3 Gross expenditure on R&D by source of funds 1986-1993, £m, cash terms

	1986	1987	1988	1989	1990	1991	1992	1993
Sector providing funds:								
Govt.	3541	3640	3665	4031	4262	4248	4355	4446
Higher ed.	54	65	77	81	84	90	98	104
Business	4199	4643	5331	5788	6156	6248	6666	7161
Private nonprofit	174	195	217	253	309	362	404	430
Abroad	640	840	937	1134	1428	1457	1458	1611

Source: Forward Look, 1995, vol. 3, ch. 4.

An examination of manufacturing industry's expenditure on R&D shows some variation on a sectoral basis, with the pharmaceuticals sector maintaining the largest share of research spending over the period since 1986. Other sectors that accounted for research spending included motor vehicles and electrical machinery, although the aerospace industry has continued to maintain second place in the spending stakes behind the pharmaceuticals industry, as Table 4.4 shows.

Table 4.4 R&D intensity in UK manufactured products, selected years, %

	1986	1989	1991	1993
Chemicals	2.3	2.7	2.9	2.7
Pharmaceuticals	11.8	14.7	15.8	21.0
Mechanical engineering	0.8	0.8	0.9	1.4
Electronics	7.2	5.4	4.5	7.0
Other elect. engineering	4.5	3.2	3.9	5.9

Source: Forward Look, 1995, vol 3, ch.4.

Foreign firms have shown a significant presence in those sectors with the highest intensity of research, suggesting there was already a European bias in the general activities of the manufacturing sector, and no doubt supported the integration of national research activity into the European programmes. The prevalence of foreign firms was noted, but not necessarily condemned.

The government was initially permissive and then actively encouraging to foreign investment, and a spin-off in terms of research activity was thus welcomed. The general attitude was expressed cogently by John Banham, once director-general of the Confederation of British Industry (CBI), that `technology can be purchased or copied, as can productive capacity.'[48]

Foreign investment was regarded by some, including the academic community, as necessary to fill a vacuum left by either indigenous firms or government. However, the evidence from Table 4.4 and elsewhere does not suggest a pervasive spread of the results of such research activity throughout the broad sweep of UK manufacturing industry.

The import penetration in UK high technology sectors had risen more rapidly than other OECD equivalent sectors. But it seemed to be the case that import penetration was largely confined to high technology sectors, rather than the medium and low technology sectors to which the majority of the UK manufacturing firms belonged.[49] Overall, manufacturing's share of GDP had been falling, from 27% in 1979 to 22% in 1989 and around 20% in 1993, but it accounted for some 23% of the total employment.

Manufacturing has continued to have economic significance,[50] but it required the ability to compete on technology in order to be able to take advantage of opportunities in the wider European market.[51] European technology programmes served two objectives, therefore - access to technological resources, and access to the single market. The UK participants were very strongly influenced by market-oriented commercial motives, rather than more directly specific research and technology related concerns, although the two sets of motives are inter-related. But there is no overwhelming evidence that the UK participation was swept along by organised interests and elite groups in the way that the Spanish participants were.

The CBI had opened its Brussels office in 1971, two years before UK accession to the European Community, and was a long-standing supporter of European integration. During the 1980s its relations with the government were not particularly close, and the smaller but more influential, Institute of Directors, was favoured. A remark by Lord Young, the Secretary of State at the DTI, best illustrated the situation - `we have rejected the TUC; we have rejected the CBI. We do not see them coming back again. We have rejected the corporate state.' [52] The lack of confidence was mutual, particularly given the government's failure to `define a worthwhile role for the Department of Trade and Industry.'[53] With the lack of activity on the part of government, the CBI did involve itself in research and technology issues to some degree.

One of its mechanisms was the Technology and Innovation Committee of the CBI which meets quarterly, and has among its responsibilities the preparation of submissions for the European Framework Programme. Given the broad spread of membership of the CBI, however, it has proved difficult to reach consensus to make specific proposals on individual programme content. The confederation preferred to avoid giving any support to sectoral interests, although `it clearly favoured the full implementation of the European single market programme.'[54] Although it has made submissions on the Framework Programme, `the CBI did not feel it had a great deal of influence on technology policy at the European level, and was consequently happy to channel its concerns through UNICE.'[55]

The inadequacy of the UK government position, in the CBI view, centred upon its unwillingness to more actively influence the nature and direction of European technology development programmes. It was not a case of doing enough to promote participation in the European programmes, but `not doing enough to influence the direction of programmes, and instead concentrating on the budget.' The British peak organisation, like many of the sectoral interest groups, did not issue policy documents specifically concerned with research and technology, instead concentrating upon more general policy issues. One of its principal concerns regarding the Fourth framework Programme was its omission of `the future needs of the market'.

A similar lack of concern over direct technological issues was apparent among other groups. One of the interest groups with the strongest European-level links, the Engineering Employers Federation, published its view of industrial strategy in November 1992. Referring to science and technology, the report commented that `invention and initial research is only the first stage of a long process which must include technology demonstration; product, manufacturing process and market development; and commercial production and marketing.'[56] The Institute of Directors (IOD) held similar views. In its manifesto for Europe, published in 1994, the IOD concentrated upon urging a faster pace upon the liberalisation programme, with a reform of the European institutions so as to reduce the power of the Commission.[57]

A tacit consensus seems to have developed among UK collective interests that the European technology programmes, even if not immediately and obviously beneficial to national interests, were certainly not harmful. This is borne out by the high level of UK participation in the programmes, `having secured more research contracts under the Third Framework Programme than any other member state.'[58] However, the `europeanisation' of the actors took place through direct participation in the already-formulated programmes, rather than through any substantive input into the policy formulation process.[59]

Chapter three of this thesis examined the formulation and management of the BRITE-EURAM programme, and suggested that it was essentially a top-down programme, notwithstanding the claims of the European Commission otherwise. A significant role was played by the European-level elite group, IRDAC, and by a very large, but de-centralised group of experts engaged by the Commission to judge project proposals. Thus was the programme formulated and managed, although the Commission did take account of the opinions presented.

Within the UK, interests were not organised in such a way as to take full advantage of this system. The de-centralised technological system, combined with the non-interventionist style of government, precluded a more proactive input by UK interests into the European policy-making process.

The evidence given to the House of Lords Select Committee on the European Communities, in its inquiry A Community Framework for R&D, seems to bear this out.[60] A range of government, industrial, and academic interests presented their views to the Committee. Many of the individual researchers and the research councils were dissatisfied with the possibilities of presenting their interests before the European Framework authorities. Feeling excluded, they considered that the programmes were decided at a political level, in the Research Council of Ministers where political considerations play a major role. The research councils felt they had little or no influence, and were not asked for their opinion.[61]

It was difficult for things to be otherwise, under the UK system, since the Advisory Board for the Research Councils (ABRC) lacked formal and acknowledged consultations with the Cabinet Office Science and Technology Secretariat. The Cabinet Office did not always appear as a first point of contact for the many business and academic organisations seeking to extend their international collaborative activity. The Lords Select Committee on Science and Technology inquiry on international scientific programmes, conducted during the 1990-1991 session, heard that the Secretariat's published guide, Guidelines for Future International Collaboration, was not sufficiently used or indeed widely known.[62]

The `europeanisation' of UK micro-level actors in the particular area examined was the result of both domestic political and institutional factors. For the business community, already undergoing an internationalisation of activities, participation in European technology programmes was a logical part of the process.

European technology programmes were presented by the European Commission to the business community in terms of the positive contribution that they could make to competitiveness, and as a complement to the essentially neo-liberal single market programme. The latter programme was one of the areas of European policy development that attracted the broadest support from otherwise cautious UK politicians, a positive attitude that spilled over to the European technology programmes.

A neo-liberal economic policy conducted by the national government had repercussions on technological activities in general, and directed the attention of the research and technology community to what the European Commission had to offer. In particular, the perception of a shift in public financial support for research and technology prompted many organisations, including universities, to seek financial support elsewhere. Government departments did not actively promote the participation by these organisations to the same extent as their counterparts in other member states for a number of reasons.

One reason was the policy of attribution of the Treasury, in which it attributed sums received from Brussels to individual departments and then adjusted the following year's budget allocation to that department by a similar amount. The Treasury policy affected the government department most closely associated with the Framework Programme, the DTI, inevitably forcing it to balance encouragement of business participation in the European collaborative programmes with a desire to maintain its own level of resources.

The Department for Education and Science (DES) which was responsible for the science community faced a similar dilemma. The policy of attribution, heavily criticised by the House of Lords Select Committee on the European Communities in its inquiry on the European Community R&D programme, forced businesses and universities to find their own way to europeanisation.[63]

Government departments retained individual responsibility for research and technology, precluding any organised effort at the national level to unite the interests of business and the academic community or to identify and channel national priorities into the European policy process. The result was growing support on a very de-centralised basis for the EC programme, but also a growing feeling among many of the UK interest groups of having little input into the integration process.

At the same time, UK industry and the universities were taking an increasing part in the European technology programmes, evident both in the number of collaborative projects undertaken by UK organisations, and in the share of the Framework Programme budget going to the UK. To a large extent, these organisations were swept along by the tide of internationalisation of technology, and by the need to secure an elusive technological, and ultimately, commercial advantage. But the more mundane financial considerations also played a part - the European Community was a source of funds for both industry and the universities at a time when the central government sought to impose more stringent conditions on public funding of research and technological activities.

On the domestic level, meanwhile, the issues raised by the House of Lords Committee on Science and Technology over the course of a decade - the need for strategic direction, the incorporation of science into politics, industry's need for innovation, and a stronger political commitment to European technological collaboration - had still to be addressed by the early 1990s.

4.6 A new beginning?

When the House of Lords Select Committee on the European Communities reported on the Third Framework Programme (1990-1994) it had concluded that `there was general agreement that the six lines of research identified by the Commission were broadly right'.[64] But the absence of strong opposition to programme content did not indicate a stated preference for European technology policy over national technology policy by the groups giving evidence to the committee. Instead, European policy filled a vacuum and met certain needs.

A report by the House of Commons Education, Science and Art Committee on the European dimension to UK science `supported the United Kingdom`s continuing to develop and strengthen her international links in order to retain her place in world science.'[65] But the Commons Committee also rejected the idea that the European Commission should play a predominant role in determining the priorities for, and funding of, scientific research in Europe, declaring that `it would be inappropriate for the Community to seek to extend its competence in science and technology beyond its present objectives.'

In 1991, John Major replaced Margaret Thatcher as prime minister and the government shifted its stance on science and technology from that which had prevailed during much of the Thatcher era. Although the emphasis on the market as the allocator of resources remained, several initiatives appeared under the new administration. The DTI became more active in its support for British industry, under the management of Michael Heseltine, through the encouragement of competitiveness, and marked its concern by publishing two White Papers on competitiveness. In 1992, the DTI set up the Industrial Competitiveness Division to ensure that all government departments and policies would take account of the need to promote industrial competitiveness. Heseltine's public speeches and the flurry of activity within the department generated a high level of optimism and expectations that the DTI would at last become the vocal and substantive supporter of industry.

The government department sought to improve the innovation of industry through a variety of means, by encouraging firms to invest more on research and development, publishing an annual R&D scorecard, publicising innovative companies, and more generally encouraging firms to undertake higher levels of training. Although this renewed initiative by the DTI did not extend to further financial support, Heseltine's emphasis on innovation was broadly conceived, and extended to areas that might more properly be considered as within the remit of the Minister for Technology, William Waldegrave. In the event, the Office of Technology, which during the 1980s had been located in the Cabinet Office, was moved to the DTI in 1995, further strengthening the profile of the industry department in the area of technology and applied research.

The DTI and the Minister with responsibility for technology operated on parallel tracks as the decade moved on, with the DTI taking a larger slice of the action and leaving less opportunities for Waldegrave to introduce technology initiatives in basic or applied research. It looked as if the vacuum might be filled at the national level, with the publication in May 1993 of the government's White Paper on science and technology, Realising Our Potential.[66] In the first government review of technology policy since the 1971 Rothschild report, the White Paper emphasised the important contribution that technology could make to wealth creation. The stated intention was to 'harness the intellectual resources of the science and engineering base to improve economic performance and the quality of life. It intends, in future, that decisions on priorities for support should be much more clearly related to meeting the country's needs and enhancing the wealth-creating capacity of the country.'[67]

Specifically, the document identified the market-pull context of science and technology, and innovation as the central element by which S&T activities are to be judged. Like its predecessor three decades earlier, the White Paper espoused the contractor-customer principle, where government departments purchase scientific advise, applied research, or commission basic research under competitive market terms according to their individual needs. What was in fact proposed in the White Paper was an organisation, and in some cases a re-organisation, of the institutional relations, to focus activities and priorities on meeting an economic challenge - that of industrial competitiveness.[68]

While government departments retained independence in their respective research and development policies, the re-orientation of the research councils and the application of market principles to public research and technological activities, including privatisation and the strategic allocation of government funds, clarified the direction and priorities that future activities should take.

In terms of the particular proposals made in the White Paper, what resulted was a continuation of the broad strands of a philosophy which had been in place since the beginning of the 1980s - which put primary emphasis on the market, on non-intervention, and on the economic use of public resources.

Closer and more substantive links between the business and scientific communities were envisioned, partly by a reorganisation of the Research Councils, increasing the number from five to six, with five of them oriented to applied research rather than basic research.[69] The DTI would, it was further proposed, become more proactive in the promotion of innovation by firms, and the department would endeavour to encourage greater awareness of innovation - by firms and by the public.

Although the arrangements set out in the White Paper preserved the de-centralised system, and in some ways extended it, the government would exert a strong coordinating role over the nature and general direction of the activities under way or proposed. It could do this in several ways. One was by moving the responsibilities of the Advisory Board for the Research Councils to the Office of Science and Technology, then situated in the Cabinet Office, and by the creation of the post of Director-General of Research Councils, also to be located in the Cabinet Office.

The Director-General assumed responsibility for coordinating the work of the research councils in the context of the priorities set out in the Forward Look (the annual review assessing future scientific and technological needs), and of advising ministers of resources needed by the councils, as well as the distribution of funds between them. The research councils would recruit more senior staff from industry, and agree targets with the Director-General towards a higher level of interaction between the councils, industry and government.

The post of Director-General thus had great political significance, and the administrative arrangements created to strengthen industrial links could be supplemented, if necessary, by the ultimate sanction of financial rectitude for those councils not measuring up to their mission statements. According to the White Paper, the government `will, of course, monitor the extent to which the Research Councils are successful in delivering this and indeed all aspects of their missions and consider their organisation and level of funding accordingly.'[70]

The existing LINK programme, aimed at furthering industry-academic collaboration, was strengthened, and lead responsibility for the programme taken by the Office of Science and Technology. As indicated earlier, government departments would retain the freedom to determine their own research needs, but would not be guaranteed an unlimited budget to meet them. The Office of Science and Technology would co-ordinate the activities of the different departments, encouraging collaboration between them and discouraging duplication of research activities. Further privatisation of government research establishments was under consideration, with the recommendation of the White Paper that `more could be done to extend and accelerate the operation of market forces in relation to the science and technology which Government departments commission in support of their policy, statutory, regulatory and procurement responsibilities.'[71] Similar expectations and restrictions were accorded to the research activities of the universities.

The radical element in the White Paper centred on the proposal for a Technology Foresight Programme. Here, the government would identify future technological needs and priorities, and ensure co-ordination of activities across the board along the lines already indicated above. It would do so by bringing together firms, scientists and government researchers to identify `emerging technological trends and market opportunities.' Under the formal structure of the Technology Foresight Steering Group, chaired by the government's Chief Scientific Adviser but with mostly non-governmental members, a list of technology sectors would be drawn up for examination and assessment of future scientific and market potential.

It was intended to channel the results of the Technology Foresight Programme into the activities of the research councils, and other public and private research and technology groups. Essentially, the Technology Foresight Programme represented the government's attempt to encourage market-based technological priorities. These priorities would set the future direction of the government's own science and technology programmes, and also become the basis of the UK's negotiating position at the European Framework Programme discussions.

In conjunction with the Technology Foresight Programme, the government announced that the Annual Review of Government Funded R&D would be replaced by an annual Forward Look, giving a longer term assessment of technological needs, and incorporating the results of the technology foresight programme. The Forward Look, prepared by the Office of Science and Technology, thus extended the annual review beyond the examination of past and present activities and current expenditure plans to consider how government plans are being aligned with the longer term science and technological needs of the economy. What was proposed was the setting of strategic objectives with a five to ten year perspective. A proposal was made to replace ACOST with a Council for Science and Technology (COST) to advise ministers on the balance and direction of government funded research, taking into account the findings of the Technology Assessment Programme.

Slightly less radical, but nonetheless important in view of earlier ambivalence, was the White Paper's commitment to an unambiguous support of European technology collaboration, stating `an important benefit of Community membership is the access which it provides to European-wide research collaborations.'

The promise to `use technology foresight and the Forward Look for Government-funded science and technology to draw industry and the science and engineering base more effectively into its policy-thinking on the purpose, size, direction, shape and content of future programmes'[72] may be regarded as a first step in an attempt to address the inadequacies of the relations between the central government and the technological community. The political process surrounding European integration had underlined the need to address institutional aspects of the technological system, as the previous section indicated.

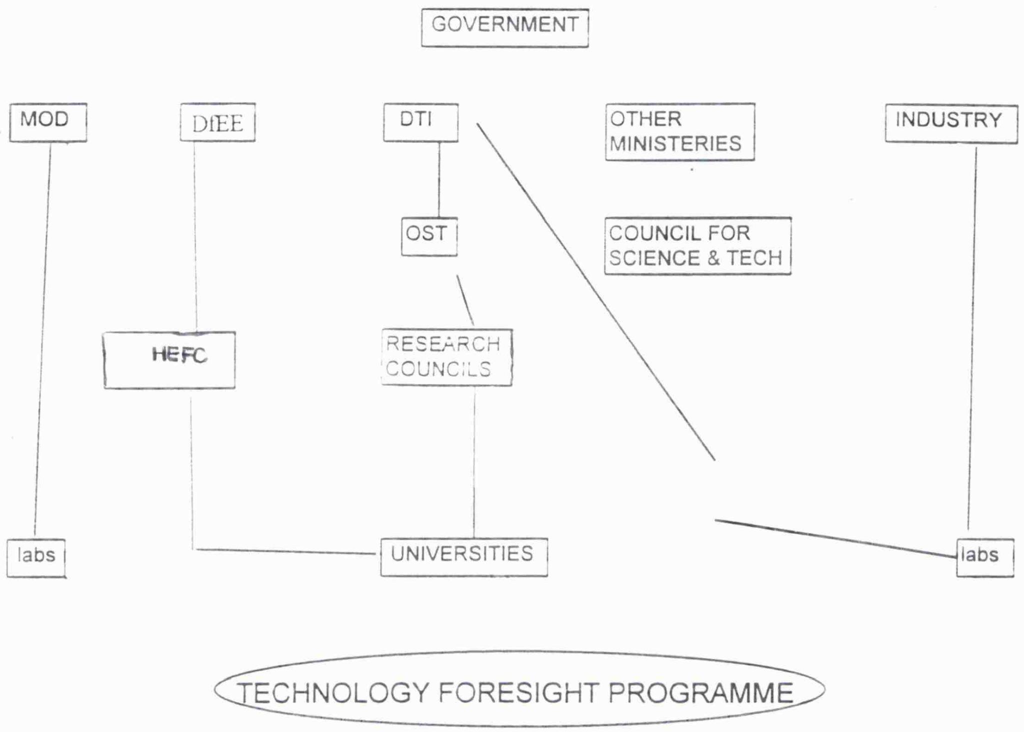
When the White Paper was finally released in 1993 it received a mixed response from the UK technological community, with industry in particular encouraged by the higher profile given to science and technology, and the encouragement of applied research.[73]

4.7 Conclusion

In many respects the 1993 White Paper on science and technology gives a focus and coherence to the activities of the UK technological system, which was not apparent during the 1970s and 1980s. With the demise of the mission-oriented technological system, the UK technological base lost a central plank which had given strong support over a period, and which helped to put in place a technological infrastructure decades before the Spanish government undertook the same task in the 1980s. By this latter date, the UK system was also showing signs of weakness, with reports of a national technology gap, lack of innovation, and inadequate levels of investment in basic and applied research.

What are the central features of the technological system in place in the mid-1990s? With the recent changes that followed on from the White Paper, the reform of science funding and administration of activities now reflect the controlling hand of the Treasury. The research councils and the universities must account for their activities, and the relevance of such activities to priorities set by the government, in contrast to the previous system of receiving block grants and then deciding their own priorities. The Higher Education Funding Council now reports to the DfEE, while the research councils report to the OST; universities report to both the HEFC and the research councils on research activities. The government ministries retain individual responsibility for technological initiatives, but financial rectitude is the guiding principle and relevance to the needs of the market the yardstick by which proposed research activities are judged, while many of the laboratories have been privatised. The Office of Science and Technology, located in the Department of Trade and Industry, epitomises this enabling role in coordinating the national and international science and technology activities of government departments, industry, and universities (see Figure 4.1 below).

Figure 4.1 UK System of Science & Technology



As the UK lacks a formal regional authority structure, there is no regional system of science and technology along the lines of the German Lander or the Spanish Autonomous Communities. Instead, regionalisation of technological resources depends on the location decisions of industries, and the links established by universities with local industry. Universities still receive most of their funding from the government, but have faced increasing pressure to increase links with industry, both as a way of furthering industrial innovation and as an additional source of funds for their research activities.

Perhaps the best summary of the UK technological system as it exists at the present time can be made on the basis of the answers to three questions - what are the sources of funds? who carries out the work? and, where are the priorities decided? The gross expenditure on R&D (GERD) for 1993 represented 2.19% of gross domestic product, with government (GOVERD - government research institutes and the research councils) accounting for 0.3%, higher education (HERD) 0.36%, business expenditure (BERD) 1.44%, and the remainder from charities 0.08%, measured by performing sector.[74] In terms of financing, the major source of funds is the private industrial sector, contributing 52.1% of the funds for GERD for 1993, while government contributed 32.3%, and 11.7% came from overseas businesses investing in their UK branches R&D activities. Charities have increased in importance both as providers of funds, and as performers of R&D. During the period 1985 to 1993, the performance of R&D by the charities, measured in cash terms, increased from £344m to £524m, while the source of funds from charities over the same period, again in cash terms, increased from £170m to £430m (Table 5.2 and 5.3, Forward Look).

To a large extent, the UK technological priorities are decided by the market as the primary provider of resources. The White Paper published in 1993 and the Technology Foresight Programme endorsed this, with the system controlled for financial reasons but now continuing very much to reflect the neo-liberal inclination of the UK government. Technology foresight was particularly important in giving direction to the various national technological activities planned by industry and by the public research and technology institutions. The approach and organisation of the foresight programme builds on the activities and programmes adopted by the Japanese government and other European member states such as Germany and Holland, and in the United States, to identify key technologies for the future and direct resources towards the development of such technologies.

On the other hand, the government's commitment to shifting the financial burden of research and technology to the private sector remained in place. So too did the policy of attribution, criticised by the House of Lords Select Committee on the European Communities, on the basis that `the system of attributing the cost of Community expenditure to Departments (on the basis of lead policy responsibility for the content of specific programmes) has given Departments a clear incentive to seek value for money from Community programmes.'[75]

Government policy had, throughout the 1980s, exhibited a broad consistency in some areas, principally in counter-inflationary strategy, in the commitment to reduce public expenditure, and non-intervention in the day-to day economy. The new developments in technology policy were broadly in line with this thinking. Competitiveness was a key goal to which all of these policy strands were directed.

In the 1980s it seemed that attaining lower inflation, and economic de-regulation would be sufficient to maintain the competitiveness of UK industry. But successive indicators suggested otherwise, while at the same time the government was coming under increasing criticism because of the lack of a technology policy.[76] The criticisms of under-funding of UK research and development made by the House of Lords Select Committee on Science and Technology, and widely supported, led to a conclusion that the country could not keep up with its competitors.

The 1993 table on world competitiveness in science and technology, prepared by IMD business school in Lausanne and the World Economic Forum, showed the UK in twelfth place, but it was the listing of general competitiveness, which placed the UK in sixteenth position that caused greatest concern (both listings are shown at the end of this chapter, in Tables 4.5 and 4.6). Some commentators described Britain as a follower rather than a leader in innovation - `the reality is that Britain is now locked into technological collaboration, and that, for British high technology firms, Europe provides the only means of achieving the requisite scale of innovative activity....Integration could well mean increasing dependence upon these more dynamic European partners.'[77]

Comparisons with other countries suggested a gap between domestic R&D efforts and major competitors, a scenario damaging to the national pride if perceived as hindering the country's competitive capability. The minister at the DTI, Michael Heseltine, had signalled a more pro-active policy for the department in the aftermath of the 1992 general election, creating an industrial competitiveness division and announcing the intention to create closer partnership with industry.[78] In general, the response which the government made to the country's perceived technology gap was a market-based one rather than a clear cut alternative strategy of investment in improving infrastructure for science and basic research.

Two White Papers on competitiveness have been published since then, in May 1994, and in May 1995.[79] Fifteen Foresight Sector Panel reports were published in May 1995, together with the report of the Technology Foresight Steering Group.[80] In mid-1995 the government announced the transfer of the Office of Science and Technology from the Cabinet Office to the Department of Trade and Industry, to the consternation of the science community.

The Cabinet Office press release explained that moving the Office of Science and Technology to the DTI would allow `the government's policy on science, engineering and technology to be developed alongside its policies on industry, and with due regard to the contribution of science, engineering and technology to long-term wealth creation.'[81] In fact the move was consistent with the philosophy of the 1993 White Paper and, more generally, consistent with the neo-liberal deregulatory approach of the government. In practice, it represented a more stringent organisation of science and technological activities and priorities within the public sector, with the latter constrained by financial considerations in its freedom to decide what S&T activities to foster.

All of the developments identified above have been aimed at improving the competitiveness of industry, and stem from a view of competitiveness - that somehow, technology is the key -which has underpinned the development of European technology policy from the early 1980s. Then, and perhaps even now, the relationship between competitiveness and technology has not been clarified. It would be ironic if the UK continued to find itself as a follower in the technology stakes because of this misunderstanding.

Table 4.5 World competitiveness in science and technology (OECD) 1993

1	Japan
2	Germany
3	USA
4	Switzerland
5	Sweden
6	Netherlands
7	Finland
8	Denmark
9	France
10	Austria
11	Belgium/Lux
12	UK
13	Ireland
14	Norway
15	Australia
16	Italy
17	Canada
18	New Zealand
19	Spain
20	Greece
21	Portugal
22	Turkey

Source: IMD Business School, Lausanne, and World Economic Forum. Ratings based on R&D spending, patents, no. of scientists in industry, and technology investment.

Table 4.6 World competitiveness table (OECD) 1993

1	Japan
2	US
3	Denmark
4	Switzerland
5	Germany
6	Netherlands
7	Austria
8	New Zealand
9	Sweden
10	Belgium/Lux
11	Canada
12	France
13	Ireland
14	Australia
15	Norway
16	UK
17	Finland
18	Portugal
19	Spain
20	Italy
21	Turkey
22	Greece

Source IMD/ World Economic Forum, 1993.

Notes to chapter four

1. DTI (1991) EC R&D: A Guide to European Community Industrial Research and Development Programmes [London].

2. William Walker (1993) National Innovation Systems: Britain in R.R. Nelson National Innovation Systems: A Comparative Analysis [Oxford University Press], p. 187.

3. Henry Ergas (1987) The Importance of Technology Policy, in Partha Dasgupta and Paul Stoneman, Economic Policy and Technological Performance [Cambridge University Press], ch. 3.

4. Jad Adams (1992) Tony Benn [London, Macmillan], p. 272.

5. Philip Gummett (1991) The evolution of science and technology policy: a UK perspective, Science and Public Policy, February.

6. J. D. Bernal (1939) The Social Function of Science [London, Routledge and Kegan Paul].

7. P. Piganiol (1961) Science and the Policy of Governments: the Implications of Science and Technology for National and International Affairs [Paris, OECD].

8. The OECD has exerted increasing influence on technology policy, and published a number of well-received studies on the impact of technology - one of the most recent being the Technology/Economy Programme. See OECD (1992) Technology and the Economy. The Key Relationships [Paris]. The organisation also publishes regular statistical information on research and activities in the member states of the organisation, and is referred to approvingly in the latest report on national science and technology from the UK government as `the most respected and internationally accepted source of information on R&D expenditure' - see HMSO (1995) Forward Look of Government-Funded Science, Engineering and Technology, vol. 3, 6.1.

9. Interest was aroused with the publication of Servan-Schreiber`s book warning against the technological threat from the United States. See Jean-Jacques Servan-Schreiber (1968) The American Challenge [New York, Athenaeum, transl. R. Steel]

10. See Keith Middlemas (1990) Power, Competition, and the State, vol II: Threats to the Post War Settlement, 1961-74 [London, Macmillan].

11. See Jad Adams (1992) Tony Benn [London, Macmillan], ch. 21; Middlemas (1990) suggested that the failure of policy in the 1960s was due to the fact that government continued to base policy on the post war consensus that was in reality breaking down.

12. See Keith Middlemas (1986) Power, Competition and the State, vol I: Britain in Search of Balance, 1940-61 [London, Macmillan].

13. Reported in Barbara Castle (1984) The Castle Diaries 1964-70 [London].

14. Adams (1992) op. cit., ch. 22.

15. V. Rothschild (1971) `The organisation and management of government R&D' in A Framework for Government Research and Development [HMSO, Cmnd 4814].

16. OECD (1977) Towards Full Employment and Price Stability [Paris, OECD]. Economic turmoil, the slow-down of growth coupled with stagflation all contributed to this re-appraisal of the role of government in economic management.

17. R. Nelson and S. Winter (1982) An Evolutionary Theory of Economic Change [Cambridge, Harvard University Press].

18. The government White Paper on Science and Technology, published in May 1993, announced a number of changes to this system - the functions of ABRC are now absorbed into the Office of Science and Technology; the Science and Engineering Research Council is to be converted into an Engineering and Physical Sciences Research Council and a Particle Physics and Astronomy Research Council; the Agricultural and Food Research Council will be modified into a Biotechnology and Biological Sciences Research Council. The White Paper also proposed that ACOST be developed into a new body, the Council for Science and Technology, which will draw on the findings of the Technology Foresight Programme - the latter being a joint attempt by industry and the scientific community to pool views on areas of priority for government attention. See Realising our potential: A strategy for Science, Engineering and Technology, Cm2250 [London, HMSO].

19. ACOST (1991) Science and Technology issues: A review by Acost (London, HMSO), p. 10.

20. ACOST (1991) Science and Technology issues: A review by ACOST [London, HMSO].

21. OECD (1985) Innovation Policy in France [Paris].

22. Department of Trade and Industry White Paper, DTI - The Department for Enterprise [Cm 278, London HMSO].

23. Margaret Sharp and William Walker (1991) Thatcherism and Technical Advance:Reform Without Progress? Part II: The Thatcher Legacy The Political Quarterly, 62, 3, p. 329.

24. The Forward Look of Government-Funded Science, Engineering and Technology 1995, the successor to the Annual Review, reported that over 570 individual Link projects had been initiated, involving over 800 companies collaborating with 130 science and engineering institutions. The collaborative projects cover pre-competitive research and operated on a shared-cost basis with government providing up to 50 per cent of the cost. See vol 1, p. 73.

25. See HMSO (1993) Annual Review of Government-Funded R&D, p. 230.

26. Annual Review of Government-Funded R&D 1993, p. 231.

27. Annual Review, ibid., p. 236.

28. CEC (1993) Evaluation of the BRITE-EURAM programme (1989-1992), Research Evaluation report no 53, February, EUR 15070 EN.

29. Annual Review of Government-Funded R&D, 1993, p. 236.

30. See Hugh Ward and Geoffrey Edwards (1991) Chicken and Technology: the politics of the European Community's budget for research and development Review of International Studies, 16, p. 115.

31. See chapter 3 for details of expenditure on the Framework Programme.

32. House of Lords Select Committee on Science and Technology (1983) Engineering Research and Development; (1986) Civil Research and Development, HL 20 [HMSO]; International Scientific Programmes: 2nd report session 1990-1991, HL 24-I/II [HMSO, 1991]. The House of Lords Select Committee on the European Communities also made a contribution with the report, A Community Framework for R&D:with evidence, session 1989-1990, HL 66 [HMSO, 1990].

33. See P.D.G. Hayter (1991) 'The Parliamentary Monitoring of Science and Technology in Britain' Government and Opposition, vol. 26, 2, June for a review of the Select Committee's activities in the area of science and technology during the 1980s.

34. The Committee is made up of 15 members, representing the three major parties, who serve for five years, and conducted research on topics blending politics and science which often cross government departmental concerns. The reports of the Committee often set the agenda for debate, and influenced government activity. In 1990, the House of Commons Procedure Committee suggested a Joint Committee with the House of Lords, as an opportunity to avail of the House of Lords expertise in this area.

34. House of Lords Select Committee on Science and Technology (1986) Civil Research and Development [HMSO].

36. House of Lords (1983) Report on Engineering Research and Development. The report findings were accepted by academic researchers; for instance, Pavitt and Patel suggested that the UK was sixth among the OECD members in all R&D, and ninth in civil R&D. Pavitt, P. Patel (1987) The elements of British technological competitiveness, National Institute Economic Review, November.

37. HM Government (1987) Civil Research and Development, White Paper [HMSO, July].

38. House of Lords Select Committee on Science and Technology (1991) International Scientific Programmes [HMSO].

39. The Financial Times of 30 March 1987 calculated that for every £1 Britain spent on Community research, the Community itself spent £1.25 in Britain.

40. Realising Our Potential: A Strategy for Science, Engineering and Technology, Cm 2250 [London, HMSO].

41. Stephen George (1990) An Awkward Partner: Britain in the European Community [Oxford, Oxford University Press].

42. House of Commons Education, Science and Arts Committee.
Science Policy and the European Dimension : 1st report, session 1990-1991, HC 127 [HMSO 1991], p. ix.

43. House of Commons (1990), ibid., p. xii.

44. House of Lords Select Committee on Science and Technology,
Civil Research and Development, HL 20 [HMSO, 1986]

45. DTI (1988) The Department for Enterprise, Cmnd 278 [London, HMSO].

46. These statistics are taken from the Forward Look, vol 3, chapter 4.

47. See P. Patel and K. Pavitt (1987) The Elements of British Technological Competitiveness National Institute Economic Review, November, p.73.

48. John Banham (1994) The Anatomy of Change [London, Weidenfeld & Nicholson], p. 164.

49. J. Barber, G. White (1987) Current policy practice and problems from a UK perspective, in P. Dasgupta and P. Stoneman (eds) Economic Policy and Technological Performance [Cambridge University Press].

50. See The Economist (1992) 'Down but not out: a survey of Britain', 24 October.

51. See Richard Freeman (1991) 'The Future of UK manufacturing', in The Business Economist, vol. 22, 2.

52. Quoted in Wyn Grant (1993) Business and Politics in Britain, 2nd ed. [London, Macmillan], p.31, and taken from the Financial Times, 9 November 1988.

53. See Banham (1994) op. cit., p. 276.

54. Stewart Judd, CBI, London 25 May 1994.

55. Stewart Judd, ibid.

56. See Engineering Employers Federation (1992) Industrial Strategy [London], p. 16.

57. Institute of Directors (1994) A New Agenda for European Prosperity [London].

58. Forward Look of Government-Funded Science, Engineering and Technology 1995, vol.1, p. 51.

59. One independent study of the impact on the UK concluded that `EC RTD support is having an impact in the UK beyond that which its proportion of R&D expenditure might be expected to effect. Probably the most important and sustainable effect has been to re-orient the research community to the point where it regards itself as a part of an emergent European scientific community.' See Luke Georghiou et al (1993) The Impact of European Community Policies for Research and Technological Development upon Science and Technology in the UK [HMSO, July] Report prepared for DGXII and the Office of Science and Technology.

60. House of Lords Select Committee on the European Communities (1990) A Community Framework for R&D, Session 1989-1990, 17th report, HL paper 60 [London, HMSO].

61. House of Lords, ibid., part 5, par. 79.

62. House of Lords Select Committee on Science and Technology, International Scientific Programmes, HL 24-I/II [HMSO,1991]

63. House of Lords Select Committee on the European Communities (1990) A Community Framework for R&D, HL 66 [London, HMSO], part 5, par. 118.

64. House of Lords, HL 66, ibid., par. 47, p. 14. The six lines were: information and communications technologies; industrial and materials technologies; environment; life sciences and technologies; energy; human capital and mobility.

65. House of Commons Education, Science and Arts Committee (1991) Science Policy and the European Dimension, session 1990-1991, HC 127 [London, HMSO], p. ix-xii.

66. Following the 1992 general election the government appointed a cabinet minister for science, the first in thirty years, and established the Office of Science and Technology.

67. HMSO (1993) Realising Our Potential. A Strategy for Science, Engineering and Technology, Cmnd 2250, p. 26.

68. Realising Our Potential, p. 11.

69. Prior to the White Paper, the organisation of the Research Councils originated from the Science and Technology Act of 1965. Out of the six councils - Biotechnology and Biological Sciences Research Council, Economic and Social Research Council, Engineering and Physical Sciences Research Council, Medical Research Council, Natural Environment Research Council, Particle Physics and Astronomy Research Council - only the latter is to be exclusively responsible for supporting basic research.

70. Realising Our Potential, 3.34.

71. Realising Our Potential, 5.9.

72. Realising Our Potential, 6.9.

73. Kam Patel (1993) `Get set for the big bang', Times Higher Education Supplement, 4 June.

74. HMSO (1995) Forward Look of Government-funded Science, Engineering and Technology, vol. 3, section 5, Figure 5.1.

75. Realising Our Potential, 6.10.

76. See, for example, Financial Times (1993) `The missing link in Britain's economy,' 13 January. The author of this article, Neil Johnson, was at the time Director-General of the Engineering Employers Federation. His argument centred on the need for strategic thinking to underpin technological development, and suggested that market forces alone could not allocate resources efficiently.

77. See M. Sharp and W. Walker (1991) `Thatcherism and Technical Advance: Reform without Progress' Part II The Political Quarterly, 62,3, pp. 335-337.

78. Financial Times (1993) `Heseltine's plan to `help Britain win'', 26 April.

79. HMSO (1994) Helping Business to win, Cm 2563. In November 1994 the DTI published a joint study with the CBI which examined the 100 best UK companies, `Competitiveness -How the best UK companies are winning.'

