

I

(Acts whose publication is obligatory)

DECISION No 1110/94/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 26 April 1994

concerning the fourth framework programme of the European Community activities in the field of research and technological development and demonstration (1994 to 1998)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community and in particular Article 130i (1) thereof,

Having regard to the proposal from the Commission ⁽¹⁾,

Having regard to the opinion of the Economic and Social Committee ⁽²⁾,

Acting in accordance with the procedure laid down in Article 189b of the Treaty ⁽³⁾,

Whereas Article 130f of the Treaty states the Community's objectives in the area of research and technological development as being to strengthen the scientific and technological bases of Community industry and to encourage it to become more competitive at international level while promoting all research activities deemed necessary for the implementation of other Community policies;

Whereas it is important for the Community and the Member States to coordinate their research and technological development activities so as to ensure that national policies and Community policy are mutually consistent;

Whereas, in accordance with Articles 130f (3) and 130i (1) of the Treaty, a multiannual framework programme, setting out all the activities of the Community in the area of research and technological development, including demonstration projects (hereinafter referred to as 'RTD'), shall be adopted;

Whereas by Decision 90/221/Euratom, EEC ⁽⁴⁾ the Council adopted a third framework programme for the period 1990 to 1994, which is in the process of being implemented; whereas on 9 April 1992 the Commission presented an assessment of progress in implementing the third framework programme; whereas Decision 93/167/Euratom, EEC provided for supplementary financing for the last two years of implementation of the third framework programme;

Whereas on 18 November 1992 the Commission presented a document on the future of the ECSC Treaty and its financial activities until the year 2002, the date on which it expires;

Whereas Community RTD activities should continue to focus on generic and pre-competitive research of multisectoral application; whereas more synergy between these activities and those undertaken in the context of Eureka should be sought;

Whereas the European Council of 12 December 1992 at Edinburgh stated that the development of expenditure on R&D should be consistent with the overall development of expenditure on internal policies pursuant to Category 3 of the Financial Perspective, remaining between one-half and two-thirds of the overall figure;

Whereas Community RTD activities must take ethical considerations into account;

Whereas the Community should only support RTD activities of high quality;

Whereas the purpose of Community RTD in accordance with the objectives laid down in the Treaty should be to foster a prosperous Community based on industrial competitiveness, quality of life and sustainable development; whereas it is also desirable that it contributes to supporting economic growth and a high level of employment;

⁽¹⁾ OJ No C 230, 26. 8. 1993, p. 4.

⁽²⁾ OJ No C 34, 2. 2. 1994, p. 90.

⁽³⁾ Opinion of the European Parliament of 18 November 1993, OJ No C 329, 6. 12. 1993, p. 264. Council common position of 14. 1. 1994, OJ No C 101, 9. 4. 1994, p. 21 and Decision of the European Parliament of 9. 2. 1994 (OJ No C 61, 28. 2. 1994).

⁽⁴⁾ OJ No L 117, 8. 5. 1990, p. 28. Decision as amended by Decision 93/167/Euratom, EEC (OJ No L 69, 20. 3. 1993, p. 43).

Whereas small and medium-sized undertakings are able to make a significant contribution to the innovation process and should play a substantial role in the implementation of Community RTD activities; whereas, therefore, particular attention should be paid to the specific needs of such undertakings in order to facilitate their access to information, encourage them to take part in Community programmes and enhance their ability to exploit their results where appropriate;

Whereas the formulation and implementation of the Community's policies and actions must take into account the objectives related to economic and social cohesion; whereas the Community framework programme should play its part, along with other Community instruments, in contributing to strengthening scientific and technological capacity and potential throughout all parts of the Community;

Whereas, in conformity with the principle of subsidiarity, the Community should take action only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States and can therefore, by reason of the scale or effects of the proposed action, be better achieved at Community level;

Whereas, furthermore, the Community RTD effort should concentrate on activities which are carefully selected in accordance with well-defined criteria;

Whereas Article 130g of the Treaty defines four activities to be carried out by the Community in pursuing the objectives laid down in Article 130f;

Whereas the first activity, which concerns the implementation of RTD programmes, should constitute the main component of the framework programme;

