FOREIGN ACCESS TO TECHNOLOGY PROGRAMMES

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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FOREWORD

The participation of foreign firms in government-funded programmes for research and development remains a controversial issue. OECD governments have sometimes restricted access by foreign firms for reasons of competitiveness as well as national security. And they have imposed certain restrictions on the exploitation of research results and regarding the treatment of their firms abroad. There are continuing fears that foreign firms may gain technology and know-how at the expense of the funding country. And there is concern that the home countries of foreign firms may not grant access on comparable terms. Unfortunately, both the rules and practice regarding foreign participation in publicly-supported research are not very transparent. This study is intended to illuminate the current status of foreign firm participation in the major technology programmes of the United States, Europe and Japan.

The analysis of foreign access to technology programmes is part of the work on international technology issues of the Working Group on Innovation and Technology Policy (TIP) of the OECD Committee for Scientific and Technological Policy (CSTP). This background report will contribute to identifying barriers to the implementation of the OECD Principles for Facilitating Technology Co-operation Involving Enterprises, adopted by the OECD Council in September 1995. These principles state that "*governments, in furthering the public good, can fulfil a useful role in structuring and implementing co-operation between each other, that involves enterprises and other institutions as partners.*" They further instruct the CSTP to continue work in this area to determine what actions might be necessary to remove barriers inhibiting mutually-beneficial international technology co-operation involving enterprises.

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SUMMARY

Participation by foreign firms in government-funded R&D and technology programmes is increasing in the OECD area, although on a small scale. Participation is most often by *domiciled foreign firms* (those with an R&D or production presence in the country), while participation by *non-domiciled foreign firms* is still relatively rare. In general, access for foreign firms may be restricted for strategic purposes as well as for concerns relating to economic and technological competitiveness. This paper reviews the rules and status of access of foreign firms to the major national technology programmes in the United States, Europe and Japan; it is not intended to be a comprehensive survey of foreign participation in all technology activities or in all OECD countries.

There are no clear national, regional or international rules governing the eligibility of foreign firms for access to government-funded technology programmes. Rules and participation tend to differ from country to country and from programme to programme, which gives rise to a wide variety of situations. Access by foreign firms may be negotiated on a bilateral basis for certain projects. Access decisions may also be based on criteria relating to: (1) *reciprocal or comparable treatment* of domestic firms in the home countries of foreign firms; and (2) *domestic exploitation* in the host country of the results of the R&D programme. Although such provisions may be included in the authorising legislation or frameworks for technology programmes, it is unclear to what extent they are applied in practice.

Discrepancies in the treatment of domestic and foreign firms with regard to government-funded technology programmes, although intended to help capture R&D spillovers at the national level, are generally not conducive to international technology co-operation. Three aspects of these programmes have been highlighted as potential barriers to technology co-operation involving enterprises:

Reciprocity – Reciprocity requirements (i.e. *that domestic firms be granted equal access to national technology programmes in the foreign firm's home country*) may be specified in government-funded technology programmes. In some cases, these requirements have extended beyond technology access to foreign investment conditions and the protection of intellectual property rights.

Exploitation – Criteria for technology access may be included which relate to economic performance or exploitation (e.g. *that foreign firms exploit or manufacture in the host country innovations resulting from access to technology programmes*). These conditions may be part of the intellectual property or funding provisions of technology programmes.

Transparency – Foreign participation in national technology programmes may be regulated by a variety of directives, agreements and requirements within individual countries. Access by foreign firms may be discouraged by a dearth of information and lack of transparency of the rules relating to their participation in national technology programmes.

BACKGROUND

A. Introduction

Against a background of increased globalisation of research and development (R&D) efforts, the issue of foreign access and participation in national technology programmes has raised concern among policy makers in OECD countries. Foreign participation in government-supported technology programmes may engender both costs and benefits to host countries and participants which are difficult to quantify. There is a perception among some elements of the government and public that foreign access to public R&D may confer foreign entities with technology and know-how, largely at the expense of the host country. In another view, foreign participation is seen as leveraging public support and strengthening a country's national knowledge base, particularly at a time of decreasing government research budgets in many OECD countries.

While many OECD governments have tended to promote foreign participation in *private* R&D activities - by reducing barriers to investment and trade - as a way of harnessing economic and technological benefits, they have been more cautious with regard to foreign access to *public* R&D programmes, at times for reasons of national security, but also partly for reasons of technological and economic competitiveness. Governments tend to fund these programmes to correct local market failures which lead to under-investment in R&D and to capture spillover benefits; they may not want these spillovers to accrue to other countries. The net costs and benefits of foreign access to public research programmes depends to a large extent on the rules governing participation, particularly the degree of access that OECD countries confer to one another. There is a view that asymmetries in foreign access to public R&D among countries can distort the playing field, especially when countries grant access to foreign firms whose home country does not grant access on comparable terms or imposes a range of restrictions that effectively discourage access by foreign firms. This background paper aims to shed light on the current status of foreign firm participation in the major technology programmes of the United States, Europe and Japan and to highlight the main issues for policy makers.

B. Modes of foreign participation

Foreign participation in government-funded R&D and technology programmes can take a variety of forms. The participants can be foreign governments, firms, non-profit institutions, universities or individuals (researchers or students). The programmes can be those of governments, universities, national laboratories and/or other research institutions. This paper focuses on participation in government-funded technology programmes by foreign firms. In considering the issue of foreign access, a distinction should be made between two types of foreign firm: domiciled foreign companies and non-domiciled foreign companies.

- ◊ *Domiciled foreign companies* are firms with a research and development and/or production presence in the country.
- ◊ *Non-domiciled foreign companies* are firms without an R&D and/or production presence in the country.
- ◊ *Domestic firms* are those which are indigenous or nationally-owned.

This paper discusses the rules and status of foreign participation in national technology programmes in terms of domestic firms, domiciled foreign firms and non-domiciled foreign firms. It should be noted however that, given the current degree of industrial globalisation, it is becoming more and more difficult to distinguish between domestic and foreign firms.

Three aspects of foreign participation are important to take into account: access, finance and exploitation.

- ◊ *Access* refers to the rules and regulations governing the right of foreign firms to participate in publicly-funded technology programmes.

- ◊ *Finance* refers to the rules and regulations governing the funding of foreign firms participating in these programmes.

- ◊ *Exploitation* refers to the rules and regulations governing the right of foreign firms to exploit the outputs of work conducted within publicly-funded programmes, including statutes pertaining to patents and other intellectual property rights.