80. See Forward Look of Government-funded Science, Engineering and Technology 1995, vol 1. [London, HMSO].

81. The Guardian, `Hilary Rose on discouraging trends for researchers', 27 July 1995.

CHAPTER 5

SPAIN - THE DEVELOPMENT OF A TECHNOLOGICAL SYSTEM

Pero, al mismo tiempo, si no asumimos la revolución tecnológica, nuestra vitalidad social y nuestra calidad de vida se deterioraran rapidamente, frustrando una nueva oportunidad histórica para armonizar españolidad y modernidad, identidad cultural y desarrollo tecnoeconómico.[1]

In Spain technological change was regarded by many in government, industry, and the academic community as key to industrial renewal, and more broadly as affirming the cultural identity and modernity of the country. However, in post-war Spain technological development occurred slowly. After 1959, much of the technology was imported, as the Franco government pursued a modernisation policy on the strength of foreign investment.[2] By the beginning of the 1980s, when the Socialist government of Felipe Gonzalez launched a new phase of modernisation, the technological deficiencies of Spanish industry were clearly apparent.

Accession to the EC in 1986 was the culmination of an association with the Community that began when the government first initiated talks in 1962. Following on from the Preferential Agreement in 1970 which removed duties on exports and imports between Spain and the EC, formal negotiations on membership began in the late 1970s. Full membership had important economic and political implications, although the economic aspects were generally emphasised.[3] Both public and private sectors gave unwavering support, even when rational argument indicated the benefits were more likely in the medium-term than in the immediate future.[4] In the short term, adjustment costs could hit some sectors extremely hard.

One year after joining the European Community the Ministry for Industry and Energy[5] intimated the immediate effects of EC integration on Spanish industry would be in terms of an increase in commercial trade and a greater level of internationalisation, both of which would result from the process of modernisation and the competitive pressures that the open market would bring.[6]

The effects of membership were expected to be seen in the modernisation of industry, but also of Spanish society including broad areas of government policy. This chapter begins by identifying the technology gap that existed in Spain, a deficiency which can be attributed to the nature of the industrial system combined with the institutional structure which had evolved in the post-war period.[7] The chapter goes on to identify the support for EC technology policy among government and business, and examines the impact of EC developments on national policy and the technological system as a result of participation in the EC technology programmes.

A key question which underlies the examination is the extent to which the institutional structure of the country determined the nature of the support for European technology programmes, and the pattern of policy development in Spain.

5.1 The Spanish technology gap

Twentieth-century Spain inherited poor levels of technological development, a fact that was recognised even earlier than the period with which this thesis is concerned. In the early 1900s the Spanish Nobel prize winner for medicine, Santiago Ramón y Cajal, stated `Spain is an intellectually backward, not a decadent, country, where scientific development has never been advanced,'[8] iterating a view that was to be repeated by academics, business people and government in the succeeding decades. During the Franco era the almost total reliance on foreign technology suggested that all of these groups were content to follow the maxim of Miguel de Unamuno, `let others invent.'[9]

The European Community incorporated a number of political institutions within which Spain could take part in the European political process, while at the same time modernise its own industrial and political structures. In the area of technology, an opportunity was offered to close the gap which existed between Spain and some of its partners.

Membership of the Community was seen as inevitable since Spain would in any case be affected by decisions taken in the Community, and it was better to be inside in order to have the best chance of influencing those decisions. Otherwise, the peripheral position of the country within the European space could mean even greater marginalisation of business and society generally. Spanish entry to the Community coincided with the announcement of the Single Market programme, and the development of a European Technological Community. The national strategic programme was thus well timed.

At the same time an obvious question was whether Spanish industry was capable of taking full advantage of the potential opportunities. One aspect of membership that became evident early on was the increase in the openness of the Spanish economy, and particularly in the level of inter-industry trade. But, whether domestic firms could sustain a position in the new open trading system depended on technological capability, and the ability to gain economies of scale. Viñals (1990) suggested that much of Spanish industry not only could not sustain this technological capability, but also many firms were of sub-optimal size.[10] Research by the European Community found that Spanish firms were aware of this, conscious of the need to improve competitiveness and to engage in co-operation agreements with partners in other countries.[11]

While the Single Market meant greater market access, participation in European Community programmes offered additional support to a national technological capability that was below the EC average. In 1986, the year Spain joined the Community, Spanish R&D expenditure was 0.6% of GDP, while the EC percentage was above 2% on average (see Table 5.1). While the percentage of Spanish GDP devoted to research and development increased throughout the 1980s, the figure still lagged behind other European member states.

Table 5.1 R&D as per cent of GDP

Country:	1983	1985	1987	1990	1992
Spain	0.45	0.53	0.61	0.82	0.87
UK	2.25	2.38	2.26	2.21	2.12
Germany	2.51	2.71	2.85	2.84	2.65
Italy	0.95	1.12	1.19	1.29	1.38
France	2.11	2.25	2.28	2.38	2.36
US	2.71	2.92	2.90	2.78	2.68

Source: Comision Interministerial de Ciencia t Tecnologia, Resumen de la Memoria de Desarrollo del Plan Nacional de I+D en el periodo 1988-1990 y revision para 1992-1995: Ministerio de Industria y Energia, Informe Anual sobre la Industria Espanola 1993.

A report by the OECD, published in 1987, suggested that much needed to be done in terms of improving the technical innovationstructure.[12] It was critical of the low level of research spending by the universities, and of the inadequate number of researchers and technical staff, recommending that the level of university funding should be increased by a factor of 15. But the report also stressed the need for industry to bear more responsibility for innovation, and to develop the internal capability to judge the best areas of research.

The division of research expenditure between the public and private sector in 1983, at the time the White Paper on modernisation was introduced, is shown in Table 5.2 below. The share of the business sector was below the EC average. A high proportion of Spanish firms operated under foreign licence, or as subsidiaries of multinationals. Some 55% of the capital goods produced in Spain were manufactured under licence, while 85% of Spanish patents were taken out by foreigners, as against an EC average of 45%.

Table 5.2 Spain- research expenditure by sector, 1983

Sector:	MPTA	% of total	% of GDP
Public administration	68814	61.5	0.300
Public enterprises	21429	19.2	0.094
Private enterprise	21571	19.3	0.095
Total	111813	100	0.489

Source: OECD (1987).

Cooperation between industry and the university sector had tended to be poor, a fact acknowledged by the OECD, and this needed to be reversed in order to establish an effective system of innovation. In the view of the OECD, technical innovation called for social innovation and a new way of managing the interactions of researchers, industrialists, engineers, and customers. For Spain, a crucial problem centred upon the nurturing of a new set of relations among the actors in a technological system that was still at the embryonic stage.

In regard to cooperation, the OECD suggested that the responsibility for arranging, devising and managing research programmes lay with the professional bodies. There were benefits to be gained nationally from the involvement and commitment of all levels of society in the development of research and technology. `Public opinion should be persuaded by all possible means of the need for a commitment alike to basic and to applied research in the interests of Spain's future economic competitiveness'.[13]

The Spanish government developed the national technology plans of the 1980s alongside the modernisation programme of industry, the latter set out in the 1983 White Paper (see following sections). A report by the government, España en Europa, produced in 1987 suggested some agreement with the OECD innovation study.[14] It proposed a division of responsibilities for government and the business sector. Government would tackle the public sector, including the restructuring of industry, while Spanish industry should aim towards establishing an international presence, improve the quality and design of output, and pursue technological innovation.

The report, España en Europa affirmed the role of government in industrial development, and thus represented a continuation of the modernisation programme begun by the Socialists in 1982-83. However, the expectations placed on the business sector to foster technological development, design and quality improvement, as well as greater market share, extended the modernisation approach in a more European way.

But two features of the system remained amidst the changes of the 1980s. Firstly, the chief financial responsibility for research and development continued to lie with the public sector. The government failed to shift the responsibility for research funding to the private sector to the same degree as other partner states, and according to the evidence published by he government and presented below in Table 5.3 the industrial sector continued to lag behind other countries in terms of both providing research funding and carrying out research activities. The public sector proved to be one of the most important forces in the technological system, both as a provider of funds and in terms of carrying out technological activities.

Table 5.3 R&D, sector of performance/ source of funds (%) 1988-90

	Germany	UK	France	Spain
Sector of performance:				
Business	73	67	60	58
Higher ed.	14	15	15	16
Public sector	12	14	25	25
Other	1	4	1	1
Source of funds:				
Business	65	51	43	40
Public sector	32	37	49	40
Other	1	3	1	1
Abroad	2	9	7	4

Note: The figures for Germany and Spain refer to 1990, while those for UK and France apply to 1988.
Source: Comision Interministerial de Ciencia y Tecnologia, op. cit., p.7.

Secondly, the traditionally poor level of domestic cooperation between industry and the academic sector continued, as much of industry looked towards European partners to support their collaborative activities. The government's efforts, together with those of the European authorities, proved singularly successful in encouraging greater participation in European technology programmes, as Table 5.4 below shows. While both the academic and business sectors became involved in European programmes, the level of business involvement was particularly high.

Some 43% of business researchers were involved in European programmes, compared to 28% in the national technology programmes. The situation is almost the reverse in the context of university researchers, although public research centres have increasingly taken up much of the European collaborative work. Despite the government rhetoric on greater industrial responsibility for research, it was in practice ready to direct the allocation of research resources, and to provide public funds. The following section provides an examination of manufacturing industry which explains why this trend continued.

Table 5.4 Distribution of Spanish researchers between national and Community programmes, 1990 %

Researchers:	**EC programmes**	**National programmes**
University	29	50
Public research centres	28	22
Business	43	28
Total	100	100

Source: Comision Interministerial, op. cit., p. 82.

5.2 Profile of Spanish manufacturing

Three different groups comprise the industrial sector in Spain -a large number of small and medium-sized enterprises, a very small number of large public enterprises that have largely withstood the privatisation efforts of the government, and multinational enterprises which significantly increased their investment in Spain following the country's membership of the European Community. Despite the resources of the latter, the political power of the public enterprises, and the government's push of SMEs towards the European Community technology programmes, none of the groups has been able to make a significant contribution to the technological intensity of industry.

The absolute size of the Spanish manufacturing sector is small by comparison with Germany, France, and the UK, although its relative size (as a proportion of the economically active population and GDP) is in line with other European countries.[15] In 1990 the number of people working in industry (excluding construction, but including energy, water and mining) was 2.98 million, 24% of the total occupied population, and contributing about 29% of the GDP, compared to the UK's 20%.

Manufacturing industry is characterised by small scale firms, and it is often difficult for these firms to carry out R&D. Some 90% of industrial companies have fewer than 100 employees, accounting for 50% of industrial employment.[16] Only one Spanish company, the State holding company INI, was among the one hundred largest industrial companies in the world in 1988 (by value of sales), in 61st position. In 1988, INI and Repsol were the only two Spanish companies in the top 100 European Community companies (measured by turnover).[17]

Inevitably, such small sized firms have difficulties in technology creation - from a lack of research and technical staff, to inadequate laboratory facilities, or a lack of financial resources, or an insufficient knowledge of what technological resources are needed to meet the needs of the organisation or the industry.

The predominance of small-scale industry is one problem, sectoral and geographic concentration another. When Spain became a member of the EC much of the industrial structure was dominated by the traditional sectors. In 1986 one third of all employment and one quarter of value-added in manufacturing industry arose from the three sectors food, drink and tobacco; textiles and clothing; wood, cork and furniture. There was, also, an element of concentration on a geographical basis. The province of Barcelona accounted for 25% of manufacturing employment, while Barcelona with Madrid, the

Basque country, Valencia, and Alicante accounted for 60% of industrial employment. The location of foreign direct investment also follows this geographic concentration.

During the period 1985-1989 the volume of investment in manufacturing in Spain rose by a much greater level than in the EC as a whole. During 1986-1988 the average annual rate of investment in manufacturing in the EC was 5.7% compared to a rate in Spain of 26.8% in the same period.[18] Since 35% of manufacturing investment was accounted for by foreign-owned firms, there was a significant inflow of capital to the more dynamic sectors. Foreign direct investment tended to be centred on computers, electronics, pharmaceuticals, and these sectors have contributed to the high technology content of small areas of Spanish industry, as well as in car production, food, paper, chemicals.

Table 5.5 **Private foreign investment in Spain 1983-1990 (MPTA)**

	1983	1984	1985	1986	1987	1988	1989	1990
Direct	140	177	194	321	444	691	806	1257
Real estate	117	127	163	195	227	275	311	245
Portfolio	16.8	55.5	120	501	1483	1211	1774	1636
Other	41.8	39.7	52.8	111	69.6	71.4	102	161
Total	316	412	530	1129	2224	2249	2994	3313

Source: Alberto Recio (1992), p. 3.

The growth of foreign direct investment in Spain during the 1980s (see Table 5.5) created a pool of general support for European integration, but it was not the decisive force pushing the government in the direction of the European technology programmes. While Spain was successful in attracting some of the largest multinationals, encouraged by the low costs of labour and the support of the government, these organisations did not contribute greatly to the technological basis of Spanish industry. Their failure to do so rested with the particular organisation of activities on a multinational basis, including the location of research.

Multinationals produced for the export market.[19] The concentration on commercial activities meant less resources were devoted to research and technological development.

Research has indicated that up to the middle of the 1980s the multinationals located in Spain had obtained technology through contracts, rather than patents. In-house development of technology seemed less preferable than commercial acquisition.[20] Often, these technology contracts covered the use of imported equipment, rather than the transfer of knowledge. In the four years following accession to the EC much of the foreign direct investment originated in other member states, as Table 5.6 shows, suggesting a relocation of investment to take account of the Single Market.

Table 5.6 Foreign direct investment, % of total by country of origin

	1984-85	1986-89
EC:	38.4	52.0
Holland	7.3	16.5
UK	7.5	10.1
France	8.2	9.4
Germany	10.5	8.7
US	18.4	4.9
Foreign companies in Spain	12.9	25.3
Other countries	30.3	17.8

Source: OECD Economic Survey: Spain 1990, p.64.

Technology transfer was thus restricted, and diffusion was largely excluded from what was essentially a series of commercial activities between the multinational plant and the parent organisation.[21] There was no particular need for these organisations to make a strong bid for European Community programmes, even when the parent company had established close links with the Brussels machinery.[22] Castells concluded that the location of multinationals was not enough to guarantee technology transfer to the local community. Although the evidence from other countries such as the UK, Taiwan and Singapore indicates certain beneficial effects for the host region, particularly in terms of new machinery, methods of work organisation, and management styles, other technological benefits may depend upon the degree of expertise already available in the region to enable it to avail of opportunities presented by MNC investment.[23] Despite the high level of investment made by such firms, the figure was substantially below the Spanish government's spending on public programmes to stimulate the economy. Spain's technological gap with the rest of Europe made it clear that some kind of government action was necessary to assist the technological development of indigenous industry.

While the Spanish economy experienced significant growth in the period of the 1980s, accompanied by an increased internationalisation of business through foreign direct investment, domestic industry did not display the same drive to establish distribution and other commercial links abroad.

Table 5.7 Direct investment ('000 PTA)

	Fdi in Spain	Spanish fdi abroad
1991	462,289	18,433,048
1990	1,080,242	45,481,577
1989	672,167	28,038,366
1988	514,244	2,297,079
1987	321,500	100,597,453
1986	248,200	668,578

Source: El Pais panorama semanal (1991) 'En manos ajenos', p.24, 19 August.

Over the past three decades the volume of exports as a percentage of GDP has increased from 9.8% in 1960 to 20.6% in 1984, while the volume of imports showed a similar trend, moving up from 13.9% to 21.3% over the same period.[24] Although still below the EC average, this represented the average for the OECD as a whole. During this period there was a gradual opening up of the previously protected domestic market, largely in recognition of the need to import technology in order to build up the indigenous industrial base.

The dependence on foreign technology was evident throughout the 1980s, and in this respect there are parallels with the United Kingdom. However, Spain was starting from a smaller base and was still relatively far behind the UK in terms of technological development by the beginning of the 1980s.

By the 1980s the dependence on foreign technology continued through the foreign direct investments of multinationals. At this time, the government actively pursued a policy that could almost be described as `Spain For Sale'. Technology was needed to develop the industrial base, but the expansion of this base fuelled the demand for even more advanced technology. Despite the significant levels of investment, Spanish industry was seen to have lower levels of technical efficiency by comparison with industry in Western Europe.[25] Many studies have noted the dependence of Spanish industry on foreign technology,[26] and tended to take a generally pessimistic view of the possibility of changing this situation. A large number of Spanish firms produce goods with foreign patents, or under licences. Such patents frequently stipulated domestic production only, reinforcing the strong orientation towards the domestic economy which was a result of protection and the absence of international competition.

The situation may be appreciated more clearly by looking at the country's technological balance of payments, defined as the money paid or received for the use of patents, licences, trademarks, designs, inventions and know-how. In 1981 there was a deficit of 35684 million pesetas, rising rapidly to 63277 million pesetas the following year and by 1988 to 140243, a 50% increase on the previous year (see Table 5.8). The majority of the technological deficit was due to other EC member states, principally France, Germany and the UK, with Holland and the United States also contributing to the technological flow. One obvious conclusion from this is that Spanish industry placed an increasing reliance on technology developed elsewhere, rather than through in-house research efforts.

Table 5.8 Technological balance of payment deficit

	MPTA
1981	35,684
1982	63,277
1983	69,647
1984	63,962
1985	78,600
1986	81,500
1987	93,000
1988	140,243
1989	157,200
1990	181,500
1991	171,400

Source: El Pais (1989) 'El deficit tecnologico se dispara durante el primer ano del Plan Nacional, 27 Jan.; MINER (1991) Informe sobre Industria Espanola.

Four years after accession the European Commission also expressed concern over the situation of Spanish industry and its ability to remain competitive in the single European market.[27] The Commission view was conflicting and somewhat mixed.[28] It regarded the foreign investment as speculative and detrimental to overall long-term production growth, but then went on to suggest that the presence of multinationals in Spain could compensate for the as yet badly prepared domestic industry.

The sectors with the best future were ceramics, shoes, toys, sports goods, wine, food, shipbuilding and cars, many of the areas targeted by the European Community BRITE-EURAM programme. In the high technology sectors such as aeronautics, information technology, telecommunications, Spanish enterprises were identified as having poor competitive capability in the face of international competition. Overall, the report concluded the general problem for Spanish industry was the poor technological capability.

Building the technological capability of industry became a part of the modernisation process begun by the Socialist government following its election in 1982. It was clear that the domestic industry was ill-prepared to compete at the international arena, but there was also a lack of confidence in the ability of industry to raise its capability without the continued assistance of imported technology.[29] The national technology plan, introduced by the Spanish government in 1988, was essentially a continuation of the modernisation approach adopted earlier in the decade. Before examining these changes to the technological system the following section takes a brief look at the early modernisation strategies implemented by the Socialist government.

5.3 Modernisation - from intervention to liberalism

Industrial policy in the period 1977-1982 centred on supporting industrial firms, even those that were inefficient. The two energy crises of the decade had left their mark on the Spanish economy, exposing weaknesses in what were considered sectors of national comparative advantage. The unwillingness to restructure when the other advanced countries were doing so stemmed from the strong influence which industrial groups had with the government. Government was willing to provide subsidies to support these industrial sectors, and to channel resources into sectors in order to save jobs, thus hiding the need to reorganise in order to improve productivity. In effect, the policy was a continuation of the policies that were pursued in the 1960s.

The Socialist government under the leadership of Felipe González set out plans, in a White Paper published in 1983, for the restructuring and modernisation of industry, including many of the large public organisations which had sheltered for so long behind government subsidy. The Ministry for Industry had the responsibility for identifying a sector in need of restructuring. It could activate the process itself, or act on the basis of representations from trade union or employer organisations. Once the sector was identified, restructuring proceeded on the basis of a course of action agreed between the three partners.

This approach was criticised by some as resulting in a less than optimum allocation of resources.[30] But it had the advantage of continuing with the consensual approach which had developed in the post-Franco period and was useful to elicit support from industry for the government programme. Modernisation was seen as a necessary prerequisite to European integration.

The 1983 White Paper which set out the strategy to improve competitiveness by a two-pronged attack, on productivity and the promotion of investment and technological innovation in those activities with good future potential, showed how the indicative planning approach was beginning to adopt more market features. Industrial restructuring required the introduction of measures to adapt industry to the changing environment.

The modernisation plan was intended to cover a large number of sectors including integrated iron and steel, special steels, carbon steels, shipbuilding, textiles, footwear, motor vehicle parts, electronic components, kitchen appliances, semi-manufactured products of copper and its alloys. It focused on cost cutting, reinvestment and mergers, and building up new markets. Tax incentives were given to firms that merged. Other measures used covered modernisation and rationalisation, financial restructuring (writing off debts, rescheduling debt, new lines of credit, public underwriting of loans), tax rebates, extension of the payment period for tax and social security debt.

The government anticipated the adverse effects which might be felt by labour, with an envisaged reduction of 80,000 to 90,000 jobs. It tried to soften the blow through early retirement and redundancy packages, and through the provision of free retraining and subsidies to employers to encourage them to employ people. Such labour market policies proved of limited success, and Spain continued to have one of the highest rates of unemployment in the Community throughout the decade of the 1980s. Between the period 1975-1985 one million jobs were lost, while the years after EC membership witnessed unemployment rates of 18%, despite the creation of new jobs through multinational investment.

All of these measures involved substantial public expenditure. In the period 1984-1986 some Pta 1000 bn. (about £5 bn.) was expended on the reconversion plan. Investment in modernisation and rationalisation of installations between 1981-1989 totalled Pta 650 bn., out of which some Pta 50 bn. was allocated for design and research.[31]

Modernisation was additionally to be effected through the continued encouragement of foreign investment, the privatisation of much of the public sector enterprises, and a concentration of production in areas where it was difficult for small firms to gain entry.[32] Foreign direct investment was expected to promote the modernisation and internationalisation of the Spanish economy, and at the same time exert greater competitive pressures on domestic industry. Frequently, these competitive pressures were expressed by domestic firms preferring to create alliances with foreign firms rather than other domestic firms, and a climate of rivalry dominated relations among industrial firms. In the context of what the government was trying to do, namely to improve competitiveness and prepare for international competition, this was not necessarily a bad thing. However, in the context of interest group representation it represented a difficulty. At the national level, it was difficult to organise business interests and to establish common positions on areas of concern.

Judging the success of the modernisation programme is not easy, regardless of the set of criteria used. Structural change was affecting all of the European states to a greater or lesser degree, with different effects and very varied capabilities towards adjustment. But it cannot be said that the modernisation programme instituted a structure for technical innovation in Spain. The observations of the OECD study published in 1987 suggested that there was still much room for improvement of the technological system (section 5.1).

Before 1986, two government departments shared the responsibility for the management and co-ordination of research and technology -the Ministry of Education and Science had responsibility for science, and the Ministry of Industry and Energy for technological innovation. However, like the practice in the UK, most of the government ministries carried out R&D activities with little central co-ordination. The existence of inter-ministerial rivalry within the Spanish administration meant that the restructuring plan lost some of its sharper edges, as particular departments sought to satisfy long-entrenched interests, and political goals were sometimes more to the forefront.[33]

At a general level the Socialist government was caught between the traditional ideals and the desire to safeguard the interests of workers on the one hand, and the urgent objectives of modernisation of the industrial base in preparation for EC entry on the other. In one sense, perhaps, it tried to follow conflicting policies. But the government was anxious to pursue agreement on the modernisation plan, and to protect jobs as far as possible, and this approach had the effect of slowing down the restructuring of industry. In the UK, by contrast, the government had already broken down the industrial relations structures, and the liberalisation process of the labour market had gone much further.

Membership of the European Community brought a shift to a more open liberal economy, and also a gradual move in the direction of a more liberal economic management. But the policy shift should not be over-stated. By the end of the decade, the government still maintained a strong position in many areas of decision-making and wealth creation - despite privatisation programmes on the one hand, and the creation of the regional autonomous communities, on the other. Policy could be described as liberalisation combined with selective public sector intervention, compared with the earlier era of widespread intervention across the board. The earlier reference (see Tables 5.2 and 5.3) to the continued public financing of research and development, contrary to trends elsewhere in Europe, was just one instance of the central role of government.

The Spanish government was constrained by the requirements of Community legislation after 1986, but it continued to pursue an active industrial policy through the latter years of the decade. However, there was a shift away from supporting traditional industries, towards producing an economic environment conducive to the emergence of new industry. This meant policies aimed at greater flexibility of the labour force, new technologies, helping SMEs and promoting industrial exports.

Up to the mid-1980s, very little public funds had been directed at stimulating R&D in Spain, but there was an acceptance of the need to bring the base up to a comparable level with the other Member States. The next section examines the institutional and policy developments that occurred following accession to the European Community.

5.4 Planning the institutions

The Bill on Science and Technology, passed in April 1986, was described by the OECD as the most important step taken by Spain towards setting up a policy of innovation, provided the basis for a technology policy.[34] It contained institutional arrangements for the co-ordination of functions (see Figure 6.1 at the end of the chapter), and provided for a national technology plan - but what developed from it was a structure and policy framework modelled very closely on European Community developments.

The Interministerial Commission on Science and Technology (CICYT) was the principal instrument of coordination of scientific, technological and innovation issues with an Advisory Council for Science and Technology which operated alongside it. In addition, the Centre for Industrial Technological Development (CDTI) was given a greatly extended role within the Ministry of Industry. Originally set up in 1977 as a result of a credit of US $18m. from the World Bank for five years, CDTI became the focal point for much of the government's efforts to promote co-operation at the national, and the international level, facilitating participation in international cooperative ventures, and acting as a marriage broker for the various individuals interested in technological cooperative activity. It was both the national contact for the BRITE/EURAM and other EC programmes, and the manager of the government's national technological policy.

As manager of the public technology policy, it carries out three broad tasks: financing research and development projects by industry, representing Spanish interests in international programmes, and general promotional activities to encourage greater technology transfer and diffusion. The OECD regarded CDTI as an essential instrument for the technological development of Spain, and recommended that it should be provided with a regularly growing budget.

It was, in actual fact, the kind of elite group typified in the neo-functionalist theory, and a principal vehicle for pushing forward the integration process through technology policy. CDTI was very strongly supportive of the European technology programmes. It was staffed by intellectual elites, from the young generation of post-Franco Spanish bureaucrats and professionals that embraced modernity and progress. Modernity was represented in European integration, and the possession of an international outlook.

In addition to the aforementioned three bodies, the Bill also provided for the establishment of a General Council for Science and Technology, intended to co-ordinate the national and regional policies. Many of the regional autonomous communities have developed, or are in the process of developing a technology plan for the region. The scope of the regional technology plan varies from region to region, depending on the capability of the regional authorities, and the degree of autonomy each has negotiated with the national authorities. Policy is, thus, the responsibility of the Interministerial Commission, while the General Secretariat for the National Plan has responsibility at the operational level.

The Bill on Science and Technology also provided for a National Plan (drawn up for four years, with annual revision), to bring the country's research potential up to the level of the EC partners within 5-10 years at most. The Plan set out a target for R&D expenditure above 1% of GDP, with an increasing proportion to be met by industry. In this emphasis on industrial financing, the government was aligning itself with the OECD and the European Commission.

But the practice was somewhat different in the Spanish case. The country was starting from a low technological base, and the degree of technological co-operation between different groups was weak. It was perhaps inevitable that government retained a directive role in the development of the technological system, even when the technology Bill provided for the industrial interest representation at the various levels of government responsible for decisions on technology policy.[35]

The National Plan (1988-1991) coordinated research activity in a series of programmes which identified technological priorities within a broad societal framework. It was intended to increase technical activity of industry, and also the public research institutions as well to support the research of the Autonomous Communities. It planned to increase the number of researchers in Spain from 20,000 to 30,000 by 1991, and the proportion of GDP going to research from 0.7% to 1.2%. Largely funded by the government, the objectives of the first Plan (1988-1991) focused on a range of what are essentially very general socio-economic goals of broad application:

- progress of knowledge and advance in technological innovation and development;
- conservation, enrichment and optimum exploitation of natural resources;
- economic growth, job promotion and improvement in working conditions;
- development and strengthening of the competitive capacity of industry, commerce, agriculture and fishing;
- development of public services, especially those related to housing, communications and transport;
- promotion of health, social welfare and the quality of life;
- strengthening of national defence;
- defence and conservation of the national artistic and historical heritage;
- promotion of artistic creativity and the progress and dissemination of culture in all its forms;
- improvement of the quality of education;
- adaptation of Spanish society to the changes brought about by scientific development and new technologies.[36]

Funding of 235.400 million pesetas (174 million ECU) was allocated for 1988, and increased to 348.000 million pesetas (257 million ECU) for the following year. In terms of development and organisation, the National Plan bore distinct resemblance to the policy-making style at the European level. Priorities were set by the Interministerial Commission, following a process of consultation with over 400 experts from the scientific community, private sector experts, and government departments. Containing a total of 23 constituent programmes, the structure mirrored the European programme.

But the national plan was in practice too broadly designed to address the specific problems of a technological system: the gap in industry-academic relations, inadequate technology transfer mechanisms, and the historical role of the state in technological development. Moreover, it catered for precompetitive research, much of which was conducted under the aegis of the Ministry of Education and Science.

The national plan proved to be highly ambitious in its objectives, particularly given the fact that the country was still not well equipped with an institutional base to co-ordinate all the necessary activities. The plan represented a form of leadership from the top, and incorporated the ambitions and objectives of those involved in the formulation. It was less associated with the needs of the grassroots of Spanish industry, particularly the small- and medium-sized firms that made up the majority of the manufacturing base, low spenders on research and technology generally, yet in need of the means to modernise their activities.

Nonetheless, the plan set a strategic direction for technological development which would bring Spanish industry into line with other European partners, and at the same time continue to strengthen the indigenous resource base.[37] The Ministry for Industry was anxious, like the DTI in the UK, to promote greater collaboration by firms and research centres in the European Community programmes, even though the motives differed substantially.

While the UK government regarded the EC funds in support of business collaborative research as a substitute for national government financial support, the Spanish authorities regarded participation as a way of acquiring technology, and upgrading standards, and believed that co-operation could increase the European presence and identity of Spanish firms.

The implementation of the national plan for technological development showed up a number of problems which needed to be addressed - technical skills shortages,[38] the inadequate industry-university cooperation with low levels of applied research,[39] and poor technological diffusion.

5.5 Bridging the industry-academic divide

Encouraging the business sector to conduct more research, and to finance greater levels of research activity was one of the tasks for the Spanish government. But, equally important and difficult was that of bringing industry and universities together to conduct collaborative activity directed at the technological needs of industry. Universities were more inclined to pursue basic research, and consequently industry was discouraged from financing the research activities which they perceived as being irrelevant to their needs.

It was not only a question of developing a system of providing and diffusing information, and publicity, but also of encouraging businesses and universities to change their attitudes and practices. This required the creation of mechanisms to bring the business and academic communities together, and to develop strategies to enable non-university laboratories to act as intermediaries.

Table 5.9 Industrially-financed HERD, % of total, selected countries

UK	3.90
Germany	5.30
France	1.90
Spain	1.60
Italy	1.54
Ireland	7.20

Source: CEC (1991) HEI/Research centre/ Industry links in Europe, Innovation/SPRINT report.

A report by the European Commission on research centre-industry links, published in 1991, suggested that something needed to be done to improve relations between the two.[40] Many in the private sector believed that relations between business and the academic community were completely inadequate, and `existed in a climate of mutual mistrust'.[41] Universities had, for several decades, been increasing their international cooperative links, not just through CERN, the European Space Agency, and other European-level initiatives, but to a great extent with American institutions. Often this had resulted in a brain drain, and the belief among scientists that little opportunities existed for scientists in Spain, and little freedom from the bureaucratic approach of the government.[42] The Spanish scientific links with America had attracted criticism that it was neglecting its European counterparts.[43]

A system of industrial liaison offices (ILO`s) set up to foster greater industry-academic cooperation in Spain, and provided for in the 1986 Technology Bill, exhibited many of the weaknesses associated with distant business-academic ties. A European Commission report found that they were academically oriented, often with little formal training in innovation or technology management, and concluded that `they seem unsure of or even disinterested with the needs of industry'.[44] The problem of poor communication with industry was compounded by a serious lack of adequate information among much of the industrial sector regarding European R&D, technology and industrial activities, making intervention by the government seem a reasonable institutional development.

The communication gap operated in both directions, with much of the business sector having little knowledge of the research programmes conducted by research centres or the European Community. As the EC report acknowledged `Spanish businessmen are generally ill-informed of this type of activities and programmes, and know very little about how to gain access to them'.[45] In this regard, Spanish businesses were less well prepared to approach the European Commission directly regarding participation in the EC programmes than UK businesses.

This point need to be qualified, however. It was the small and medium-sized firms, increasingly targeted by the European Commission, that were particularly ill-informed about the European programmes, and most in need of upgrading their technological capability. Small firms took part in the research projects of the National Plan, on an individual and collaborative basis, but participated most frequently in the applied research area, where there was less need for sophisticated R&D facilities. Large firms, especially those multinationals with operations in Spain, were already associated with the European technology network either through the Spanish operations or those elsewhere.

One horizontal measure in place since 1989 was a network of technology transfer organisations, the OTRI (Oficinas de Transferencias de Resultados de Investigación), with branches in the universities throughout the country. The OTRI built up extensive databases on technological developments, including European programmes, and on financing and potential partners. Close liaison with the central authorities was the hallmark of these units scattered around the country. The OTRI network was modelled on the data bases established by the European Commission to provide support to applicants under the European technology programmes, and similar to the European Documentation Centres located in certain universities in the United Kingdom.

As a result of the direct invitation of the Spanish government, IRDAC addressed a gathering of the Spanish business community in 1993 to encourage greater participation in European programmes, especially the BRITE-EURAM programme.[46] Given the small-scale and limited resource base of industry, the Spanish government took a more active and direct role in co-ordinating the participation of both the business and the academic community in the EC Framework Programme than did the government of the United Kingdom.

The mixed results of mechanisms such as the ILO's and the OTRI network, amidst the initiatives of the national plan, suggested industrial technological development and innovation was taking place slowly. To push forward technological innovation, the authorities adopted a plan for the introduction and use of industrial technology, Plan de Actuación Tecnológico (PATI) 1991-1993, which was in effect a programme of horizontal measures and sectoral initiatives designed to run alongside the broad-based programmes of the National Plan, dealing specifically with industrial technology and applied research. Three priority areas were identified: information and production technologies; natural resources, agriculture and food technologies; quality of life. In the area of information and production technologies certain categories of research were identified:

- new materials
- information and communication technologies
- microelectronics
- space
- training of researchers.

The PATI was intended to improve the technology infrastructure so as to bring the technological capability of Spanish industry up to the level of other advanced countries, through support for individual and collaborative research and technological activities.[47] An equally important objective was to guarantee the continuance of existing initiatives within the framework of the conditions of the European Single Market. In effect, the government wanted to continue national efforts of support for technological development, but mindful of the European Community's policy on state aid to industry. The intention was that such public support at the domestic level could act as a springboard for taking these activities to the European level.[48]

By 1991 the percentage of GDP devoted to research had increased to 0.81%, but still below the projected figure of the National Plan. A second National Plan, covering the period 1992-1995, regrouped the original set of programmes, and attempted to address the problems which had been identified in the first programme.

However, even without the establishment of this system for transferring technology, the size of the government sector by itself could almost certainly guarantee some degree of technology transfer. In Spain, the public sector is substantially larger than in the United Kingdom, and represents a major element of the total demand for new technology. But a key part of the plan to set up a technology transfer network was the need to increase the demand for new technology generally among indigenous industry. Diffusion of technology was the best way to ensure the increase in total productive capability throughout the economy, and not just those isolated sectors dominated by multinationals. Otherwise, the efforts to increase technological development merely offered a subsidy to the foreign investors.[49]

Paradoxically, while membership of the European Community brought with it increased competition for Spanish industry it exposed the technological inadequacy, forcing the government to take an even more active role in ensuring that industry could meet the challenge. Surviving the single market required more intervention in Spanish industry and the technological structure rather than less, as the European Commission in general favoured. But at the same time, there was no sense among the Spanish authorities or technology community that European technology policy was in conflict with national policy. In fact, national policy continued to evolve along a European design, even during the recessionary years 1991-1993 when general support for integration declined.

5.6 Evaluating integration

The Spanish authorities continued to promote participation in the European programmes as the recession took hold in Spain. It was clear that the Spanish business community had some way to go towards matching the level of participation by other member states in European technology programmes.[50] In spite of the goals set out in the National Plan, and specifically in PATI, to increase the technological capability of Spanish business and shift the financing of R&D to the private sector, the state still retained much of the initiative in this area. It was acknowledged by the director general of CDTI, Antonio de Carvajal, that the plan had been ambitious, and that there was still improvements to be made in regard to innovation.[51]

One of the objectives of the CDTI, and a statutory duty, was to secure for Spain a technological return commensurate with the country's economic contribution to the EC. This objective was pursued much more forcefully in the period 1991-1994, as Spain questioned its contribution to organisations such as CERN, ESA, Airbus, and EUREKA.[52]

By 1990, the ESPRIT programme had attracted a substantial number of Spanish participants, although this numerical strength was not matched by an equivalent share of the total funds. Ortega pointed out that Spain had received 5.04 % of the total funds while the European average was 7%.[53] This suggests that the influence of multinationals persisted in the identity of those firms participating in the EC programmes,[54] while national firms still lacked the confidence to make a large scale assault on European collaborative programmes.

The BRITE-EURAM programme, which particularly suited Spanish industry through its targeting of SMEs, attracted less firms overall than the ESPRIT programme up to 1991, although Spain received more in terms of funds under BRITE-EURAM. The apparent contradictory experience of the two programmes can be explained by the nature of the collaborative participation of the Spanish firms.

Participants often had a limited responsibility in the collaborative project, and the financial receipts reflected this. In other words, greater numbers participating in a programme did not always mean a greater contribution of the programme budget going to Spain, if the nature of the role played by Spanish participants was small in comparison to other national partners. Apart from the financial implications, a limited participation in European programmes meant reduced access to the technological developments of the projects.[55] Public sector organisations participated in the European programmes to a greater extent than did the private sector business firms.

Table 5.10 Spanish participation in EC R&D 1989

	% total budget (1)	projects approved (2)	projects with Spanish participants (3)
BRITE-EURAM	6.20	170	46
BRITE: Aeronautics	3.70	29	8
ESPRIT	5.10	158	73
RACE	4.40	88	38
ECLAIR	8.50	25	9
SPRINT	10.20	121	

Source; MINER (1989) Informe sobre la Industria Española, p.254.
(1) gives % of total current programme budget going to Spain, (2) total projects approved at that time, (3) number of projects with Spanish participation.