Whereas the second, third and fourth activities cover respectively international cooperation, the dissemination and optimization of RTD results and the stimulation of the training and mobility of researchers; whereas there may be similar activities in each of the specific programmes covered by the first activity, in the manner appropriate to and to the extent required for proper implementation of these programmes;

Whereas the Joint Research Centre (JRC) contributes to the implementation of the framework programme, particularly in those fields where it has the appropriate competence to offer impartial and independent expertise for the benefit of Community policies; whereas the JRC will also progressively compete for the funds available through indirect action and for scientific and technical support activities which are suited to a competitive approach;

Whereas rules for the participation of undertakings, research centres and universities as well as rules governing the dissemination of results shall be determined in a separate Council decision according to Article 130j of the Treaty;

Whereas, in accordance with Article 130i (3) of the Treaty, the framework programme shall be implemented through specific programmes; whereas the framework programme may also be implemented through the means provided for in Articles 130k to 130n of the Treaty;

Whereas the interdisciplinary nature of the activities to be undertaken in this framework programme requires close coordination between the different cross-discipline research programmes;

Whereas assessment and monitoring operations should be intensified and expanded to maximize the effectiveness of RTD policy;

Whereas there should be continual and systematic monitoring of progress with the fourth framework programme; whereas the Commission shall provide the European Parliament and Council with information on the implementation of the framework programme at the beginning of each year, in accordance with Article 130p of the Treaty; whereas there should also be an independent assessment of management of the programme and of progress with the activities undertaken, before the presentation by the Commission of its proposal for the fifth framework programme;

Whereas there should also be technology assessment monitoring the possible risks, advantages and disadvantages of new technologies developed in this framework programme;

Whereas, in accordance with Article 130i (1) of the Treaty, it is necessary to fix the maximum overall amount and the detailed rules for Community financial participation in the framework programme and the respective shares in each of the activities provided for;

Whereas, in order to ensure coherence between Community RTD activities and those undertaken by virtue of the EAEC Treaty, the decision relating to the framework programme of Community activities in the field of nuclear research and training should be adopted simultaneously with this framework programme and for the same period;

Whereas the Scientific and Technical Research Committee (Crest) has been consulted,

HAVE DECIDED AS FOLLOWS:

Article 1

1. A multiannual framework programme for Community activities in the field of research and technological development and demonstration, hereinafter referred to as the 'fourth framework programme', is hereby adopted for the period 1994 to 1998.

2. The fourth framework programme shall include all Community activities in the area of research and technological development, including demonstration projects. The definition of demonstration projects is set out in Annex III.

3. The maximum overall amount for Community financial participation in the fourth framework programme shall be ECU 11 046 million. Of this, ECU 5 472 million is for the period 1994 to 1996 and ECU 5 574 million is for the period 1997 to 1998. Not later than 30 June 1996, in the light of an assessment of value for money, of the state of implementation of the framework programme, of its contribution to the competitiveness of Community industry at international level, of value for money and of the development of the financial perspectives of the European Union, the European Parliament and the Council, acting in accordance with the procedure laid down in Article 130i (1) of the Treaty, shall review the maximum overall amount, with the possibility of increasing it to ECU 11 641 million.

Annex I fixes the respective shares in each of the activities provided for and indicates the breakdown between themes in the first activity.

4. The selection criteria to be applied in the implementation of the fourth framework programme are laid down in Annex II.

5. Annex III establishes the scientific and technological objectives to be achieved by the activities, in accordance with the abovementioned criteria, fixes the relevant priorities and indicates the broad lines of such activities.

Article 2

1. The fourth framework programme shall be implemented through specific programmes developed within each activity, each of which shall specify its precise objectives on the lines of the scientific and technological objectives in Annex III, define the detailed rules for implementing it, fix its duration and provide for the means deemed necessary.

2. The implementation of the fourth framework programme may also give rise, as necessary, to supplementary programmes within the meaning of Article 130k, to Community participation in RTD programmes undertaken by several Member States within the meaning of Article 130l, or to the setting up of joint undertakings or any other structure within the meaning of Article 130n. It may also give rise to cooperation agreements with third countries or international organizations, within the meaning of Article 130m, second subparagraph.