C. Overview of foreign participation

There is no single source of information or data concerning the participation by foreign firms in national technology programmes. Although limited in nature, the data collected by the DSTI Industry Committee project on "*Public Support to Industry*" gives some insight into the extent of foreign participation in such programmes (OECD, 1996). The objective of this project is to improve international transparency and comparisons of trends and patterns in public support to manufacturing industry. It reviews the evolution of support policies in 24 OECD Member countries, the Slovak Republic and at the level of the European Union based on reporting of 1 552 support programmes, including support schemes for research and development. Approximately 17 per cent of the programmes surveyed were reported as having R&D and technological innovation as their primary objective. Net expenditure for these programmes increased strongly between 1989 and 1992 from US$ 6.4 billion to US$ 10.0 billion but decreased to US$ 8.7 billion in 1993, perhaps due to reporting gaps. In terms of both programmes and expenditure reported, public support to R&D and technological innovation ranked as the second most important policy area at the end of the reporting period.

As part of this project, information was collected on foreign access to public support programmes and the degree of "*national treatment*". Programmes were broken down into four categories:

1) *national only* – limited to nationally-owned enterprises;

2) *all domestic* – limited to domestically-established enterprises, including foreign-owned;

3) *world-wide* – open to all manufacturing enterprises, wherever established and whatever their ownership; and

4) unspecified.

In general, public support programmes illustrated increasing internationalisation with only 4.1 per cent of all programmes reported being limited to nationally-owned enterprises at the end of the reporting period. Approximately 78 per cent of programmes are open to domiciled foreign firms and 8 per cent have no restrictions on the geographical location or ownership of firms.

The same profile existed for programmes supporting R&D and technological innovation: only 4 per cent were reported as limited to domestic enterprises, while 74 per cent were open to domiciled foreign firms and 9 per cent were open to non-domiciled foreign firms (*see* **Table 1**). Almost 13 per cent of programmes were placed in the unspecified category. With regard to the financing instruments used in the nationally-limited R&D support programmes, seven were funded by regular grants, one by a reimbursable grant, one by a regular loan and two by mixed instruments. On the basis of these data, it appears that few national technology programmes in the OECD area have a policy of restricting participation by domiciled foreign firms, although such access is often not extended to non-domiciled foreign firms. It should be noted that this reflects the legal or "*de jure*" situation rather than the actual or "*de facto*" participation by foreign companies.

Table 1. R&D support programmes by national treatment (1993)

Type of national treatment	Number of R&D programmes	Percentage of R&D programmes
All domestic	199	74.0
National only	11	4.1
World-wide	25	9.3
Unspecified	34	12.6

Source: OECD Industrial Support Database, April 1996.

TRENDS IN FOREIGN PARTICIPATION

A. United States

Overview

The United States has no general policy or rules governing foreign participation in government-funded R&D and technology programmes. For the most part, access by foreign companies is determined on a programme-by-programme basis. Due to the decentralised funding and management of publicly-funded research activities in the United States, there exist no comprehensive data or information on overall foreign participation. However, survey evidence shows that in 1988, foreign entities accounted for nearly 2 per cent of publicly-funded R&D activities in the United States. Nearly two-thirds of this is accounted for by foreign governments and non-profit institutions, while it is estimated that foreign firms contributed slightly more than one-third of all foreign funding for public research (NAE, 1996).

Certain requirements regarding economic performance and reciprocity have been included in US legislation for access by foreign firms to government-funded research and development programmes (OTA, 1995 and NAE, 1996). These legislative requirements have stemmed from concern that in some foreign countries, US firms have faced barriers to access to technology programmes funded by foreign governments. Economic performance requirements may call for '*localised exploitation*' in the United States of the results and outputs of the R&D carried out by firms (both domestic and foreign). '*Reciprocity*' asks for equal access for US firms to the national programmes of the foreign firm's own country. More recently, efforts have been made by the US Administration to prevent the inclusion of such requirements in authorising legislation for technology programmes. The discussion below focuses on rules pertaining to foreign firm participation in selected US national technology programmes. In practice, it appears that these rules have been interpreted in a flexible manner.

Co-operative Research and Development Agreements (CRADAs)

Since the late 1980s, there has been increased participation by foreign firms in *Co-operative Research and Development Agreements* (CRADAs), which are research accords between industry and US federal laboratories. It is estimated that US federal laboratories perform 13 per cent of all technological development-based R&D and 18 per cent of all basic research as well as 16 per cent of all applied R&D in the United States. Under the CRADAs, which were authorised by the 1986 *Federal Technology Transfer Act*, a private organisation provides personnel, equipment and/or financing for a specified R&D activity that complements the mission of its federal laboratory partner. Available data show that between October 1986 and end-September 1997, at least 104 CRADAs were negotiated with foreign companies by the National Institute of Standards and Technology (NIST), the National Institutes of Health (NIH), Argonne National Laboratory and Oak Ridge National Laboratory (*see* **Table 2**).

Table 2. US CRADA with foreign firms in selected laboratories
(1986-1997)

Laboratory	Total CRADA	CRADA with foreign firms or subsidiaries of foreign firms
NIST	500	47
NIH	475	41
Argonne	92	2
Oak Ridge	225	14

Source: US Government.

Authority for entering into a CRADA has been delegated to the respective agencies, who are generally instructed by legislation to "*give preference to business units located in the United States that agree that products embodying inventions made under the [CRADA] or produced through the use of such invention will be manufactured substantially in the United States.*" As such, participation in CRADAs is effectively limited to domestic and domiciled foreign firms. Federal agencies must also consider reciprocity or comparable treatment conditions for foreign firms, or whether comparable access to similar public research activities is granted in their home country. In some cases, the reciprocity or comparable treatment criteria have been extended beyond the issue of comparable access to research in the home country of the foreign firm to encompass comparable access to investment and intellectual property protection.

Some of the initial economic performance guidelines issued by the Department of Energy (DoE) in terms of the requirement for "*substantial US manufacturing*" were criticised as excessively restrictive in so far as they stipulated that intellectual property resulting from the CRADA should only be exploited in the United States. US companies as well as foreign firms expressed concern about these guidelines which they believed would weaken their ability to compete globally. In response, efforts were made to improve the process of approval and certification by DoE by streamlining procedures and allowing flexibility with respect to certain economic and intellectual property criteria. As of 1995, DoE had made eligibility determinations on 50 foreign companies and had found no company ineligible to participate in CRADAs with DoE laboratories (OTA, 1995).

Advanced Technology Program (ATP)

US subsidiaries of foreign-owned firms are participating in the *Advanced Technology Program* (ATP), which is administered by the US Department of Commerce's National Institute of Standards and Technology (NIST). Since 1990, the ATP has been investing directly in the growth of the US economy by cost-sharing with industry in the development of high-risk, enabling technologies that form the basis for new and improved products, manufacturing processes and services. The ATP was created by the Omnibus Trade and Competitiveness Act of 1988 to help US companies accelerate the creation and commercialisation of innovative technologies with strong potential for generating broad-based economic benefits. ATP multi-year awards are made to individual companies and to joint research ventures through a competitive peer-reviewed selection process. Only US-owned companies and US subsidiaries of foreign-owned companies that meet certain requirements are eligible to receive awards. Through 1997, the ATP has funded 352 projects, involving 842 participants, including for-profit companies, universities and non-profit organisations. Currently, there are 21 foreign-owned companies, representing 12 different

countries, involved in 30 ongoing and completed projects. A few of these companies are participating in more than one project.