By 1991, the principal programmes under the EC Framework programme of concern to CDTI covered the areas of industrial and information technology, agri-industrial research, telematics, pharmaceuticals/medicine. Spain received 5.3% of the total EC research budget, while the programme which stood out as giving the highest percentage share of an EC programme budget was the ECLAIR programme (European Collaborative Linkage of Agriculture and Industry through Research). The table below shows the position.

Table 5.11 EC R&D - Spanish share of EC programme budgets %, 1991

ECLAIR	9.00
BRITE-EURAM	8.10
ESPRIT	6.20
BRIDGE	3.80
RACE	0.20

Source: Ministerio de Industria, Comercio y Turismo (1991) Informe sobre la Industria Española, p.319.

By 1992, when Spain attained full membership of the EC, one thousand groups within Spain had submitted research projects under the European programmes, principally those included in Table 5.10 above, with over half of them being approved for support. CDTI expected 13538 million pesetas in 1992 from the BRITE-EURAM programme. By contrast, 326 projects were supported in that year under the national programme covering technological development, and technological innovation, with CDTI itself providing 18200 million pesetas.

EC programmes offered access to new technology, and the opportunity to develop a `culture of co-operation' in industry-academic relations. Eventually, the sum of all the participative efforts would, it was hoped, have the effect of upgrading the level of the technology base. The BRITE-EURAM programme was seen as `an EC initiative which complemented the Spanish government's modernisation plan'.[56] In addition, the programme offered opportunities to a substantial section of Spanish industry to acquire new technology, and at the same time to plug into the European network.[57] The survey results presented in chapter six of this thesis suggest this is what they wanted from the programme. But it also provided Spanish researchers with the chance to supplement research efforts already under way. In the area of new materials, for instance, there were numerous research projects being carried out by the universities, with the support of government funds.[58]

5.7 Conclusion

European technology policy exerted its influence on the Spanish policy, in a way that reflected the particular nature of the domestic institutional system. The driving force for change of the existing system was undoubtedly the governing elites, although they were strongly supported by the business and academic communities. Developments were set within the twin-pillar support of modernisation and European integration.

A tradition of high state involvement in society generally proved difficult to displace, however. This meant prominent support and intervention by the government in the technological system - an increasingly European-oriented elite appeared, one which was not always so well attuned to the particular needs of industry or to the deficiencies of the institutional system of technology transfer and diffusion. The statutory provisions regarding CDTI's development thus created some concern that technological projects of interest or relevance to industry could be neglected. However, the Ministry for Industry and Energy made strong efforts in the second half of the 1980s to bridge this divide, and attempted to direct industrial policy to the needs of industry.[59]

European Community technology programmes represented both a challenge and an opportunity to industry as well as the national authorities. For industry, it was the opportunity to build industry-academic relations in order to improve the technological capability of industry, to 'europeanise' the technological activities underway or planned, to upgrade technical processes of Spanish industry, and finally to extend commercial links throughout the European market. For government, it was the opportunity to construct a technological system that would underpin it. And for Spanish academic researchers, the European programmes represented an opportunity to construct links with researchers and technologists in other member states.

Having undertaken the task of constructing a technological system, the government was then put under pressure from the early 1990s to justify Spain's involvement in the European programmes at a time of declining economic activity within the country. Industry and the academic sectors, as well as other areas of Spanish society came to question the extent of Spain's share in the European technology programmes. The picture in 1993 (illustrated in Table 5.12) showed that the highest share came from participation in the European programme promoting agro-industrial research cooperation (AIR) and the BRITE-EURAM programme.

Table 5.12 Third Framework Programme 1993, Spanish share %

	EC budget	Spanish share MPTA	%
Programme:			
Telematics	5895	405	6.9
RACE	12300	501	4.1
ESPRIT	66825	4715	7.0
BRITE-EURAM	48780	3705	7.6
BRIDGE	1695	119	7.0
ECLAIR	24405	2640	10.8
Environment	17355	990	5.7
Total	177255	13075	7.4

Source: MINER, Informe 1993, p. 431 (1993 exchange rate: 1ECU=150 PTA)

Moving from a rather autocratic style of government to one based on consensus was a challenge - the national technology plan was a response to that challenge. It was modelled on the European Framework Programme, with wide-ranging consultation. But, like its Brussels counterpart, it was in reality a top-down programme rather than one based on substantive representation of sectoral interests.

The large number of small and medium-sized firms with low technological capability, combined with weak organisation of business interests and the poor history of industry-academic co-operation opened the way for the Spanish authorities to adopt the European model, yet not in fact adapting it sufficiently to the national circumstances.[60] At the same time, technological dependence on the one hand, and the demands of international competition based on technological capability emphasised the political significance of European and national technology programmes, making them complementary.[61] The need to improve competitive ability in the international economy encouraged higher levels of intervention.[62] It proved to be the public sector elites, more than economic interests, that exerted the integrative pressures within Spain.

The integrative pressures were harnessed by the central government with the support of areas of the public sector such as the research centres and the universities. Spanish business had long supported the idea of integration, but the overall sector was not organised as an effective pressure group. Among the large industrial groups there was often rivalry, and co-ordination of activities was not frequent. The small and medium-sized firms did not have the resources, or the capability to approach the Commission directly, as many of the UK firms were prepared to do. Weaknesses in the organisation of business interests, and the dominance of international companies in Spanish industry left the way open for the government to take more of a leadership role, so that throughout the 1980s and into the 1990s the government was a primary actor in the drive towards technological development.[63]

The lack of technological capability relative to European competitors was a factor in bringing the different groups together - industrial organisations, research centres and government. Participation in the European Community Framework Programme offered benefits to the individual participants, while, at the same time, could help to offset some of the problems in the Spanish technological system.

Many of the business firms had little experience of international technical cooperation and welcomed the coordinating role which the authorities were prepared to undertake. Unlike the United Kingdom firms which often approached Brussels directly, or followed up earlier collaboration efforts, the Spanish firms were happy to allow the CDTI to deal with Brussels, to find partners, and to attend the information workshops organised by the national authorities. There was substantially greater interaction between the Spanish authorities and the Brussels bureaucrats at the implementation stage than was the case for the United Kingdom.

The more extensive direct involvement of the Spanish authorities with Brussels meant that the learning effect associated with the integration process, discussed in chapter one, operated through the government elites. By contrast, in the case of the United Kingdom it operated directly through the participants in the collaborative programmes. The Spanish authorities were in a position to manage the process to some extent, to direct the entry points of new technology, and to set up mechanisms for assimilation and transfer of new technology. At the same time, CDTI and other organisations set up by the government were eager to study and adopt the Brussels model of technology management, without concern for sovereignty loss.[64]

Interest of the Spanish authorities in the EC technology programmes was in large part driven by the commitment of the government, led by Felipe Gonzalez, to the pursuit of an international dimension in domestic policy. As one writer expressed it - `The only way for Spain to become an internationally respected and politically and economically powerful nation, it is argued, is to think and act internationally'.[65] Both the government of Señor Gonzalez, and the bureaucrats within the national ministry and the science and technology institutions, contributed to the creation of the political spill-over.

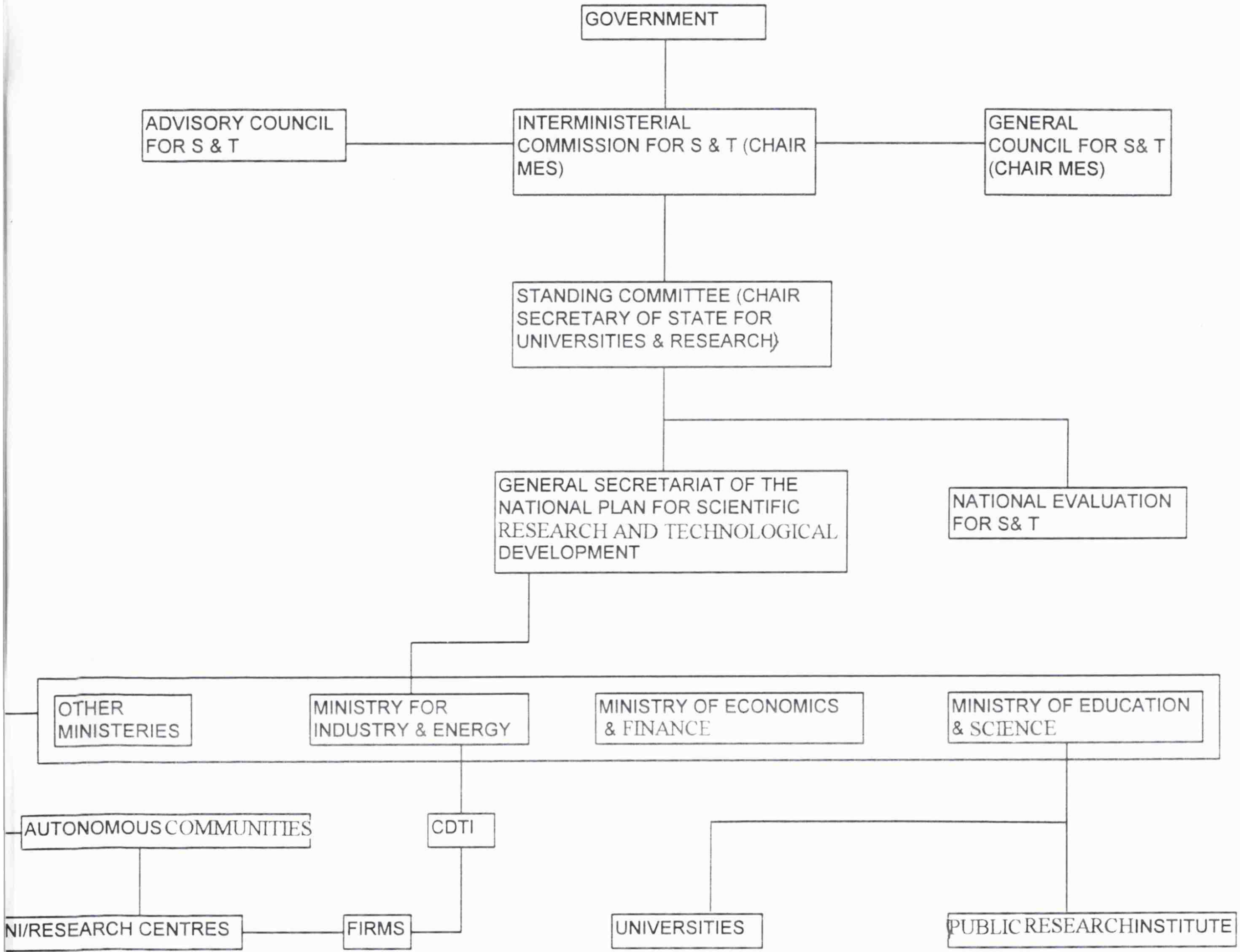
The experience of deep recession during 1992-1993 did not reduce the government's support for integration, although it did result in a more critical position by the government. At the Edinburgh summit in December 1992, the prime minister, Felipe Gonzalez exerted his influence and determination to secure greater financial benefit from the country's membership of the EC by securing the agreement of the European Community for the Cohesion Fund to support environmental and transport projects in Spain, as well as Greece, Portugal, and Ireland, in return for support of the Maastricht Treaty.[66] Since then, the government has set macroeconomic policy so as to meet the convergence criteria, while microeconomic policy was directed at improving the competitiveness of the Spanish economy.[67]

With greater competition for foreign direct investment among the member states of the European Union, policy inevitably turned to ways of maintaining Spain's competitive edge. Given the shift to a more neo-liberal approach, this has meant a greater emphasis on cost reduction and structural reform of the labour market, rather than on technological innovation activities. Although the level of foreign investment in the country began to rise again in 1994 (with 62.5% of the total originating from the EU, principally Holland, Germany and France) favouring particularly the manufacturing sector, much of it was targeted at existing Spanish enterprises rather than new fixed capital formation.[68] This suggests that the technological capability of Spanish industry remained to be addressed at both the macro and the micro level.

The Cohesion Fund was in many respects a compensation for the hardship that the Spanish economy would have to endure in order to meet the Maastricht convergence criteria for eligibility to the next stage of monetary union. By 1995, the public sector deficit was 5.8% of GDP (the requirement was 3%), with inflation at 3.4% but showing an upward tendency. The tight monetary policy imposed by the government had a knock-on effect on business investment and R&D in the early 1990s, which showed little sign of abating. The expected growth for 1996 was 2.3%, revised from 3.4%, while unemployment in 1995 was 22.&%, more than twice the EU average. Private consumption, which had been one of the contributing factors to the growth of the second half of the 1980s, was expected to increase by 2% in 1996, at the same rate as the previous year.

The examination of the national institutional systems presented in this chapter, and in the preceding one, opens up the context for the actions and motivations for technological collaboration by individual actors. But it gives no clear picture of the micro level, where the decisions to collaborate or not are made, nor does it elaborate on the changing expectations and attitudes of these actors. For this, we have to go directly to the micro level so as to identify what, if any, changes in attitudes and expectations are evident from their experience in the European programme. The next chapter presents the evidence from a survey of the Spanish and UK participants, conducted in two stages over a three-year period between 1992 and 1995. It is to this empirical evidence that we now turn.

Figure 5.1 Spanish technological system



Notes to chapter five

1. `But, at the same time, if we do not experience a technological revolution, our social vitality and our quality of life will deteriorate rapidly, preventing a new historic opportunity to reconcile Spanish identity and modernity, cultural identity and techno-economic development' - Manuel Castells, Antonio Barrera, Pilar Casal, Cecilia Castano, Pilar Escario, Javier Melero, Javier Nadal (1986) El Desafío Tecnológico España y las nuevas tecnológicas [Alianza Editorial, S.A., Madrid], p. 378. The view that technological change was closely tied to social progress and the quality of life, as well as being identified with a Spanish identity and modernity, was much more readily adopted in the consciousness of Spain's political and academic community than in the United Kingdom's. This is true, even when in practice technological change was slow to appear in the industrial sector, to say nothing of the other sectors of Spanish society.

2. Manuel-Jesus González (1979) La Económica Política del Franquismo: Dirigismo, Mercado y Planificación [Madrid].

3. The OECD concluded rather cautiously that Spanish accession brought trade creation effects for industry which outweighed the trade diversion effects for agriculture, an increase in investment and a faster dissemination of technical progress. The opening of domestic markets to foreign competition was regarded as having a number of positive effects - reducing the inflationary leanings, greater appeal for foreign investment, and improved opportunities for specialisation and economies of scale. These conclusions reflect traditional customs union and neo-classical theoretical analyses, where the market is taken as the ideal or natural order rather than as a social institution which is supported by a network of other social institutions. See OECD (1991) Economic Survey: Spain 1990/91, Part IV. The impact of EC membership on Spain's economy [Paris, OECD].

4. See L. Gámir (1990) Política de Integración en la CEE in L. Gámir (ed.) Política económica de España [Madrid, Alianza Universidad Textos]., ch. XXII. In its first year of membership Spain was assured of receiving as much from the Community as it paid in - El País (1986) España recibirá de la Comunidad lo mismo que aporta, 14 July 1986 (panorama semanal).

5. The former Ministry for Industry, Commerce and Tourism was renamed the Ministry for Industry and Energy at the beginning of the 1990s.

6. Ministerio de Industria, Comercio y Turismo (1987) España en Europa: Un Futuro Industrial (Madrid).

7. The principal concern of this chapter is with aspects of the institutional system which affects the technological activities of manufacturing industry, although research and technological activities are conducted on a much broader front. However, the issues identified in this chapter offer a microcosm of the Spanish system, and its widely acknowledged research deficiencies. See El País panorama semanal (1986) `Por qué no investigamos', 22 December - this article attributes the deficiencies partly to the historical development of isolated research activities of an idealistic rather than practical nature; `robinsonismo' and `quijotismo'.

8. Quoted in Ramón Tamames (1986) The Spanish Economy An Introduction [London, C. Hirst & Co.], p. 85.

9. Miguel de Unamuno (1864-1936) was an influential literary figure, whose semi-philosophical writing was a precursor of the Existentialist movement.

10. See Jose Viñals (1990) `Spain and the `EC cum 1992' shock' in Christopher Bliss and Jorge Braga de Macedo (eds.) Unity with diversity in the European Economy [Cambridge University Press]. The chapter has an extensive bibliography of studies on the impact of EC membership on sectors of Spanish industry.

11. CEC (1988) Research on the `Cost of Non-Europe' Basic Findings vol 3, p. 214.

12. OECD (1987) Innovation Policy: Spain [Paris, OECD].

13. OECD (1987), p.84.

14. España en Europa, ibid., pp. 99-100.

15. See Keith G. Salmon (1991) The Modern Spanish Economy [London, Pinter], ch. 6.

16. R. Tamames (1986) The Spanish Economy [London, C. Hurst & Co.].

17. K. G. Salmon (1991) The Modern Spanish Economy [London, Pinter].

18. Viñals (1990) op. cit., p. 196.

19. See Manuel Castells, Antonio Barrera, Pilar Casal, Cecilia Castano, Pilar Escario, Javier Melero, Javier Nadal (1986) El Desafío Tecnológico España y las nuevas tecnologías [Madrid, Alianza Editorial, S.A.], p. 150.

20. Castells (1986), p. 137.

21. The evidence suggests that multinationals still carry out substantial amounts of research in the home country, or in a few key locations around the globe, although this does not preclude the possibility of government policy to influence the location of such activities. See Mark Casson (1991) Global Research Strategy and International Competitiveness [Oxford, Basil Blackwell].

22. See chapter three.

23. Castells et al (1986), p. 164. This affirms the findings of Mark Casson (1991), op. cit.

24. See Manuel Castells et al (1986) El Desafío tecnológico España y las nuevas tecnologías [Madrid, Alianza Editorial], p. 119.

25. A. Berges, R. Simarro (1987) in F. Maravell (ed.) Eficiencia Tecnica en las grandes empresas industriales de España y Europea.

26. See Tamames (1986); and also José Molero (1983) Foreign Technology in the Spanish economy: an analysis of the recent evolution Research Policy, 12.

27. El País panorama semanal (1990) `Preocupación en la CE por las industrias españolas', 12 November. Spain spent 0.7% of GDP on technological development compared to an average in the Community of over 2%.

28. European Economy (1990) `The impact of the internal market by industrial sector: the challenge for the member states', Special issue [CEC, 1990].

29. Manuel Castells (1990) El Impacto de las Nuevas Tecnologías en la Economía Internacional. Implicaciones para la Economía Española [Instituto de Estudios de Prospectiva, Universidad Autónoma, Madrid], p. 340. Castells suggested that the relative technological capability of Spanish industry was less important than the degree to which industry incorporated advanced technology in the form of imported goods. He concluded that the technological capacity of Spanish industry was still in the process of being created. His report offers a detailed study of Spanish industry, but it does not consider the technological system in the broad sense used by other studies such as Nelson (1993), or Lundvall (1992) - and so gives only a limited examination of the processes of technology transfer, and diffusion.

30. See V. Oller (1990) Política Industrial en España, in Luis Gámir, Política económica de España [Madrid, Alianza Universidad Textos], p. 296.

31. See Salmon (1991), p. 118.

32. In the 1980s the comparatively low cost of labour attracted a number of multinationals to Spain - Ford, General Motors, IBM, Digital, Siemens, Sony, Fujitsu. Salmon identified a risk for national resource allocation inherent in the domination of industrial production by foreign multinationals, expressing the concern that Spain could become peripheral to the whole process of resource allocation within the Community. See K. Salmon (1991) The Modern Spanish Economy [London, Pinter].

33. Spanish involvement with CERN, the Geneva-based European nuclear research organisation exemplifies these problems. Spain joined this scientific club in 1961 but left in 1968, with the then minister for industry, Gregorio López Bravo, claiming that it was too expensive. Membership was renewed in 1983 amidst the general reorientation of government policy and aspiration towards Europe, but again in March 1993 the industry ministry, responsible for the Spanish contribution, expressed concern over the cost of membership as debt owed to CERN rose. The education ministry was, however, anxious to retain membership in the interests of the Spanish scientific community. A tightening economic situation at home forced the government into making a sharper evaluation of the benefits of membership.

34. OECD (1987) Innovation Policy: Spain [Paris], p.9.

35. The government's intentions may be best illustrated by the view expressed by Florencia Ornia, of the Ministry of Industry's General Directorate for Industrial Innovation and Technology `We must opt for close co-ordination at the planning stage, less in the management stage and none in the execution stage' - OECD (1987) ibid., p. 57.

36. CEC (1989) Comparison of scientific and technological policies of Community Member States: Spain. EUR 11981 [Brussels], p.2.

37. Indicative planning was not new to the Spanish economy - forms of planning were adopted during the Franco regime, and by the government in the years following Franco's death. The Socialist government introduced the National Electronics and Information Technology Plan (PEIN) covering the period 1984-1987, to provide assistance to micro-electronics, telecommunications, advanced automation, and the establishment of science parks. The PEIN was intended to identify areas with future growth potential, with the potential to create jobs, and to improve the industrial structure.

38. José María Navarrete, president of ANIEL, the Spanish electronics association, identified the shortage of professionals in the new technologies as being a key problem for Spanish industry. See report of interview in ImasD, November 1990, p.8.

39. CEC (1991) HEI/Research Centre/Industry Links in Europe. Innovation/SPRINT report, EUR 13206 EN [Brussels], p.291.

40. CEC (1991) HEI/Research Centre/Industry links in Europe, p. 293.

41. CEC (1991) ibid., p.311.

42. El País panorama semanal (1989) `Científicos residentes en el exterior creen que en España no se incentiva a los investigadores', 3 March.

43. See, for example, El País panorama semanal (1988) `Críticas a España en el seminario de Luxemburgo por sus elevadas compras de tecnología fuera de la CE', 8 February; `Cánovas: ``Nuestros científicos se relacionan más con los de EE UU que con los de Europa" -entrevista con el impulsor español de la Academia Europea de Ciencias, 5 December 1988.

44. CEC (1991) The university-industry and research-industry interfaces in Europe, p. 373. EUR 13204 EN. Other studies have identified the lack of movement of higher education personnel into industry, thus restricting technology transfer, while the nature of higher education systems tended to exclude personnel with direct experience of working in industry - see David Charles and Jeremy Howells (1992) Technology Transfer in Europe. Public and Private Networks [Belhaven Press].

45. See CEC report, EUR 13204 EN, ibid., p.312.

46. Interview with Robert Smits, IRDAC, Brussels 5 July 1994.

47. See Ministerio de Industria, Comercio y Turismo (1991) Informe Sobre la Industria Española [Madrid], p. 300-311. The account suggests that technological initiatives were being generated by the industry ministry at a very rapid rate, and that the ministry had a fondness for acronyms second only to that of the European Commission. Included in PATI were several sectoral plans - in electronics and information technology: Plan Electrónico e Informático Nacional (PEIN II); in advanced automation: Plan de Automatización Avanzada (PAUTA III); in the pharmaceutical sector: Plan de Fomento de la Investigación de la Industria Farmacéutica (FARMA II); biotechnology, chemicals, and new materials: Plan de Desarrollo Tecnológico en Biotecnologías, Tecnologías Químicas y Tecnologías de los Materiales (BQM); Plan de Apoyo Tecnológico a los Sectores Industriales Básicos y Transformadores SBT) which supported technical innovation processes in traditional production sectors such as machinery and equipment, textiles, confectionery.

48. Interview with Cecilia Hernandez of CDTI, May 1992, Madrid.

49. See Peter B. Evans (1985) Bringing the State Back In [Cambridge University Press]. The Spanish government was generally favourable to foreign direct investment, while at the same time anxious to protect national interests. It was not concerned with fostering international cooperation programmes other than in the context of the EC programmes, whereas the UK government encouraged international co-operation more generally. As Evans notes `the threat that the local economy might come under the domination of transnational capital of foreign origins is an important element in legitimating the development of an extensive array of mechanisms for state economic intervention. Like Third World states, advanced industrial states with local economies that are vulnerable to the vagaries of transnational markets and susceptible to domination by TNCs based elsewhere tend to take on an expanded role - both because the `foreign' character of the threat legitimates state intervention and because the self-interest of local capital in protection from economically superior adversaries reduces resistance to the expansion of the state`s role,' p. 210. To some extent, the EC`s development of the technology programmes was a response to the threat from external competitors with more advanced technology, although TNCs operating within the Community were not perceived as such a major threat and were even included in the technology collaboration programmes.

50. Patricio Morcillo Ortega (1991) La Dimensión Estrategica de la Tecnología [Editorial Ariel, Barcelona], p. 130.

51. Interview with Antonio de Carvajal, director general of CDTI, in ImasD, January 1990. De Caravajal identified the low level of technical specialists as a problem, and suggested that CDTI had a low profile with some areas of business.

52. See, for example, El País semanal (1993) `España, prácticamente decidida a abandonar los programas espaciales tripulados europeos', 22 March 1993. El País semanal (1993) `Ciencia de ida y vuelta, España estudia retirarse del CERN debido a los elevados costes', 29 June 1993.

53. Ortega (1991), ibid., p. 129.

54. This corresponds with the argument put forward by Robert Reich, to the effect that the increased internationalisation of business is blurring the national identity of large international companies, and thus calling for a reorientation of national policy away from the focus on firms and towards human capital. Robert Reich (1991) The Work of Nations. Preparing Ourselves for 21st Century Capitalism [London, Simon & Schuster].

55. Ortega acknowledged this, referring to the lost opportunity for Spanish firms `siendo relegadas a un rol de comparsas', (being relegated to the role of an extra) ibid., p.130.

56. Interview with CDTI official, July 1994, Madrid.

57. See Sabine Urban and Serge Vendemini (1992) European Strategic Alliances. Co-operative corporate strategies in the new Europe [Blackwell, Oxford]. The authors suggest small firms see cooperation as a way of extending and strengthening their share of foreign markets, without the risks and costs associated with pursuing alternative strategies such as acquisition or by creating new organisational units, p. 151.

58. See Ministerio de Industria, Comercio y Turismo (1992) Plan de Desarrollo Tecnológico en Biotecnologías, Tecnologías Quimicas y Tecnologías de los Materiales (BQM) [Madrid] - one of the sub-programmes under PATI, described in section 6.5.

59. See España en Europa, ibid., pp. 69-84.

60. The ownership pattern of MNEs in Spain moved from being US- dominated to European-based, particularly German, multinationals. By itself, this group did not channel the interests of Spanish business, which were often poorly organised and subject to rivalry. The SMEs, representing the largest proportion of industrial firms in the country, did not have the political skills to make initial contact with the European Commission, and often lacked the technological capability to make an independent contribution towards a research proposal.

61. R. Pampillon (1990) Política de Innovación Tecnológica, in Luis Gámir, Política económica de España [Madrid, Alianza Universidad Textos], p. 312.

62. The increase in state involvement in the economy, as a response to international pressures, has been analysed by several commentators. `Analysts must take account of the embeddedness of nations in changing transnational relations, such as wars and interstate alliances or balances of power, market flows and the international economic division of labour, and patterns of intellectual communication or cultural modelling across national boundaries,' - Peter B. Evans (1985) Bringing the State Back In [Cambridge University Press], p. 350. Peter Katzenstein identified increased state involvement in the economy as being particularly evident in the strategies of smaller countries facing an increasingly `transnationalised' economy - Peter Katzenstein (1985) Small States in World Markets [London, Cornell University Press].

63. Chapter 7 examines the organisation of Spanish business interests.

64. España en Europa: Un Futuro Industrial (1987) Ministerio de Industria, Comercio y Turismo. This document explicitly acknowledges the loss of sovereignty, while emphasises the compensatory gain for the country in being more closely involved in decision-making at the Brussels level, p. 104-105.

65. Otto Holman (1993) Transnationalism in Spain. The paradoxes of socialist rule in the 1980s, in Henk Overbeek, (ed.) Restructuring Hegemony in the Global Political Economy [London, Routledge], p. 151. Holman suggests that the loss of sovereignty, as a result of membership of the European Community, is a sign of strength in that it implies the maximisation of the conditions for profit-making by Spanish business in the world economy, p. 139.

66. Under the Cohesion Fund, Spain will receive 7900 million ECU over the period 1994-1999, with 2600 million ECU each going to Greece and Portugal, and 1300 million ECU to Ireland. In addition to this figure, a further 26300 million ECU under the Objective 1 category for regional support and 2200 million ECU from other European Commission initiatives would result in 36400 million ECU (5.5 billion pesetas) going to Spain. See El País panorama semanal (1993) `España recibirá 5.5 billones de pesetas de la CE para las regiones más pobres hasta el año 1999', 25 October.

67. See European Economy (1994) `The Economic and Financial Situation in Spain', Report no. 7 [CEC, Brussels]. This report attributed an unbalanced policy mix (expansionary fiscal and restrictive monetary) in the late 1980s and early 1990s as a factor in the loss of competitiveness, pushing up cost and price inflation.

68. The volume of foreign investment in Spain increased by 26.5% in 1994 over the previous year, giving a total of 2.34 billion pesetas. Manufacturing industry received 1.31 billion pesetas of this total, and some 62.5% of the total fdi came from the EU. See El País panorama semanal (1995) `La inversión extranjera en España aumentó un 26.5% y alcanzó un record de 2.34 billiones', 30 January.

CHAPTER 6

COLLABORATION AND COMMUNITY BUILDING - THE EVIDENCE

One of the central tenets of the neo-functionalist theory was that economic forces should respond to an initial integrative step by exerting pressure for further integration, as the perception of successful integration causes a spill-over into other decision-making mechanisms to satisfy other demands in an interdependent economy. Chapter three of this thesis examined one instance of an initial integrative task, a programme to integrate European manufacturing through collaborative research. The question now is to consider whether subsequent demands will be made by these actors on the supranational authority. How would these economic actors respond to integration? What force operates on these economic actors, prompting calls for integration, and resulting in a transfer of loyalty to a supranational institution?[1]

Neo-functionalist writers disagreed over the priority given to the actions and expectations of individual economic actors at a more disaggregated level.[2] Yet it was clear that the programme for establishing a single market in Europe offered substantial benefits to the business community, and was consequently supported individually and collectively by business leaders. The integrative pressures which appeared before and after the Single European Act have prompted a closer look at the nature of these pressures.[3]

As this thesis will show, with the development of the BRITE-EURAM programme business pressure and demands on the Commission were intensified more often through the leadership and actions of the Commission itself - by developing a programme that was accessible to participants, and harnessing it to a broad institutional structure of a supranational nature. Business leaders played a more direct role at an early stage in the formulation of the Single Market programme through their private consultations with both national and Commission officials.[4] In the case of European technology policy, however, the nature of the business-government relationships in the different national economies of the Community have also played a part in the political process. This chapter presents the results of the survey of the UK and Spanish participants in the BRITE-EURAM programme. The analysis considers the pressures and motives of the actors, and the extent to which the experience of participation leads to a change of attitudes, expectations or loyalties towards the central authority. The objective is to consider the evidence, quantitative or qualitative, to suggest that a community has been, or is in the process of being created.

6.1 Survey Methodology

This section provides details of the research design and methodology, and the results of the survey will be presented in the following sections. The results are based on information provided by responses to written questionnaires issued to participants in both Spain and the United Kingdom. (The questionnaires are included in Appendix 5 at the end of the thesis).

Survey samples consisted of a roughly representative cross-section of the participants - business firms from across the industrial sectors targeted by the programme, universities, and research centres. The survey included SMEs as well as the larger firms. A total of 214 questionnaires were issued to the project leaders and representatives of participating firms and research centres, 104 in the UK and 110 in Spain. This total of 214 represented around 40% of the 530 projects running under the BRITE-EURAM programme in September 1992, when the first survey was made.

A follow-up survey was carried out in September 1995, with a total of 200 questionnaires issued, 100 in the UK and 100 in Spain. The slightly smaller number of questionnaires issued the second time around was a result of updated information regarding the status of the original list.[5] The overall response rate to the first survey was 61%, with a total of 68 usable replies from the UK, and 63 from Spain, while the second survey had a lower response rate at 47%, with 53 responses from the UK and 40 from Spain.

No previous survey of the BRITE-EURAM had attempted such a detailed analysis of national participation, and at the same time the survey benefited from the maturity of many respondents' collaborative experience. One of the intentions of this survey was to identify some generalisations regarding the experience of collaboration under the BRITE-EURAM programme, and to establish any differences in the experience at a national level, or sectoral level.

The BRITE-EURAM Programme Current Projects 1990-1991 (revised 1992 edition) provided the information on the UK participants, while a list of the Spanish organisations participating in the programme was provided by the Comisión Interministerial de Ciencia y Tecnología (CICYT) in the Spanish Ministry of Industry and Energy (MINER). The reason for the different sources lay in Spain's then relatively recent membership of the European Community. As Spain only joined the European Community in 1986, Spanish organisations were slow to provide leadership for many of the collaborative projects.

The Synopsis of Current Projects (referred to above) lists each project, giving details of the project leader and merely listing the national origins, but not the identity, of the other partners. The Spanish government, unlike the UK government, maintained an information base on the national participants in this and other EC programmes under the Framework Programmes, and has tended to be very closely involved in the implementation and evaluation of national participation in the European programmes.[6]

The questionnaire for the first survey was pilot tested at a workshop organised by the Commission for BRITE-EURAM participants, held in Seville in May 1992. A member of the Spanish authority, CICYT, also advised on the form of the questionnaire.[7]

6.2 Purpose of the survey

The first survey sought to obtain a profile of the participants under the programme, to establish the sectoral and structural origins and nationality of the partners, the reasons for engaging in collaborative research under the auspices of the programme, and the perceived difficulties and benefits of European research collaboration. In particular, it was intended to show the response of the partners to collaborative transnational research, and to ascertain whether this might result in future changes in behaviour towards support of the Commission in developing technology policy.

In order to show the extent to which a change in attitudes, expectations and loyalties occurred on the part of the participants a number of questions from the first survey were repeated in the follow-up survey. Both questionnaires are included in Appendix 5. In particular, respondents were again asked about the problems of collaboration, the benefits which they perceived, and how they considered the Commission could provide more assistance.

In addition, respondents were again asked to indicate whether they would continue collaboration with their current partners to commercialise the research results, whether they considered that taking part in the BRITE-EURAM programme improved the organisation's cooperative capability, and whether they would participate in future BRITE-EURAM projects. The success of a collaborative venture may be measured by the degree to which the objectives set out at the beginning of the project are met, and to the extent that all of the partners are satisfied that this is the case.

This survey considers whether the participants expressed a change of preference, as a result of the collaborative experience, likely to lead to a consideration of further collaboration with the same or alternative partners and without the direct assistance of the Commission. Where such evidence of further independent collaboration by the participants exists, it supports the development of economic integration. But more is needed to test the predictions of neo-functionalism. For this, there should be evidence of `loyalty transfer' by participants, who now direct their R&D proposals to the Commission, and are ready to suggest or accept initiatives in technology policy beyond what has been presented to them thus far.

6.3 SURVEY RESULTS

6.3.1 - the participants

This section concentrates primarily on the results of the first survey carried out in 1992 to provide a profile of the participants and of the general nature of the collaboration, but there is occasional reference to the findings from the second survey conducted in September 1995 where it is considered that the follow-up results provide additional clarification. A more detailed presentation of the findings from the second survey, and a comparison with the earlier picture is given later in the chapter.

The BRITE-EURAM programme sought to increase the representation of SMEs to a greater extent than some of the other Framework Programmes, and the profile of the participants which was established through the first survey suggested some success in this. However, the success was mixed, as the Spanish profile showed, and as the comments of respondents indicated. Out of the total of 131 respondents, 28% comprised industrial firms of more than 500 employees, with 18% in industrial firms of 250-499 employees and a total of 42 industrial respondents (32%) employing less than 250 people. There were 16 research centres and 13 universities (see Table 6.1), making a total of 29 public organisations in the survey.[8] The profile of the participants suggests a particular national bias in the size of the organisations involved. Spanish participation tended to comprise firms of less than 500 employees. From the total of 37 respondent organisations employing more than 500 people, 22 were of UK origin and only 15 of Spanish origin.

Table 6.1 size (no. of employees) and type of participants

	Total	UK	Spain
	131	68	63
Industrial firm, 500+	37	22	15
250-499	24	5	19
150-249	14	5	9
50-149	17	3	14
less than 50	11	6	5
Research centre	15	15	n/a
University	13	10	3

n/a: not applicable

Note: Firm size is identified by number of employees.

Table 6.2 gives details of the sectoral origin of the industrial participants under the BRITE-EURAM programme for the total of the UK and Spanish respondents. The principal industrial sectors represented in the survey were aeronautics, construction, ceramics/glass, electronics, engineering, with a smaller representation from pharmaceuticals, robotics, textiles, and enterprises involved in the area of advanced materials.

Table 6.2 industrial sector by respondent

	Total	UK	Spain
Aeronautics	13	10	3
Construction	10	6	4
Ceramics/glass	6	4	2
Electronics	10	7	3
Engineering	35	25	10
Robotics	8	4	4
Pharmaceuticals	5	3	2
Textiles	6	3	3
Footwear/clothing	6	3	3
Food/drink	4	3	1

Although BRITE-EURAM was presented by the Commission as a multi-sectoral initiative, there was little evidence of cross-sectoral collaboration. Many of the industrial sectors collaborated with partners from within their own sectoral grouping, although this was not the case uniformly.

Table 6.3 cross-sectoral collaboration

Respondents	Total	Sector Aero.	Constr.	Ceramics	Electr.	Engin.	Others
Aeronautics	13	8	1	2	1	6	5
Construction	10	1	7	n/a	n/a	4	1
Ceramics/glass	6	2	n/a	4	2	3	3
Electronics	10	2	1	1	5	5	5
Engineering	35	5	3	1	1	25	12

Respondents in the aeronautics industry collaborated with partners from engineering and advanced materials, as well as with public research centres. Ceramics/glass industrial participants included electronics, engineering and textiles enterprises in the venture. Both electronics and engineering collaborated with partners in the aeronautics, construction, ceramics, but again these industrial sectors displayed a bias towards their own industrial sectors in the choice of collaborative partners.

The survey results suggested a distinct national bias in terms of the introduction to and involvement in the programme by participants. It showed that there were differences in the way national participants became involved in the BRITE-EURAM programme, which stemmed from the nature of the support and encouragement given by the national authorities, or the degree to which participants were already involved in technology collaboration networks.