Article 3

The detailed rules for financial participation by the Community in the fourth framework programme shall be

those provided for by the specific provisions regarding RTD funding of the Financial Regulation applicable to the general budget of the European Communities, as supplemented by Annex IV to this Decision.

Article 4

1. The Commission shall continually and systematically monitor the progress of the fourth framework programme as regards the criteria set out in Annex II, which include that of contributing to the economic and social cohesion of the Community, and the scientific and technological objectives set out in Annex III. It shall examine in particular whether the objectives, priorities and financial resources are still appropriate to the changing situation. If necessary, it shall make proposals to adapt or supplement the framework programme according to the results of this assessment.

At the beginning of each year the Commission shall submit a report to the European Parliament and the Council with information on RTD activities and the dissemination of results during the previous year, and the work programme for the current year.

2. The Commission shall have an external assessment conducted by independent qualified experts into the management of and progress with Community activities carried out during the five years preceding this assessment. It shall communicate this assessment and conclusions, accompanied by its comments, to the European Parliament, the Council and the Economic and Social Committee prior to presenting its proposal for the fifth framework programme.

3. In order to help ensure, *inter alia*, cost-effective implementation of the framework programme, each specific programme shall provide for systematic monitoring and, on completion of the programme, independent evaluation against the precise objectives referred to in Article 2; the modalities of such evaluation shall be laid down in each specific programme.

Done at Brussels, 26 April 1994.

For the
European Parliament
The President
E. KLEPSCH

For the Council
The President
C. SIMITIS

ANNEX I

FOURTH FRAMEWORK PROGRAMME (1994 to 1998):

AMOUNTS AND BREAKDOWN

	Ecu million (current prices)
First activity (Research, technological development and demonstration programmes)	9 432 ⁽¹⁾ ⁽²⁾
Second activity (Cooperation with third countries and international organizations)	540
Third activity (Dissemination and optimization of results)	330 ⁽³⁾ ⁽⁴⁾
Fourth activity (Stimulation of the training and mobility of researchers)	744
MAXIMUM OVERALL AMOUNT	11 046 ⁽⁵⁾ ⁽⁶⁾

Indicative breakdown of the themes and subjects in the first activity	ECU million (current prices)
A. Information and communication technologies	3 405
1. Telematics	843
2. Communication technologies	630
3. Information technologies	1 932
B. Industrial technologies	1 995
4. Industrial and material technologies	1 707
5. Measurements and testing	288
C. Environment	1 080 ⁽⁷⁾
6. Environment and climate	852
7. Marine sciences and technologies	228
D. Life sciences and technologies	1 572
8. Biotechnology	552
9. Biomedicine and health	336
10. Agriculture and fisheries (including agro-industries, food technologies, forestry, aquaculture and rural development)	684
E. 11. Non-nuclear energy	1 002
F. 12. Transport	240
G. 13. Targeted socio-economic research	138
	9 432 ⁽¹⁾ ⁽²⁾

⁽¹⁾ Of which ECU 600 million for the operational budget of the JRC.

⁽²⁾ Of which ECU 91 million for programmed scientific and technical support activities suited to a competitive approach.

⁽³⁾ Apart from the funds allocated to the third activity, an average of 1% of the total budget of the fourth framework programme will be allocated to dissemination and optimization of results in the framework of the first activity. Close coordination of dissemination and optimization activities carried out under the specific programmes of the first activity with those carried out under the third activity will be ensured.

⁽⁴⁾ Of which ECU 37 million for *ad hoc* scientific and technical support to other Community policies which will be allocated on a competitive basis.

⁽⁵⁾ A framework programme for research and training for the European Atomic Energy Community (1994 to 1998) is decided along with this programme, for a total of ECU 1 254 million, taking the total for Community RTD activity to ECU 12 300 million.

⁽⁶⁾ With the possibility of an increase to ECU 11 641 million, in accordance with Article 1 (3).

⁽⁷⁾ Environment-related research projects will also be conducted within several other lines of the first activity, in particular in the fields of industrial technologies, energy and transport.

ANNEX II

SELECTION CRITERIA FOR COMMUNITY ACTIVITIES

Community research, technological development and demonstration activities should complement the activities undertaken in the Member States and focus on clearly defined objectives. The projects will be selected on the basis of their scientific and technical excellence. The activities should:

- strengthen the technological base of Community industry and provide it with the knowledge and know-how required to make it more competitive at international level,

and/or

- contribute to the implementation of other Community policies.