The ATP decides whether a US subsidiary of a foreign-owned company is eligible to participate in the ATP on a case-by-case basis. All companies regardless of ownership must be able to show that the project in which they are involved provides potential broad-based benefits to the United States and satisfy other published selection criteria related to technical and commercialisation plans. According to the ATP Statute, US subsidiaries of foreign-owned companies must satisfy the broad-based benefits to the US criterion, taking into account the likely impact of foreign ownership, and must also meet three additional eligibility criteria related to the national policies of the country of incorporation of the foreign parent company. The foreign parent's country of incorporation must provide US companies opportunities comparable to those provided to any other company to participate in programmes similar to the ATP; must provide US companies local investment opportunities comparable to those provided to any other company; and must adequately and effectively protect the intellectual property rights of US companies. The ATP bases the determination of eligibility on evidence gathered from a number of sources. Each of the four eligibility criteria is required to be met for a foreign-owned applicant to receive funding from the ATP.

US Display Consortium

Membership in the *US Display Consortium* (USDC) is currently limited to US-owned firms, with the exception of Canadian-owned firms which are defence contractors, primarily for reasons of economic and technological competitiveness. USDC is an industry-led, public/private partnership initiated in 1993 to develop US manufacturing capability for high definition displays. Under this programme, 13 flat-panel display manufacturers and developers, 52 flat-panel display equipment and materials suppliers, the flat-panel display user community and the government are working together to enhance domestic competitiveness in this specific technical area.

Like some other R&D consortia established in the United States in past years focusing on critical technologies, foreign participation in the USDC has been restricted in the early days of technology development, but could be expanded in later stages. For example, the *Semiconductor Manufacturing Technology Research Corporation* (SEMATECH), a consortium of 14 US semiconductor firms founded in 1987 to enhance domestic semiconductor manufacturing capabilities, also limited access to US-owned companies in earlier years. The Department of Defense provided approximately half of the consortium's operating budget. Recently, however, SEMATECH has entered into technical alliances with its European counterpart, the *Joint European Semiconductor Submicron Initiative* (JESSI). SEMATECH has also initiated a research and development programme in which 12 companies from the United States, Korea, Europe and Taiwan are participating.

B. Europe

Overview

Foreign access to EU programmes is here discussed at three levels: (1) the R&D programmes of the European Union itself; (2) pan-European research ventures such as those of EUREKA; and (3) R&D programmes at the national level. **Box 1** summarises the situation for each level with regard to the rules governing access, finance and exploitation. There are no formal restrictions to the participation of domiciled foreign companies at any level. The participation of non-domiciled foreign companies is restricted both formally and informally at all levels. Participation by non-domiciled foreign firms is possible in certain programmes if bilateral agreements exist, the presence of individual firms is considered

desirable for strategic reasons or participation is warranted on the basis of reciprocity. Restrictions on exploitation, e.g. formal requirements to exploit project outputs within the European Union or relevant nation states, are believed to be the greatest impediment to the participation of foreign firms in European research programmes (Guy, 1996).

Box 1. Foreign firm access to European Union R&D programmes

		Domestic companies	Domiciled foreign companies	Non-domiciled foreign companies
EU R&D programmes	Access	Unrestricted access across programmes for indigenous firms from Member States.	Unrestricted access in principle, some restrictions in practice.	Restricted to firms from specific countries or to instances of mutual benefit in a limited number of programmes.
	Finance	Standard Commission ceilings for state and across programmes, in line with GATT and WTO guidelines.	Standard Commission ceilings for state aid across programmes.	Firms pay an overhead contribution and receive no support from the European Union, with exceptions, e.g. firms from Eastern Europe.
	Exploitation	Standard Commission rules across most programmes. Exploitation must benefit the European Union, and contractors generally own IPR.	Standard Commission rules across programmes.	Foreign companies sign standard EU contract dealing with exploitation by foreign firms.
Pan-European research ventures	Access	Rules differ for each venture, though generally signatory governments negotiate access for indigenous firms.	No apparent difference between indigenous and domiciled foreign companies, though perhaps some restrictions in practice.	Generally restricted either formally or informally, though exceptions made in special circumstances.
	Finance	Rules differ for each venture, with ceilings generally in line with GATT and WTO guidelines.	No apparent difference between indigenous and domiciled foreign companies.	Individual governments and/or firms negotiate financial agreements for non-domiciled firms.
	Exploitation	Rules differ for each venture.	No apparent difference between indigenous and domiciled foreign companies.	Individual governments and/or firms negotiate exploitation rights for non-domiciled firms.
National R&D programmes	Access	Unrestricted access across programmes for indigenous firms.	Unrestricted access in principle, some restrictions in practice at programme level. No difference between EU and other domiciled foreign companies.	Restricted to cases of mutual benefit, often decided at the programme level. Bilateral agreements between governments are common.
	Finance	Standard Commission ceilings for state aid; variable arrangements within these across countries and programmes.	No apparent difference between indigenous and domiciled foreign companies.	Financial arrangements for non-domiciled foreign companies negotiated on a bilateral or case-by-case basis.
	Exploitation	Rules differ across countries and programmes.	No apparent difference between indigenous and domiciled foreign companies	Exploitation restrictions discourage participation by non-domiciled foreign companies.

Source: Guy, 1996.

EU R&D Programmes

Most EU research activities are carried out within the context of the Framework Programmes, currently the 4th Framework Programme which commenced in 1994 and runs to 1998. Policy discussions concerning the shape and context of the 5th Framework Programme are also well advanced. Finance for projects generally follows the subsidy guidelines of the World Trade Organisation (WTO), with funding ceilings (expressed as aid intensity) established for specific categories of research. EU regulations limit the support available to industry and this support is restricted to research potentially capable of benefiting the European Union as a whole. Programmes can usually support 50 per cent of the cost of *industrial research* (research aimed at the acquisition of new knowledge relevant to the development of new and improved products, processes and services) and up to 25 per cent of the cost of *pre-competitive development* (configuration of the results of industrial research into a plan, design or prototype for a new product, process or service). As the activity gets closer to the marketplace, the Commission looks for even lower levels of aid, although support for small and medium-sized enterprises (SMEs) to conduct applied research (i.e. pre-competitive development) has a ceiling of 35 per cent.