Table 6.4 how organisations became involved

	Total	UK	Spain
	131	68	63
Response to the Commission	16	13	3
Response to national govt.	15	2	13
Approach by interested party	49	8	41
Own proposal	54	42	12
Other	11	9	2

The UK respondents were already well established in the ways of collaborating, with 42 out of the total of 68 replies initiating their own proposal directly as opposed to 12 from Spain. For many of the Spanish participants, the learning effect occurred slowly, and there was a strong dependence on the national government to provide the initial guidance around the Brussels maze.[9] Respondents in the UK did not receive a comparable level of support from the national authority in setting up the collaborative project. Table 6.5 shows that in general there was a strong perception of national support by the Spanish participants.

Table 6.5 level of national support for project

	Total	UK	Spain
Substantial	24	1	23
Moderate	17	2	15
Limited	30	14	16
None	60	48	12

A high proportion of the UK participants indicated no support from the national authorities in setting up their collaborative project under the BRITE-EURAM programme, while there was a significant response from the Spanish participants (22%) with a similar view.

Finding partners was one of the difficult and time consuming aspects of proposed collaboration, and many of the participants used previously established contacts (see Table 6.6). Overall, the survey showed a steadily emerging web of collaborative alliances, and it was from this web that many of the participants were able to secure partners, although some replies indicated the use of two or more sources even when already engaged in collaboration. In the case of the United Kingdom, 53 of the respondents found partner organisations through previous contacts, not necessarily originating from the Framework Programme, whereas only 15 of the Spanish participants did so. The picture here was one of relative inexperience on the part of the Spanish enterprises, shown in a reactive role rather than an active one of partner seeking. Out of the total 63 replies from the Spanish participants 45 were contacted by other interested partners. This did not, however, indicate a lack of interest in collaborative activity.

Table 6.6 finding partners

	Total	UK	Spain
EC data base	16	7	9
National data base	2	n/a	2
Contacted by other partner	58	13	45
Other	68	53	15

n/a: not available

Only 7 of the UK and 9 Spanish participants used the EC data base set up by the Commission to provide information on enterprises willing to pursue collaborative activity. This is perhaps not so surprising since the data base only became operational well into the Third Framework Programme (1990-1994), and by the time this survey was undertaken the participants were only slowly becoming acquainted with it. The Commission has encouraged participants to use the data base as one way of overcoming the delays and bottlenecks associated with Brussels procedures.

6.3.2 the network pattern

The first BRITE-EURAM programme (1984-1987) funded projects with an average of 2-3 partners. Since then the average has increased to 4 partners, with Table 6.7 indicating 27 UK respondents and 30 Spanish involved in collaborative ventures of five or more participants. For smaller sized projects the pattern was similar for both countries, 14 UK and 11 Spanish participants were involved in projects containing four partners. Only 16 projects between the two countries contained two partners - the minimum required to form a transnational collaborative project.

Table 6.7 number of partners

	Total	UK	Spain
Two	16	10	6
Three	27	16	11
Four	25	14	11
Five or more	57	27	30
Don't know	6	n/a	6

n/a: not applicable

When asked if they had collaborated with current partners previously, both Spanish and UK respondents answers suggested that many of the projects had been created on the basis of prior collaborative experience together. This is consistent with the findings from Table 6.4 and Table 6.6. The survey findings suggested that two thirds of respondents had collaborated with at least one partner before, and that 8% had collaborated with four or more partners previously (see Table 6.8).

Table 6.8 previous collaboration by number of partners

	Total	UK	Spain
	131	68	63
One	43	21	22
Two	20	12	8
Three	13	7	6
Four or more	11	8	3
Dont know	44	20	24

It is instructive to consider the choice of partners by nationality, and to see how far participating organisations are willing to go beyond the national boundary in search of partners. While this may be one measure of the degree of integration that has taken place, it is also a problematical one. There is often a tendency to engage in collaboration with partners in neighbouring countries, the familiarity and proximity sometimes being more important than other tangible factors.

But the pattern of collaboration also mirrored the flow of trade, and as shown below participants have been encouraged to include users or potential users of the new knowledge in the collaborative venture (see Table 6.11). France, Germany, Italy and

Netherlands figured prominently as partners in the collaborative activities of the two countries surveyed.

Table 6.9 national origins of partners

Country	Mean
Belgium	1.33
Denmark	1.24
France	1.95
Germany	1.81
Greece	1.29
Ireland	1.20
Italy	1.41
Holland	1.70
Portugal	1.23
Spain	1.81
UK	1.91

A comparative analysis of the national origin and number of partners from each country confirms this, and Table 6.9 gives the mean score. The Spanish showed a strong preference for collaborating with Dutch, French and German partners, in that order. In the case of the UK participants, the pattern was not so concentrated. Although there was a strong preference for German, French and Italian partners, Table 6.10 shows organisations in the United Kingdom also collaborated to a greater extent with other domestic partners than was the case with Spanish participants.

Instead, the Spanish participants showed a strong European bias in the collaborative network. They were anxious to obtain a foothold in the European market, and at the same time to secure access to new technology unavailable at the domestic level. In the United Kingdom there was a stronger tradition of industry-academic collaboration, and many participants brought domestic partners with them with whom they had previous, sometimes long-standing, collaborative experience. Both countries showed little collaborative activity with the EFTA member countries, although the UK participants did collaborate to some degree with Swiss and Swedish partners.

Table 6.10 European partners

	Total	UK	Spain
Belgium	17	11	6
Denmark	19	12	7
France	63	24	39
Germany	56	33	23
Greece	14	7	7
Ireland	12	8	4
Italy	33	16	17
Holland	60	11	49
Portugal	24	12	12
Spain	24	14	10
UK	73	48	25

The follow-up survey in September 1995 pursued this issue further, asking if national characteristics and cultural traits affected either the choice of partners or the success of the collaborative venture. Looking at the responses on a purely quantitative basis, the picture is somewhat mixed for the UK and Spain. Overall, the majority of respondents in the UK and in Spain considered that cultural traits and national characteristics did not have an effect.

Of the total respondents under the second survey, some 56% of the UK respondents affirmed that neither the choice of partner nor the success of the collaboration was affected by national characteristics and cultural traits, while 60% of the Spanish respondents said the same for partner choice. Although the degree of certainty among the Spanish was reduced when it came to considering whether cultural and national traits affected the success of collaboration - at this point respondents were evenly divided.

UK respondents were more inclined than the Spanish to identify particular national aspects which affected the collaborative process -

'From my limited experience Germans have a different approach to research, the French always want their own way, the Spanish and Italians are very pleasant but never deliver on time',

'French are necessary to get funds, but are the most independent. Germans most workmanlike',

'Southern EU nations take more than Northern partners in agriculture funds. There is no reason why the opposite cannot be the case for industrial funding',

'Compromises on ideal consortia are made to meet the rules on distribution of funds. French and Italians tend to be nightmare to work with',

Although Spanish respondents acknowledged national differences, they tended to accept such differences as inevitable -

'Partners bring the characteristics of their national markets',

'National characteristics are especially evident at the conception of the project. At the international level, what influences the success of collaboration is the contract between the partners',

'At the national level, competitive interests can either help or block the conception of the project'.

The replies in the second survey thus suggested that both Spanish and UK respondents displayed a strong degree of pragmatism, especially evident among those with a long experience of collaboration. One Spanish respondent suggested that what influenced choice of partners and success of collaboration was 'the competence and prior experience with such partners. Nationality/culture are irrelevant.'

Long experience of collaboration prompted many to the belief that what was important, and more relevant, was common or complementary interests among the partners, rather than national characteristics - *'I believe success is due to the importance of the project to the collaborators and the willingness of the individual participants to achieve success'.* One company with long experience of collaboration, British Aerospace, commented *'British Aerospace has had a large number of collaborative projects with many European and American partners, and not just under the BRITE-EURAM programme, and 'national characteristics' do become apparent in the way companies operate'.*

The overall impression established by this follow-up survey was that those engaged in collaboration recognised the cultural differences which affected the way partners operated, but that these differences were not major difficulties as far as either the choice of partners or the eventual outcome of the collaboration was concerned. But what was important was that partners clarified at the outset what they expected from each other, and from their joint efforts.

Development of a European network was facilitated by the Commission encouraging participants to include users of the technology in the collaborative project. From the beginning of the Third Framework programme gentle encouragement was replaced by exhortation. While it is not easy to establish if a partner is indeed, or will become, a user of the results of joint research, the results of this survey showed at least participants were aware of the conditions and of the need to preserve the market relevance of research results.

But in any event many respondents indicated they intended to go on to commercialise the results themselves, suggesting the market-led motives of many organisations carrying out research. For those organisations, the Commission provision regarding end users seemed superfluous.

Table 6.11 collaboration with end user

	Total	UK	Spain
Yes	117	64	53
No	9	4	5
Don't know	5	n/a	5

n/a: not applicable

On the other hand, many firms do not want to share the results of research effort with potential competitors. For some, the work was still far enough away from the market to need further research and development, which would have to be financed somehow. The first survey suggested that although projects did include end users, this was done to conform to the requirements of the programme, rather than of the research projects themselves. It suggests, moreover, that the European Commission forced this provision as a way of widening the network further, while at the same time aiming to preserve the notion that the programme was market-driven.

Within Europe, a pattern of collaborative alliances has grown under the umbrella of the European Commission programmes, incorporating initiatives such as ESPRIT, COMETT, STRIDE, VALUE, CRAFT, and the EUREKA programme. Table 6.12 shows the extent to which the partners under the BRITE/EURAM programme also take part in this network of technological alliances. Both countries are well represented in all the above-mentioned programmes, with a slightly stronger UK presence in all but the CRAFT programme.

Table 6.12 the European programme network

	Total	UK	Spain
ESPRIT	45	25	20
EUREKA	44	25	19
COMETT	27	16	11
CRAFT	7	1	6
STRIDE	4	n/a	4
VALUE	11	6	5
Other	25	16	9

n/a: not applicable

Spain has achieved a very high participation rate in the CRAFT programme, an initiative within the overall BRITE-EURAM programme, which was launched in 1992 to assist smaller firms that did not have sufficient internal technical resources to take part in the larger programme but wanted, nevertheless, to engage in collaborative research. Under the first phase, a total of 195 projects were approved by the Commission, 32 of which were Spanish projects. By September 1993, one fifth of the total number of firms participating in the CRAFT programme were Spanish.[10] The Commission claimed to have 1200 SMEs taking part in the programme in 1994, most of which had not previously participated in European research cooperation.[11]

The European collaborative network has been strengthened by the creation of a layered structure of alliances that have grown up through the inter-linkage of different programmes both within the Framework Programme, and outside via the Eureka programme. The evidence of this survey lends support to the notion of integration through joint activities among private actors on a cross-national basis, and Table 6.12 shows the degree to which respondents were associated with other collaborative programmes.

Further collaborative activities were conducted through a wider international network, to which many of the participating organisations were also linked. To a significant extent, the organisations most inclined to cross-border collaboration, over whatever spatial distance, were the ones most easily attracted to the European programme. While undoubtedly this inclination was evident in organisations regardless of size, in practice it was easier for the larger organisations, with greater resources and larger markets, to pursue cross-border research collaboration. The CRAFT programme therefore filled a vacuum in the network, which BRITE-EURAM had not been able to do, despite the particular encouragement given to SMEs by the Commission.

In the first survey respondents were asked if their organisations undertook other collaborative research at the international level, with a total of 76% responding in the affirmative (see Table 6.13).

Table 6.13 the international picture

	Total	UK	Spain
Yes	100	56	44
No	24	10	14
Don't know	7	2	5

6.3.3 EC collaboration - motives and organisation

One of the main reasons for transnational alliances has centred around the need to achieve and sustain competitiveness, although it was frequently not identified directly as such by alliance partners.[12] It is, however, a primary objective of the public policies directed at the support of alliances, and the BRITE-EURAM programme is no exception in this regard. Inter-firm cooperation was acknowledged by the Commission as a strategic instrument for medium-term and long-term corporate development in the context of EC programmes.[13]

The complexities of transnational collaboration which were identified in chapter two make formal programmes such as the European Framework Programme an obvious attraction.[14] But public support will not eliminate all the difficulties in a collaborative relationship which often evolves organically and informally.[15]

A key concern of the burgeoning literature that has appeared in the last five years on corporate alliances has been the necessity of situating alliances within the framework of a broader organisational strategy.[16] A variety of competitive pressures have prompted business firms to engage in cooperation, although joint activities also bring their own inherent risks. Alliances are inherently unstable and research has shown that two thirds of all alliances experience problems during the first two years, particularly in aspects such as leadership and finance.[17] International co-operation agreements need a stable legal structure in which the parties are able to formalise the elements of industrial property.[18]

Against this background, respondents to the first survey were asked whether their organisational strategy included collaboration at the European level, and to indicate the degree of strategic significance given to collaborative activity. Table 6.14 indicates the results, with the left hand side of the table showing the extent to which respondents regarded European collaboration as substantial, moderate, or a limited part of the organisational strategy. The right hand side shows the aggregated results for those respondents who also considered international collaboration as an element in the organisational strategy - with international defined as outside the remit of the European programmes.

There is a strong positive relation with European-level collaboration, and international R&D - the results show organisations also had important collaborative links at the international level.

Table 6.14 European and International R&D collaboration

	European			International R&D (UK+Spain)		
	Total	UK	Spain	Yes	No	Don't know
	131	68	63	100	24	7
Substantial	62	28	34	57	3	2
Moderate	37	21	16	30	6	1
Limited	28	16	12	11	14	3
None	4	3	1	2	1	1

Table 6.14 suggests that European research collaboration was a significant element in organisational strategy, and therefore part of the long-term planning of the enterprise. But to obtain a more balanced view it may be advisable to consider other aspects of the way collaboration is organised by the enterprises concerned. For instance, one indication of the potential strength of co-operative ties may be the degree to which other functional areas of organisations are brought into the collaborative project - in particular personnel from marketing, production, and finance.

This would suggest the intention to continue the activities to the commercialisation stage - and mark a degree of integration over the long term. However, the results on this query present a less conclusive picture than that given to the query on organisational strategy. It would seem that while there is some involvement of personnel, other than those concerned with technical and research matters, there is still a functional distinction in the way R&D activities are organised.

There are, however, interesting differences between the two countries as Table 6.15 shows. While both countries included marketing personnel in only 8% of the responses, production and finance personnel were involved to a greater extent by participants from Spain and the United Kingdom. However, the involvement of finance personnel was more important than production personnel in the case of the UK. The reverse applied to the experience of the Spanish participants, with more than twice the number of the Spanish participants opting to involve production personnel. In other words, the UK participants brought the accountants, while Spanish firms brought the technicians.

Table 6.15 involvement by marketing/production/finance

	Total	UK	Spain
	131	68	63
Marketing	11	3	8
Production	30	10	20
Finance	29	20	9
At least two of these	22	10	12
Don't know	45	28	17

The high figures given in the `don't know/no response' category above are explained by the fact that for many participants the collaborative venture was purely a technological one, requiring the efforts and expertise of professionals in that area. A further point to bear in mind is that where respondents were not leaders of the project they tended to concentrate on completing their agreed area of activity, and were not bothered about the involvement of others. This was particularly true in projects with a large number of partners.

Over time collaboration patterns can become more complex, and R&D partnerships may develop into applied research and/or production agreements. The Commission has, in fact, set up mechanisms to enable technology transfer and commercialisation to take place, particularly through the VALUE and SPRINT programmes - as was shown in Table 6.12 above. Overall, the figures indicate only a moderate attempt to link up the collaborate research to the next stage of commercialisation. This is consistent, therefore, with the evidence from the survey presented here which suggests that organisations have some way to go in integrating the capabilities of the organisation into their collaborative activities.

At a very basic level strategy should be directed to maximising opportunity and minimising the risks to an organisation. Much of the efforts of the Commission have been directed at easing the difficulties and the cost of technological collaboration. One obvious difficulty was the risk of losing knowledge to a competitor - the free rider problem identified in economic theory applies with particular resonance to the development and ownership of technological knowledge. The latter determines who has competitive advantage, or at least potential advantage. These problems which could affect the success of collaborative agreements were covered by the Commission encouraging participants to make agreements covering intellectual property rights, and by the setting up of the European Patent Office.

Under the BRITE-EURAM programme all participants are entitled to ownership rights over the results of the collaborative activities in their respective projects. While the participants are encouraged, during the implementation and management phase of the programme, to establish such agreements, many are slow to do so. Various reasons were put forward by respondents for this, sometimes it was simply a case of delay on their part, but other times it reflected either a lack of concern over the value of the results, or a belief that national patent systems would provide an adequate safeguard. Table 6.16 shows the number of respondents who had negotiated intellectual property rights agreements with partners.

Table 6.16 protection of research results

	Total	UK	Spain
	131	68	63
Yes	55	41	14
No	34	15	19
Not yet	36	7	29
Other/no response	6	5	1

Spanish respondents were junior partners in some cases of research collaboration, and were less concerned about the risks of losing the results to competitors. But there was a significant number of participants from both countries that were less concerned about such risks than about the potential benefits that were expected and were slow to avail of the legal protection offered.

It is also true that respondents were of the view that the research being pursued, and the technologies being developed, were not `cutting edge technologies', and they worried less about the threat of rivals. At the same time, when asked if such research would have been conducted in any event, only 9% of the total said yes. Out of the total number of respondents to the first survey, 70 replied that the research would not have been carried out without the support of the BRITE-EURAM programme, while 39 said it probably would (see Table 6.17).

Spanish organisations took a secondary part in the collaborative ventures, in terms of decision-making, division of responsibility and general direction of the collaborative work. Participation did, however, give the opportunity to gain experience of technological collaboration at the European level, and by the beginning of the 1990s Spanish industrialists and their academic counterparts were anxious to take a more direct role.[19]

While the Spanish respondents did not regard intellectual property rights and the risk of losing the results of the research to competitors as seriously as the UK respondents (the participants do in fact take out a patent and a contract is prepared which gives equal access to the results for all the participants), there was a growing concern that results of Spain research was being transferred out of Spain through the country`s participation in this and other programmes - a fact all the more unpalatable with the recognition that the Spanish financial contribution was not balanced by the results of their participation. At times there has been closer linkage by Spanish researchers and scientists with the industrial structures of other countries than with industry in Spain itself.[20]

Table 6.17 would collaboration exist without BRITE-EURAM?

	Total	UK	Spain
	131	68	63
Yes	12	8	4
Probably	39	14	25
No	70	42	28
Don't know/no response	10	4	6

The results here are not conclusive. However, the analysis so far has built up a picture of a pattern of collaboration at various levels - while not in any way giving a clear view of the strength of such alliances. The follow-up survey revealed, however, a majority of the respondents from both countries with long experience of collaboration under the programme who declared themselves ready to undertake further collaborative projects. The second survey presented a more conclusive picture of support for continued collaboration under the BRITE-EURAM programme.

Alliances will continue so long as the benefits to the participants outweigh the costs, at the micro level. This is true also at the macro level involving member states and the European authorities, although obviously the costs and benefits are defined in a much broader sense. To-date, there has been no serious evaluation of the Framework Programme on this basis.

Respondents were asked to identify the benefits from collaborating in the BRITE-EURAM programme, and to rank the benefits in order of importance. The question was asked in the first survey, and in the follow-up survey conducted in September 1995.

Table 6.18 shows the responses to the first survey, giving the positioning for the three most important benefits.

Table 6.18 benefits of collaboration

	Total	UK	Spain
	131	68	63
Interchange of ideas	106	64	42
Early access to technology	102	50	52
R&D costs reduced	88	57	31
Improved competitive position	83	49	34
Larger project/increased funds	77	57	20
Eliminating duplication	72	48	24
Improved product completion	66	41	25
Development of standards	62	42	20
Knowledge of partners products/strategy	62	42	20
Mobility of personnel	54	40	14
Access to customers	49	36	13
Access to suppliers	45	32	13
Protection from foreign competition	44	31	13

It is interesting to note that the technological benefits, such as exchange of ideas, early access to new technology and lower R&D costs are significant for a large number of participants.[21]

In the Spanish case, early access to new technology is rated higher than the financial benefits or the market-related benefits. For the UK respondents, the exchange of ideas was important for nearly all of the participants, while the financial benefits associated with reduced R&D costs or increased funds were relevant for over 80%. The UK respondents also regarded the benefit of collaboration as a way to influence the development of standards, with 62% of respondents including it in their top three compared to 32% of the Spanish participants.

Only 46% of UK respondents considered `protection from foreign competition' in their top three, while only 21% of the Spanish participants did so. Of lesser importance, but nonetheless valuable, were improvement of the competitive position, mobility and exchange of personnel, and access to a supplier network. The variety of the response to this question reflects the different reasons firms have for collaboration - as an element in the long-term technology search or as a solution to short-term or temporary problems.

The responses of the participants highlighted a number of priorities, which are shown in Table 6.19 below. Of the respondents who indicated early access to new technology as the most important 38% were from the UK, while 62% of the Spanish affirmed this. On the other hand, of the total who saw the interchange of ideas as being the most important benefit from collaborating in the BRITE-EURAM programme, 75% were UK and 25% were Spanish.

The evidence suggests that UK participants were more confident of their technological capability, and wished to keep in touch with what was happening generally.[22] This scanning activity would suggest that organisations sometimes place more emphasis on the tactical use of collaboration rather than as part of strategic policy.

A substantial number of UK respondents saw collaboration as a way of reducing the burden of R&D, although they also received financial support from the national government (these include universities which would receive substantial public funding in any event). From the total of 49 respondents who considered reduced R&D costs as the most important, 37 were from the UK and the remaining 12 Spanish.

That finance was an important consideration for the UK participants is confirmed by the response to the `larger project or increased funds' option - the UK respondents considered this to be important, to a much greater extent than did the Spanish participants. As chapter four shows, the UK's position on the public financing of R&D shifted considerably during the past decade. The government persuaded the private sector to carry a greater share of the financial responsibility, while also persuading private enterprise to increase its participation rate in the European Community programmes.

Table 6.19 benefits of collaboration - rank order

	UK	Spain
1	Interchange of ideas	Early access to new technology
2	R&D costs reduced	Interchange of new ideas
3	Larger project	R&D costs reduced
4	Improved competitive position	Eliminating duplication
5	Early access to technology	Improved product completion
6	Eliminating duplication	Improved competitive position
7	Development of standards	Larger project
8	Improved product completion	Knowledge of partner strategy
9	Access to customers	Access to customers
10	Knowledge of partner strategy	Development of standards

To summarise, Spanish participants anticipated technological rewards from the BRITE-EURAM programme, whereas the UK respondents considered a broad range of competitive factors, including an improvement of the overall competitive position, better chance of product completion, and the opportunity to influence technical standards.

There is no doubt that the participants brought to the European collaborative programme expectations that reflected their national experience and context. For Spanish participants, coming from a less mature national technological system and eager to establish the competitive position of Spanish industry in the European market, research and technical advance was an important means of securing such aims. UK participants were more confident of their own technical capability, but saw in the programme a way to keep abreast of more general developments in European policy, in competitive changes, as well as an additional source of funding for research.

Has collaboration changed participants views of the benefits to be obtained from the programme? The follow-up survey attracted 53 responses from the UK and 40 from Spain, giving a lower response rate than the first survey three years earlier. Both national groups had a number of years experience of collaboration, 70% of the UK group and 65% of the Spanish respondents with six or more years. None of the UK respondents had less than two years experience, while four out of the forty Spanish respondents had between one and two years experience of European collaboration.

Several observations emerge from the perceived benefits of collaboration, in the light of this second survey. Interestingly, there was a consensus among both national groups as to the principal benefit - that of the interchange of ideas. The top two priorities, interchange of ideas and reduced R&D costs, were nominated by a significant number of both the Spanish and UK participants. While UK respondents did not change their view on the three main benefits, although the ranking of the second and third was reversed, there was a significant change in the attitudes of the Spanish participants regarding the technical benefits to be obtained from the programme. Early access to new technology, ranked number one in the first survey, was ranked fourth in the follow-up survey.

Also of interest, both groups ranked improved competitive position in the top four, even though a later question on the impact of the programme on the competitive position of European industry produced a very mixed, unfavourable response. It seems that perceptions differ, depending on the perspective taken. From an individual viewpoint taking part in the programme must, or ought to, improve the competitive position of the participant, yet from the general perspective of industry, there is no appreciable improvement. The attitude of the individual participants seemed to be `if you are not in, you can't win.'

The result here is somewhat contradictory, but may perhaps be explained by the often subjective perception and interpretation of competitiveness. While the 1993 evaluation of the BRITE-EURAM programme suggested there was a positive contribution to the competitiveness of European industry, in terms of the direct effects such as market share, and the indirect effects (technology transfer, cohesive networks, improved internal knowledge and better organisational effects), the European Commission report on Science and Technology indicators for 1994 pointed to the lack of clarity pertaining to the definition of competitiveness - 'the evaluations of some of the more industrially orientated Community research programmes have touched on the contribution of such programmes to industrial competitiveness. However, it was recognised that both the meaning of competitiveness and the part that R&D can play in increasing competitiveness were not well understood' (p.257). Chapter one gave some indication of the variety of approaches to the concept, and suggested that emerging definitions favoured a dynamic view so that firms must continually pursue a constantly moving target in order to sustain competitiveness.

Therefore firms must engage in a process of behavioural change across the whole range of their activities, complementary to the collaborative activities under the European R&D programmes. For smaller firms without the internal capability and knowledge to do so, there will inevitably be a gap between expectations from the programme and the eventual outcome - as was indicated in the impact study evaluating the experience of Spain under the Framework Programme. Moreover, the effects of closer links between industry and universities can take time to emerge, particularly where such collaboration must nurture a whole new culture of cooperation among previously disparate groups - particularly so in the case of Spain.

In the meantime, the prize seems to be a combination of the financial inducements offered under the programme, and a more nebulous benefit of being at the centre of things, knowing what is happening, and remaining involved in an ill-defined competitive process. Ill-defined, because neither group rated in the top six more market-related commercial benefits such as improved product completion, or access to new customers, or to a supplier network. Table 6.20 shows the ranking of benefits, giving the top six, from the follow-up survey conducted in September 1995, with the original ranking from survey one given in brackets.

Table 6.20 SURVEY II - benefits of collaboration (previous ranking in brackets)

UK

1. Interchange of ideas (1)
2. Larger project (3)
3. Reduced R&D costs (2)
4. Improved competitive position (4)
5. Eliminating duplication (6)
6. Access to new technology (5)

Spain

1. Interchange of ideas (2)
2. Reduced R7D costs (3)
3. Improved competitive position (6)
4. Access to new technology (1)
5. Larger project (7)
6. Eliminating duplication (4)

6.3.4 technology networks and integration

This section examines the extent to which the BRITE-EURAM programme has contributed to, or laid the ground for further integration. One measure of the success of EC research programmes in laying the foundations for a more integrated European industry could be the extent to which new intra-European partnerships are likely to form as a result of the learning experience of programme participants.[23] To what extent has the programme developed trust at a number of different levels? - at the organisational level in terms of confidence in its own ability to benefit from further collaboration, at the European level in terms of trust in the policy-making capability of the European Commission, and more generally in the benefits to economic actors of further intra-European technological collaboration.

Why should firms and other organisations wish to pursue further collaboration? While there is no doubt that a recognition by all parties of the potential gains to be secured from such a course of action is a general prerequisite for continued collaboration, this, alone, does not clarify the specific requirements needed to ensure success. Reference has already been made to the organic nature of collaboration, and it is this gradual process which contributes to learning by the organisation.[24] The experience of successful collaboration, where all the parties have a positive perception of either qualitative or quantitative gain, establishes an important precondition for continued co-operation.

The results of the first survey indicated that 71 out of the total of 131 respondents took part in the BRITE-EURAM for the first time, 32 from the UK and 39 from Spain. In most cases, however, research collaboration was focused on activities which they had previously carried out independently, rather than being a new departure (see Table 6.21).

Table 6.21 'Europeanising' the research activity' (Survey1)

First BRITE-EURAM project			Prior activities	
	UK	Spain	UK	Spain
Yes	32	39	48	32
No	33	23	17	20
Don't know	3	2	3	11

According to some studies, successful collaboration comes from established relationships which have evolved through careful nurturing.[25] Parties learn to co-operate, and this leads to the expectation of further collaboration.[26] In this case, respondents were asked whether they thought the initial participation would improve their ability to engage in collaborative activity in the future, and the question was posed again in the second survey. Table 6.22 presents the initial response made under the first survey to this question.

Table 6.22 improving collaborative ability

	UK	Spain
No	3	2
Slight improvement	43	20
Major improvement	17	32
Don't know	5	9

This time around, fewer people said participation did not improve collaborative ability. Overall, the responses indicated that participation in the programme had improved the collaborative ability, although the improvement was not in general regarded as a major one. The lack of change in the number of respondents regarding a major improvement from collaboration may be explained by the comment of one respondent, `we already collaborate significantly so improvement will be slight'. Hardly anyone considered it had made no improvement, and those who were unsure the last time around were now prepared to consider some slight improvement. In general, respondents were willing to consider collaborating under the BRITE-EURAM programme again, and a significant number would collaborate with current partners. None of the respondents rejected the possibility of future collaboration under BRITE-EURAM, while participants in the two countries expressed similar levels of satisfaction with their current partners (see Table 6.23).

Table 6.23 considering future collaboration (Survey 1)

	in BRITE-EURAM		with current partners	
	UK	Spain	UK	Spain
Yes	59	44	51	43
No	n/a	n/a	8	6
Don't know	9	18	9	14

n/a: not available

The question was repeated in the second survey. Again, none of the Spanish respondents said they would not consider taking part in a future programme, while two of the UK respondents said they would not consider a future BRITE-EURAM project as `it was not worth the effort.' By far the majority of respondents in both countries said they would collaborate again with current partners, although there were reservations `with some of them' or on the basis that there was `an appropriate exploitation and marketing plan'.

The role of the Commission has been acknowledged to have been particularly important, directly and indirectly in enabling the SMEs to develop collaborative activities.[27] At the simplest level, the committees, review groups, and workshops and information days organised by the Commission allowed the participants to make contacts and develop cooperative relationships.[28] Indeed, many of the respondents indicated that the information days offered them the opportunity to make contacts, and identify new partners.

At the same time the bureaucratic requirements associated with making applications for support, and for managing the collaboration over the lifetime of the project was perceived by the participants as one of the main problems associated with collaboration. Together with problems of finding the right partners, and managing the different expectations among collaborative partners, the bureaucratic requirements accounted for the most important problems identified by participants in both countries.

Different expectations among the partners was a more significant problem for the UK participants than for the Spanish. The substantial support and involvement of the Spanish national authorities, in particular the CDTI and the CICYT, provided a way of ironing out many of the problems and uncertainties which participating enterprises encountered. UK participants did not have this support, and tended to enter projects with much higher expectations.[29] This was confirmed by the responses to the issue of deciding where to locate the collaborative work, and the risk of results going to competitors.

Table 6.24 problems of collaboration - % of respondents Survey 1

	UK	Spain
Administration/paperwork	88	68
Finding right partners	71	62
Different expectations	76	41
Intellectual property rights	66	29
Absence of skilled personnel	57	29
Language problems	50	33
Fixing location of collaboration	46	35
Greater risk of results going to competitors	54	25

In the second survey, respondents were asked to identify the problems in collaborating. In general, administration and finding the right partners proved to be ongoing problems, despite continued efforts of the Commission to deal with them. In the past three years, the Commission has attempted to speed up the application and administration process, and has established data bases with details of organisations interested in research and technological collaboration.

Respondents were again asked to rank each problem. If each ranked problem is selected according to the number of respondents who identified it by that particular ranking then a slightly different result appears for the two countries. Taking this approach, the outcome (for the top four only) is as follows:

SURVEY II

UK	Spain
1. Administration	Different expectations
2. Language	Right partner
3. Different expectations	Location of work
4. Absence of skilled personnel	Absence of personnel

This outcome throws light on the specific problems that arise for collaborative actors operating in a particular institutional setting. The principal problem for UK participants continues to be that of administration, highlighting also the different approaches taken by the two governments towards assisting domestic organisations to operate at the European level. The principal problem for Spanish participants that emerges from the second survey is that of different expectations on the part of participating organisations, marking a growing maturity for participants in cross-border collaboration as they seek higher returns and benefits from the programme.

Spanish organisations have, with a few exceptions, still to make significant inroads into the collaborative process, and particularly in terms of leading the projects, or at least taking a senior role. The tendency to treat Spanish participants as junior partners has been criticised by leading academics in Spain, and also by the respondents in this survey.[30] As junior partners, Spanish organisations `receive less of the work, and fewer funds'. In addition, many of them remain convinced that the programme is still biased towards large projects and large firms with the requisite resources to carry out the work, therefore discriminating against the typical Spanish firm. In the words of one Spanish respondent `the programme is almost inaccessible for SMEs',

The absence of skilled technical personnel was highlighted as a problem in collaboration by both groups, often to the extent of preventing organisations from conducting the tasks allocated under the project contract. Although the number of researchers in Europe has grown over the past decade, including the number of researchers in industry, the growth has not spread evenly over countries or industrial sectors.[31] The importance of highly skilled technical staff as a factor in competitiveness has been recognised in recent years,[32] and a sufficient supply of qualified personnel remains an issue for both countries.[33]

The strength of opposition to the Commission's administrative requirements was reflected in the response made by participants to the question how the Commission could provide more assistance. Over half the total respondents wanted an elimination of the delays in dealing with applications and accepting proposals. However, some 66% of the respondents considered that more funding from the Commission would offer the best assistance, and only 15% sought more direct involvement in managing the collaborative venture.

The results shown in Table 6.24 suggest the general preference is for a hands-off approach to collaboration by the Commission, once the partners have been found and the project commences. The participants do, however, regard the Commission as having the capability to counteract the difficulties of international technology collaboration that were identified in chapter two. Risk management and risk reduction are necessary roles, which the Commission can play to a more effective degree than national authorities.

Table 6.25 how the Commission can help

	Total	UK	Spain
	131	68	63
More funding	87	44	43
Eliminate delays	68	44	24
Information on partners	39	15	24
Direct involvement in management	20	5	15
Help with standards	17	7	10
Other	17	16	1
Don't know	4	3	1

In the follow-up survey, the results showed a striking similarity with those produced in the first one, with greater financial support and the elimination of bureaucratic delays nominated by the majority (two thirds in both cases) of the respondents from the two countries.

Financial considerations were identified in chapter two as being of significance in decisions to engage in collaborative technological development. The rising cost of creating new technological knowledge, combined with the need to sustain a competitive advantage has prompted firms to conduct joint efforts, even at the risk of losing competitive edge to rivals. In practice, many organisations considered the risk from rivals to be offset by the advantages of cross-border collaboration. The evidence presented so far suggests that participants were willing to continue with European cooperation, even when they questioned the contribution of the programme to competitiveness and innovative capability. Does this inclination by micro-level actors towards the European level mean, therefore, a shift away from interest representation at the national level?

6.4 Collaboration in the national context

For individual actors, the financial incentive was an important element in the decision to participate in European collaboration programmes. One of the principal ways that the Commission could further such collaboration at a practical level, according to the survey, is through providing greater financial support. Individual actors displayed a general acceptance of the international competitive pressures, and of the position of technological advantage in meeting these pressures.

It is true to say that such economic concerns allowed for a consensus among the micro-level actor, a converging of belief in the advantage of European technological collaboration to them individually, while at the same time acknowledging that the BRITE-EURAM programme budget, and the Framework Programme in general represented no more than a drop in the ocean as far as dealing with the broader technology and competitiveness gap facing European industry.

The business community's apparent acceptance of the European Commission's political rhetoric on industrial competitiveness and technological collaboration was evident through its participation in the European programmes. But, equally apparent in the results of this survey, the business community did not shift all its political representation to the European level.

The national level remained important as a focus of political representation, and as a source of financial support. It was this national context which influenced the form and extent of `europeanisation' of the micro-level actors. National technology policies could support, or in some cases force, collaboration at the European level.

National authorities contributed to the R&D costs of many of the participants, with a total of 79% affirming that they received national support. From this total, 82% were from the UK and 75% of the Spanish participants received national funding. Table 6.26 shows the extent of the national contribution to research costs.

Table 6.26 national contribution to R&D costs

% of R&D	% of total respondents UK	Spain
31-50%	9	11
21-30%	10	10
15-20%	9	10
10-14%	12	5
5-9%	10	11
< 5%	13	24

The amount of financial support by the national government was not substantial in either country, but then neither could it be said that one source of financial support was tending to displace the other.[34] In the UK, the government has been trying to encourage the private sector to fund more of the research and technology effort. The Spanish experience reflects a mix of the country's historic dependence on foreign investment and research, and the split between the industrial and academic sectors in the provision of research.

Respondents were asked to identify what proportion of R&D costs was covered by EC funds. Out of the 131 who replied to the first survey, some 32 indicated that EC receipts covered between 31% and 50% of the R&D budget, while 27 said it was less than 10% (see Table 6.27 below). It is difficult to get a precise picture on this, and many people involved in collaboration may not have complete information on their organisation's European collaborative activities, particularly given the trend towards greater decentralisation of organisational activities.

Table 6.27 EC financial contribution to organisation's R&D costs

% contribution to R&D budget	Total number of respondents		
	Total	UK	Spain
31-50%	32	11	21
26-30%	11	4	7
21-25%	9	6	3
16-20%	6	4	2
11-15%	13	8	5
3-10%	27	13	14
< 3%	23	15	8

The follow-up survey asked participants whether they considered Community technology programmes and national technology programmes to be complementary, independent, similar or overlapping. It further asked if national programmes facilitated the participation in Community programmes.

Certain national differences emerged from the responses to the second survey. In the Spanish case, 60% of the respondents considered national and Community programmes were complementary, whereas just under 40% of the UK respondents thought so. Half of the Spanish respondents thought that national programmes facilitated the participation in European programmes, whereas only 20% of the UK responses did. A significant number of the UK respondents, 40%, considered that national programmes were independent of Community programmes, with 25% of Spanish respondents saying the same.

Despite the growing integration of many of these organisations into the European network, and their support for a continuance of European-level programmes, there is no indication that they consider European programmes should replace national initiatives.

At the national level, the organisations contacted through the first survey were already enmeshed in a domestic web of collaboration quite apart from their European collaborative activities, as Table 6.28 shows. Here again, certain national institutional features were evident. The UK domestic collaborative pattern was one which reflected long-standing activities between all the groups associated with research and development in both the private and public sectors, including closer industry-academic relations. The latter had its roots in the mission-oriented technological system of the 1960s, and provided industrial and academic organisations with the necessary learning upon which to base fruitful cooperation.

Table 6.28 pattern of domestic collaboration

	Total	UK	Spain
	131	68	63
Business firms	81	52	29
Research centres	90	47	43
Universities	93	59	34
Other/don't know	14	4	10

In the Spanish context, collaborative research and development was more likely to take place among the research centres and universities, with the research centres particularly favoured. Universities tended to operate with a very traditional view of the proper role of a university, and this was reflected in their preference for basic science over applied and industrial research. As chapter five shows, universities still obtain much of their finances from central government, and have not faced the same financial and strategic pressures imposed on their counterparts in the UK, hence they have not made the same degree of effort to work with industry. At the same time, the historical dependence on imported technology or foreign direct investment meant there were areas of industry that had not taken the necessary steps to develop technological potential, and which would inevitably have taken them into closer contact with the universities.

Nevertheless, domestic collaboration was regarded generally to be of significance to overall research and development efforts in both countries, as Table 6.29 shows. The responses show a degree of coincidence between the two countries perceptions' of domestic collaboration. The pattern for the UK was one of greater inter-firm collaboration, although industry-academic collaboration is also common.

Table 6.29 significance of domestic collaboration (% of respondents)

	UK	Spain
Substantial	43	37
Moderate	38	29
Limited	16	24
None	3	8

The evidence from Table 6.29 above, together with the views elicited through the follow-up survey, does not suggest that European level collaboration is slowly supplanting technological collaboration at the domestic level. But of particular interest was the limited involvement in European technological collaboration by interest groups or trade associations in both countries. The pattern that emerged from this study was of a large number of participants already established in networks, or anxious to become part of a collaborative network. From the total number of respondents to the first survey, only 18% indicated their decision to collaborate was influenced by trade associations or interest groups.

Interest groups are frequently more active in areas that are perceived to have an adverse impact on the interests of their members, and particularly in policy areas of a regulatory nature. There was no suggestion that European collaboration programmes were so perceived. At the level of domestic interest representation, there was little evidence of activity by industrial or sectoral interest groups in the formulation of the European technology programmes, so that the European Commission was left free to develop its own approach towards integrating the industrial and technological community.

The limited influence of organised interest groups is suggested by the number of respondents who indicated that they were not influenced by trade association or sectoral interest groups to collaborate in the programme - 99 out of a total of 131. The Spanish respondents were more influenced by trade associations than those from the UK.

Table 6.30 role of interest groups in EC programmes (Survey 1)

	Total (%)	UK (%)	Spain (%)
Yes	18	13	22
No	76	84	67
Don't know	6	3	10

The follow-up survey asked whether trade associations and sectoral interest groups should play a more active role in the formulation and management of the BRITE-EURAM programme. A majority of the respondents from both countries, 52% in Spain and 58% in the UK were not in favour of this involvement. A number of reasons for this preference emerged from the responses and views of participants. For one thing, there was the fear that greater involvement of interest groups at either formulation or management stage could only add to the bureaucratisation, slowing down the implementation of the programme. Many of the respondents did not believe that their interests could be accurately represented by interest groups, and preferred to approach the Commission directly. This was particularly true in the case of the UK respondents. However, a number of respondents indicated that they would like to see greater interest group involvement in the formulation of the programme.

From the beginning, this vacuum in the political process associated with the European technology policy had been filled largely by IRDAC, and more immediately by the various arrangements developed by the Commission to assist the development of European collaborative alliances, including the information days, workshops, data bases and other means. In other industrial areas sectoral representation has significant impact, notably in information technology, telecommunications, and biotechnology. However, in this particular case, the policy covered such a broad range of activities affecting a number of sectors that sectoral representation was much less feasible.

6.5 Conclusion

How has the experience of collaboration changed the participants? It seems reasonable to conclude that a degree of economic integration has occurred through BRITE-EURAM and the other initiatives under the Framework Programme. During 1994 alone, a total of 706 new projects were signed under the BRITE-EURAM programme, involving 1836 participants.[35] The programme claimed in that year by far the largest number of projects and participants among all the industrial collaborative programmes. Can we conclude from the evidence that economic actors are transferring their expectations and demands to the central authority, in this case the European Commission?

The answer to this question is not such a straightforward one. The European Commission has played an important role in developing and managing an ever-growing network of European alliances, a fact which has been recognised by the organisations involved in such alliances. It provided both financial and non-financial resources to support a range of activities that are generally recognised to be complex and risky.

A stable legal structure was established which governs the various elements of international cooperation, including ownership of industrial property rights. This is an important requirement in international cooperation agreements, and one which cannot be provided under the national legal institutional framework.[36] The contract which governs the collaborative activities of projects provide the contracting parties with the ownership of the results.

The consistent emphasis on competitiveness in the development of the EC technology programme, and particularly the BRITE-EURAM programme, meant that the development and refinements tended to be designed to meet the needs of the economic actors. A frequently mentioned concern has been Europe's poor level of innovation and the inability to commercialise research results. This has been a problem for many individual countries, even those with high levels of R&D spending and the volume of research to match it. In the memorandum, Towards a European Technological

Community, issued in 1985, the European Commission promised to deal with these issues through the creation of a European technological community, thus encouraging expectations among the industrial community that it would deliver innovative, commercial capability.

The Commission response has been made at several levels. At one level, it has encouraged the participation of potential users of the new technology in the collaborative venture, and Table 6.14 shows the general success that has been achieved in the case of the BRITE-EURAM programme. Arrangements made by the Commission to link the participants into related initiatives which promoted technology transfer and commercialisation (for example SPRINT and VALUE) also typified this concern with the needs of the market.

Actual programme management by the Commission served both as a way of counteracting the complexity and risks associated with cross-border research collaboration, and of bringing more organisations into the collaborative network. The Commission workshops, information days, data bases, and legal framework formed part of an enabling framework which national authorities could not offer, and which were necessary to the promotion of research and technological cooperation in a secure and stable environment.

Taking part in the programme gave the participants opportunities to develop technological knowledge, but also to develop collaborative ability - an important aspect in the post-Fordist, globalised production system where cooperation among firms has become commonplace, and often the key to the rapid technological and demand changes facing industries. The follow-up survey indicated that over 80% of the total number of respondents had attended one or two of the information days organised by the Commission, while over half of them made regular use of the Commission data base. Less than 10% of the total considered that the information provided by the Commission for participants was inadequate, 50% of UK respondents and 55% of Spanish respondents thought it was adequate, with the rest classifying it as good. In chapter one, it was suggested that the notion of loyalty, used in the neo-functionalist analysis of the political process, was an inappropriate concept to apply to economic actors that operate in an increasingly globalised economy. Instead, borrowing from the literature on collaborative technology networks, the development of trust between the partners is a precondition for the success of what is by nature a long-term arrangement.

European collaborative programmes provided a framework under which such long-term arrangements could be fostered and through which the participants could build up trust. As the previous section 6.3.4 indicated, participants were willing to continue collaboration with their current partners. However, the existence of a transnational collaborative network of diverse participants does not by itself guarantee the output of qualitative research through the network; many of the members may play only superficial roles, thus limiting the beneficial spill-over effects, and the innovation effects. In the case of the European Community programmes this possibility may have acted as a limiting factor on the long-term integrative potential, as well as having little real impact on the level of the new technology.

Did such trust extend to a regard for the political authority of the European Commission? The European technology programmes were seen by economic actors as being a necessary response to the threat of international competitiveness, and the Commission was regarded as the appropriate authority to develop policy. However, the evidence from the survey does not suggest that expectations are being directed solely towards the central authority in Brussels. Instead, there has emerged a more complex set of expectations, some directed at the Commission, and some towards the national government.

The duality of the expectations stem from the actual nature of the collaborative experience involving the other partners, from the perceptions of the political process in which technology policy-making is developed, and from the role played by national authorities. The views and opinions expressed by the respondents, some of which are quoted in this concluding section, reflect this combination of actual experience, political process, and national institutional framework.

Inevitably, cross-border technological collaboration has been more fruitful and productive for some of the participants than for others. Prior experience of collaboration, and the expectations about the actual benefits to be obtained were influential, as was the extent of technical expertise available, and the project management and nature of work undertaken by the collaborative team.

Long-term collaborative research was not generally favoured by participants, as funding might not be available to continue the work. As the British Aerospace respondent commented:

`one should not look on BRITE-EURAM as replacing strategic research. Projects are generally ad hoc selections, there is no systematic approach to the final goal. Programmes (ie. projects) are short-term with no guarantee of follow-up funding. In fact the existence of previous projects tends to count against you. What has happened on a number of our BRITE-EURAM projects that have been successful in themselves is that no follow-up funding could be obtained, the work has consequently lapsed and therefore the projects have been suspended. Ultimately there was no advantage since we have been unable to move them forward to the stage where we can take advantage. The `lottery' of proposal selection is no replacement for a decent long-term strategy.'

One respondent held the view that motivated end-users were key to success, but considered that the lack of financial support for exploitation was a big problem, recommending *`do not make EU contract research part of your core business. Only participate in projects directly relevant to the core business.'*

Participants were particularly concerned that the programme should support more applied research, and that the programme, or the Commission, should give greater support to the commercialisation of results. There is clearly an expectations gap here, since the Commission has always claimed the programme to be market-driven, yet it has also been constrained to support only pre-competitive research. Going beyond this, to support exploitation raises questions concerning not only the authority of the

Commission but also the legitimacy on which it has operated since the technology programmes commenced. Also, there is the question as to how, properly, to support exploitation - it is the choice of organisations themselves as to whether to use results, and the Commission has confined itself to a publicising role as far as research results have been concerned.

A number of Spanish respondents pointed to the impact of the collaborative experience on national firms, particularly in terms of creating a '*European culture*' in the organisation, learning to work in an international group, and '*reducing the inferiority complex of Spanish industry*'. But they were more sceptical than in the first survey about the technological benefits, and considered there was an imbalance as far as the country was concerned. The programme had not reduced '*the technological differences between countries or between large and small firms*'.

There was a widely held view among Spanish respondents that the programme was not suitable, or accessible for small firms, and that it favoured to a greater degree basic research appropriate to large projects. Moreover, there was a belief that the uncritical government support for integration had left small firms without adequate interest representation, '*the abandonment of national plans in favour of the EU deprived SMEs of R&D help. The administrative details are overwhelming, and the number of approved projects too low. It is difficult to see how pre-competitive projects can help competitiveness*'.

Project selection came in for a lot of criticism from both national groups, and the view of it as a lottery was widely shared. There was, said one respondent, '*a need for a better understanding of the European decision-making process, and for greater complementarity between national and European programmes*'.

The political process appeared to many to lack transparency. For one respondent '*the selection criteria, and the selection process needs to be more open and better defined. Nobody really knows who makes the decisions and some odd choices are made. There should be much more effort made to actually apply the results in practice under real* *conditions ie. more `D' in the R&D'.* Another respondent said of project selection *`this appears to be a lottery due to the social, economic and political aims which are equally weighted to the technical potential. The proposal assessors are often inexperienced or plain wrong. Experts in a given field are required but any group must be prevented from dominating a particular field'.*

The lack of transparency in the political process prompted many to the view that national government needed to be involved so as to protect the interests of national firms. For them, national identity does matter, and Europe is not just one area defined by its outer boundaries. Indeed the need for national government involvement was widely held among both groups. Many of the UK respondents were critical of the position taken by the government, and of the view that a more competitive position should be taken. From one, *`national government should make a bigger effort to support British businesses who are trying to participate in BRITE-EURAM. Currently the support received is minimal'.*

Others suggested more government representation in Brussels to keep track of what was happening, and for the UK government to take a much more active role in the formulation of the programme so as to ensure that national industrial interests were catered for. Again, there was a keen appreciation among both groups regarding the level of support for research in other countries, and a feeling that their own government lagged behind *`in terms of the way French government looks after industrial interests'.*

Thus, in a spirit of competitive rivalry, economic actors directed expectations towards the national authorities in the two countries surveyed. As one UK respondent commented *`do not expect EU research programmes to substitute for a decent, national policy on applied research'.* Another said *`because the current level of funding of national programmes in the UK is pathetically inadequate so there is no choice but to look for EC support. National government should look for a level playing field. The UK government is too strict in the application of rules re other countries. It shouldn't use EC as only option to get out of supporting UK industry'.*

For the Spanish government, '*the lesson is to judge the return on investment*'. It should, said one respondent, '*note the help other governments give national firms*'. A number of the Spanish respondents were concerned that the programme did not adequately reflect industry needs. It was '*still too far removed from applied work, and needs more participation from industry*'.

To conclude, the evidence from the survey showed that there was not so much a transfer of loyalty from the national level to the supranational as a sustained multi-layered approach contingent on the strategies of the participants, the national systems of innovation and political structures, and the prevailing cultural environment.[37] Interest representation has changed somewhat from the way it was viewed by the early neo-functionalists, with groups and parties having different capabilities to exert influence at national or supranational level. Observation of the developments under the BRITE-EURAM programme would indicate that the influence exerted by interest groups has changed considerably, and that the nature of the political pressure exerted depended on the structure within each of the countries under consideration.[38]

Organised business interests were less influential in the development of the programme,[39] or in harnessing the support of the participants. The political process which the European Commission had put in place, including the Industrial Research and Development Advisory Committee, the widespread net of technical advisors, and the claimed bottom-up approach to what was supposedly a market-driven programme, was not adequate to ensuring that the interests and expectations of economic actors were being met. Perhaps somewhat ironically, the globalised nature of economic activity, and the competitive and technological pressures force a reappraisal of the role of national government in representing domestic interests. This is true particularly as regards technological matters since many such issues related to technology and innovation stem from national institutional systems.

Domestic technological collaboration continued to be an important part of organisational strategy in the two countries surveyed. But the general absence of organised business interests in the political process of European technology policy-making, or at the very least its minimal input in both the UK and Spain, ensured that the business community retained belief in the role of the national authorities.

The dichotomy identified earlier, a belief in the benefits of the European policy at a very individual level combined with a lack of belief in European policy to contribute more generally to competitiveness, found a broader reflection. This was in the dichotomy based on functional and political interests. By broadening the European network the European Commission was not only building up political support at the European level, but also extending the net to include those who did not feel represented by the process that the Commission was developing, and who therefore wanted to retain more national representation.

The degree to which functional links eventually lead to spill-over will be influenced by the political processes at the national as well as the supranational level, and the perceptions and activities of government and non-government actors at the national and sub-national level have a part to play. The following chapter considers the nature of the political processes operating at both the national and the supranational level, and evaluates the extent of interaction between them. In the European integration process there is no guarantee of close interaction between hierarchical interests, but it may be possible for the European Commission to mediate between interests. But, as the concluding chapter of this thesis argues, mediation by the supranational authority alone cannot secure an ongoing process of political integration.

Notes to chapter six

1. Leon N. Lindberg, The Political Dynamics of European Integration (Stanford, CA: Princeton University Press, 1971); Ernst B. Haas, The Uniting of Europe ; Political, Social and Economic Forces, 1950-1957 (London: Stevens, 1958). Under the theory, a transfer of loyalty was encapsulated in political spill-over. Elites recognised the greater potential of the supranational authority to meet their needs and redirected their expectations to the centre. Lindberg focused his analysis on the learning process of governmental elites, while Haas examined the behaviour of non-governmental elites such as trade associations.

2. For instance, Andrew Moravcsik, 'Negotiating the Single European Act : National Interests and Conventional Statecraft in the European Community' in International Organisation, vol. 45 (Winter 1991) p. 45, who argues that business interest groups organised on a transnational basis were not as influential in the 1992 initiative as the national governments. Wayne Sandholtz and John Zysman '1992: Recasting the

European Bargain' in World Politics, vol. 42 (October 1989) pp.95-128 argue that the programme represents essentially a bargain between the different protagonists.

3. David R. Cameron, 'The 1992 Initiative: Causes and Consequences' in Alberta M. Sbragia (1992) Euro-Politics [The Brookings Institute, Washington, DC], p.49.

4. Ibid., p.49.

5. The original list, amended to take account of information received with the first survey, was used for the follow-up survey - although not all the original list had replied. The same reference number system was used to identify the questionnaires, including those that were returned. This was also useful in order to make several follow-up telephone calls, to clarify comments or elicit further information.

6. To some extent, this difference in the approach adopted by the two governments reflected distinct philosophies as to the role of government in the private sector. While the UK government was busy rolling back the boundaries of the state, and reducing the bureaucratic and administrative arrangements associated with government-business relations, the Spanish government continued to retain a firm hand in the management of industry - although it was forced to take a step in the direction of neo-liberalism. The relative inexperience of much of Spanish industry in dealing with the Brussels machinery persuaded the government to maintain a directive role.

7. The Centre for Industrial Technological Development, in the Spanish Ministry of Industry, provided a covering letter of introduction to be sent with the questionnaires. The UK counterpart at the Department of Trade and Industry was unwilling to provide a similar letter, on the grounds that 'we don't do that sort of thing'.

8. There was a poor response to the first survey undertaken in 1992 from research centres and universities in Spain, while the response from the UK counterparts was very good. The poor response from the Spanish universities appears to be due to a number of factors - the questionnaire was issued in late August and replies were received over the following two months, possibly overlapping with the Spanish academic holiday. In some cases the Spanish participants were not project leaders, and may have been unwilling to reply. A number of interviews were conducted with representatives of Spanish universities, who attended a workshop organised by the European Commission for BRITE-EURAM participants in Seville in May 1992.

9. The Commission has shown a preference for supporting the Southern European states over the past few years, particularly when it comes to financial aid. Projects which favoured these areas were often considered more likely to receive financial aid.

10. Ministerio de Industria y Energía (1993) Informe Sobre la Industria Española [Madrid], p. 466.

11 BRITE-EURAM II 1994, CRAFT and Feasibility Awards - project synopses, preface. EUR 15963 EN (CEC, 1994).

12. See Philippe Gugler (1990) Strategic Alliances, Competitiveness and Government Policies [Graduate School of Management, Rutgers University; also Gugler (1992) Building Transnational Alliances to Create Competitive Advantage. Long Range Planning, vol.25, no.1; F. Sachwald (1994) European Integration and Competitiveness. Acquisitions and Alliances in Industry [London, Edward Elgar].

13 .CEC (1991) Key Factors for Industrial Partnership in EC programmes, p.28 [MONITOR/SPEAR, EUR 13991 EN].

14. Wim G. Biemans (1990) The Managerial Implications of Networking. European Management Journal, vol.8, no.4. The author suggests that collaboration demands ongoing management of the activities, and a clear articulation of the expectations of all concerned, testing the managerial capabilities beyond that required in other functional areas.

15. Hakan Hakansson (1990) Technological Collaboration in Industrial Networks. European Management Journal, vol.8, no.3.

16 See, for instance, Sabine Urban and Serge Vendemini (1992) European Strategic Alliances. Co-operative corporate strategies in the new Europe [Oxford, Blackwell]; Alan Rugman and Alain Verbeke (1991) Research in Global Strategic Management, vol 2 [London, JAI Press Inc].

17 Chrisotoph Bronder and Rudolf Pritzl (1992) 'Developing Strategic Alliances: A Conceptual Framework for Successful Co-operation', European Management Journal, vol.10 no.4, p. 419.

18 Urban and Vendemini, op. cit., p. 220.

19 . There was a strong view in Spain, particularly among the professional researchers and academic observers, that Spain should only take part in these programmes if it had a more front-line position - see M. Paloma Sánchez, op. cit., p. 47.

20 . This is a problem for technological development and innovation in Spain, and has prompted the Spanish government to introduce measures to try to address the gap between industry and the academic world. Chapter 6 examines what has been done to date.

21. A draft questionnaire was tested on a small number of participants attending a workshop organised by the Commission in Seville, in May 1992. It contained all the questions that were eventually used for the survey, but the benefits were listed on the draft questionnaire in a different order, with a number of more market-related benefits placed at the beginning. The reponses, however, showed a preference for the technological benefits and were similar to the findings presented here.

22 . This scanning activity was identified as a motive for collaboration by David Charles and Jeremy Howells (1992) Technology Transfer in Europe. Public and Private Networks. [London, Belhaven Press].

23 . Michel Delapierre, Jean-Benoit Zimmerman, Towards a new Europeanism: French firms in strategic partnerships, ch. 5 in Mytelka (1991).

24 . The notion of a gradual learning process which results from collaboration is identified by Alan M. Rugman, Alain Verbeke, Research in Global Strategic Management. Global Competition and the European Community [London, Jai Press], p.9.

25. Hakan Hakansson (1989) Corporate Technological Behaviour. Cooperation and Networks [London, Routledge], p.124.

26. Ibid., p.126.

27. Delapierre and Zimmerman (1991) op. cit., say that the European Commission policies were instrumental in the conversion of French firms to the pursuit of European strategies, including both the large and small firms.

28 . Dermot O'Doherty (1990) The Cooperation Phenomenon. Prospects for Small Firms and the Small Economies [London, Graham & Trotman].

29. At a workshop organised by the European Commission in Seville, 25-27 May 1992, for BRITE-EURAM participants, the representative of one of the UK participating firms, ERA, indicated in a personal interview that the enterprise preferred to collaborate with non-UK partners, as the UK partners were more likely to want to dominate the venture and to impose their own views on how the collabortive activities should be conducted.

30. See Ana María Barañano, J.J.R. le Castro (1990) EvaluaciónTecnológica, Económica y Organizativa de la ParticipaciónEspañola en los Programas Europeos de Cooperación Tecnológica, Informe 4; María Paloma Sanchez (1992) El Programa Tecnología-Economía de la OCDE. Aplicabilidad de sus conclusiones al caso Español. Documento no. 19.

31. The average annual growth rate of researchers in industry in Europe over the period 1981-1985 was 4.2%, and in the period 1985-89 was 4.7. The figures for UK and Spain during the same period were UK 1.3% and 0.2%, and Spain 10.7% and 18.0%. The number of researchers in the government sector

32. See OECD (1992) Technology and Economy. The Key Relationships [Paris].

33. For a detailed and critical examination of the UK experience, see William Walker (1993) National innovation systems: Britain, in R.R. Nelson, National Innovation Systems: A Comparative Analysis [Oxford University Press]; The Spanish case is examined in Amparo Almarcha Barbado (1993) Spain and EC membership evaluated [London, Pinter Publishers].

34 . Respondents were asked to indicate the proportion of total R&D budget covered by Community, and national government financing. In some cases this is difficult to ascertain and replies indicated an estimate. In other cases the information was not available to respondents. Consequently, the information here is a guide rather than being used to offer any firm conclusions.

35. CEC (1995) Research and Technological Development Activities of the European Union Annual Report, Table 2, p.85.

36 . Sabine Urban, Serge Vendemini (1992) European Strategic Alliances. Cooperative corporate strategies in the new Europe [Oxford, Blackwells], p.220.

37. See chapter four for the situation in the UK , while chapter five examines the context of Spanish technology policy.

38. The UK government adopted a distinctly hands-off approach to the implementation of EC technology policy, including the BRITE-EURAM programme; beyond advocating that UK business should take part in EC collaborative programmes, it has devoted much less resources at the national level to guiding firms and academic centres than the Spanish government. Spain adopted a more centralised approach to facilitate and encourage the participation of business in the EC programmes, linked to the network of regional authorities and the universities.

39 . The Commission elicits the involvement of representatives from the industrial and academic sectors in the formulation of the programme, particularly through the Industrial Development and Advisory Committee, which is essentially a group of representatives hand-picked by the Commission.

CHAPTER 7

TOWARDS A TECHNOLOGICAL COMMUNITY

The European Community's technology policy entered its second decade when the Fourth Framework Programme (1994-1998) was finally agreed to by the European Parliament and the European Council on 26 April 1994.[1] Technology policy has consistently received the broad support of the business and scientific communities, and the member state governments throughout Europe, a support which seemed even more secure with the ratification of the Fourth Framework Programme.

Undoubtedly, one of the reasons for the success of the policy was the way in which it was linked by the European Commission to the pursuit of competitiveness. This objective was at the heart of national government economic programmes during the 1980s and right through to the present decade, and it also struck a chord with the neo-liberalism of the time which favoured the market as the most efficient allocator of resources, including technological resources.

Although the Framework Programme, and the specific programmes, represented a form of public intervention even the staunchest neo-liberal had to accept that the intervention essentially was an enabling one, facilitating the spread of technological alliances rather than channelling huge amounts of public funds into firms. The overall Framework Programme budget never rose above 4% of the member states R%D expenditure, and most of the collaborative projects attracted matching private sector funds.

A second reason for the success of the technology policy relates to the management role adopted by the European Commission in the evolution and development of the policy. This chapter puts forward the view that there were deficiencies in the national institutional system, and in the supranational system of interest representation which the European Commission attempted to remedy through the implementation of the BRITE-EURAM programme.

Chapter three concluded that through the BRITE-EURAM programme, the Commission established an institutional system which facilitated the participation of actors around the Community, enabling them to by-pass national government, and which compensated for the unrepresentative nature of supranational interest groups. The programme encouraged a culture of industry-academic cooperation, and the spread of this culture on a cross-border basis, even if sometimes with mixed results. The Framework Programme itself encouraged national governments to become more conscious of technology policy, of deficiencies in the national policy, and of 'best practice' models.

7.1 Returning to the national domain - Spain

7.1.1 Economic adaptation

Looking at the operation of one of the European collaborative programmes and the level of participation in it by the two member states, it seemed clear that existing national structures had different capabilities to undertake European collaborative R&D. The evidence in chapter three indicated a much higher level of participation in European programmes among UK firms than was the case with Spanish enterprises, although the Spanish authorities have made strenuous efforts to redress the balance, with some degree of success, as was shown in chapter six.

For Spain, the decade of the 1980s was one characterised by policies of modernisation and liberalisation. Modernisation was a political goal, and liberalisation one of the means of reaching it. European integration, supported by the broad mass of the Spanish people, was another means of achieving this political goal. According to the Deputy Prime Minister, Adolfo Guerra, 'Total insertion into Europe...has been a central point of reference for the Socialist government'.[2]

The modernisation programme begun under the direction of the Minister of Economy and Finance, Miguel Boyer, was launched with the view that as the prospect of European integration loomed, Spanish industry needed to change in order to become more competitive. It included therefore plans to restructure large areas of the industrial economy, moderating the wages of workers, and liberalising the economic institutions. Economic policy thus came to the fore during the 1980s, following a decade when economic matters had to take a back seat as the political forces set about restoring democracy after the death of Franco in 1976. The approach taken in the economic programme, like that towards European integration, placed the government very firmly in the driving seat. It was perhaps ironic that in restoring economic matters, the political forces and processes often took centre stage leaving the private economic actors on the sideline. Certain aspects of the institutional system can help to explain why this happened.

In particular, there was a greater acceptance of state responsibility to regulate the economy in the wider public interest and to intervene in business through support for R&D, training, investment and so on. The large bureaucracy was one of the legacies of Francoism, and the large state sector continued throughout the 1980s, although coming under increasing pressure. Many parts of this bureaucracy were staffed by an elite that was keen to drive the modernisation process forward, and who were very pro-European in their outlook.

The bureaucratic elite differed in certain respects from their UK counterparts. While the latter tended to employ civil servants with a liberal arts education who worked as generalists, Spanish civil servants tended to have specialist degrees, in law or economics. Such different backgrounds influenced the respective approaches to work, the UK often accused of being gifted amateurs with a pragmatic approach who were unable to interpret situations in a broader framework,[3] while the technical expertise of Spanish civil servants was applied in a more formal, structured way following the rules. The latter approach may sometimes result in a neglect of the practicalities of a situation as technocrats react to a situation at a high level of abstraction. This has sometimes been a problem in the Spanish case.

It was a problem when it came to developing the technological system during the 1980s. A very ambitious technology plan, comprehensive in scope and detail was introduced through legislative decree to coincide with accession to the European Community. But the plan failed to provide adequately for the diffusion of technology. The network of technology transfer organisations, known as Oficinas de Transferencias de Resultados de Investigación (OTRI), was set up by the government with offices in all the universities, but without adequate consideration of the traditional industry-academic gap.

Historically, Spanish industry devoted a very small amount of resources to research, and had for long depended on imported technology which was often brought into the country through direct foreign investment. Under these circumstances there was little pressure on industry to turn to the university sector as a source of innovation and technological knowledge. Universities tended to see themselves in a traditional, classical role, and were regarded with suspicion by the business community as far as their likelihood of contributing to applied research was concerned.

For a long time there was, similarly, little pressure on Spanish universities to turn to the industrial sector as a source of finance for their research activities, as universities were increasingly forced to do in the United Kingdom. While the UK government was rolling back the boundaries of the state, and attempting to shift the funding of research from the public to the private sector, the state continued to be a major player in the Spanish economy during the 1980s. In the university sector, expanding student numbers and the continued guarantee of public support for their research activities meant Spanish universities were not forced to look to the private sector for funding.

Despite these historical differences, the bureaucratic elite were willing to promote a culture of collaboration between the sectors which would extend beyond the domestic level to the European Community. While the technocrats exhibited a high degree of professional and technical expertise, they also were strongly committed to European integration and highly market-oriented.[4] The Centre for Industrial Technological Development (CDTI) and the Ministry for Industry and Energy were keenly supportive of European integration, and had strong links with Brussels bureaucrats.

The Spanish authorities sought to integrate the national technology programmes with the European Framework Programme.[5] On the domestic front, national programmes were intended to serve several objectives - to improve the technological base and at the same time to prepare Spanish firms, and public organisations for participation in the European technology programmes.[6] There was a gradual increase, from the second half of the 1980s in the levels of participation of public research organisations and universities in the European programmes, as Table 5.4 showed.

Spanish industry also raised its profile in the European programmes, with the very active encouragement of the national authorities. However, Spain was unable to shift the responsibility for research funding to the private sector to the same degree as other member states (see Table 5.3). Nonetheless, the participation of industry, universities and research centres in the European programmes was helping to link the Spanish technological system to the European system.

However, the particular links being created had certain weaknesses. For one thing, such ties were unable to address the fundamental problem of diffusion of technology throughout the economy generally and throughout industry characterised by small- and medium-sized firms.[7] The latter were the least able to invest in R&D, and hence had technological deficiencies which larger enterprises avoided. Larger firms were often linked to foreign multinationals, themselves a source of technology.

Partly because of the large number of small- and medium-sized firms, with the associated technological problems identified in the previous paragraph, Spanish participants occupied subordinate positions in the European collaborative projects. This had the effect of reducing the technological benefits of participation, and prompted a demand from academic observers for corrective measures by the government.[8]

But there were many, including the government, who believed that additional benefits could accrue in the form of the higher European profile that participation in EC programmes brought, and by attracting foreign capital investment, especially in such industries as automobiles, industrial equipment, electrical machinery, chemicals, and non-metallic mineral manufacturing.[9] BRITE-EURAM offered opportunities for technological development to those sectors of industry that were considered to represent Spain's best chances for competitive advantage - particularly machinery, equipment, electronics, and parts for aircraft and cars. As Table 5.12 showed, it was the programme from which Spain derived the largest share of budget out of all the industrial research programmes.

However, the country could have benefited more, and at an earlier stage, if the modernisation programme had been able to achieve the changes to domestic structures promised in the Socialist government pronouncements following its arrival in office in the early 1980s. Instead of directing concerted attention to innovation and diffusion structures at the grassroots level, the government embarked on a top-down approach which was increasingly used in the second half of the 1980s to prepare the Spanish economy for economic and monetary union.

Macro-economic policy was directed instead to entering the European Monetary System and to maintaining the peseta within the system. This outcome had the support of the Spanish Central Bank, which the governor, Mariano Rubio, described as `the culmination of a long opening up process of the Spanish economy towards Europe.'[10] During its first presidency of the European Community, in the first half of 1989, the prime minister, Felipe Gonzalez declared his support for economic and monetary union.[11] Twelve months earlier, the Economy Minister had predicted that the peseta would become part of the ECU before 1990.[12]

The overwhelming support of the central government, and of the central bank and big business for this type of economic policy overshadowed other areas where economic policy could have been directed towards effecting change in the innovation and diffusion structures. For a time, Spain experienced unprecedented levels of economic growth, partly spurred by rising levels of foreign direct investment and partly by buoyant consumer demand. All this confirmed the expectations of the Spanish government and the business community that European integration was good for Spain.[13]

There was a similar view among Spanish society that European integration was a good thing in the years following accession. The broad-based consensus that existed for European integration suggested no obvious need to change the existing institutional structure. Any change might, indeed, have induced uncertainties across the different interest groups, and threatened the very consensus that underpinned the government programme.[14]

The Socialist government which came into office in 1982, under Felipe Gonzalez, was returned in three consecutive general elections, although the last one with a reduced majority, thus adding a degree of stability to the government programme.[15] The Socialists were, like their Conservative counterparts in the United Kingdom, able to enjoy an uninterrupted spell in office to pursue their agenda towards modernisation and European integration. Although Spain followed similar macro-economic policies to those of the UK in order to meet the convergence criteria for economic and monetary union, there was no attempt to pursue the type of institutional change which marked the Conservative government's agenda. Nor were there pressures from below to do so.

By 1991-92 this consensus was breaking down, as growth rates declined and economic activity stagnated while unemployment rose above the EC average. With the number of firm closures and rationalisation cuts increasing, and the level of foreign direct investment in decline, the Spanish government had to find some way to retain popular support for the European integration drive. And it had to do so quickly, as Europe considered the ratification of the Maastricht Treaty.[16]

7.1.2 Political adaptation

The solution was found through the Spanish government's demand for a Cohesion Fund to support investment in infrastructure and environmental projects in the four poorest member states of the EU with a view to promoting their convergence to the average EU level. This the government successfully obtained at the Edinburgh summit in December 1992, and by a more trenchant attitude towards Europe.[17] Having become a net contributor to the Framework Programme by this time, the authorities adopted a more stringent approach in evaluating the costs and benefits of the programme for the country.

In a submission on the Fourth Framework Programme, the government called for more specific weight to be given to the BRITE-EURAM programme, and to those areas within it that dealt with modernisation of traditional industry. It also acknowledged that raising the European profile of Spanish industry, and of its researchers, and plugging into the Community network would not be enough to improve the value of human capital and the level of skills throughout the broader economy generally.[18] The expected benefits of participation should extend beyond network building to the structural development of the economy and society. Narrow market-based factors were supplemented by broader institutional factors.

The authorities also focused more effort on deepening the participation of domestic industry in the European programmes, particularly that of the small- and medium-sized firms.[19] One consequence of this focus was to enlarge the participation of those firms in the recently-introduced CRAFT programme, which very soon saw the highest proportion of participants coming from Spain. At the invitation of the Spanish government, IRDAC undertook a presentation to Spanish SMEs during the course of 1993, in order to improve the knowledge and awareness of European technology programmes among these enterprises.[20]

The Cohesion Fund was intended to alleviate the costs of adjustments necessary to meet the convergence criteria for economic and monetary union. After protracted negotiations by the Spanish government during the course of 1992, the European Council finally agreed a package at the Edinburgh summit. The position adopted by the government during the negotiations did not mean that it was turning its back on the European vision, but that it regarded the package as essential to bringing the vision closer to reality. The Fund would secure the continued political legitimacy of the government's objective, and retain the support of the regions.

Regional disparities had continued, despite the prosperity generated by European integration. Some of the regional authorities were anxious to exert a greater level of autonomy, particularly in regard to relations with the European Community.[21] By the beginning of 1993, ten out of the seventeen Autonomous Communities had regional offices in Brussels, which the central government tolerated if the offices were there just for lobbying purposes, or to obtain information for the region. But the central government prohibited them from conducting a representative function, which it considered as being incompatible with the Constitution.

The more independent regions conducted their own regional technology policies, particularly the Basque country and Catalonia,[22] and were anxious to see an increase in the economic powers of the European Community, especially towards the financing of less developed regions, the promotion of technological innovation, and regional investment projects.

However, the central government continued to have some influence over the amount and direction of research funding for two reasons. While the transfer of new powers to the autonomous communities enabled the regions to take some responsibility for developing technology initiatives, they did so with central funding. Regional research centres have a remit to carry out research to support technological development in certain sectors, but it is coordinated in the National Plan, through the General Council for Science and Technology chaired by the Minister for Education and Science. The General Council contains representatives from the regional authorities, and facilitates a two-way relationship in which the regions can determine their own research needs while the regional R&D programmes draw on the National Plan funds. Regional priorities can be recommended for both new regional programmes and for amendments to national programmes, but they depend upon the funds being provided by the national authorities.

The regional dependence on the central government is further aggravated by the continuing regional disparities that exist in Spain.[23] The effect of this is to ensure that the regions retain close dependence on the central government for financial and other support. This is no less the case where the regions receive substantial payments under the European Structural Funds. In any case, the provisions for regional participation in European decision-making are still somewhat inadequate.[24] While Spanish regions are anxious to increase and strengthen direct links with the European Commission, it is clear that the socio-economic structures in the regions are ill-adapted to the European market - of particular relevance in this context are the levels of technological innovation, the labour force skills.[25]

7.2 UK technology policy - ideology vs. market?

7.2.1 The policy vacuum

Unlike the Spanish case, much of the drive towards European integration came from the grass roots. The government, concerned though it was with industrial competitiveness, adopted a much more hands off approach to both technology policy generally, and to European technology policy in particular. In chapter four it was noted that the government had made direct attempts to keep the Framework Programme budget within what it considered to be acceptable limits, while industrial enterprises were free to make their own approach to the European Commission. But, in an indirect way European technological developments had an effect in the eventual introduction of the 1993 White Paper on Science and Technology.

The state of UK manufacturing industry had given rise to debate and concern for several decades.[26] For some, it was a case of decline, notably in the volume of production and in the share of world manufacturing output.[27] From a share of 17% in 1960 to 10.6% in 1970, it fell to 7.5% in 1984 to revive slightly towards 8.5% in 1990.[28] Industry appeared unable to match the productivity levels in other European countries, combined with low levels of investment in manufacturing generally.

The policy towards manufacturing was set by the limits of the free market ideology that infused much of the government thinking and its actions from the time the Conservative government took office in 1979. The prime minister, Margaret Thatcher, lent her name to the ideology that was to retain its influence after her departure in 1990. Thatcherism was intent on a complete change in the institutional and conceptual framework - a total reliance on the market, even in matters affecting infrastructural investment, and technological development.

In the area of research and development the government sought to shift the financial burden to the private sector, and to encourage market-driven research with the objective of improving the competitive position of UK industry. In addition to attempting this switch to private funding of research and development, public research centres and universities were exposed to sweeping changes which affected both the nature of their activities and the financial resources that enabled those activities to be conducted in the first place.