With regard to intellectual property, the existence of sound plans for the utilisation and dissemination of the results of projects is also an increasingly important selection criterion in the European Union. Contractors are urged, once a project has been accepted, to draw up a consortium agreement among themselves which, *inter alia*, stipulates the details concerning utilisation and exploitation of the results of the project. These arrangements must not, however, conflict with the provisions of the Community standard contract. The following principles apply to patents and other intellectual property:

- ◊ *Knowledge gained from work directly carried out by or fully financed by the European Union is fundamentally the property of the European Union (e.g. any fundamental work funded at the 100 per cent level).*

- ◊ *Knowledge arising out of work carried out as part of a cost-sharing contract (e.g. work supported at the 50 per cent level) is fundamentally the intellectual property of the contractual partners, and details of the rights to this intellectual property must be organised and agreed by the partners themselves.*

- ◊ *Knowledge which could be put to industrial or commercial use must be suitably protected in the interests of the European Union and its contractual partners.*

- ◊ *The European Union and its contractual partners are obliged to make use or allow use to be made of any knowledge gained, with account taken of the following: (1) the aim of increasing international competitiveness and the economic and social cohesion of the European Union; (2) the funding of research activities for other EU policies; (3) the agreements on scientific and technical co-operation concluded with various third countries or international organisations.*

Domiciled foreign companies are subject to the same rules relating to access, finance and exploitation as domestic firms in EU Framework Programmes. Insofar as all participants are expected to conduct R&D and exploit it within the European Union, foreign firms are subject to economic performance or exploitation requirements. In the case of programmes such as the *European Strategic Programme for Research and Development in Information Technology* (ESPRIT), the exploitation rules have been flexibly interpreted so that the participation of foreign firms has been allowed on a case-by-case basis. Both IBM (United States) and Fujitsu (Japan) have participated in ESPRIT.

Non-domiciled foreign companies can generally participate in EU R&D programmes if specific programme decisions allow such co-operation (*see* **Box 2**). The majority of programmes allow for the participation of firms from prescribed sets of *European Third Countries* (i.e. countries in Europe which are not member states of the European Union). A smaller set of programmes allow access to firms from non-European Countries if there is a co-operation agreement of one form or another between the European Union and the countries concerned. The participation of non-European firms is also acceptable if there is sufficient Community interest to justify their inclusion and the potential for reciprocal benefit exists, e.g. the opportunity for European firms to participate in other nations' R&D programmes.

Box 2. Eligibility of non-domiciled foreign firms to participate in EU Framework Programmes

Most EU Framework R&D Programmes (except for the Controlled Thermonuclear Fusion Programme in the case of Israel and activities at the Joint Research Centre) are open to non-domiciled foreign companies whose countries of origin are:

- Formally associated with the European Fourth Framework Programme (Norway, Iceland, Israel and Liechtenstein, with Swiss participation currently being negotiated).
- The European Third Countries, or countries in Europe which are not member states of the European Union such as the European New Independent States. These are expected to participate on a non-funded basis, though the specific programme for Co-operation with Third Countries and International Organisations sometimes provides financial support to facilitate their participation.

The participation of non-European firms in a more circumscribed set of programmes is possible when the European Union has concluded a general framework agreement on scientific and technical co-operation with the country of the parent company. To date, these have been agreed with Australia, Canada and South Africa. Participating firms from these countries may be asked to make a contribution of ECU 5 000 to the overhead costs of projects, and they receive no financial support from the European Union. The range of programmes in which these countries can participate varies. Australia, for example, can only participate in programmes concerned with Biotechnology, Biomedicine and Health, Marine Science, Environment, Information Technologies and Communication Technologies.

Firms from Non-European countries which have not concluded an agreement with the European Union on technical and scientific co-operation can participate in 11 programme areas (or parts of them) if there is sufficient EU interest and participation is warranted through the principle of reciprocity. Programmes in which participation is not generally allowed include *'Strategic'* programmes such as Industrial and Materials Technologies, Agriculture and Fisheries and Controlled Thermonuclear Fusion. Project funding for firms from non-European industrialised countries and developing countries can sometimes be provided by the specific programme for *Co-operation with Third Countries and International Organisations*.

Source: Guy, 1996.

Participation by non-domiciled foreign companies is limited for some programmes determined to be "*strategic*". Strategic programmes include most of the more industrially-oriented programmes such as industrial and materials technologies or telematics, while the more open "global" programmes include environment and climate, non-nuclear energy and information technologies. Although it is an industry-oriented programme, the information technologies activity is classified as 'global' rather than 'strategic', thus enabling firms from non-European countries to participate, but only if it is in the interest of the European Union and provided that the firms contribute effectively to the implementation of the project, taking into account the principle of mutual benefit.

Pan-European research ventures

Pan-European research ventures include research networks and international organisations with a specific science-related mission such as the following: European Co-operation in the Field of Scientific and Technical Research (COST), EUREKA, European Laboratory for Particle Physics (CERN), European Space Agency (ESA), European Molecular Biology Laboratory (EMBL), European Southern Observatory (ESO) and European Science Foundation (ESF). Some of these programmes are aimed primarily at academics, while others encourage the participation of private sector firms. The rules covering access, finance and exploitation vary from one programme to another. Generally, governments are signatories to framework agreements which allow domestic firms and other organisations to participate and specify funding ceilings and exploitation rights. CERN and EUREKA are two examples which illustrate that few overt distinctions are made between domestic and domiciled foreign firms, but that non-domiciled foreign firms are specifically excluded except in exceptional circumstances.

CERN (the *European Laboratory for Particle Physics*) is an inter-governmental organisation set up in 1953 to conduct fundamental research in the field of particle physics. It currently has some 20 European member states, with negotiations under way with some non-member states (United States, Canada, Japan, Russia and India) concerning the provision of equipment. CERN's relationship with industry is mainly limited to the purchase of equipment, though some opportunities for the joint development of equipment do exist. As a general rule, only firms from member states (including domiciled foreign firms) are allowed to develop these relationships. Exceptions are made when firms within member states are unable to supply or develop the required products, or where there is the possibility for CERN to derive substantial technical or financial advantages. In practice, non-domiciled foreign companies have been involved in the supply and development of advanced computers and electronic instrumentation.

There are no fixed rules in CERN concerning the conduct, finance and exploitation of joint development projects. They vary in detail from one case to another. Normally, however, CERN attempts to retain a share of the intellectual property rights and the revenues which arise from the development work, but agrees to grant exclusive exploitation rights to its industrial partner, subject to its being entitled to use the technology free of charge for its own research needs and to its receiving a share of revenues generated.

EUREKA is a collaborative research venture involving some 25 member countries (the EU member states and the Commission, former EFTA members, Russia, Slovenia, Turkey, Hungary, Poland and the Czech Republic). Projects are generally more near-market than in the EU Framework Programme and are aimed at improving technology bases and industrial competitiveness. Each project must involve at least two partners from two different member states. EUREKA was created in 1985, and by 1996 a total of ECU 14.5 billion had been invested in more than 650 projects involving 2 400 firms and 1 100 other participants. Firms from all EUREKA member states can propose collaborative projects on a bottom-up basis. Decisions on funding and funding levels for individual participants in a project are then made by their respective governments. In some countries, EUREKA projects have a preferred status, in others there are special EUREKA funds, but in all cases national rules apply.

Exploitation agreements are negotiated between the members of the consortia. A Co-operation Agreement spells out the objectives of the project, the contribution of each partner, plans for the exploitation of results, a business plan and confidentiality and ownership arrangements. This agreement may be simple or complex, depending on the structure of the partnership, and may be adapted, subject to the consent of all partners, during the course of the project. Following general EUREKA principles, however, the use of a co-operation agreement is not a legal requirement to attain EUREKA status.