When the Science and Technology White Paper was finally introduced in May 1993, it gave particular emphasis to the importance of technology for wealth creation. The White Paper stated the intention to `harness the intellectual resources of the science and engineering base to improve economic performance and the quality of life. It intends, in future, that decisions on priorities for support should be much more clearly related to meeting the country's needs and enhancing the wealth-creating capacity of the country.'[29]

The wholesale embrace of neo-liberalism that Thatcherism epitomised had a contradictory side to it. This was in terms of the frequent rejections of the voice of industry, and the encouragement given to financial capitalism which more readily conformed to the precepts of Thatcherism. Undoubtedly, the growing power and influence of the City within government circles overwhelmed the interests of other sectors of the business community. Manufacturing in particular suffered from the unbalanced division of influence, and policies such as deregulation and privatisation aggravated this as the benefits flowed more to the interests of big capital and the larger corporations.

There were many ways in which government ignored the voice of industry. One case in point concerned the Central Policy Review Staff, which was set up in 1970 comprising members from industry, civil service, the City and the academic community to advise the cabinet on policymaking and to provide a forum for generating new ideas, which was disbanded in 1983. This think tank represented an early attempt to extend business-like attitudes into government policy making, and was headed by Victor Rothschild who lent his name to the 1971 White Paper on government's role in research and development.[30]

The unit specialised in analysing domestic issues in the international context, of particular relevance during the 1970s, yet it was unable to maintain influence with government even during that period. During the 1980s there was little use made of this unit, despite its expertise and industrial connections. The image of the Central Policy Review Staff also did not fit with the prevailing notions of Thatcherism, being regarded with disdain as exemplifying the political identity of an earlier period, particularly that of an academic leftist tendency.

The change in government-industry relations prompted one commentator to observe `the relationship between the two has not been between two partners pursuing generally shared goals, as could be said to be the case in Japan. Rather, it has often been characterised by mutual mistrust and misunderstanding. Government's withdrawal from some of its relationships with business has not solved this problem. Indeed, in some respects, it may have compounded it by undermining some of the mechanisms which had developed to improve contacts between business and government.'[31]

It seemed indeed that ideology took precedence over the market, or at least over certain markets. A national technology policy, of the type being developed by the European Community, was less likely under such conditions. The government's reply to concerns about the technology gap between Britain and other major competitors, particularly regarding the technical and research deficiencies in industry and education, was to press for further liberalisation and de-regulation.

The early 1980s saw some attempts at technology policy, with initiatives such as the Alvey programme, but increasingly there was an unwillingness on the part of government to provide the financial support for science and technology. Towards the end of the decade, and particularly from 1992 onwards the government was talking in terms of specific efforts which the business community itself needed to make to improve competitiveness rather than emphasing specific publicly supported technology programmes. Government spending on the science base, as a proportion of GDP, fell from 0.37% in 1978 to 0.28% in 1995. Looking at international comparisons of government funding of R&D by socio-economic objectives, the picture is rather mixed. In 1993 for example the UK government provided 8.6% for industrial development compared to Germany's 12.7%, France 7% and Italy 16.3%. The UK government spent 22.3% of the R&D budget on advancement of knowledge and the largest share, 42.5%, on defence. By contrast, the share of other countries R&D spent on advancement of knowledge was Germany 51.4%, France 31.9%, Italy 46.4%; France allocated 33.5% of the budget to defence, Germany 8.5%, and Italy 6.5%. UK business interests were completely free to look towards the European technology programmes for financial support.

UK industrial interests were well represented in all of the European industrial research programmes, as noted in chapter three. Large companies were particularly attracted to the ESPRIT programme, while BRITE-EURAM offered opportunities to the smaller firms, and to the public and private research organisations. The government's Annual Review of Government-funded R&D for the year 1992 noted that the amount of research contracts by UK enterprises had increased significantly over the course of the Second Framework Programme, with Table 7.1 below showing the total number concluded up to that point in time.

That this pattern developed was less the result of a concerted action by the central authorities to promote it than a drive by UK industry to be at the centre of things. Manufacturing industry had become much more export intensive during the 1980s, and attained higher levels of profitability in doing so. Between the years 1981 and 1990, manufacturing output increased on an annual basis, and by the end of this period was 30% higher in real terms.[32] During the same period, exports increased in volume terms by 62%. Hughes (1993) reported that profitability in the manufacturing sector had risen by 34% in real terms between 1979 and 1990. The Single Market Programme had drawn the attention of the business community to the greater role played by Europe in national policies generally, and to the potential commercial opportunities it offered.[33]

Table 7.1 UK and European collaborative links 1992

Belgium	362
Denmark	354
France	1557
Germany	1298
Greece	329
Ireland	227
Italy	659
Luxembourg	4
Holland	640
Portugal	218
Spain	493
UK	824

Source: Annual Review of Government-funded R&D 1992, p. 70.

The strength of industrial interest in the European programmes has continued. Under the Third Framework Programme, the UK had engaged in a total of 5668 collaborative links during 1994. Only Germany and France exceeded this, with 6874 and 6719 contracts respectively.[34] The corresponding figure for Spain was a much lower 3120 contracts. Undoubtedly, the capacity to undertake technological collaboration depends not only on the degree of national government support but also on the internal capability of the enterprises with potential interest in collaboration, the degree of sophistication of the industrial sector, and the size of the country.

The UK government's preference for a very loose approach to technology policy was clearly evident in the lack of any attempt to identify particular technologies, or sectors for technological development. A comparison of the submissions made by the UK and Spain towards the negotiations for the Fourth Framework Programme is instructive in this regard.[35]

Under the BRITE-EURAM programme, the Spanish government had lodged a series of concerns in respect of particular areas:

- Basic and traditional materials - improvements in quality and in processes.
- Advanced materials - construction, optics, composites.
- Recycled materials and raw materials.
- New technologies for traditional industry.
- Prenormative research.
- Design, manufacture and management of the product life cycle.
- Integrated projects - in areas such as textiles, machinery.

The UK submission concentrated on technologies of general application:

- Clean manufacturing
- Noise reduction
- Energy saving technologies
- Advanced materials and processing
- Aeronautics.

The inclusion of aeronautics reflected a long standing sectoral interest which still retained influence with the Department of Trade and Industry.[36] The DTI also regarded the BRITE-EURAM programme as complementing its own efforts to encourage new materials technologies, and it supported the emphasis that BRITE-EURAM gave to the area of design and advanced technology in manufacturing processes. However, the department devoted comparatively fewer resources to the programme than its Spanish counterpart. Instead, it contracted out the work of publishing the programme, as well as other activities associated with the programme implementation, all of which were conducted directly by the Spanish ministry.

7.2.2 Filling the vacuum

When the White Paper on Science and Technology was published in May 1993, it was welcomed by the business community on the basis that it at least raised the profile of science and technology on the government agenda, and the emphasis that the document gave to applied research was commended by industrialists although less so by the science community.[37] Chapter four examined the thrust of the White Paper, so this section is confined to considering the rationale for the White Paper, and the potential synergy with European policy.

Drawn up by the Office of Technology, then situated in the Cabinet Office but from mid-1995 in the DTI, the White Paper did not suggest an immediate change of strategic direction.[38] It did, however, propose a number of institutional changes - the re-organisation of the research councils, the newly-named Council on Science and Technology (formerly ACOST) to take greater responsibility for forecasting, and the announcement of the technology foresight programme to identify key technologies expected to play a major role in underpinning industrial development and growth.[39]

But even here the emphasis was on the involvement of industry so as to target public research funds in the direction of technologies closely aligned to the needs of industry - where `this country could and should benefit from the application of technology foresight, not only as a means of gaining early notice of emerging key technologies but also as a process which will forge a new working partnership.[40]

In giving explicit emphasis to the role of S&T in wealth creation, the White Paper stressed the need to strengthen links between the scientific community and business - but the White Paper did not discuss the possibility of setting up technology transfer channels along the lines of the Spanish OTRI, or the German Frauenhofer Institutes Although the science and technology minister, William Waldegrave, indicated the poor ability of UK business to innovate, the government's unwillingness to seek more active involvement in the system won the day. Among the UK technology community proposals were put forward however to adopt the German model in the UK, under the name Faraday Institute. By the time the White Paper was introduced, however, some of the limelight had been stolen by the earlier initiatives and declarations of the DTI, including the setting up of the Industrial Competitiveness, followed later by two white papers on competitivesss.

The White Paper stressed the commitment to strengthening the UK's international and European links. At the international level, in particular, the minister urged the scientific community to build and maintain close ties with researchers in Japan and other parts of Asia - thus offering a coherence to technological activities and industrial activities that have strong connections with that part of the world, and complementing the high volume of Japanese investment in the UK.

While the government reiterated its support for UK participation in European programmes, it identified a distinct division of responsibility for both government and the participants. The former's role should centre on ensuring a `strategic' balance between domestic and European programmes, while industry and the academic community should take a bigger role in formulating submissions to the European Commission as to the future content and direction of European research collaboration.

This approach by the UK government contrasts significantly with the Spanish government's more direct involvement in preparing submissions to the Commission, and the greater willingness to identify particular sectors or technologies for support. The White Paper sought to bring the different actors in the UK innovation process closer together, whilst distancing government from what was regarded essentially as a market-led activity.

It is too early to judge the ultimate impact of the technology foresight programme on the technological system in the United Kingdom. As noted in chapter four, the fifteen panels made their reports in the spring of 1995, and it will take a certain amount of time for the proposals to be incorporated into the research and technology programmes of the national technology community. Nevertheless, a number of observations may be made.

Technology foresight involved setting predictions regarding the likely future demand for certain technologies, based upon a broad consultation process, spanning the widest possible range of industrial, scientific and technological viewpoints. The method is one long favoured by the Japanese government and adopted by other European member states during the 1980s. One of the attractions of the method for the UK was that it encouraged greater consideration by the business community of the future developments in technology and the likely impact on their activities, and in prompting greater interaction among a variety of groups with a common interest in technological development (even if for different ends) it could strengthen the links of the technological community. A similar outcome is much desired in the Spanish case, but the idea has not as yet been taken up.

However, while the European Commission has taken a leadership role in technology management, the UK government retains its non-interventionist position, leaving the financing and the leadership to industry. The outcome is a bias towards applied research rather than basic research.[41] Despite this bias, the CBI gave technology foresight a very lukewarm reception, suggesting that `there is a lack of clarity in the foresight objectives' and `a perception of it as a mechanism for moving money around the Research Councils.'[42]

These recent policy developments in the UK retained much of the neo-liberalist ideals in the sense that the 1993 White Paper, and the technology foresight programme, adopted the principle of letting the market decide on the allocation of research and technology resources. Why then did the government decide to introduce a technology policy, after such a long period with no formal policy?

It certainly was not the case that the government feared the encroachment of European technology policy on the national circumstances. The White Paper had endorsed the European programmes, `the government believes that an important benefit of Community membership is the access which it provides to European-wide research collaborations.' On the other hand, the position of manufacturing had changed by the early 1990s, manifested through falling output, reduced employment, and a deficit in the manufacturing trade balance.

The inter-twining of cause-effect relationships add to the difficulty of trying to explain the deterioration in manufacturing at this period. Government inflationary policy forced adjustment costs onto the domestic economic sector, particularly manufacturing. UK manufacturing had to protect the export markets through a sustained battle with competitiveness, and the only way to do so in the absence of exchange rate adjustments was by cutting labour costs. In addition to this policy-induced decline of manufacturing, there was another explanation which centred upon a secular decline which the neo-liberal programme of liberalisation and de-regulation had failed to halt.

In the period since 1979 manufacturing employment fell significantly, and the sector's share of GDP also declined. Between 1979 and 1983, 20% of the labour force in manufacturing disappeared, and over the longer period 1979-1992 manufacturing employment fell by 2.6 million.[43] The most serious decline probably occurred at the beginning of the 1980s, but was obscured by the revenue from North Sea oil which gave a buoyant balance of trade. From the mid-1980s, the decline in oil revenues revealed the poor trade balance in manufacturing which continued through to the 1990s in ever-worsening trade figures.

Industrial competitiveness has been a recurring concern of the UK government, and was mostly dealt with through macro-economic policy in the 1980s. However, in the early 1990s some extra contribution was called for as the economy continued in recession. Constrained by policy and conviction from increasing public spending, the two white papers on competitiveness and the technology white paper could be seen as a response to a situation which called for a more constructive approach than had been tried up to that point.

7.3.1 National interest representation

Whatever the general reservations on European integration held by the UK government, it gave tacit approval to the European technology programmes. But as the national technological community was to experience, the government was less ready to take a more active part in the programme implementation. As the results of the survey presented in chapter six show, not all the UK and Spanish organisations were persuaded to take part in European technology collaboration on the basis of national interest representation. The United Kingdom respondents had the highest figure for non-national representation. While the style of government had an undoubted influence on this figure, there are other factors that arise in an examination of the two national contexts.

In particular the structure of business interest representation at the national, and at the supranational level influenced the degree to which sectoral interest groups were involved in the formulation of both BRITE-EURAM and the Framework Programme. The argument presented here is that business interest representation was not sufficiently strong at either the national or the supranational level to act as a focus for technological demands of the members.

The hierarchical nature of the Framework Programme itself determined different levels of interest representation, and this was sustained by the management approach adopted by the European Commission. For instance, national governments tended to be more directly and actively involved in the negotiations on the Framework itself, leaving the constituent programmes to intermediate and lower level interests. National governments' primary concerns were with the level of the budget allocated to the Framework Programme, rather than the substantive content or the strategic direction of the policy.[44]

As far as European technology policy was concerned, there appeared to be a rather steep learning curve attached to business interest representation. Although policy had been developing since the early 1980s, business interests still operated at a very disaggregated and uncoordinated level. It was only in the area of information and communication technology, sectors dominated by large multinational organisations and concentrated production, closely linked to national interests, that interest representation had reached a high level of sophistication.[45]

Across manufacturing industry generally, the diversity of business representation at both national and supranational level made for an unbalanced focus in representing interests. Technological concerns were relevant only in so far as they contributed to competitiveness, and defence of market share. Often business interests were focused on legislation of a regulatory nature that impinged on, or restricted companies' activities.

The peak business associations, the Confederation of British Industry (CBI) and Confederación Española de Organizaciones Empresariales (CEOE) in particular suffered from the diversity of membership, which often hindered a common opinion being reached.[46] Nevertheless, the two organisations maintained strong support for European integration even before the entry of their respective countries into the European Community, and maintain long-established offices in Brussels.

During the period under study, these two organisations faced quite different conditions governing their relations with their respective governments. In the UK, the CBI found itself somewhat left out in the cold (until 1992 with the return of Heseltine to the DTI) while the Institute of Directors, much smaller but more influential, found favour with the Conservative government.[47] CEOE is recognised under Article 7 of the Spanish Constitution, and receives subsidies from the Spanish government.[48] Despite this apparently privileged position for the business association, CEOE did not always take full advantage of it, and was regarded as weak by some of its members.[49]

Part of the explanation for this weakness could be attributed to the structure of the organisation - it comprises a large number of sectoral and regional associations, which often cannot find grounds for common agreement. The regional associations, with whom many business firms were more closely affiliated, tended to direct their demands to local or regional authorities, while small firms felt excluded from the process. Several delegates at the 1992 Seville conference organised by the European

Commission expressed their lack of knowledge of the strategies and motivations of the CEOE, exhibiting a degree of apathy to this nationally-organised business association.[50]

In Spain, small- and medium-sized firms have not been able to develop a strong voice, nor a coherent national well-orchestrated campaign for their particular interests. One vehicle which might have provided this role, the Spanish Confederation of Small and Medium Firms (CEPYME) was incorporated into CEOE in 1980.[51]

The Confederation of British Industry has involved itself with research and technological issues at various levels, and the Technology and Innovation Committee of the CBI meets quarterly. The Committee makes submissions to the Framework Programme, and also made a submission to the Technology Foresight programme launched under the supervision of the Office of Science and Technology. Although CBI has a clearer policy on technological issues than its Spanish counterpart, it was not confident that it could exert much direct influence at the European level as far as European technology policy was concerned.[52]

At the domestic level, CBI has come to acknowledge that the decentralised approach adopted by the government brought its own problems. In particular, the government's unwillingness to impose direction on the growing number of technological networks has hindered its use of the DTI's innovation unit to establish inputs into business.

CBI has also been `concerned at the tendency for each government department to go its own way, which merely has the effect of confusing people in the marketplace.'[53] In general, the business community did not have faith in the DTI to represent its interests, and considered it to be unable to stand up against the pressures from Whitehall, and particularly from the Treasury with the latter's preference for a high interest rate policy to control inflation when business favoured lower rates to encourage investment. John Banham, Director of the CBI from 1987-1993, commented that `the department seemed ineffective in preventing inflationary own goals being scored by players elsewhere in Whitehall and lacked the detailed understanding of how key sectors of the economy would be affected by particular measures.'[54]

National sectoral associations made little direct impact on the formulation of either the Framework Programme, or the BRITE-EURAM programme for a variety of reasons. Within manufacturing, many sectoral associations were slow to engage in the European political dialogue on research and technology, although there were significant exceptions in other issue areas.

Sectoral associations were more closely involved in the BRITE-EURAM programme at the implementation stage, either information gathering on behalf of their members, or making contacts with European Commission officials and counterpart associations from other member states at the information days and workshops organised by the Commission. Despite the proliferation of sectoral associations, one study of these groups concluded that it has not been possible to develop `a single cohesive association managing substantial diversity and possessing a de facto monopoly of representing the sector concerned.'[55]

More importantly, the European Technology programme was `sold ' on the basis of the intention to promote generic technologies that could be appropriated on a cross sectoral basis, and sectoral associations have not proved themselves adept at representing interests on a cross-sectoral basis. Instead, they have tended to take a narrow perspective on the extent of interest representation that is appropriate to their brief. This is particularly true in the case of nationally-based sectoral associations. Inevitably, the results of the survey reported in chapter four indicated that much of the collaboration undertaken by the participants was with firms in their own sector.

The BRITE-EURAM programme targeted a range of sectors, many with low to medium concentration levels, which tended to weaken the influence of sectoral representation. Some of the larger participants, in sectors such as the car industry, aerospace, chemicals, and computers were in a position to make direct representation to the European Commission.[56] However, the Commission itself has stressed from the beginning the multi-sectoral nature of the BRITE-EURAM programme, implicitly discouraging sectoral representation, and putting primary emphasis on the Industrial Research and Development Advisory Committee (IRDAC) to put forward the industrial interest.

At the same time the national peak associations have been either unable or unwilling to act for a sectoral interest, or indeed for a combination of sectoral groups.[57] The Confederation of British Industry recognised, with its opening of the British Business Bureau in Brussels in 1991, the need for greater representation of sectoral interests. However, the Bureau's role is essentially one of information gathering, and with its very small staff (three) it is unlikely to be able to make a significant impact.

Where CBI found itself in disagreement was in the national government's concentration on budgetary matters, to the exclusion of any attempts to influence the nature and direction of European programmes on technology development.[58] It was much less concerned with the way the government undertook promotional and informational campaigns on the technology programmes.

Both UK and Spanish sectoral groups have been slow to address interest representation at the European level, the Spanish particularly so. Many UK sectoral groups have really only taken Europe into consideration in terms of interest representation in the past three to four years, and to an even lesser degree in Spain. The Engineering Employers Federation, one of the more competent of the UK sectoral associations at the European level, has suggested that 'what is needed is better effort by sectoral groups to build links comparable with those already achieved with the DTI.'[59]

Some sectors do not need representation through an interest group, particularly where concentrated production is the principle feature of the industry,[60] or an emerging high technology sector which organises a European level interest group, such as bio-technology. Where a proposed policy is not regarded as a threat to members' interests, nor takes the form of a regulatory measure, there may be little impetus towards active representation.

Technology policy is sometimes seen in this light, and all the more so when the policy does not fall into the `picking winners' category. Sectoral interest groups were less inclined to publish policy statements and position papers on technological issues than on more general matters. The UK Engineering Employers Federation was a good example, publishing a rather comprehensive report on industrial policy in 1992, but avoiding technology policy despite widespread acceptance of a link between competitiveness and technology. At the supranational level, business interest groups were more inclined to take a direct position on technology matters, and were involved in the European policy formulation process through the Industrial Research and Development Advisory Committee and, less directly, other European-level groups.

7.3.2 Supranational interest representation

The creation of a European technology community called for a political process where interests were represented at different levels. In the earlier technology policy experiments, the failure of policy to adequately meet all the interests involved, and to do so fairly, was one of the causes of failure. During the 1980s, the Framework Programme sought to counteract this political deficit through a broadening of the participant base at the grass roots level, and at the supranational level through the establishment of IRDAC.

IRDAC was in many respects an artificial construct, created to establish the legitimacy of the European Commission's activities. The question must be asked why it was necessary to create such a committee, given that business interests appeared to be adequately represented by UNICE. The latter had indeed developed as a competent political actor, and was accepted as such by the European Commission and by the national affiliate employer organisations.

In Spain, the employers association CEOE had supported the government in the drive towards European integration, and was anxious to `europeanise' business activities as well as upgrading the technological input of manufacturing production. In the years following accession, the association did accept that UNICE could represent national industrial technological interests at the Brussels level, but not to the exclusion of the role which the Spanish government could play in the process.[61]

In the UK, the Confederation of British Industry liked to keep in tune with what was happening at the Brussels level, but accepted that UNICE could do more to actively represent the interest of national industry in this policy area. It was much less sanguine when it came to what were regarded, in the British case at least, as contentious issues - particularly the Social Dialogue, working time, consultation and worker representation.[62]

The peak associations by their very nature comprise a diversity of membership, taking in as they do industrial interests which cover a broad spectrum, at both the national and the supranational level. Given this diversity, it can be very difficult for these `umbrella' organisations to represent a common interest. Even with the issue of research and technology, which could be regarded in the most functional sense, raises a myriad of concerns and interests - affecting finance, industrial processes and products, capabilities, education and training, to name but a few.

Many interest groups still organise on national or sub-national lines, and even then sectoral representative abilities differ significantly.[63] The previous section identified the inability of the business community to create a broad-based, representative association capable of uniting the diversity of interests at either the national or supranational level.

IRDAC provided the answer to the question of diversity, it represented the `composite' voice of industry in matters of research and technology. The members were appointed in a personal capacity from among the most influential group of industrial leaders throughout Europe, and included as well representatives from the European-level peak associations.

There was an assumption in creating this elite group that it could represent the common interests of European industry in matters of research and technology. To what extent was the assumption that industrial technological interests exhibited a degree of commonality justified?

It may not have been justified at all. However, the European Commission largely ignored the question as technology policy began to develop. Instead, it concentrated on generic technologies that could have applicability throughout large areas of industry, and which secured immediate and wide support for the Framework Programme. UNICE accepted the idea of generic technologies at the Community level, and continued this support through to the Fourth Framework Programme.[64] The European Parliament has supported the generic technologies focus of the Framework Programme from the beginning, with the Energy, Research and Technology Committee rejecting any sectoral bias in the technology programme. The Committee has also given a strong endorsement to the socio-economic activity in the Fourth Framework, another long-standing interest of the Parliament.[65]

The European Round Table, a European-level interest association, proved more anxious to set out its views on European technological development than the national associations. In particular, it emphasised the importance of much closer collaboration between industries and universities, pointing out `the advanced materials revolution will impose major changes on European industries and on the R&D sector. The new technologies will need to be introduced into the strategic planning of industrial companies at a much earlier stage. R&D centres will need to have a greater critical size to reduce the ``luck" element, while researchers will have to be much more ``dialogue oriented" if they are to work alongside producers.'[66]

The consensus that existed on developing generic technologies combined an unwillingness on the part of the European Commission and the European Council to promote sectoral policies of any kind. Concorde, Airbus, and the ELDO and ESRO projects of the 1960s and 1970s were sectoral collaborative projects with mixed results, based on conflicting national technological priorities and the threat of an uncontrollable financial burden. The second time around the Commission sought to avoid all of this, and to minimise the sectoral representations at the European level.

The European Commission preferred a general consultative approach to technology policy formulation, inviting views from a wide cross-section of largely independent individuals, scientists and industrialists, rather than sectoral representation. Since there was initially little discussion or critical analysis of how technological advance might affect individual industrial sectors it was not so surprising that the policy process could develop through the political process set in motion by the European Commission.

7.4 Conclusion

The limited involvement of sectoral groups in the process of community building partly reflected the style of policy formulation adopted by the Commission. But at a more general level, the Community sought to avoid or at least minimise sectoral support. At the national level, an encroaching neo-liberal agenda variously followed by member state governments meant that sectoral intervention was regarded as anathema to the creation of a competitive market.

The creation of a technology community was dependent on the establishment of a wide base, not just in terms of general political support but also in terms of greater numbers of participants to the programmes. The evidence presented in chapter two, and in chapter six from the results of the survey suggested that the strategic planning by participants was concerned with market-related objectives, rather than simply technological strategies to be pursued at the European level.

European technology policy was presented as a market-based programme, helping to secure the grass roots support for collaborative programmes. However, there was not a simple change of attitudes and expectations on the part of these actors. They were linked to the emerging European Community through the efforts of the European Commission and through their participation in collaborative projects, and at the same time to a national institutional structure. It was through the adaptation of the institutional structure that the changes in attitudes, expectations and behaviour were effected.

From the national perspective, the process of establishing this political community depended upon the institutional structure already in place. In the United Kingdom there was a lack of technocrats in the central government with a `European' vision, willing to take an active part in assisting national interests to secure representation at the European level. The political community was created through a more decentralised process, through the academic community, the House of Lords Committee, and the research organisations acting as elites driving the process, supported in a general way by the business community.

Spain had a government with a clear view of how European integration could contribute to the modernisation of the country, and the technocrats with a European vision. The country had the intellectual resources at the level of central government, but it lacked the technical and specialist resources of a mature innovation structure, so that in order to take an active part in the process some degree of institutional adaptation was necessary.

The supranational elites made an important contribution to the integration process, and particularly so in the area of European technology policy, as the activities of IRDAC indicated. But this study suggests that while the supranational elites were largely unchallenged in the area of technology policy, they were only loosely connected to the national institutional structure which ultimately determines the strength of technological activity.

The position of the supranational elites in the national/supranational structure of interest representation, inadequately incorporated into the national institutional structure suggests possible `veto points' in the development of the integration process. The following chapter attempts to identify where such "veto points"" might occur to obstruct integration through European technology policy.

Notes to chapter 7

1. In respect of the Fourth Framework Programme, see Official Journal L 126, 18 May 1994.

2. Alfonso Guerra (1989) `El socialismo y la España vertebrada' in Felix Tezanos, Ramón Cotarelo, Andres de Blas (eds) La Transición Democrática Española [Madrid, Editorial Sistema].

3. See Michael Keating (1993) The Politics of Modern Europe [Aldershot, Edward Elgar Publishing], ch. 1.

4. Interviews conducted, as part of this research, with bureaucrats in the Ministry of Industry and Energy, and the CDTI (Centre for Industrial Technological Development) confirm this view. Interviewees displayed an in-depth knowledge of the academic literature throughout Europe and North America dealing with technology policy and economic policy, as well as recent work from leading writers on management issues such as competitiveness and business strategy.

5. Although the government introduced a number of sectoral programmes and concerted actions under the National Plan for Science and Technology, this has never been seen as a substitute for European Programmes. There was no national bias in the technology policy, notwithstanding the risks to technological advantage associated with openness of the system to the international economy. The government declared its intention to continue the pursuit of integration of the science and technological system - `Continuara siendo una actividad preferente dentro del Plan Nacional el fomento de la participación de grupos de investigación y empresas en los programas de I+D internacionales y muy especialmente en las activades incluídas en el Programa Marco de la CE, dentro de la política de integración del Sistema español de Ciencia y Tecnología en el Comunitario. Para ello, se continuara con la ya iniciada labor de difusión de las convocatorias y oportunidades, tratando de optimizar los circuitos de difusión existentes y de facilitar a los interesados la preparación y elaboración de las correspondientes propuestas y el necesario asesoramiento en aspectos tales como la firma de contratos, protección de resultados y derechos de propriedad industrial' - Comisión Interministerial de Ciencia y Tecnología (1991) Resumen de la memoria de desarrollo del Plan Nacional de I+D en el periodo 1988-1990 y revisión para 1992-1995.

6. Ministerio de Industria y Energía, Informe Anual sobre la Industria Española 1993, section VI (Madrid).

7. Comisión Interministerial de Ciencia y Tecnología (1992) On the Coming Fourth Framework Programme: Comments from the Spanish Delegation [Ramón González Rubio, March 1992).

8. Similar concerns were expressed by academic observers. See, for example, M. Paloma Sanchez (1991) El Programa Tecnología-Economía de la OCDE. Aplicabilidad de sus Conclusiones al Caso Español [Facultad de Ciencias Económicas y Empresariales, Universidad Autónoma de Madrid].

9. Juergen B. Donges and Klaus-Werner Schatz (1989) The Iberian Countries in the EEC - Risks and Chances for their Manufacturing Industries in George N. Yannopoulos (ed.) European Integration and the Iberian Economies [Macmillan].

10. El País semanal (1988) `Mariano Rubio afirma que España debe integrarse plenamente en el Sistema Monetario Europeo', 29 February 1988.

11. El País semanal (1989) `González desea que la Comunidad Europea profundice su unión económica y monetaria', 12 June 1989.

12. El País semanal (1988) `España entrará en el ECU antes de 1990, según el Ministro de Economía', 11 July 1988.

13. Heywood points out that from 1986 to 1991, Spain had the highest, investment-led, output growth in the OECD area. GDP per capita rose from 72.8% of the EC average to 79.2%. The levels of foreign

direct investment were significantly higher than previous, in 1986 alone inflows exceeded those for the whole period 1970 to 1979, and were 50% higher than for the period 1980 to 1985. By 1988 foreign companies were generating half of Spanish production, and employing 43% of the workforce. See Paul Heywood (1993) Spain and the European Dimension: The Integrated Market, Convergence and Beyond (University of Strathclyde, Strathclyde Papers on Government and Politics).

14. Commenting on the 1970s, Lieberman noted `the new government succeeded in democratising political institutions in a very short period of time. Economic institutions however proved more difficult to alter' - Sima Lieberman (1982) The Contemporary Spanish Economy: A Historical Perspective [London, George Allen & Unwin], p. 23. A similar observation may be made in respect of the 1980s.

15. The PSOE obtained 48% of the vote in 1982, retaining power in 1986 and 1989 with diminishing majorities. It lost its majority in the 1993 general election, but with the support of the Catalan national party, Convergence and Unity, PSOE was able to regain its position in government.

16. Spain did not hold a referendum on the Maastricht treaty, but the Treaty did provoke the first reform of the Spanish Constitution - so as to allow non-Spaniards to vote in municipal elections. The prime minister considered that with the popular support for European integration there was no need for a referendum - `the Maastricht Treaty will be ratified by the will of the government' - El País semanal (1992) `El Tratado de Maastricht provoca la primera reforma de la Constitución Española', 6 July 1992. A survey conducted by The European newspaper around this time suggested that 74% of Spaniards would like a referendum, with 29% of the respondents saying they would vote yes, 9% saying no, and a substantial 62% saying they did not know. The same survey also found that 64% were in favour of retaining the level of integration achieved through the EC - El País semanal `España quiere un referendum', 22 June 1992.

17. Loukalis Tsoukalis (1993) The New European Economy: The politics and economics of integration [Oxford, Oxford University Press]. Tsoukalis regards the Cohesion Fund as having been very much shaped by the priorities and concerns of the Spanish government, p.247.

18. See Comisión Interministerial de Ciencia y Tecnología (1992) On the Coming Fourth Framework Programme: Comments from the Spanish Delegation [Ramón González Rubio, March 1992].

19. Interview with Ramón González Rubio, Secretaria General del Plan Nacional de I+D, Comisión Interministerial de Ciencia Y Tecnología on 21 May 1992.

20. Interview with Robert Smits, IRDAC, 5 July 1994 in Brussels.

21. Under the 1978 Constitution which set up the Autonomous Communities, each one of the seventeen negotiated with the central government the level of autonomy it would exert. Some, such as Catalonia and the Basque country, had much higher levels of autonomy over regional policy making than the poorer regions.

22. Comisión Interministerial de Ciencia y Tecnología (1989) The System of Science and Technology in Spain [CICYT, Madrid].

23. G. Saenz de Buruaga (1990) Política Regional, in Luis Gámir (ed)., Política Económica de España [Alianza Universidad Textos, Madrid].

24. See Francesc Morata (1993) A comparative analysis of four Spanish regions in R. Leonardi (ed.) Regions and the European Community: The Regional Response to 1992 in the Underdeveloped Areas [London, Frank Cass]. Some effort was made to redress the balance through the creation of the Committee of the Regions under Article 198a of the Maastricht Treaty, the first occasion on which the EU Treaties recognised the existence of local and regional governments. The Treaty set out certain circumstances under which the Committee will deliver an opinion, and the conditions under which the Commission is required to consult the Committee. Although the Committee is made up of democratically

elected local representatives, it has not the authority to act as a further chamber of the European legislature - this is its essential weakness at the moment. See Charles Gray (1994) The Committee of the Regions in Frank Brouwer, Valerio Lintner, and Michael Newman, Economic Policy Making and the European Union [London, The Federal Trust].

25. See Morata, ibid.

26. See F. Blackaby (1979) De-Industrialisation [London, Heinemann] which provides a comprehensive review of the decline within the UK manufacturing sector.

27. See Andrew Gamble (1990) Britain in Decline, 3rd ed. [London, Macmillan], ch. 1.

28. These figures are taken from Kirsty Hughes (1993) The Future of UK Competitiveness and the Role of Industrial Policy (Policy Studies Institute), p. 8.

29. HMSO (1993) Realising Our Potential. A Strategy for Science, Engineering and Technology. Cm 2250, May 1993, p. 26.

30. Central Policy Review Staff (1971) A Framework for Government Research and Development, Cmnd 4814 (The Rothschild Report) [London, HMSO].

31. See Wyn Grant (1993) Business and Politics in Britain, 2nd ed. [London, Macmillan], p. 2.

32. See Kirsty Hughes (1993), op cit.

33. Simon Bulmer, Stephen George and Andrew Scott (1992) The United Kingdom and EC Membership Evaluated [London, Pinter]; Andrew Scott concluded that the Community policies did not seriously interfere with independent decisions on industrial policy in the UK, p. 76. He attributes the lack of any serious clash to the pragmatism of the Commission, and an extensive use by the UK government of protection in the form of non-tariff barriers which did not show up as contraventions to European policy. This trouble-free relationship did not extend to other areas of macroeconomic policy, such as monetary policy, or the social arena.

34. These figures are taken from the Research and Technological Activities of the European Union Annual Report 1995, published by the European Commission.

35. CICYT (1992) On the Coming Fourth Framework Programme, ibid., Appendix.

36. Interview with DTI official, September 1994.

37. Kam Patel (1993) Get set for the big bang, Times Higher Education Supplement, 4 June 1993.

38. Realising Our Potential, op. cit. The Office of Science and Technology clearly had the leading role in setting direction and priorities, within a strongly neo-liberal economic framework.

39. Realising Our Potential, op. cit., pp. 16-20.

40. Realising Our Potential, ibid., p. 17.

41. The White Paper also suggested that public research funds would in all likelihood be allocated to areas that reflect the priorities established by the technology foresight panels.

42. Stewart Judd, CBI, 25 May 1994.

43. Hughes (1993) op. cit.

44. See Hugh Ward and Geoffrey Edwards (1990) 'Chicken and technology: the politics of the European Community's budget for research and development' in Review of International Studies, 16.

45. See Wayne Sandholtz (1992) 'ESPRIT and the Politics of Collective Action' Journal of Common Market Studies, vol XXX, no. 1.

46. CEOE was formed in 1977, and by 1990 had around 1.3 million members. It incorporates 165 individual employers organisations of which 45 are inter-sectoral and region-based, and the remainder are sectoral, representing activities such as banking, iron and steel, advertising, and construction.

47. Lord Young, the Secretary of State at the DTI, made a trenchant remark that illustrates the hostile conditions facing the CBI - 'we have rejected the TUC; we have rejected the CBI. We do not see them coming back again. We have rejected the corporate state.' [Financial Times, 9 November 1988, quoted in Wyn Grant (1993) Business and Politics in Britain, 2nd ed. [London, Macmillan], p. 31.

48. Article 7 of the Constitution recognised the significance of employers' organisations and their right to defend and promote the interests of their own members. The basic constitutional requirement made of them is that their structure and operation must be democratic and they must be properly registered, (Art 22).

49. Two delegates commented to this effect on the perception which was widely held by business organisations - Julio Arias, Indal S.A., Juan Antonio Bas, Ames S.A., Seville conference 25-27 May 1992.

50. These problems have been confirmed by other commentators. See Michael Keating (1993) The Politics of Modern Europe [Aldershot, Hants., Edward Elgar Publishing]; Robert E. Martinez (1993) Business and Democracy in Spain [Westport, CT., Praeger Publishing].

51. Robert Smits, ibid.

52. Interview with Stewart Judd of the CBI, 25 May 1994.

53. Stewart Judd, ibid.

54. John Banham (1994) The Anatomy of Change [London, Weidenfeld & Nicolson], p. 272. Banham refers to a survey in September 1990 of 700 companies, employing over 3 million employees between them, which rated the average effectiveness of the DTI's seven programmes as 1.3, on a scale of 0 to 5.

55. This was the conclusion made by Justin Greenwood, Jurgen R. Grote and Karsten Ronit (1992) Organised Interests and the European Community [London, Sage], p. 241.

56. Interview with Miguel Angel Llorca, of the Spanish aircraft firm, CASA, and a delegate at the Seville conference. As CASA is a public sector organisation, it obviously has little difficulty obtaining the ear of the Spanish government. Whether the government always acts on its behalf will depend, among other things, on the political conditions under which government decisions are made.

57. Both CBI and CEOE have been careful to take a general approach in their pronouncements. This is also true with regard to UNICE - interview with Daniel Cloquet, UNICE, 6 July 1994. For all three organisations, the diversity of membership makes this consequence somewhat inevitable.

58. Interview with Stewart Judd, CBI, 25 May 1994.

59. Interview with Ann Branch, Engineering Employers Federation, 14 June 1994.

60. See Alan Cawson (1992) Interests, Groups and Public Policy-making: the Case of the European Consumer Electronics Industry in Justin Greenwood, Jurgen R. Grote and Karsten Ronit, Organised Interests and the European Community [London, Sage], p. 107.

61. Enrique De La Lama-Noriega, CEOE, Seville, 25 May 1992.

62. Interview with Stewart Judd, CBI, 25 May 1994.

63. See Wyn Grant (1993) Business and Politics in Britain, 2nd ed. (London, Macmillan). Grant distinguishes between the logic of membership (ie. characteristics of members such as heterogeneity, the tendency to see Europe as a single market, etc.) and the logic of influence (influence on association structure by state actors, or the EC in the case of Europe-wide associations) as determining the sectoral representation. Grant saw the interest group activity as affected by the speed and direction of the integration process, rather than being the motor of the integration process.

64. Daniel Cloquet, UNICE, interviewed in Brussels, 6 July 1994.

65. Richard Kalb, EP Energy, Research and Technology Committee, Brussels 7 July 1994.

66. European Round Table (1990) Bright Horizons [Brussels], p. 11.

CHAPTER 8

THE TECHNOLOGY COMMUNITY - AN ASSESSMENT OF THE PROCESS

This concluding chapter looks at the nature of the community that has been created through the BRITE-EURAM programme, and considers whether the outcome constitutes a robust community. Some ten years in existence, the European technological community can be said to have a certain degree of maturity and stability. It is a natural point of departure, therefore, to want to consider whether the members of this club can, or indeed would want to achieve more than merely creating technological links to qualify for a share of the European Commission Framework Programme budget.

What is clear from the research so far is that a hierarchical community has been evolving, including within its multi-layered structure actors at the grassroots, at the national and the supranational level, and that the European Commission played a key role in the gradual development of this community. Not only was the supranational authority a major political actor in the process, it was facilitated in expanding its position through the legislative changes associated with the Single European Act and the Maastricht Treaty.

The hierarchical community is one which exhibits a degree of unevenness that is partly a reflection of the individual nature of national institutional structures, and partly a response to these differences. Each national institutional structure has its own particular dynamic through which integrative pressures appear, and which determines the degree to which interests are directed towards the supranational level.

Through European technology collaboration an overlapping structure has been created, linking economic actors in a collaborative web which connects with the domestic structures in an intermittent fashion depending on the broader technological capabilities of each national structure. Perhaps the real truth of the matter is that the political actors took the easy way towards the creation of a technological community - by adopting a politically safe goal of industrial competitiveness and a programme with an immediate aim of bringing in as many actors as possible.

The size of the community, rather than its quality, was guaranteed by packaging the programme in terms of its promised contribution to competitiveness. At best, governments would support a political agenda that coincided with the national agendas. Industrial firms, not naturally tending towards alliances for purely technological purposes, could be persuaded to participate for the financial support, and broader indirect commercial benefits. The thesis has so far concentrated on outlining the development of the political process initiated by the European Community to establish a technology community, and chapter three provided an ex post evaluation of the extent to which this was achieved in terms of the number of alliances and the geographic spread throughout the EU. In the next two sections, a different form of assessment is made by starting from the political objectives behind the programme. The following section looks at the emerging goal of cohesion and takes an ex ante view of the possibility for creating a political community around this particular goal.

8.1 Assessing the cohesive potential

The major responsibility for economic and social responsibility lies primarily with the Structural Funds, but as a Commission report evaluating the effects of technology policy on economic and social cohesion issued in 1992 noted `technology policy must also interact and contribute, in order to foster the cohesive impact of Community actions in all fields.'[1] In it's evaluation, the report identified a number of conditions the existence of which would denote economic and social cohesion. The set of conditions do in fact provide a very useful bench mark against which to evaluate the BRITE-EURAM programme, and some of them are highlighted here -

- isolation of scientific and technological communities is being reduced, especially in the case of Less Favoured Regions
- disparities in RTD capabilities and the backwardness of Less Favoured Regions are being reduced

- an overall harmonious development of the EC RTD system, is being brought about, including the involvement of enterprises, research centres and universities, resulting in benefits for all regions
- an overall climate of trust and understanding is being built in the EC RTD system, based on mutual interest, and through actions based on commonly accepted standards and procedures
- the Framework Programme, along with other instruments, is contributing to strengthening scientific and technological infrastructure and potential through all parts of the Community,
- coordinated RTD actions between the EC and national authorities are being implemented leading to an efficient cooperative effort in RTD across the Community.

How does the BRITE-EURAM programme measure up on the basis of this set of criteria? The answer has to be that it does not measure up at all well. In chapter three, section 3.6, the existence of a core-periphery in the emerging pattern of alliances was identified, which in fact reflects more general patterns of core-periphery in the economic activity and economic development of the European Community. The Framework Programme in general, and the BRITE-EURAM programme, is still overwhelmingly dominated by the larger member states, with their more mature technological systems and advanced technological capability.

Out of all the European industrial collaborative programmes, the BRITE-EURAM programme is the one with the most potential for changing this, and the one most suited to doing so. The reason is that the other programmes, ESPRIT and RACE, are essentially single-sector programmes, in areas where large size operations tend to dominate, while BRITE-EURAM is multi-sectoral, ostensibly targeting areas where smaller operations tend to proliferate. However, under the Second Framework Programme, SMEs represented only 22% of the total participants, and 21% of the project co-ordinators in BRITE-EURAM.

The programme evaluation reports have tended to adopt a more positive view of the BRITE-EURAM's contribution to economic and social cohesion than the one taken here. For instance, the evaluation of the BRITE-EURAM 1989-1992 (under the Second Framework Programme) concluded, and without further evidence, that it `has helped increase Europe's cohesion by facilitating international partnerships, with all its benefits. It is highly unlikely that those benefits would have been attained if the research had been funded by purely national institutes. Less favoured regions are well represented in the projects, although they tend to be represented more by universities than by commercial enterprises.'[2]

More realistically, the evaluation report went on to suggest that the programme might be trying to meet a number of objectives, which were fundamentally incompatible. In particular, the declared intention of the Commission to support SMEs to a greater extent through the programme might not be feasible in the context of the aim of promoting pre-competitive research, rather than near-market activities that may be closer to the interests of the SMEs.

Furthermore, the objective of cohesion may not be compatible with a policy which has a mandate to select collaborative projects on purely scientific and technical merit. A more general, but no less relevant point, was that the total programme budget available was very much inadequate to the task of developing the technological skills of Europe's two million SMEs.

In fact, the evaluation report went on to make a number of policy recommendations that would take the programme even further away from meeting the economic and social cohesion criteria set out above.[2] It recommended that the programme should move back to a more pre-competitive phase, and to adopt stricter application of pre-competitive criteria. In addition, it advocated increased emphasis to be given to generic technologies with a greater share of the funding going to strategic as opposed to purely applied research. Under these circumstances SMEs would, if not excluded altogether, find it difficult to engage in long-term collaborative research with their comparatively limited resources and the need to realise profit potential at the earliest point possible. The panel did, however, recommend that the Commission should explore ways to extend the CRAFT programme to meet the needs of the small- and medium-sized firms.

There was no immediate sign of the European Commission to heed this advice regarding support for pre-competitive research. A 1993 evaluation study of completed projects under the BRITE-EURAM programme noted a greater focus on applications-oriented research, with a drop in the average time-to-market between 1992 and 1993.[3]

Another independent report evaluating the economic effects of the BRITE-EURAM programme on European industry, the BETA report prepared by the Bureau d'Economie Théorique et Appliqué at the Université Louis Pasteur in Strasbourg, noted that SMEs faced challenges in participating in the European programmes - the lack of resources to evaluate technical needs, to define R&D plans, to find partners in other countries, and to study the technical feasibility of an idea before getting involved in a major R&D project.[4] The study covered a statistically representative sample of fifty completed projects, and found that fully integrated companies were best placed to benefit from the projects, and this often did not include SMEs.

The BETA report concluded that only the small- and medium-sized companies that actively conducted research in the industrial sectors covered by the BRITE-EURAM programme held a technological and market monopoly in a niche which, the report observed, was invariably lost to larger companies that entered the niche.

Undaunted by the nature of this advice, the European Commission identified strengthening economic and social cohesion as one of the objectives of the current BRITE-EURAM programme, with a number of strategic aims including the 'increased involvement of manufacturing SMEs in European RTD thereby developing links with other enterprises and to better manage their resources.'[5] There is no doubt that it continues to see a major responsibility in enlarging the technology community, and that widening the base at grassroots level remains as much a priority in 1995 as it was ten years earlier.

Linked to this is a further responsibility of the European Commission, to foster cooperative capability and to strengthen those cooperative links created. One of the lessons from the BRITE-EURAM programme, and which was reiterated in the successive evaluation studies, was that the effective exploitation of the results from collaboration depended upon clearly stated strategies for exploitation being established by the partners at the outset. From 1994, the Commission adopted a more stringent approach to project proposals, rejecting those which did not have strategies for exploitation of the results included as part of the research proposal. In support of this approach, it has also promised stricter evaluation at the mid-term and final assessment of projects in pursuance of higher standards of cooperation.

Many of the UK and Spanish participants surveyed for this research confirmed that the collaborative ability of the organisation had improved through participation in the programme. For a few with widespread prior experience, the programme made only a marginal impact, but there were no negative responses to this question. In the case of many of the Spanish organisations, the programme made a very positive contribution to collaborative capability.

Participants did not hold the same positive view of the programme's cohesive potential. On this issue the views were mixed, reflecting partly the particular experience of each individual organisation in the programme, or the perception of the political process operating generally, or the national circumstances within which the participants operated.

Some United Kingdom participants suspected the European Commission of deliberately channelling funds to the southern member states through the choice of projects. Many respondents from both countries considered that the overall level of funds available under the programme was insufficient to make any real impact on economic and social cohesion. While Spanish respondents considered the programme brought a number of benefits in general, they were overwhelmingly in agreement that it could not bridge the gap between the member states with advanced technological systems and those countries that lagged behind.

Against the criteria set out above, at the beginning of this section, the survey evidence does not support the view that the programme has strong cohesive potential. A significant number from the two countries regarded the programme as making little impact on innovative capability. Despite this conclusion, however, there was continued interest among the respondents in the programme, and most expressed a belief in pursuing further collaboration under the programme.

Chapter six noted the contradictory expectations of respondents from the programme, particularly as regards the impact on innovative capability and on competitiveness. Despite the doubts concerning the programme's contribution to innovation, there was a large number who considered that BRITE-EURAM could contribute positively towards industrial competitiveness. The following section examines the basis for this belief.

8.2 The issue of competitiveness

Industrial competitiveness has been a recurring concern of national governments and the European Commission for most of the 1980s and the 1990s. The member state governments adopted various and often conflicting strategies to promote the strength of domestic industry against international competitors, in both the domestic and foreign markets. At the national level, the type of strategies pursued was influenced by a number of factors, including the prevailing overall economic strategy and the room for manoeuvre allowed within it, the philosophy of the government, and the particular domestic industrial circumstances.

With a varying array of measures, from de-regulation and privatisation, to support for research and technology, measures to cut labour costs, or to improve productivity and investment, there was one common element which bound the governments together. This was the belief that industrial competitiveness was key to broader economic welfare and growth.

While falling industrial competitiveness was not a new problem, during the 1980s governments could not use the traditional methods such as industrial subsidies, devaluation and so on. They were constrained from doing so by shifts in economic thinking away from the traditional means, and by the constraints of European Community membership. Furthermore, the counter-inflationary macro-economic policies practised throughout many of the member states of the European Community during the decade threw into sharp relief the policy vacuum in other areas of economic management, which most were content to see filled by European Community initiatives.

European technology policy was in a sense filling the vacuum, and the goal of industrial competitiveness secured the support of the member state governments. But the policy pronouncements of the European Commission never made explicit precisely how technology policy would secure the goal of industrial competitiveness, merely that it would. From the 1985 memorandum on creating a technological community through the various Commission proposals concerning the successive Framework Programmes, a precise definition of competitiveness was avoided. The mere use of `the rhetoric of competitiveness' was enough to allay even the fears of the most anti-European of the national governments concerning the Community proposals. [6]

However, even a cursory examination of the definitions in use suggest that the European Commission's technology policy proposals were in reality likely to have little immediate and direct links to competitiveness. In addition there was no agreed definition among economists, and in fact those definitions that were in use centred on the nation state, rather than on a supranational political community in the course of being established (see section 1.3).

Traditional definitions centred upon relative cost and price differences, based upon variables such as money wages, productivity, and the exchange rate. Changes in any of these measures are taken to reflect movements in a country's competitive position vis-a-vis other countries.

One widely-accepted definition of competitiveness concerned the ability of a country, under market conditions, to produce goods and services which meet the test of international markets, while simultaneously maintaining and expanding the national real income over the long term.[7] Michael Porter's definition started from the question of national competitiveness but is then turned into an examination of the role of the national environment in influencing firms' competitiveness within a sector. His analysis identified four sets of national attributes which interact as a system and exert influence on firms.

These were the factor conditions, demand conditions, competitive conditions, and relations between an industry and its business partners (or what Porter described as the related and supporting industries). Factor conditions comprised the characteristics of the labour force and infrastructures, while the demand conditions referred to the nature, size and level of sophistication of the home market. The pattern of national demand was an important contributing factor in the innovation process. Of the other two sets of conditions, one related to the analysis of competition within sectors. In particular, the structural characteristics and firms' strategies, with the strength of rivalry between companies, was identified as being a strong incentive to competitiveness. The other set of conditions took into account the whole process of production and distribution in the analysis of competitiveness. Taking examples from Japan and Italy, Porter argued that strong and efficient relationships with suppliers and distributors was a competitive asset, and were increasingly important to achieve innovation.

European technology policy was not framed in the extremely comprehensive manner of the Porter model, which offered a combination of issues in an inter-related system.[8] Instead, technology policy was much less precisely formulated, in the context of a generalised fear that the member states together were losing out to competitors rather than in terms of more particular indicators. Under the Single European Act, article 130f paragraph 1 stated `the Community's aim shall be to strengthen the scientific and technological basis of European industry and to encourage it to become more competitive at the European level.' The specific programmes then went on to encourage the cooperation of firms, universities and research centres in pre-competitive research - where it is difficult to apply specific indicators of competitiveness.

In the light of this preference for non-specific indicators, it is perhaps not so surprising that evaluations of European technology policy tended to stress general achievements, such as the restored confidence in European capabilities and the growth of cooperation between firms.[9] The evaluation of the BRITE-EURAM programme (1989-1992) reflected this avoidance of specific indicators of industrial competitiveness, in concluding ``the relationship between investment in BRITE-EURAM and the expected increase in turnover, which participating companies will obtain from the application of the results of supported projects is substantial'(p.91).

The same evaluation report suggested that competitiveness of a firm was determined by many factors, other than technology, and proceeded to cite the impact that collaborative research had on the quality of the research, enhanced international status of a firm engaged in collaborative research, and the improved organisational effects. At the level of specific programmes, the evaluations were often less concerned with the potential contribution to industrial competitiveness, which had not in any event been defined by the European Commission, than about improved programme management and implementation.

Perhaps the clearest proof of the European Commission's use of the rhetoric of competitiveness came in an admission made in the first European Report on Science and Technology Indicators, published in 1994, where it admitted `it was recognised that both the meaning of competitiveness and the part that R&D can play in increasing competitiveness were not well understood.' The failure of policy makers to address the connection meant `the impact of the Community research on the competitiveness of European firms is more difficult to assess.'[10]

Even before this public admission of failure, it had become clear that industrial competitiveness needed a more direct and sustained comprehensive policy. This began to emerge on several fronts - a study commissioned by the European Commission to identify the concepts and approaches relevant to an assessment of the impact which the research programmes had on competitiveness reported in 1993, and a White Paper on industrial competitiveness was published in the following year.[11]

The report on concepts and approaches suggested that any evaluation of the impact on competitiveness had to take account of evolutionary processes which differ across firms, and are reflected in a number of dimensions, including knowledge, skills and artifacts. The conclusions of the report highlighted the complexity of effecting technical change, and the extent to which it is dependent on wider technological capability.

In particular, the conclusion that skills development made an vital contribution to long-term competitiveness, and the means of exploiting and of disseminating the results of research point towards the importance of national institutional structures, and their capability or otherwise of contributing to long-term competitiveness. To-date, national policies have addressed skill and human resource development to a much greater extent than European policy, although the White Paper on industrial competitiveness is attempting to redress the balance somewhat.

However, the Fourth Framework Programme introduced new obligations on evaluation, as a much-enlarged budget was agreed for a wider set of activities. The 1995 Annual Report on RTD activities represents one aspect of this new evaluation approach, giving for the first time direct financial evidence of the benefits from a Commission programme, when it revealed that on average 1 ECU invested in research under the BRITE-EURAM programme generated 6 ECU of potential economic impact within five years of project completion.

8.3 Supranational technological interest

By the 1990s there appeared to be a certain convergence of ideas among the supranational elites regarding the basis of competitiveness. The generally accepted, but ill-defined, view that technology was linked to competitiveness was replaced by the belief that competitiveness depended on the broader institutional framework.[12] In particular, the educational and training environment, the financial structure, and the relationship between the creators and users of new knowledge all combined to have an impact on industrial competitiveness.[13]

The principal concern of this thesis is whether the evidence points towards a supranational technological community. Several of the supranational interest groups - UNICE, ETUC, European Round Table - took an increasing interest in European technology policy. Although each made independent contributions to the formulation of policy, much of their respective concerns were channelled through the organisational permanent representative on the Industrial Research and Development Advisory Committee (IRDAC).[14]

The committee had broadened its remit beyond industrial research to provide a number of opinions on the contribution which qualitative strategies such as education and skills development could have on competitiveness.[15] A new stage in the integration process was reached when this broader remit was formally ratified by a decision of the Commission in September 1995, thus allowing IRDAC powers to examine broader strategic issues of technology policy.

In a report on strategic fundamental research published in 1992 the committee sought to encourage more focused Community support for basic research, relevant not only to industrial needs but also the needs and demands of society.[16] The opinion of IRDAC was that all R&D programmes should contain an element of education and training.

One of the members of IRDAC, David Giarchardi, in an interview conducted for this research, supported the idea of a European industrial policy `provided it was adequately debated', but doubted that a sectoral approach would work as the many examples of failure in this area exemplified. The committee was ready to encourage a policy which would support `leading edge technologies at the frontier of knowledge, which will determine major developments of the whole economic fabric.'[17]

None of the other supranational groups offered any serious criticism of the European dimension to technology policy, or questioned its contribution to competitiveness. Nor did any of them challenge the role of the European Commission. The European Round Table had been involved in policy development since the first ESPRIT programme, and UNICE considered that in the absence of the Framework Programme `research and development efforts would be very scattered.'[18] .

A paper prepared by UNICE on the management of the European technology programmes concluded that while some decentralisation in management was desirable, `such delegation must not include responsibility for decision-making tasks relating to definition of ...the content and themes of a programme...which must remain the exclusive domain of the Commission.'[19] The problem, according to UNICE, lay with the fact that not enough effort had been directed towards selecting priorities, a view also held by ERT.[20]

Balancing its natural concern with competitiveness, UNICE also supported the view that qualitative factors such as education and skills had an important contribution to make in this area, in the context of `additional investment ...in infrastructure, in particular in rail transport, air traffic control, information networks and education.'[21] European technology policy could best serve the needs of industry through its support for pre-competitive research, but UNICE advocated the need for industrial relevance and the use of an `exploitability' criterion when assessing projects.[22]

Fearing that the Maastricht Treaty had forced a change of emphasis on technology policy, giving a stronger voice to non-industrial interests, UNICE moved to keep competitiveness at the top of the agenda.[23] In addition to the publication of a detailed report on the factors which determined competitiveness, the organisation proposed a Competitiveness Council, along the lines of the American model.

However, the idea proved unacceptable since it was regarded by UNICE members as a potential competitor, and more immediately as increasing the amount of bureaucracy at a time when UNICE itself was actually trying to reduce the bureaucratic burden on business.[24] A similar proposal was made by the European Round Table, which advocated that the status of the council should be set by a decision of the European Council.[25]

The European Trade Union Confederation sought to establish the priorities of technology policy in a broader societal context, proposing that the Fourth Framework Programme should meet the needs of society as well as those of European industry.[26] It concluded `that the door opened by the Maastricht Treaty, through the extension of research to cover social considerations and the provisions ensuring that the RTD Framework Programme should no longer be geared exclusively to increasing companies' competitiveness, needs to be pushed further.'[27]

Can it be concluded from the apparent newly emerging consensus regarding competitiveness among the supranational interest groups that there has been an upgrading of interests, providing the conditions for further integration? In his view of the integration process, Ernst Haas regarded the development of supranationality as `a cumulative pattern of accommodation in which the participants refrain from unconditionally vetoing proposals and instead seek to attain agreement by means of compromises upgrading common interests.'[28]

Supranationality is, however, only one part of the process. The evidence from the research conducted here suggests that supranational interests need to have some base and to be linked to their micro-foundations in order for the process to move forward. More generally, community building requires the broadest possible base of support at the grass-roots level so as to establish the legitimacy of the political integration. Without this, supranationality will be little more than another platform for ideas. Ideas have to find a practical expression through a broad institutional structure. In the context of European technology policy, a hierarchical structure proved unable to adequately represent all the interests, or to link the different levels in a constructive way.

The elite groups at the European level observed this division of responsibilities between national and supranational level, with the resulting vacuum being filled through the programme management and implementation by the Commission. UNICE, the industrial interest organisation, was less concerned with the specific programmes than with the general emphasis of the Framework Programme.[29] This left the way free for the Industrial Research and Development Advisory Committee to represent industrial interests within the Community.

Yet neither organisation was well equipped to do so - UNICE as an `umbrella' organisation with a diversity of membership had difficulty finding a common reference point in regard to the variety of technological needs of its members, and preferred instead to concentrate on more general issues where consensus was possible. IRDAC was intended to be the best alternative, with its mandate to represent industrial research interests. However, its mandate came from the European Commission, not European industry, and the members were appointed in their personal capacity. In addition, these members came from the leading corporations within the Community, and appreciated the benefits which membership of the committee could bring, but without necessarily having a keen appreciation of the technological needs of all areas of European industry.

Despite the growth of interest representation at national and supranational level with a few sectors, such as pharmaceuticals, particularly adept at supranational interest representation, the business community has been unable to achieve a common voice on a great many issues. This general lack of unity, combined with a tendency among the large corporations to engage in individual representation left the way open to the style of community building adopted by the European Commission in the BRITE-EURAM programme. IRDAC established the legitimacy of the programme presented by the supranational authority, while the Commission instituted a variety of means whereby the grass-roots level participants could gain direct access to Brussels.

The development of European technology policy through the Framework Programme, with the constituent specific programmes, saw debate or argument often concentrated on the former rather than the latter. This was frequently the case with the BRITE-EURAM programme. Consequently, while seeking the views of a large body of independent experts throughout the Community in the formulation of the programme, who responded in a personal capacity, the Commission had more influence over the constituent programmes.

From the Second Framework programme, the Commission could with some confidence regard `adoption as a formality' as far as BRITE-EURAM was concerned.[30] It partly benefited in this respect from the perception held by some that the specific programmes were regarded as `relatively technical', giving the Commission freer rein.[31]

A final point may be made at this point regarding supranationality. The European elites concentrated their efforts on influencing technology policy at the European level, avoiding any depth of interaction with national groups that might allow national systems to help shape supranational policy. The acknowledgement that `national systems differ, for historical and social reasons' conditioned their approach.[32] However, in the context of technology policy a clearer understanding of such differences and of ways to overcome them could be of use in devising a technology policy that would both facilitate economic and social cohesion and improve the technological base.

Reference has already been made to the hierarchical nature of interest representation which partly explained the low level of interaction between supranational and national interests. An additional factor centred on the neo-liberal ideology, which supported the market as the efficient allocator of technological resources while at the same time respected the sovereignty of national governments and national institutional systems.

8.4 Bringing back the national level

In its memorandum on creating a technological community, issued in 1985, the Commission promised that one of the means by which it intended to create this community was through the coordination of national technology policies. It failed to do this in the ten years since then. Partly, the failure is attributable to the fact that `each country is still convinced that they can do it on their own'.[33] And, in part, the fault lies with the European Commission itself which opted not to take on the coordination role.

Instead, the Commission chose a policy which would create a community by linking the economic actors throughout the Community on the basis of decentralised technological efforts conducted through collaborative projects. It was a programme that reflected the market bias, and an early introduction to the value system inherent in the Single Market Programme that was to coincide with the emerging European technology policy. And, linking the technology policy to the political agenda of competitiveness ensured the similar widespread support that the Single Market Programme received around the Community.

While it may be suggested that competitiveness was merely a political goal manipulated by the Commission to justify the technology programme, to encourage participants, and to keep the national governments happy, such a view must also take into consideration the actual conditions of European industry at the time. There was some basis for the view that the technological basis of European industry was in need of improvement and, as chapter two showed, industry was clearly reluctant to do anything about it unaided. The market failure thesis applied to technical change has a long and respected pedigree.[34]

European technology policy developed, therefore, with the Commission as leader and the co-ordinator of economic actors, and with a strong market bias. It was presented in a form which suited the neo-liberalist tendencies that were gathering strength in the member states of the Community.

However, the context which has been sketched out above had the result, intended or otherwise, of locking in the policy to a particular trajectory of development that was tacitly supported by national governments. This was to a market-based programme of technological cooperation, which has yet to make a significant impact on technological and structural change through promoting the use and diffusion of new technologies. The issue of industrial competitiveness continues to be a matter of political concern among the authorities at the European and national level, as indeed does the issue of economic and social cohesion.

The political nature of the competitiveness concept was underlined once again by the European Commissioner responsible for research, education and training, Edith Cresson, at the annual BRITE-EURAM conference held in Vienna in October 1995, when she stressed again the fact that Europe spends less than its competitors on research - 2% in Europe compared to 2.7% in the United States, and 2.8% in Japan. A similar agrument was used to launch Europe's technology policy in the early 1980s. She identified a number of steps needed to overcome the impediments to industrial competitiveness, including greater cooperation between industry and research to overcome the traditional compartmentalisation of the scientific world and the industrial sector, a concentration of resources and efforts on specific priorities.

An obvious omission was that the supranational policy interacted poorly with domestic institutional structures. In a Green Paper on Innovation, the result of an initiative by Edith Cresson, and the Commissioner responsible for industrial affairs, telecommunications and information technology, Martin Bangemann, and adopted by the Commission on 20 December 1995, the need for coordination with national systems was identified with the paper identifying thirteen lines of action to improve innovation and hence industrial competitiveness.

The Spanish and UK systems exemplify in many respects opposite ends of the technology system spectrum, and were chosen for study partly on that basis. In the UK, a mature technological system developed from its early mission-oriented style to a much more market-oriented system, driven partly by the government's desire to shift the burden of financing research to the private sector. It has a long tradition of openness to foreign technology, something which has continued to the present time, with a significant increase in foreign direct investment during the 1980s which brought high technology investment.

The dependence on foreign technology, and the influence of the mission-oriented system left their mark on domestic industry, particularly in the reluctance or inability of large areas of industry to conduct research and to innovate. The United Kingdom shares with Spain the burden of a large number of small- and medium-sized firms with a limited capacity for technological development.[35]

The weakening of the mission-oriented system did not lead to a more diffusion-oriented one. For a long time, SMEs received little public support for technological development and diffusion. The survey results in chapter six indicated a large number of UK industrial respondents who engaged in European collaboration in order to acquire technological expertise, a finding corroborated by other research.[36] The government policy of shifting the financial responsibility for R&D onto the private sector was a significant factor, also, in encouraging both private and public organisations to engage in European technology collaboration.[37]

In addition to the perceived lack of government support for technological development, and a lack of leadership in respect of the European Community technology programmes, it was left to other actors in the system to raise both the profile of research and development and of the European programmes in particular. The House of Lords Select Committee on Science and Technology played a prominent role in this regard, as did the public research bodies.

With a strong tradition of industry-academic collaboration, the universities were eager to take part in the European programmes and further encouraged by government public spending cuts. This tradition remained with a continued high level of domestic collaboration, which was noted in the preceding chapter seven. UK firms maintained a strong position in the European Framework Programme from the early days, however this was not enough to secure domestic industrial competitiveness. The government was eventually forced to address the problem directly in 1994 with the publication of a White Paper on Industrial Competitiveness, and a further one in 1995.

Spain had, like the UK, a long history of dependence on foreign technology which was encouraged by the modernisation policies of the Franco regime in the 1960s. The dependence continued in the 1980s, with a high level of foreign direct investment following Spain's accession to the European Community. In the Spanish case, the gain was in the area of mature industries with low to medium technology. It was the Spanish government which provided the leadership on European integration, and in the modernisation of the technological system following membership of the Community.

Modernising the technological system, and modelling it on the lines of the European Community system, was part of an overall effort by the government in the reconversion and restructuring of the domestic industrial system. It was not linked, as traditional mission-oriented research tended to be, to national security. However, the government-initiated changes were grafted on to the existing system, rather than offering a complete overhaul.[38]

The result was continuing weaknesses in innovation and diffusion, and the weak links between industry and the academic community exacerbated the difficulties in technological development. When the university technology transfer network (OTRI) was established, its initial problem was the divide that existed between the two sectors, and the lack of knowledge regarding its potential on the part of industry.

A more general problem lay in the fact that the changes to the technological system that were brought about by government decree did not address the deep-rooted structural deficiencies.[39] The authorities recognised the problem regarding technological diffusion, and considered that the European Framework Programme could be one of the means of reducing the deficiencies in the domestic industry.

In its submission to the Fourth Framework programme, representatives put forward the national case that 'the Spanish government is deeply concerned by recurrent stimuli in favour of the so-called vertical programmes (or integrated projects) designed to support certain industrial sectors which can result in a relative decrease of the effort devoted to horizontal diffusive technologies.'[40]

The national authorities provided the leadership for participation in the European technology programmes, supported by the large, often foreign-owned multinationals. But most of the domestic industry was ill-prepared, either by accident of history or inherent industrial characteristics, to fully avail of the opportunities offered by the European policy.

8.5 Conclusion

The mode of interaction between national technological systems and the European institutional system provides a necessary link in the integration process. The examination of the process that operated between the two levels offers a contribution to integration theory, by highlighting the need to consider not simply questions of issue linkage, with the consequent package deal negotiation that is involved, but also the institutional system within which actors operate.

The quality of the institutional system within which actors operate, can act as a force for integration, or equally as a brake upon it. By restricting our attention to the institutional changes at the European-level, it is possible to neglect the fact that actors are also embedded in a local system that both affects their behaviour, and often their capacity to exert influence. More generally, the interests and motives of economic actors are expressed through a multi-level institutional system, which has a spatial element, within which interaction occurs. It is not only difficult but also unrealistic to expect an integration process where there is a simple uni-linear transfer of loyalties, and expectations.[41]

Theoretical analyses of the integration process which focus on particular elements, such as the role and authority of the supranational institution, or of the national government, or the power and influence of elite groups give only a partial analysis of the process. Such approaches may also serve to obscure the real limitations and perhaps overshadow possibilities for progress.

National governments have not always acted to the detriment of the integration process, and various analyses have shown that during the 1980s states recognised the benefits to integration as a means of solving common problems.[42] While approaches which concentrate upon the role of elite groups in the process have certain merit as explanatory tools, and the early 1980s technology policy reflects this fact, it has also come to be recognised that elite groups cannot always secure the broad base of support which the integration process ultimately needs.

Moreover, the difficulties of integrative measures which do little to integrate the national and supranational institutional systems become even more evident in the particular context of a European technology policy that seeks to add economic and social cohesion to the political goal of competitiveness. The institutional changes brought about by the Single European Act and the Maastricht Treaty will contribute little to the integration process without a consensus on, and a clear definition of all the political goals. But mostly, it will require an integration of the national and supranational institutional systems, not just the creation of a European network of mainly large firms.

8.5.1 The hypotheses reviewed

This thesis has been concerned with aspects of the new diplomacy in the European context, and in particular with the interaction between private actors, national governments and the supranational authority of the European Commission in technological collaboration. It is now time to return to the hypotheses that were put forward in the first chapter, and to consider the extent to which these hypotheses are supported by the evidence of the research.

Two hypotheses were put forward for testing against the empirical evidence. The first hypothesis was that national institutional capability is a key determinant in the integration process.

The evidence of this thesis supports the hypothesis. It was found that in both countries examined the motivations and expectations of actors were shaped by the institutional structure in which they operated, and not simply by the decisions of the supranational authority. The neo-functionalist prediction of an integration process that was driven by changes in attitudes, expectations and demands of economic actors, and a re-direction towards the central authority did not materialise in quite the straight-forward way that the theory implied. There were changes in attitudes and expectations certainly, but frequently the result was an adaptation of the domestic institutional system towards the European model.

A particular set of domestic circumstances giving rise to its own peculiar configuration of interests influenced the integrative pressures in each of the countries studied. In the UK, the national government played only an indirect role, but the policy of cutting public spending on research and technology and more general approach to public resources and private technological activities had the effect of switching the attention of domestic interests to the European level. European technology policy, as presented in terms of the battle for competitiveness and operated on the basis of broadly neo-liberal principles, represented no threat to the national government ideology. Unlike the European technology policies of the 1960s and 1970s, there was no challenge to national security, or anything that would oppose the often-stated purpose of cutting public spending.

In the technological system that was evolving under the government ideology of the 1980s, integrative pressures were exerted through the private economic actors, and the public organisations with responsibilities or interests in this area. With a more mature technological system, the country was able to attain a much higher participation rate in the European technology programmes than Spain, despite the latter's strong leadership role of the government and the widespread support for European integration throughout Spanish society. Technological capability was therefore key to the extent of integration actually achieved, and in large measure such capability is determined by the domestic institutional system.

Spanish support for integration was not matched by the technological capabilities of domestic industry and its ability to fully avail of the opportunities for European technological collaboration. Despite the ambitions and aspirations of the government, and a strong leadership drive towards European integration, it was not enough to bring the same level of participation in the European programmes that the large member states had attained. By 1994, it was evident that not enough had been done over the course of the 1980s to create a modern technological system, and European integration only served to underline this fact. Therefore, the government announced in 1994 a series of measures to establish a technological infrastructure to be put in place over a four-year period.

What has emerged from the study of these two member states was that expectations did not flow uni-directionally towards the centre. Actors were affected by changing interests in a complex interaction with other groups, and the result was the creation of a multi-level structure with actors articulating interests at the different levels, from the local to the supranational level.

The second hypothesis was that the nature of the community formed was influenced by underlying ideology and ideas, creating in the case of European technology policy a market-based community. The corollary to this hypothesis is that unless the upgrading of common interests can be experienced at all levels in the institutional structure it is impossible to create a real and lasting community.

The early view of sectoral integration as being inherently expansive cannot be accepted with certainty, but neither can one which relies upon the role of elites in a political process, if they are not perceived to represent the interests of a broad range of groups affected by the political processes that ensue. Economic actions and economic pressures, the original source of integrative pressures, occur as part of a broader set of social relations within an institutional structure. For instance, technology creation depends on the capability that the education and training systems provide, the provision for patent protection, and for a secure framework under which to conduct the necessary long-term research.

The second hypothesis raises more general issues regarding the integration process, and how neo-functionalist theory sees the process. Integration would proceed, the theory suggested, on the basis of the purely functional and technical. What has emerged from this research is that the functional and technical, like all economic activities, are not isolated from the political and social relations of which they are a part. The notion of an integration process centred upon the functional can only be sustained if the common interest is expressed in terms of what is essentially the lowest common denominator. Any attempt to upgrade the common interest will come face-to-face with the reality of the broader political and social relations that surround economic activities.

And it seems likely that any effort to take the integration process forward demands more than the leadership of the supranational authority. Equally relevant to the question of spill-over are the ideas which underpin the political process, and which give it momentum. Ideas also play a significant role in determining the path of integration, and the actors that will be involved, as well as the issues upon which integrative pressures are exerted.

The development of European technology policy is illustrative in this regard, where the objective was the creation of a technological community to foster the competitiveness of European industry. Competitiveness proved to be a unifying idea, but it also circumscribed the strategies, issues, and interests that would be considered, locking the community into a particular path of development.

By linking technology policy with competitiveness, policy inevitably took on a market-oriented bias, even when policy was in practice confined to pre-competitive activities. The formulation of policy was, despite the proclamations of the European Commission, essentially a top-down process which was then supplemented by a series of management activities to incorporate a wider number of actors. The Industrial Research and Development Advisory Committee (IRDAC) fitted into this structure - hand-picked by the Commission, with a brief to put forward the views of industry, but with only tenuous links to national institutional systems.

Is there a European technological community? The answer has to be in the affirmative, and the empirical findings of this research support this conclusion. There is a very active community of interests engaged with technological issues at the supranational level, complemented at the micro-level by a strongly integrated network of collaboration that has strengthened over the course of the past decade. But it is a technological community based around the narrow pursuit of competitiveness, managed by a supranational institution which upholds the market ideal. It is acknowledged that competitiveness and economic performance and growth are still greatly dependent on technology.[43]

As the early part of this chapter indicated, there is also some evidence of convergence in the views held by the supranational elites concerning what should be done to improve the competitiveness of European industry. But a convergence of elite views may not be enough to sustain a spill-over into other areas, and the difficulties arise when trying to identify the strength of this community.

But spill-over needs a broader base - an institutional system encompassing societally-based actors and interests beyond the confines of the market. Society's interests over a wide area are affected by technological development, and political integration has to recognise this reality. To date it has not done so, opting for a community based around a common interest in competitiveness and one that consequently represented the lowest common denominator. The introduction of economic and social cohesion is a challenge to this community, and to the ideas upon which it has developed.

8.5.2 Avenues for further research

Several observations may be made arising from the research presented here. One observation concerns the nature of technology policy generally. The European policy has been developed with very simple objectives, principally securing and retaining industrial competitiveness through a stronger technological base. But technology has an increasing and pervasive impact on society and economy both for good and ill. Despite the large amount of work conducted in recent years on the processes of technical change,[44] the results have been slow to filter through to public and political debate. A debate such as this could provide a useful input into future European technology policy, and indicate ways in which policy could develop so as to achieve economic and social cohesion. The argument that technological change creates a positive impact on employment has not it would seem been won, and there is much scope for a technology policy that could improve the position of European employment.[45]

The second observation centres upon the nature of theoretical debate on European integration. Despite the widespread interest in the process and the number of different approaches that have been adopted, there are in many respects very little differences between them. Similar elements feature throughout all - principally the role of the state as a significant actor, the supranational institution, and the power struggles and bargaining strategies of key players. Very little attention is given to the impact of integration processes on actors and institutions that fall outside the neo-realist frame of analysis. With growing scepticism over the democracy deficit in the European Union, it would seem like a good time to extend integration research to consider the impact of integration on social relations within and between member states.