The bottom-up nature of EUREKA means that it is perfectly feasible for potential participants to propose consortia containing domiciled and non-domiciled foreign companies. Many of the former participate, and EUREKA rules have allowed the participation of non-domiciled foreign firms since the late 1980s - as long as there are at least two other firms from member states involved in the consortia. Given that EUREKA was set up specifically to improve European competitiveness and productivity, however, it is not surprising to find that the presence of non-domiciled foreign companies is a rarity. Consortia seeking support from national governments are quite aware that the presence of a foreign firm from a non-EUREKA country could count against them, unless exceptional circumstances apply (Guy, 1996).

National R&D programmes

Just as the access and finance rules for the participation of domestic companies in the national research programmes of individual European countries resemble EU practices, so the corresponding rules for domiciled foreign companies also mirror the EU rules. In theory, these firms are treated much the same as domestic companies: access is unrestricted and the same funding ceilings apply. In practice, however, consideration of eventual exploitation routes and net know-how flows may influence selection practices in different settings as may exploitation arrangements in different programmes. In the smaller EU countries, the participation of domiciled foreign companies in national programmes is mostly welcomed. For example, **Ireland** encourages domiciled foreign companies able to demonstrate significant manufacturing capabilities in the country to participate in national R&D programmes such as the *Programmes in Advanced Technology* (PATS). The expectation is that benefits will flow to Irish firms working in collaboration with foreign-owned firms, thus strengthening indigenous capabilities and making Ireland an attractive home for international technology-based capital.

Some countries, however, have specific rules relating to exploitation of research results. In **Germany,** the rules which cover the participation of domiciled foreign companies in the research programmes of the *Federal Ministry of Education, Science, Research and Technology* (BMBF) require an R&D capability in Germany and subsequent exploitation beneficial to the German economy. In the **Netherlands**, the *Business-Oriented Technological Co-operation* (BTS) programme supports R&D in information and communication technologies, biotechnology, environmental technology and new materials. Domiciled foreign companies are welcome to participate, but only if they can demonstrate that exploitation will occur in the Netherlands. To this end, exploitation agreements have to specify that intellectual property and production based on project results remain in the Netherlands for set periods of time, e.g. one year after the completion of the project. In the **United Kingdom,** multinational companies are able to participate in the *LINK Scheme* provided that they have a significant manufacturing and research base in the United Kingdom, and that the benefits of the research are used for wealth creation within the United Kingdom or the European Union. Exploitation outside of the European Union within the first five years of a project's completion requires written permission from the Department of Trade and Industry (DTI).

For non-domiciled foreign companies, access, finance and exploitation arrangements vary widely across countries and across programmes. Generic rules governing the participation or non-participation of non-domiciled foreign companies in national R&D programmes *per se* are rarely specified. While participation is generally permitted in principle, it takes place most often when it can be demonstrated on a case-by-case basis that mutual benefit is a likely outcome. Conditions on subsequent exploitation are often imposed to ensure that this benefit is captured in local economies. Sometimes rules exist which allow firms from countries with bilateral arrangements to participate in national R&D programmes. A number of European countries have programmes specifically geared towards scientific and technological collaboration between domestic firms and non-domiciled foreign companies. The Netherlands, for

example, has bilateral agreements with Israel and Indonesia, and France has similar arrangements with Canada, the United Kingdom and Germany. For the most part, these agreements encourage collaboration via information exchange, the formation of networks and attendance at workshops.

In the **United Kingdom**, consortia bidding for projects within the Department of the Environment's *Partners in Technology* (PIT) programme of construction-related R&D are welcome to submit proposals which include non-domiciled foreign companies, as long as these firms are not project leaders. In theory, they are eligible for funding, since there is nothing in the programme's protocols to prevent public funds going to foreign-based firms. However, companies located abroad are excluded from participation in the UK LINK programmes, even though companies in general receive no public support (academics receive 100 per cent support). In **Sweden**, non-domiciled foreign companies are allowed to participate in industry-oriented NUTEK programmes, but not as project leaders. In the **Netherlands**, non-domiciled foreign firms may participate in research programmes if exploitation of results takes place within the country.

In **Germany**, access is allowed if there is a reasonable chance of '*mutual interest*'. The BMBF allowed one Swiss firm to participate in its new materials research programme despite the fact that a substantial part of the research was to be performed in Switzerland; the Swiss firm collaborated closely with the University of Heidelberg, donated valuable technical equipment and planned to set up a production unit in the area. In the *German Civil Aeronautics Research* programme, various foreign-owned and foreign-based firms are allowed to participate if they are also members of European consortia such as *Eurocopter* or *Airbus*. In **France**, Ministry of Industry programmes require firms to have significant R&D and production capabilities in the country in order to be eligible for funding. Exceptions arise only when foreign companies bring specific skills to consortia which cannot be accessed in any other way (Guy, 1996).

C. Japan

Overview

The Japanese government has not adopted any explicit general policy or rules governing foreign participation in government-funded R&D and technology programmes. As in the United States and Europe, implicit rules governing individual programmes may differ with selection of participating firms based on a number of criteria. Many of Japan's industrial technology-oriented R&D programmes are organised and supervised by the Ministry of International Trade and Industry (MITI). Some past MITI projects, such as the *Very Large-Scale Integrated Circuit Project*, were closed to foreign firm participation due primarily to competitiveness concerns. In recent years, however, MITI has made efforts to improve access of foreign researchers and participation by foreign firms in a number of government-funded research programmes. As for policy toward ownership of intellectual property rights acquired through participation in these R&D programmes, the government has in the past tended to claim possession of intellectual property; however, this policy has evolved to joint ownership with the participating firms. For those projects for which IPR rules are adopted, the ownership belongs to the innovating firm as in the case of the Japan Key Technology Centre. In other programmes, it comes under joint ownership of the government or the research association supervising the project and the participating firms.

MITI is responsible for about 12 per cent of the government's budget for science and technology, behind the Ministry of Education, which funds all university research, and the Science and Technology Agency (STA), which funds megascience projects such as nuclear, space and ocean research. This section

discusses the extent of participation by domiciled and non-domiciled foreign firms in the larger MITI technology programmes, which account for 44 per cent of the total MITI R&D budget (*see* **Table 3**). Two types of R&D programmes are discussed: those funded entirely by the Japanese government and others such as the *Intelligent Manufacturing Systems* (IMS) programme, where the participating countries and/or firms fund their part of the research effort.