The final observation may present a greater difficulty for integration theory. Many analyses of the integration process, including this one, have adopted an essentially short term perspective to examine the processes that led to a particular outcome, reflecting perhaps the dominance of researchers from the area of political science that have captured the topic. It could prove more fruitful to extend the time frame of analysis, a possibility which becomes more feasible as the European Union advances in maturity. Taking a longer term perspective, and using alternative disciplinary approaches, could offer valuable insights into integration that have been obscured by the political science approach.

Notes to chapter eight

1. CEC (1992) Evaluation of the effects of the EC Framework Programme for Research and Technological Development on Economic and Social Cohesion in the Community, Research evaluation report no. 48, EUR 13994 (Brussels).

2. The Evaluation panel consisted of eight members from a variety of backgrounds: industrial managers, research scientists from industry and university, and industrial consultants - representing Germany, Italy, Belgium, Switzerland, Finland, France, Holland and the United Kingdom.

3. CEC (1994) BRITE-EURAM, A Measurable Impact, EUR 15276 (Brussels).

4. CEC (1994) Economic Evaluation of the effects of the BRITE-EURAM programmes on the European Industry, M. Ledoux, Bureau d'Economie Théorique et Appliqué (BETA), Université Louis Pasteur, Strasbourg.

5. Research and Technological Development Activities of the European Union Annual Report, COM (95) 443, p. 30. BRITE-EURAM II (1990-1994) is sub-divided into three areas, raw materials and recycling, materials; design and manufacturing; aeronautics research.

6. The phrase `the rhetoric of competitiveness' was used by Paul Krugman, who argued that governments have mistakenly adopted the view that they are in competition with other states, a view that leads to dangerous policies such as protectionism and trade wars. See Paul Krugman (1994) Competitiveness: A Dangerous Obsession Foreign Affairs, March/April.

7. This is the definition used by Michael Porter who was considered a very influential contributor to the competitiveness debate. See M. E. Porter (1990) The Competitive Advantage of Nations (London, Macmillan). The same definition was used by the UK government in the 1994 White Paper, see HMSO (1994) Competitiveness: Helping Business to win, Cmnd 2563.

8. Porter did not see much merit in collaborative alliances, as they could damage the spirit of rivalry that he considered so essential to competitiveness. European policy, on the other hand, was based upon the encouragement of cooperation, and competition policy made specific provision, through the block exemptions, for this policy. As a result of the block exemptions, the Commission avoided any scrutiny of actions which, under the Porter analysis, could have an adverse impact on competitiveness.

9. See for instance, L. Mytelka (1991) Strategic partnerships. States, firms and international competition (London, Pinter); P. Laredo and M. Callon (1990) L'Impact des Programmes Communitaires Sur le Tissu Scientifique et Technique Francais (Paris, La Documentation Francaise).

10. See CEC (1994) European Report on Science and Technology Indicators (Brussels), p. 257.

11. See L. Georghiou et al (1993) Evaluation of the Impact of European Community Research Programmes upon the competitiveness of European Industry - concepts and approaches. MONITOR/SPEAR (Brussels); CEC (1994) An industrial Competitiveness Policy for the European Union, COM (94) 319 final.

12. A similar shift in thinking was becoming evident in the United States, although it had not yet become clear what new policies were needed, and whether any changes could move beyond a protectionist position. See, for example, William Milberg (1994) `Market Competition and the Failure of Competitiveness Enhancement Policies in the United States' in Journal of Economic Issues , vol XXVIII, no. 2, June. Milberg's critique centres on the view that competitiveness policies operated from a narrow view of competitiveness - stemming from the neo-classical allocative function of markets, while ignoring the other key functions of markets, the promotion of productivity, growth and technological innovation, and the generation of growth in income and demand. He concludes that `competitiveness is not synonymous with lower production costs and higher profit rates,' but depends also on skill development,

and upon work organisation, the competitive and cooperative environment, and organisational commitment.

13. The director of the FAST programme, Riccardo Petrella, in an opening address to a FAST conference in London, 29/30 March 1993, suggested that `while competitiveness is important, other factors such as cooperation, cohesion, complementarity and coherence may be more important in the long run.' See UK FAST Conference, The Future of Industry in Europe: Is Competitiveness the only Issue? [Conference papers, FAST, Brussels].

14. While both UNICE and IRDAC represent the voice of industry, there are constitutional differences between them. IRDAC was formally constituted by decision of the European Commission in 1984, while UNICE is the umbrella organisation for the national employers associations. Furthermore, IRDAC describes itself as a practical actor, with UNICE as a political actor. In practice, and depending upon the circumstances, such differences may not be significant.

15. IRDAC has been particulary active in this area, publishing several reports recently - School and Industry (1991), Skills Shortages in Europe (1991), Quality and Relevance. The Challenge to European Education (1994).

16. IRDAC Strategy Paper on Future Community RTD Policy, Opinion requested by Vice-President Pandolfi discussed at IRDAC`s Plenum/Seminar on 6/7 March 1992 and approved on 31 March 1992.

17. Communication from Yves Farges, Chairman of IRDAC to Commissioner Pandolfi, 29 June 1992.

18. Interview with Daniel Cloquet, UNICE, Brussels.

19. UNICE ``Research and Technological Development (RTD)" Working Group, Comments on desirable changes in the way community RTD activities are managed [Brussels, 2 December 1993], p. 4.

20. See report, ERT (1993) Beating the Crisis, which suggested that `governments and industry should work together to identify strategic areas which meet the needs of society and embody those enabling technologies where a major industrial society must be strong' (p.18), and it identified education and training as one of the conditions for competitiveness.

21. UNICE (1994) Making Europe more competitive. Towards world-class performance [Brussels].

22. Interview with Daniel Cloquet, UNICE, 6 July 1994, Brussels.

23. See Torger Reve and Lars Mathiesen (1994) European Industrial Competitiveness [SNF report, Norwegian School of Economics and Business Administration, Bergen]. This report was commissioned by UNICE, and prepared by the Foundation for Research in Economics and Business Administration, Bergen, Norway. It surveyed the literature on models of competitiveness, and identified micro-economic models which highlighted three sets of determinants: entrepreneurial people, aggressive firms and dynamic industrial clusters - the common element in all of these being knowledge and the organisation of relationships within and between firms. The report acknowledged the existence of market failure, and the role of public policy in stimulating networks between firms, research organisations and universities as part of an integrated industrial policy.

24. Bruce Ballantine, UNICE, interview 6 July 1994. The proposal has been put into storage for review again prior to the inter-governmental conference in 1996.

25. European Round Table (1993) Beating the Crisis. A Charter for Europe`s Industrial Future [Brussels, December]. At this time, two industrial representatives from the 40 members of ERT were also members of IRDAC.

26. ETUC (1993) Analysis of the 2nd Commission Working Document Concerning RTD Policy in the Community and the 4th Framework Programme (1994-1998) of Community RTD Activities (COM (93) 158) - RTD working group, doc.9306/2 [Brussels].

27. ETUC described its overall reaction to the European Commission's White Paper on Growth, Competitiveness and Employment (December 1993) as 'positive, but constructively critical.' It was particularly in agreement with the proposals on infrastructure investment and on new areas of job creation, but fearful of the role of social clauses in international agreements, and of the risk that macro-economic recommendations might slow the growth process. [ETUC, 14 March 1994, Brussels].

28. Ernst B. Haas (1964) 'Technocracy, Pluralism and the New Europe' in Stephen R. Graubard (ed.) A New Europe? (Boston, Houghton Mifflin), p. 64.

29. Daniel Cloquet, Industrial Affairs Committee UNICE, interview in Brussels, 6 July 1994.

30. Richard Escritt, Head of Division Framework Programme, DG XII, 6 July 1994.

31. Richard Kalb, Energy, Research and Technology Committee of the European Parliament, interviewed in Brussels, 7 July 1994.

32. Michael Miller, ETUC, interviewed in Brussels, 20 June 1994.

33. This was the view of Harry Beckers, Chairman of the Dutch Advisory Council for Science and Technology Policy and former IRDAC chairman - see IRDAC News, No. 5, Winter 1994.

34. See G. Dosi, C. Freeman, R. Nelson, G. Silverberg, L. Soete (1988) Technical Change and Economic Theory (London, Pinter).

35. A study by Eurostat (1994) showed that only 7% of the 14m enterprises in the European Union have more than 9 employees. Enterprises with fewer than 9 employees account for around one third of EU employment and a quarter of the EU's 10500 billion ECU annual turnover. Small businesses predominate in Spain, while in Germany, France and the UK larger firms have a bigger share of employment. Around 15% of the Spanish workforce is employed in companies with 500 people or more, against 38% in Germany. The four largest economies - France, Italy, Germany and the UK account for 67% of the 14m enterprises, and for 75% of the 92m people employed in the EU.

36. Luke Georghiou et al. (1993) The Impact of European Community Policies for Research and Technological Development upon Science and Technology in the UK (HMSO, report prepared for DG XII and Office of Science and Technology).

37. Science and Engineering Policy Studies Unit (1989) European Collaboration in Science and Technology: Pointers to the future for policy makers (London, The Royal Society).

38. It would appear from research that technological (institutional) systems develop slowly, and that even changes in direction are made within the context of the existing institutional system more often than by changing it. For example, Todd Schafer and Paul Hyland (1994) 'Technology Policy in the Post-Cold War World' Journal of Economic Issues, vol. XXVIII, no. 2, suggest that the call for defence conversion policy has opened the door to civilian technology policy - but policies continue to be largely mission-oriented, with the primary mission continuing to be national security.

39. It was perhaps not surprising that industry was regarded as the Achilles heel of the Spanish economy - it needed to improve the work organisation, cooperation among industrial sectors, introduce innovation into the production processes and products, and introduce greater flexibility in management. See Jean-François Larribau (1993) 'La politique économique, contraintes et perspectives de l'intégration européenne,' in Franck Moderne, Pierre Bon, L'Espagne Aujourd'hui (Paris, La documentation Française).

40. Ramón Gonzalez Rubio, CICYT (1992) On the Coming 4th Framework Programme - Comments from the Spanish Delegation, mimeo (Madrid). The government based its case on the following grounds: (a) legally, the concept of `scientific and technological basis' (Art. 130f) was not compatible with the actions of these programmes, which the government considered targeted more the needs of a handful of large companies that monopolised the sector, (b) politically, contrary to the spirit of the Treaty these actions might well contribute to an increasing of the scientific, technological and socio-economic gap among the member states, (c) technically, dissemination of results, the last step of Community R&D policy, would be seriously impaired.

41. Wolfgang Streeck concludes that what is needed is to look `not just at the interaction between two kinds of institutions, national and supranational, but at the relationship between the entire political-institutional complex that takes part in such interactions and results from it, and the integrated Internal Market economy that is embedded in it' - Wolfgang Streeck (1995) `From Market-Making to State-Building? Reflections on the Political Economy of European Social Policy', in S. Leibfried and P. Pierson, Prospects for Social Europe: the European Community's Social Dimension in Comparative Perspective (Washington, D.C., The Brookings Institute).

42. See for example, Wayne Sandholtz and John Zysman (1989) `1992: Recasting the European Bargain', World Politics, vol.42, no.1; David R. Cameron (1992) `The 1992 Initiative: Causes and Consequences' in A. Sbragia, ed., Euro-Politics (Washington, D.C., The Brookings Institute); R. O. Keohane and S. Hoffman (1991) The New European Community: Decisionmaking and Institutional Change (Boulder, Westview Press).

43. Margaret Sharp and Keith Pavitt (1993) `Technology Policy in the 1990s: Old Trends and New Realities' in Journal of Common Market Studies, 31, 2, June, p. 139.

44. A useful synthesis of this can be found in G. Dosi, C. Freeman, R. Nelson, G. Silverberg, L. Soete (1988) Technical Change and Economic Theory (London, Pinter).

45. Luc Soete and Christopher Freeman (1994) Work for all or mass unemployment (London, Frances Pinter).

APPENDIX 1 Third Framework Programme 1990 - 1994 (MECU)

I ENABLING TECHNOLOGIES		
1. Information and communication technologies		2490.84
- Information technologies	1516.68	
- Communication technologies	548.46	
- Telematics systems	425.7	
2. Industrial and materials technologies		996.93
- Industrial and materials technologies	839.52	
- Measurement and testing	157.41	
II MANAGEMENT OF NATURAL RESOURCES		
3. Environment		581.17
- Environment	464.35	
- Marine sciences and technologies	116.82	
4. Life sciences and technologies		831.6
- Biotechnology	184.14	
- Agriculture and agro-industry research	373.23	
- Biomedical and health research	149.49	
- Life sciences and technologies for LDCs	124.74	
5. Energy		1052.37
- Non-nuclear energies	259.38	
- Nuclear fission safety	230.67	
- Controlled nuclear fission	562.32	
III MANAGEMENT OF INTELLECTUAL RESOURCES		
6. Human capital and mobility		581.13
Centralised action for dissemination and optimisation of results		66
		6600

Note: *the initial agreed budget for the Third Framework Programme was 5700, with 900 MECU added on, bringing the overal total allocated to 6600 MECU.*

Source: Research and Technological Development Activities of the European Union Annual Report 1995, COM (95) 443 (Brussels).

APPENDIX 2
Fourth Framework Programme (1994-1998) MECU

ACTIVITY 1 - RTD and DEMONSTRATION PROGRAMMES			10686
I Information and communication technologies		3405	
1. Telematics	843		
2. Communications technologies	630		
3. Information technologies	1932		
II Industrial Technologies		1995	
4. Industrial/materials technologies	1707		
5. Standardisation/measurement/testing	288		
III Environment		1080	
6. Environment and climate	852		
7. Marine sciences and technologies	228		
IV Life sciences and technologies		1572	
8. Biotechnology	552		
9. Biomedicine and health	336		
10. Agriculture and fisheries	684		
V Energy		2256	
11. Non-nuclear energy	1002		
12. Nuclear fission safety	414		
13. Controlled thermonuclear fusion	840		
VI Transport		240	
VII Targeted socio-economic research		138	
ACTIVITY 2 COOPERATION WITH THIRD COUNTRIES			540
ACTIVITY 3 - DISSEMINATION OF RESULTS			330
ACTIVITY 4 - TRAINING AND MOBILITY OF RESEARCHERS			744
	TOTAL		**12300**

(In April 1995 the European Commission proposed a 7% increase in the allocated funds to cover the recent enlargement of the EU)

Source: Research and Technological Development Activities of the European Union Annual Report 1995, COM (95) 443, Brussels.

APPENDIX 3

RTD activities 1994 - selected programmes: new projects (contracts signed under the Third Framework Programme)

	BRITE-EURAM	ESPRIT	RACE
Total EC contribution (MECU)	261.05	249.2	46
Number of projects	706	178	25
Number of participants	1836	983	223
Average participants/project	2.6	5.5	8.9
Average number M.S./project	2	3.1	5.1
Average EC contribution (MECU)	0.37	1.4	1.84

M.S. = Member State
Source: Research and Technological Development Activities of the European Union Annual Report 995, COM (95) 443 (Brussels).

APPENDIX 4
Changes in RTD priorities between Framework programmes
(% of total budget)

	Framework Programmes			
	I	**II**	**III**	**iV**
	1984-87	1987-91	1990-94	1994-98
Information/communication technologies	25	42	38	28
industrial and materials technologies	11	16	15	16
Environment	7	6	9	9
Life sciences and technologies	5	7	10	13
Energy	50	22	16	18
Transport	0	0	0	2
Socio-economic research	0	0	0	1
international cooperation	0	2	2	4
Dissemination of results	0	1	1	3
Human capital and mobility	2	4	9	6
Total (%)	100	100	100	100
Total (MECU)	3750	5396	6600	12300

Source: European Report on Science and Technology Indicators, 1994 (CEC, Brussels)

APPENDIX 5
Survey questionnaires

BRITE/EURAM PROGRAMME
SURVEY 1

Please circle letter (s) corresponding to appropriate responses and return to:

Mary Farrell
77a Evering Road
London N16 7PR

Tel 0171 241 4591

1. How did your organisation become involved with the BRITE-EURAM programme?

A. Response to the European Commission (DG XII)
B. Response to national ministry circular
C. Approached by other interested party/participant
D. Our organisation initiated a proposal
E. Other ______________________________

2. How did you find your partner organisations?

A. EC data base
B. National data base
C. Partners contacted us
D. Other ______________________________

3. Is your organisation

A. An industrial firm with more than 500 employees
250-499 employees
150-249 employees
50-149 employees
0-49 employees
B. A research centre
C. A university
D. Other ______________________________

4. To what industrial sector does your organisation belong?

A. Aeronautics B. Construction C. Ceramics/glass
D. Electronics E. Engineering F. Food/drink
G. Leather/footwear H. Pharmaceuticals I. Robotics
J. Textiles/clothing
K. Other (please specify) ______________________________

5. To what industrial sectors do your partners belong?

A. Aeronautics B. Construction C. Ceramics/glass
D. Electronics E. Engineering F. Food/drink
G. Leather/footwear H. Pharmaceuticals I. Robotics
J. Textiles/clothing
K. Other (please specify) ________________________

6. Is this your first project under the BRITE-EURAM programme?

A. Yes B. No C. Don't know

7. How many organisations are involved in the project (not including you)?

A. Two B. Three C. Four D. Five or more
E. Not certain

8. What are the national origins of the partners (please indicate the number of partners corresponding to each country)?

A. Belgium ( ) B. Denmark ( ) C. France ( )
D. Germany ( ) E. Greece ( ) F. Ireland ( )
G. Italy ( ) H. Luxembourg ( ) I. Netherlands ( )
J. Portugal ( ) K. Spain ( ) L. United Kingdom ( )
M. Austria ( ) N. Finland ( ) O. Norway ( )
P. Sweden ( ) Q. Switzerland ( )

9. Had you previously collaborated with any of the partners participating in your BRITE-EURAM project?

A. Yes B. No C. Don't know

10. With how many of your previous partners had you previously collaborated?

A. One B. Two C. Three
D. Four or more E. Don't know

11. To what extent does your organisational strategy include collaboration at the European level?

A. Substantial B. Moderate C. Limited
D. Not at all

12. Does your organisation undertake other collaborative Research and Development at the international level?

A. Yes B. No C. Don't know

13. Does your organisation receive national/provincial government funding for R&D?

A. Yes B. No C. Don't know

14. Does your organisation participate in any of the following EC programmes?

A. ESPRIT B. EUREKA C. COMETT
D. CRAFT E. STRIDE F. VALUE
G. Other ______________________________

15. Does the project also involve marketing/production/finance personnel from your organisation?

A. Marketing only B. Production only C. Finance
D. At least two of these E. Don't know

16. Does the collaborative project include the participation of a potential user of the new technology?

A. Yes B. No C. Don't know

17. What level of support and guidance has the national ministry provided in setting up this project?

A. Substantial B. Moderate C. Limited
D. None

18. After this BRITE-EURAM project is completed, would your organisation consider collaborating with your current partners again to pursue commercialisation?

A. Yes B. No C. Don't know

19. Do you think your organisation will improve its ability to engage in collaborative activity as a result of the experience in the BRITE-EURAM programme?

A. No B. Slight improvementC. Major improvement
D. Don't know

20. Do you think your organisation may participate in other BRITE-EURAM projects in the future?

A. Yes B. No C. Don't know

21. What are the benefits you believe your organisation will receive from this BRITE-EURAM collaborative project? (Please rank in order of importance, choosing as many as are appropriate, with 1 being the most important)

	1	**2**	**3**
R&D costs reduced	*	*	*
Early access to new technology or knowledge	*	*	*
Better chance of product completion	*	*	*
Larger project or increased funds	*	*	*
Mobility/exchange of personnel	*	*	*
Knowledge of partner's product or strategy	*	*	*
Access to supplier network	*	*	*
Protection from foreign competition	*	*	*
Influence on development of standards	*	*	*
Access to customer network	*	*	*
Interchange of ideas	*	*	*
Elimination of duplicated R&D efforts	*	*	*

Improvement of competitive position	*	*	*

22. What were the major problems involved in collaboration under the BRITE-EURAM programme? (Please rank in order of importance, choosing as many as are appropriate, with 1 as the most important)

	1	2	3
Finding the right partners	*	*	*
The administration and paperwork of the project	*	*	*
Language problems	*	*	*
Different expectations among partners	*	*	*
Intellectual property rights	*	*	*
Greater risk of results going to competitors	*	*	*
Fixing the location of the collaborative work	*	*	*
Absence of skilled personnel	*	*	*

23. Would your organisation engage in this collaborative research without the support of the BRITE-EURAM programme?

A. Yes B. Probably C. No D. Don't know

24. Did your organisation carry out any of these activities prior to the project?

A. Yes B. No C. Don't know

25. Approximately what proportion of your organisation's R&D costs will be covered by EC funds?

A. 31-50% B. 26-30% C. 21-25%
D. 16-20% E. 11-15% F. 6-10%
G. 3-5% H. <3% I. Other _______

26. Approximately what proportion of your organisation's R&D budget is covered by national government contributions?

A. 31-50% B. 21-30% C. 15-20%
D. 10-14% E. 5-9% F. <5%
G. Other _______________

27. Did you and your partners negotiate intellectual property rights or licensing agreements?

A. Yes B. No C. Not yet
D. Other ____________________

28. How could the Commission provide more assistance to participants under the BRITE-EURAM programme? (Circle as many as you consider important)

A. Provide more information about partners
B. Provide more direct involvement in managing the collaborative project
C. Eliminate delays in accepting projects
D. Provide more help with norms and standards of technology
E. Provide more funding
F. Other ____

29. Was your organisation's decision to collaborate influenced by trade association/sectoral interest group opinion?

A. Yes B. No C. Don't know

30. (I) Does your organisation engage in domestic (national) R&D collaboration with any of the following?

A. Business firms B. Research centres C. Universities
D. Other ____________________

(II) Is this collaboration

A. Substantial B. Moderate C. Limited
D. None

PROGRAMA BRITE-EURAM
<u>ESTUDIO 1</u>

Se ruega ponga un círculo alrededor de la letra o letras que corresponden a las respuestas pertinentes y devuelva este impreso a:

Mary Farrell
77a Evering Road
London N16 7PR
England

Tel. 0171 241 4591

1. ¿Cómo empezó su organización a interarse por el programa BRITE-EURAM?

A. En contestación a la Comisión Europea (DG XII)
B. En contestación a la circular del CDTI
C. A través de la iniciativa de una parte/participante interesado
D. Nuestra organización sometió una propuesta
E. Otra ________________________________

2. ¿Cómo localizaron a sus organizaciones socias?

A. Base de datos de la CEB. Base de datos nacional
C. Socios se pusieron en contacto con nosotros
D. Otra ________________________________

3. Su organización es

A. Una firma industrial con más de 500 empleados
250-499 empleados
150-249 empleados
50-149 empleados
0-49 empleados

B. un centro de investigación
C. Una universidad
D. Otra ________________________________

4. ¿A qué sector industrial pertenece su organización?

A. Aeronáutica B. Construcción C. Cerámica/vidrio
D. Electrónica E. Ingeniería F. Robótica
G. Alimentación/Bebidas H. Cuero/Calzado
I. Farmacéutico J. Textiles/Confección

K. Metal-mecánico L. Otro ________________________

5. ¿A qué sector or sectores industriales pertenecen sus socios?

A. Aeronáutica B. Construcción C. Cerámica/vidrio
D. Electrónica E. Ingeniería F. Robótica
G. Alimentación/Bebidas H. Cuero/Calzado
I. Farmacéutico J. Textiles/Confección
K. Metal-mecánico L. Otro __________________________

6. ¿Se trata éste de su primer proyecto bajo el programa BRITE-EURAM?

A. Sí B. No C. No se sabe _____________________

7. ¿Cuántas organizaciones están interesadas en el proyecto (sin incluir la suya)?

A. Dos B. Tres C. Cuatro D. Cinco o más
E. No se sabe con certeza

8. ¿Cuáles son las nacionalidades de los socios (y cuántos socios de cada país)?

A. Bélgica ( ) B. Dinamarca ( ) C. Francia ( )
D. Alemania ( ) E. Grecia ( ) F. Irlanda ( )
G. Italia ( ) H. Luxemburgo ( ) I. España ( )
J. Holanda ( ) K. Portugal ( ) L. Inglaterra ( )
M. Austria ( ) N. Finlandia ( ) O. Noruega ( )
P. Suecia( ) Q. Suiza ( )

9. ¿Ha colaborado anteriormente con cualesquiera de los socios que participan en su proyecto BRITE-EURAM?

A. Sí B. No C. No se sabe _________________

10. ¿Con cuántos de sus socios actuales ya había colaborado anteriormente?

A. Uno B. Dos C. Tres D. Cuatro o más
E. No se sabe ___________________________________

11. ¿Hasta qué límite su estrategia de organización incluye colaboración a un nivel europeo?

A. Importante B. Regular C. Limitado
D. Ningún

12. ¿Colabora su organización en empresas de colaboración para la Investigación y el Desarrollo a un nivel internacional?

A. Sí B. No C. No se sabe ____________________

13. ¿Recibe su organización financiación del estado nacional para la Investigación y el Desarrollo?

A. Sí B. No C. No se sabe _____________________

14. ¿Participa su organización en cualesquiera de los programas siguientes de la CE?

A. ESPRIT B. EUREKA C. COMETT D. CRAFT
E. STRIDE F. VALUE G. Otro _________________

15. ¿Requiere también el proyecto la participación del personal de marketing/producción/financiero de su organización?

A. Marketing solamente B. producción solamente
C. Financiero D. Por lo menos dos de éstos
E. No se sabe ________________________

16. ¿Incluye el proyecto de colaboración la participación de un posible usuario de la nueva tecnología?

A. Sí B. No C. No se sabe

17. ¿Qué nivel de ayuda y de orientación ha proporcionado al establecer este proyecto:

( ) El CDTI
( ) Asociaciones profesionales de investigación
( ) Oficinas de transferencia de resultados de investigación
( )Otras? ___________________

A. Importante B. Regular C. Limitado
D. Ningún

18. ¿A la finalización del proyecto BRITE-EURAM, consideraría su organización colaborar de nuevo con sus actuales socios para proseguir la comercialización?

A. Sí B. No C. No se sabe ____________________

19. ¿Cree que su organización mejorará su capacidad para participar en actividades de colaboración como resultado de la experiencia en el proyecto BRITE-EURAM?

A. No B. Una ligera mejora C. Una gran mejora
D. No se sabe ________________________________

20. ¿Cree que su organización participará en el futuro en otros proyectos BRITE-EURAM?

A. Sí B. No C. No se sabe ______________________

21. ¿Cuáles son los beneficios que en su opinión cree que percibirá su organización de este proyecto de colaboración BRITE-EURAM? (Se ruega lo clasifique en orden de importancia, escogiendo cuántos sean pertinentes, clasificando el 1 como el más importante, 2 importante, y 3 el menos)

	1	2	3
Reducción en los costes de Investigación y Desarrollo	*	*	*
Acceso rápido a nueva tecnología o conocimiento	*	*	*
Una mejor oportunidad de finalizar el proyecto	*	*	*
Un mayor proyecto o un aumento de fondos	*	*	*
Rotación/intercambio de personal	*	*	*
Conocimiento de los productos o estrategia del socio	*	*	*
Acceso a la red de proveedores	*	*	*
Protección de la competencia extranjera	*	*	*
Influencia sobre el desarrollo de las normas	*	*	*
Acceso a la red de clientes	*	*	*
Intercambio de ideas	*	*	*
Eliminación de una duplicación de esfuerzos en I+D	*	*	*
Mejora en el campo competitivo	*	*	*

22. ¿Cuales fueron los problemas princípales que surgieron en la colaboración bajo el programa BRITE-EURAM? (Se ruega los clasifique en orden de importancia escogiendo cuántos sean pertinentes, escogiendo el 1 como el más importante, 2 importante, y 3 el menos)

	1	2	3
Encontrar los socios idóneos/estranjeros	*	*	*
La administración y papeleo del proyecto	*	*	*
Problemas lingüísticos	*	*	*
Las diferentes expectativas entre los socios	*	*	*
Los derechos de la propriedad intelectual	*	*	*
Un mayor riesgo de que los resultados se transmitan a los competidores	*	*	*
La fijación de la ubicación del trabajo de colaboración	*	*	*
Ausencia de personal especializado	*	*	*

23. ¿Participariá su organización en esta investigación de colaboración sin el apoyo de BRITE-EURAM?

A.Sí B. Probablemente C. No
D. No se sabe ______________________________

24. ¿Llevó a cabo su organización cualesquiera de estas actividades, antes del proyecto?

A. Sí B. No C. No se sabe

25. ¿Aproximadamente, qué proporción de los costes de Investigación y Desarrollo de su organisación se cubrirán por los fondos de la CE?

A. 31-50% B. 26-30% C. 21-25% D. 16-20%
E. 11-15% F. 6-10% G. 3-5% H. <3%
I. Otro ____________________

26. ¿Aproximadamente, qué proporción del presupuesto de Investigación y Desarrollo de su organización está cubierto por aporciones del estado nacional?

A. 31-50% B. 21-30% C. 15-20% D. 10-14%
E. 5-9% F. <5% G. Otro _______________

27. ¿Negoció su organización y sus socios derechos de la propriedad intelectual o contratos de licencia?

A. Sí B. No C. Todavía no
D. Otro ________________________

28. ¿Cómo podría proporcionar la Comisión más ayuda a los participantes bajo el programa BRITE-EURAM? (Ponga un círculo alrededor de cuantos considere importante)

A. Proporcionando más información sobre los socios
B. Proporcionando una participación más directa en la gestión del proyecto de colaboración
C. Eliminando los retrasos en la aceptación de los proyectos
D. Proporcionando más ayuda con las normas y estanderes de tecnología
E. Proporcionando más financiación
F. Otro ____

29. ¿Influyeron las opiniones de alguna asociación comercial/grupo de interés sectoral en la decisión de colaboración por parte de su organización?

A. Sí B. No C. No se sabe ________________________

30. (I) ¿Participa su organización en la colaboración nacional sobre la Investigación y Desarrollo con cualesquiera de las siguientes entidades?

A. Empresas comerciales B. Centros de investigación
C. Universidades D. Otros ________________________

(II) ¿Esta colaboración es

A. Importante B. Regular C. Limitada
D. No existe?

BRITE-EURAM programme

Survey of participants - Part II

Please circle the appropriate response and return to:

Mary Farrell
77a Evering Road
London N16 7PR

1. How many years has your organisation participated in the BRITE-EURAM programme?

** 1-2 years ** 2-4 years ** 4-6 years ** 6 or more

2. How has collaboration under this programme benefited your organisation? (Please rank in order of importance, choosing as many as are appropriate, with 1 being the most important and 3 the least)

	1	2	3
R&D costs reduced	*	*	*
Early access to new technology			
Better chance of product completion	*	*	*
Larger project or increased funds	*	*	*
Mobility/exchange of personnel	*	*	*
Knowledge of partner's product			
or strategy	*	*	*
Access to supplier network	*	*	*
Protection from foreign competition	*	*	*
Influence on development of standards	*	*	*
Access to customer network	*	*	*
Interchange of ideas	*	*	*
Elimination of duplicated R&D efforts	*	*	*
Improvement of competitive position	*	*	*

3. What were the major problems involved in collaboration under the BRITE-EURAM programme? (Please rank in order of importance, choosing as many as are appropriate, with 1 as the most important and 3 the least)

	1	2	3
Finding the right partners	*	*	*
Administration and paperwork of the project	*	*	*
Language problems	*	*	*
Different expectations among the partners	*	*	*
Intellectual property rights	*	*	*
Greater risk of results going to competitors	*	*	*
Fixing the location of the collaborative work	*	*	*
Absence of skilled personnel	*	*	*

4. Should the BRITE-EURAM programme be extended to cover:

- fundamental research	*
- applied research	*
- design of prototypes	*
- development of new processes	*
- development of new products	*
- training	*
- quality control	*

5. What lessons can you draw from the experience of European technological collaboration?

____

____

What are the lessons for business generally?

____

____

What are the lessons for national government?

____

____

6 (A) Do you think that, in general, Community technology programmes and national technology programmes are:

- independent *
- complementary *
- similar *
- overlapping? *

6 (B) Do national programmes facilitate/promote the participation in Community programmes?

yes * no* don't know *

7. How would you classify the information provided by the Commission for participants?

inadequate * adequate * good *

8. How many workshops or special sessions organised by the Commission for participants have you attended?

none * 1-2 * 3-4 * 4 or more *

9. After this BRITE-EURAM project is completed, would your organisation consider collaborating with your current partners again to pursue commercialisation?

yes * no * don't know *

10. Do you think your organisation will improve its ability to engage in collaborative activity as a result of the experience in the BRITE-EURAM programme?

no * slight improvement * major improvement *
don't know *

11. Do you think your organisation may participate in other BRITE-EURAM projects in the future?

yes * no * don't know *

12. How could the Commission provide more assistance to participants under the BRITE-EURAM programme? (Tick as many as you consider important)

- provide more information about partners *
- provide more direct involvement in managing the collaborative project *
- eliminate delays in accepting projects *
- provide more help with norms and standards of technology *
- provide more funding *

13. Should trade associations/sectoral interest groups play a more active role in (i) the formulation (ii) the management of the BRITE-EURAM programme?

yes * no * don't know *

14. Do cultural traits/national characteristics affect:

choice of partners? yes * no * don't know *

success of collaboration? yes * no * don't know *

comments

____

____

____

15. In your opinion, has the BRITE-EURAM programme made a positive impact on:

the competitiveness of European industry?
the innovative capability of industry?

____

____

____

____

16. Do you have any further comments on the impact or future development of the BRITE-EURAM programme, or the European technology policy in general?

____

PROGRAMA BRITE-EURAM

ESTUDIO DE LOS PARTICIPANTES - PARTE II

Se ruega ponga un círculo alrededor de las respuestas pertinentes y devuelva este impreso a

Mary Farrell
77a Evering Road
London N16 7PR

1. ¿Cuántas años ha participado su organización en el programa BRITE-EURAM?

1-2 años * 2-4 años * 4-6 años * 6 o más *

2. ¿Cuáles son los beneficios de la colaboración BRITE-EURAM para su organización? (Se ruega lo clasifique en orden de importancia, escogiendo cuantos sean pertinentes, clasificando el 1 como el más importante, 2 importante, y 3 el menos)

	1	2	3
Reducción en los costes de Investigación y Desarrollo	*	*	*
Acceso rápido a nueva tecnología	*	*	*
Una mejor oportunidad de finalizar el producto	*	*	*
Un mayor proyecto o un aumento de fondos	*	*	*
Rotación/ intercambio de personal	*	*	*
Conocimiento de los productos o estrategia del socio	*	*	*
Acceso a la red de proveedores	*	*	*
Protección de la competencia extranjera	*	*	*
Influencia sobre el desarrollo de las normas	*	*	*
Acceso a la red de clientes	*	*	*
Intercambio de ideas	*	*	*
Eliminación de una duplicación de esfuerzas en I+D	*	*	*
Mejora en el campo competitivo	*	*	*

3. ¿Cuáles fueron los problemas principales que surgieron en la colaboración bajo el programa BRITE-EURAM? (Se ruega los clasifique en orden de importancia escogiendo cuantos sean pertinentes, escogiendo el 1 como el más importante, 2 importante, y 3 el menos)

	1	2	3
Encontrar los socios idónos estranjeros	*	*	*
Administración y papelero del proyecto	*	*	*
Problemas lingüísticos	*	*	*
Las diferentes expectativas entre los socios	*	*	*
Los derechos de la propiedad intelectual	*	*	*
Un mayor riesgo de que los resultados se transmitan a los competidores	*	*	*
La fijación de la ubicación del trabajo de colaboración	*	*	*
Ausencia d personal especializado	*	*	*

4. ¿Qué otro(s) aspecto(s) debería cubrir el programa BRITE-EURAM?

- investigación fundamental	*
- investigación aplicada	*
- desarrollar prototipos	*
- desarrollar procesos nuevos	*
- desarrollar productos nuevos	*
- formación	*
- controlar calidad	*

5. ¿Cuáles son las lecciones de la colaboración tecnológica europea para su organización?

____
____
____

para la industria?

____
____
____

para el gobierno?

____
____

6 (A) ¿Cree que en general los programas tecnológicos europeos y los programas al nivel nacional son

	independientes	*
o	complementarios	*
o	parecidos	*
o	coincidentes?	*

6 (B) ¿Cree que los programas nacionales facilitan o contribuyen a participar en los programas europeos?

Sí * No * No se sabe *

7. ¿Cómo clasificaría la información diseminado por la Comisión para los participantes?

inadecuada * adecuada * bien *

8. ¿A cuántos coloquios/jornadas informativas organizados por la Comisión para los participantes ha asistido?

Ningún * 1-2 * 3-4 * 4 o más *

9. ¿A la finalizacion del proyecto BRITE-EURAM, colaboraría su organización de nuevo con sus actuales socios para proseguir la comercializacion?

Sí * No * No se sabe *

10. ¿Cree que su organización mejorará su capacidad para participar en actividades de colaboración como resultado de la experiencia en el proyecto BRITE-EURAM?

No * Una ligera mejora * Una gran mejora *
No se sabe *

11. ¿Cree que su organización participará en el futuro en otros proyectos BRITE-EURAM?

Sí * No * No se sabe *

12. ¿Cómo podría proporcionar la Comisión más ayuda a los participantes bajo el programa BRITE-EURAM? (Ponga un círculo alrededor de cuantos considere importante)

- proporcionando más información sobre los socios	*
- proporcionando una participación más directa en la gestión del proyecto de colaboración	*
- eliminando los retrasos en la aceptación de los proyectos	*
- proporcionando más ayuda con las normas y estándares de tecnología	*
- proporcionando más financiación	*

13. ¿Deberían las asociaciones comerciales/los grupos de interés sectoral jugar un papel más importante en (i) la formación (ii) la dirección del programa BRITE-EURAM?

Sí * No * No se sabe *

14. ¿Influyen las caracteristicas cultural nacionales en la selección de socios?

Sí * No * No se sabe *

en el éxito de colaboración?

Sí * No * No se sabe *

Por ejemplo:

____

____

____

____

15. ¿Cree que el programa BRITE-EURAM ha hecho un impacto positivo en:

(i) la competividad de la industria europea?

Sí * No * No se sabe *

(ii) la capacidad innovativa de la industria?

Sí *   No *   No se sabe *

16. ¿Tiene Ud. otra opinión sobre el impacto o desarrollo del programa BRITE-EURAM, o la política tecnología europea en general?

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