Table 3. Major MITI R&D programmes
Y million (%)

	1995	1996
TOTAL	302 553	317 007
New Sunshine Programme	54 236 (17.9)	56 074 (17.7)
Industrial Science & Technology Frontier Programme	24 860 (8.2)	26 421 (8.3)
Japan Key Technology Centre	26 000 (8.6)	26 000 (8.2)
Intelligent Manufacturing Systems Programme	1 254 (0.4)	1 274 (0.4)
Global Environment and Recycling Technologies	15 246 (5.1)	18 001 (5.7)
Joint International Development of Civil Aircraft	10 831 (3.6)	11 152 (3.5)

Source: Ministry of International Trade and Industry, 1996.

New Sunshine Programme

Non-domiciled foreign firms and universities are participating in the *New Sunshine Programme*, the largest MITI industrial R&D programme (*see* **Box 3**). At present there is foreign participation, by predominantly US and Canadian firms and institutions, in four of the projects under this programme, particularly the work on international clean energy networks using hydrogen conversion (WE-NET). Rules specify that the intellectual property rights resulting from the research are to be owned jointly by the *New Energy and Industrial Technology Development Organisation* (NEDO), which manages the programme, and the participating firms.

The New Sunshine Programme was launched in 1993 by merging two older programmes, the *Sunshine* and the *Moonlight* programmes which were, respectively, the new energy technology and energy conservation technology development programmes developed by MITI in the 1970s. Emphasis has been placed on making the New Sunshine Programme internationally open to accelerate the development of innovative energy technologies as well as to promote joint research work on appropriate technologies with developing countries. In the initial years of the programme, priority has been placed on R&D on photovoltaic power generation technology, fuel cell power generation technology, the hydrogen-conversion network and the "eco-energy city" (broad area energy utilisation network system technology).

Box 3. Foreign participation in the New Sunshine Programme

Project	Participating foreign bodies	Tasks
Geothermal energy	Cambourne School of Mines Associates Ltd. (United Kingdom)	Development and fabrication of fluid sampler.
Coal liquefaction and gasification	British Gas Plc. (United Kingdom)	Experimental research on cold model in the development of coal gasification technology.
WE-NET	Hydrogen Industry Council (Canada) Canadian Association of Hydrogen Industries	Feasibility study on large scale air transportation system from Canada.
	CDS Research	Study on air transportation of liquid hydrogen.
	London Research/Imperial College Consultants	Concept design.
	SRI International (United States)	Research on hydrogen generation.
	Canadian Liquid Air Institute of Magnesium Technology MacGill University Hydro Quebec	Research on storage and transportation of hydrogen.
	BAM (Germany) MPA (University of Stuttgart, Germany)	Survey of low temperature materials assessment done in the United States and the former Soviet Union.
	Daimler Benz Aerospace University of Quebec Westinghouse Hydro Quebec	Preliminary research on such topics as hydrogen generation using biomass, magnetic freezing technology, hydrogen generation using solar energy and high temperature steam.
Broad area energy utilisation network system technology	SRI International (United States)	High-activity-high-selectivity catalyst.
	Brookhaven National Laboratory	Synthesis and decomposition of methanol.

Source: MITI, 1996.

Industrial Science and Technology Frontier Programme

Non-domiciled foreign entities are currently participating in 13 of the 21 projects being undertaken in the framework of the *Industrial Science and Technology Frontier Programme;* participants consist of 18 firms, ten universities and five research institutes and other bodies (*see* **Box 4**). This programme was launched in 1993 by putting together three existing MITI programmes: the National R&D Programme (Large-Scale Projects), R&D Programme on Basic Technologies for Future Industries and the Programme for Medical and Welfare Equipment Technologies. The purpose of this restructuring was to enable MITI to promote the development of industrial technologies by forming closer relationships with industry and academia both in Japan and abroad. Eight research areas are included in this programme: superconductivity, new materials, biotechnology, electronics information and communications, machinery and aerospace, natural resources, human life and society, medicine and welfare.

Box 4. Foreign participation in Industrial Science and Technology Frontier Programme

Projects	Participating foreign firms
Superconducting materials and devices (1988-97)	Dupont (United States)
High performance materials for severe environments (1989-96)	Crucible Material (United States)
Non-linear photonics materials (1989-98)	BASF A.G. (Germany)
Advanced chemical processing technology (1990-96)	SRI International (United States)
Silicon based polymers (1991-2000)	University of Kent (United Kingdom) University of Colorado (United States) Dow Corning Asia
Molecular assemblies for a functional protein system (1989-97)	University of Stuttgart (Germany)
New models for software architecture (1990-97)	SRI International (United States)
Quantum functional devices (1991-2000)	Motorola (United States) Hitachi Europe (United Kingdom)
Ultimate manipulation of atoms and molecules (1992-2001)	Texas Instruments (United States) Dupont (United States) BIOSTM Technologies (United States) Yokokawa Hewlett Packard (United States) Motorola (United States) Samsung Electronics (Korea)
Super/hypersonic transport propulsion system (1989-98)	Rolls Royce (United Kingdom) Snecma (France) United Technologies (United States) General Electric (United States)
Micromachine technology (1991-2000)	SRI International (United States) Royal Melbourne Polytechnique (Australia) IS Robotics (United States)
Synergy Ceramics (1994-98)	University of Cambridge (United Kingdom) Swedish Ceramics Centre (Sweden) Ecole Nationale Supérieure des Mines de Paris (France) Limerick University (Ireland) Dow Chemical International (United States)
Accelerated bio-functional construction technology (1995-98)	Virus Research Institute (United Kingdom) University of Sheffield (United Kingdom) University of Zurich (Switzerland)

Source: MITI, 1996.

Under this programme, the Director-General of the MITI Agency for Industrial Science and Technology (AIST) is to draw up the basic plan for each project specifying its purpose, mode of execution and the time period required. Also, he is to conduct preliminary research in areas where there exist uncertainties as to technological feasibility and where there are possibilities for international co-operation. Projects to be undertaken should be fundamental and creative research projects conducive to technological breakthroughs; respond to social needs such as improving the quality of life, securing a stable supply of

resources and infrastructure-building; and involve large funding, long time periods and substantial risks for the industrial sector to undertake alone. The intellectual property rights acquired through participation in the programme are to be owned jointly by NEDO and the participating entities.

Japan Key Technology Centre

Although research under the programmes of the Japan Key Technology Centre should be conducted in Japan, participation is open to any type of foreign firm. Two domiciled foreign firms, Hewlett Packard Japan and Hoechst Japan, are currently participating (*see* **Box 5**). The Japan Key Technology Centre was founded in 1985 as a special corporation to facilitate R&D on 'fundamental technologies', primarily in the areas of mining, manufacturing and telecommunications which came under the jurisdiction of MITI or the Ministry of Post and Telecommunications. The 1985 *Law to Facilitate Research on Fundamental Technologies* allows those conducting research on fundamental technologies to use government-owned research facilities and patents free of charge or at less than the normal rate. The Centre invests in stocks of corporations jointly set up by two or more firms for the purpose of undertaking research on fundamental technologies for a predetermined period of time. These investments can cover up to 70 per cent of total project funding; the Centre, in turn, purchases stock in the corporation. Access to the results of research is left to the discretion of the research corporations, which also acquire all intellectual property stemming from the research.

Box 5. Foreign participation in Key Technology Centres

Projects	Participating foreign firms
Ultra high speed electronic measuring technology (1992-2001)	Hewlett Packard Laboratories Japan
Research on human communication mechanism (1991-2000)	Nippon Digital Equipment
Phonetic translation communication technology (1993-2000)	Nippon Digital Equipment
Applied technology development using bio-functional molecules (1995-2003)	Hoechst Japan
High-speed high-precision measuring technique for environmental pollutants (1995-2000)	Nippon Millipore

Source: MITI, 1996.

Open Fundamental Software Technology Development Project

Foreign firm participation is encouraged in the *Open Fundamental Software Technology Development Project* launched by MITI in 1992. This project aims to develop operational software technology which could support all application software and promote the diffusion of open software technology systems. Application for participation is open internationally to non-domiciled foreign firms, and selection is based on the participating firms' R&D accomplishments and their research capabilities. This approach was adopted since projects in this field could benefit from the knowledge and experiences of foreign firms;

standardisation and specification setting processes could be facilitated by international co-operation; and the results of the research could benefit from wider recognition. As regards intellectual property rights, copyrights are to be owned exclusively by *Joho shori shinko jigyo kyokai* (the *Association for Promotion of Information Processing*), and patents rights are to be shared by the association and the firm which acquired the particular patent. Research results are to be disseminated free of charge through the Internet and the distribution of CD-ROMs.

Environment-related projects

Japan maintains a few environment-related projects which currently have participation by non-domiciled foreign firms. These include: (1) development of environment-friendly hydrogen production technology with participation by Eniricerche SpA (Italy); and (2) development of environment-friendly technology for recycling of metal materials with participation by Usinor Sacilor (France).

Intelligent Manufacturing Systems (IMS) Programme

The *Intelligent Manufacturing Systems* (IMS) programme was launched as an international programme from its outset in 1990 with the participation of the United States and the European Union. The Japanese government called upon the governments of the advanced industrial countries to launch a joint research programme to solve common manufacturing problems by improving the interfaces between intelligent machines and humans and constructing the advanced manufacturing systems of the next generation. A feasibility study was conducted in 1991 by an international committee consisting of participants from six areas (Australia, Canada, European Union, EFTA, Japan and the United States) which concluded that an international co-operative programme on intelligent manufacturing systems would be feasible and would bring about fair and beneficial results to all participants of the programme.

The IMS programme has defined a framework of research project selection which consists of five research areas from which project themes could be chosen; current projects and participating partners are listed in **Box 6**. Projects must be related to industrial production, undertaken by geographically dispersed consortia and not include competitive R&D. The programme has laid out explicit rules governing intellectual property rights, which assure fair and balanced distribution of contributions and benefits of the international research co-operation to all participating countries and firms. Research results are to be shared through creating an information diffusion system which assures the protection and fair sharing of the intellectual property rights acquired.

Box 6. Intelligent Manufacturing System Programme – projects and partners

1. ***GLOBEMAN 21*** **(R&D ON VIRTUAL/EXTENDED ENTERPRISE)**
   - Australia: DHP, Farley Cutling, Moldflow, CSIRO, Griffith University.
   - Canada: University of Toronto, Simon Fraser University, University of Alberta, Northern Underwater Systems, Axion Spatial Imaging.
   - EFTA: AT&T METIS, Sintef.
   - European Union: BICC Plc, Ahlstrom, Intracom, Fraunhofer (IPA), IPK-IWF, BIBA, Partek, YIT, VTT, HUT, Odanse, Logistic Support Consultants Ltd., Royal Institute of Technology, Technical University of Hamburg & Harburg, Technical University of Denmark.
   - United States: Newport News Shipbuilding (international co-ordinator), University of Virginia, Carnegie Mellon University, Deneb Robotics Inc.

2. ***NEXT GENERATION MANUFACTURING SYSTEM***
   - European Union: ABB Asea Boveri, CAM-I Europe, Fraunhofer Society, IVF, Kockums AB.
   - United States: CAM-I US (international co-ordinator), Caterpillar, Deneb Robotics, Sandia National Lab., Lockheed Martin Energy System, Trust Automation.

3. ***HOLONIC MANUFACTURING SYSTEM***
   - Australia: BHP (international co-ordinator), CRAsys, CSIRO Australia, HEC, Royal Melbourne I.T., University of Southern Australia.
   - Canada: Alberta Research Council, DuPont, Queens University, SFU, Usask, ISE, Teleflex, University of Calgary.
   - European Union: SOFTIng, ASA, Btsys, Fraunhofer (IPA), Katholieke Unive. Leuven, Mercedes Benz, Nestle UK Ltd., NDC, Profactr, Rautaniuki Oy Engineering, Tekniker R.I., University of Hannover, University of Keele, VTT.
   - United States: Rockwell Automation A.B. N.C. Manufacturing Competitiveness, United Technologies Corp., University of Connecticut.

4. ***GNOSIS***
   - Canada: Alberta Research Council, University of Calgary, University of Saskatchewan.
   - EFTA: Swiss Federal Institute of Technology (ETH Zurich, EPFL).
   - European Union: ADEPA ITMt APTOR, ABB Oy, BICCPlc., Tehdasmallit Oy, SKETSchwermaschinenbau Magdeburg GmbH, Schonk Engineering GmbH, Becos GmbH, Helsinki Univ. of Technology, Tampere University of Technology, LLP-CES Alp, University of Cambridge, Ecole des Mines, Institut für Arbeitswissenschaft, VTT, Fraunhofer (IPA).

5. ***SIMON*** **(SENSOR INTEGRATED CONTROL SYSTEM)**
   - Canada: University of British Columbia, National Research Council.
   - EFTA: Kislter (Switzerland).
   - European Union: RWTH Aachen WZL, Grau, Bosch Prometec (Germany); Fidia (Italy); Soraluce, Tekniker (Spain), GIAT (France).
   - United States: Michigan State University, Montronix Inc., Ingersoll Milling Machine Co.

6. ***RPD*** **(RAPID PRODUCT DEVELOPMENT SYSTEM)**
   - Australia: Queensland Manufacturing Institute (international co-ordinator), HPM Industries Ply Ltd., Whitco Ply Ltd., Hawker de Havilland Ply Ltd., Camplex Services Ply Ltd., IRIS, Csiro DMT, Moldflow Ply Ltd., Utilux Ply Ltd., Cooinda Ceramics Ply Ltd.
   - Canada: Génie Mécanique, Ecole de Technologie Supérieure, Hymarc Ltd., ICAM Research, Factotum Plastics Technologies, Pega Precision Inc., ACT Informatique, Tryllium, Innovmetric, Logiciels Inc., Conseil National de Recherche Canada, Ecole Polytechnique, ICAM Corporation de Technologies, Alliance Commerciale Technologique.
   - European Union: ITT FLYGT, ABB Stat AB, Electrolux Rapid Development, IVF, (Sweden), Danish Technological Institute, FIAT Research Centre (Italy), Materialise MU (Belgium), PLAMECA OY, HUT (Finland); Set SA (Portugal); Scheneider Prototyping GmbH, University of Karlsruhe, Fraunhofer Institute for Manufacturing, BIBA (Germany), ADEPA (France); TU Vienna (Austria); University of Nottingham (United Kingdom); IMPIVA (Spain).
   - United States: 3D Systems Inc., Xerox Corp.

7. ***MMHS*** **(METAMORPHIC MATERIAL HANDLING SYSTEM)**
   - Canada: Ecole Polytechnique de Montreal, Les Roues Bleutec Inc., University of Toronto.
   - EFTA: Swiss Federal Institute of Technology, ETH.
   - European Union: Noell GmbH BLCC Group, IMS Ltd., Volkswagen, Frog Navigation Systems, Pro Electronica/Nokia, De Montfort University, University of Twente, Fraunhofer Institute for Material Flow, VTT.
   - United States: Purdue University, Iowa State University.

Source: MITI, 1996.

Joint International Development of Civil Aircraft

Like the IMS programme, the projects under the programme on *Joint International Development of Civil Aircraft* are undertaken jointly by the firms of several participating countries with government support. Due to the large financial and technological risks involved in aircraft development, international co-operation is the current norm and this programme is no exception. The Japanese government is currently funding between 20 per cent and 30 per cent of the total research costs of the three main projects on large civil aircraft, jet engines and jet engines for small civil aircraft, all of which have participation by foreign firms (*see* **Box 7**). There are no rules regarding qualifications or conditions of the participating foreign firms, except that they must possess appropriate capabilities for developing sophisticated aircraft technology. The ensuing intellectual property rights come under joint ownership of the research associations supervising the projects and the participating firms.

Box 7. Foreign participation in joint international development of civil aircraft

Projects	Participating foreign firms
Large size civil aircraft (B777) development (1990-99)	Boeing (United States)
V2500 jet engine development (1980-88)	Pratt and Whitney (United States) Rolls Royce (United Kingdom) MTU (Germany) Fiat (Italy, until 1995)
Development of jet engine for small civil aircraft (1995-2001)	General Electric (United States)

Source: MITI, 1996.

MAJOR ISSUES

In general, it appears that participation by foreign companies in the national R&D and technology programmes of the OECD countries is increasing together with globalisation of industrial research and production. In theory, and as indicated by reporting to the OECD industrial support database, most government-funded technology programmes are open to participation by foreign firms. For the most part, OECD governments do not have any general policy or set of rules regarding foreign access to technology programmes. Rules and participation tend to differ from programme to programme and may be the result of bilateral negotiations between countries. However, data and information concerning both the rules on foreign access and actual participation by foreign firms in these programmes are very limited.

From this partial survey of government-funded technology programmes in the major OECD countries, several general observations may be made. Actual participation by foreign firms in these technology programmes is still very modest. There are fewer restrictions on the participation of domiciled foreign firms in national technology programmes than on non-domiciled foreign firms. Access for both domiciled and non-domiciled foreign firms may be restricted for strategic purposes (e.g. in defence-oriented programmes) as well as for reasons of technological and economic competitiveness (e.g. in programmes for the development of critical technologies). Criteria for participation relating to reciprocal treatment in home countries and domestic exploitation of research results in host countries are the greatest limiting factors. The major issues regarding foreign access to technology programmes are discussed below in terms of: reciprocity, exploitation, and transparency.

A. Reciprocity

There has been a tendency to include reciprocity requirements or to consider reciprocity when granting access to foreign firms to national technology programmes. Reciprocity refers to the condition that domestic firms be granted equal access to the national R&D and technology programmes of the foreign firm's own country. The specific reciprocity requirements may vary depending on the countries involved, the nature of the foreign firm (domiciled or non-domiciled) and the type of public research involved. Calls for reciprocal access to be a condition on entry for foreign-owned firms arise largely from concern that domestic companies may experience difficulties trying to access technology programmes and innovation systems abroad. Reciprocity requirements are an attempt to level the playing field and assure fair technological competition among countries.

In practice, reciprocity requirements may be difficult to implement; for example, there may be no similar technology programmes in the foreign country for which comparable treatment could be given. Such provisions may deny access to foreign firms because of their home government policies in matters more related to economic than technology policy. In some cases, demands for comparable treatment for domestic firms may be extended beyond access to technology programmes to foreign investment, intellectual property rights and other areas. In addition, the potential benefits of reciprocity requirements in terms of levelling the playing field may be small compared with the cost of lost access to the technical and economic resources of foreign firms.

B. Exploitation

Requirements relating to exploitation may accompany reciprocity conditions in determining access of foreign companies to national technology programmes. There is the general desire that national technology programmes be implemented so as to benefit the funding country. Programmes may require that certain conditions be met with regard to economic performance, for example, requiring both domestic and foreign firms to manufacture innovations resulting from access to public R&D in the host country. These conditions may be included in the intellectual property provisions of technology agreements, in stating that patents, copyrights and other intellectual property stemming from the technology programmes be further developed or exploited domestically. Such conditions might also be included in the funding provisions of the programme, which may bar financial assistance to companies who do not intend to pursue domestic use of research results. While applicable to both domestic and foreign firms, such requirements can impose restraints on foreign firms and deter participation.

These provisions usually stem from competitiveness motives and the desire that government-funded R&D be in the interest of the country as a whole not just the interest of the specific companies involved. They also relate to concerns about "*leakage*" or that foreign participation in national technology programmes may lead to a flow of technology, expertise and know-how out of the country. Leakage fears may be countered by the need to keep abreast of global technological frontiers; for smaller countries, reciprocity and exploitation requirements do not make sense due to the technological benefits to be garnered from participating with leading-edge firms resident in other countries. However, in the larger OECD countries, exploitation, funding and IPR provisions may be a barrier to foreign access to government-funded technology programmes. These conditions may be particularly onerous if the foreign firm intends to fund its own participation in the R&D consortia or technology programme, which is often the case.

C. Transparency

One constraint on foreign participation in national R&D and technology programmes may be the lack of transparency surrounding the rules and requirements pertaining to foreign access. As illustrated by the sketchy information included in this paper, there is no consolidated source of information on technology access conditions at the national, regional or OECD-wide level. Rules and criteria for participation in technology programmes differ by country, most of which do not have any clear national guidelines *vis à vis* the eligibility of domiciled and non-domiciled foreign firms for access to these programmes. Within individual countries, foreign participation in government-funded programmes may be regulated by a patchwork of confusing agency directives, bilateral agreements and eligibility requirements contained in statutes and legislation. Rules may evolve at a programme level on an *ad hoc* basis, giving rise to a wide variety of situations. In some cases, the rules and potential for foreign firm participation may not be well publicised which leads foreign firms, including those resident in the country, to believe they are ineligible for support.

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