The Community shall take action, in accordance with the principle of subsidiarity, only if and in so far as the objectives cannot be sufficiently achieved by the Member States and can therefore, by reason of the scale or effects of the proposed action, be better achieved by the Community. Any action by the Community shall not go beyond what is necessary to achieve the objectives of the Treaty.

Activities should contribute to meeting the general objectives of the Community, such as promoting sustainable development and improving the quality of life of the Community's citizens. Activities should be selected on the basis of thorough prior appraisal. They should also yield short-term, medium-term or long-term advantages (added value) and contribute to achieving maximum cost-efficiency, the means being commensurate with the objectives set.

Research activities should continue to focus on generic and precompetitive research of multisectoral application.

The following criteria in particular should be used to justify Community action:

- research on a very large scale for which Member States could not, or could only with difficulty, provide the necessary finance and personnel,
- research, the joint execution of which would offer obvious benefits, even after taking account of the extra costs inherent in all international cooperation
- research which, because of the complementary nature of work being done nationally in part of a given field, enables significant results to be obtained in the Community as a whole in the case of problems whose solution requires research on a large scale, particularly geographical,
- research which contributes to the completion of the internal market and research leading, where the need is felt, to the establishment of uniform norms and standards,
- research which contributes to the strengthening of the economic and social cohesion of the Community and the promotion of its overall harmonious development, while being consistent with the pursuit of scientific and technical quality,
- research actions which contribute to the mobilization or improvement of European scientific and technical potential and actions which improve coordination between national RTD programmes, between national and Community RTD programmes, and between Community programmes and work in other international fora.

ANNEX III

SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES

This Annex describes the scientific and technical objectives, including the mechanisms for implementing them.

The activities covered by the framework programme encompass all the Community's RTD effort. They aim at improving the competitiveness of European industry and the quality of life and are designed to provide the scientific and technical bases needed to support sustainable development, environmental protection and other common policies.

In keeping with the Community's industrial policy and in order to meet society's growing needs, these activities must in particular contribute to a series of more specific objectives:

- efficient and safe infrastructures, for instance as regards information and communications, as well as infrastructure responding to the requirements of the Community's transport and energy policies,
- to produce efficiently, cleanly, safely and in a way which is environment friendly on the basis of modern organization of production taking into account human factors,
- to promote protection of the environment as an opportunity for industry to increase its competitiveness,
- to promote quality of life, with emphasis on health care and hygiene,
- to ensure technological and industrial integration within the internal market (in particular by strengthening coordination between RTD policy and standardization policy),
- to anticipate technological and industrial changes so as to ensure that greater account is taken of market and society's needs, such as for instance a high level of employment,
- to increase the synergies between international cooperation in science and technology and the Community's external activities,
- to ensure efficient dissemination, throughout the whole economic and social system, in particular to small and medium-sized undertakings, of the scientific and technological advances made,
- to encourage the mastering of new technologies.

In pursuing these objectives, the Community undertakes four activities:

- the first activity covers the research, technological development and demonstration programmes,
- the second activity aims at promoting cooperation in the field of Community RTD with third countries and international organizations,
- the third activity deals with the dissemination and optimization of results of Community's RTD activities,
- the fourth activity covers stimulation of the training and mobility of researchers in the Community.

The selection of RTD actions in the context of these activities must take into account the need for greater focusing in order to increase the value of the Community's RTD effort.

The Community must aim at ensuring harmonious development of its scientific and technological resources. The research priorities set for the first activity must take account of the interests and capacities of all Member States, including the less advanced ones. The third and fourth activities will have a growing impact on the less developed regions and countries.

The Community support for RTD activities covered by the first activity will continue to focus on generic, precompetitive research of multisectoral application. This activity also includes the JRC's research and support activities of an institutional character as well as scientific and technical support activities suited to a competitive approach. Further, Community actions will be orientated towards certain major topics in order

that European research is able to contribute, in the most effective way, to the solution of problems with which industry and society are faced. There will be no financing of product or process development.

The need is to develop an operational approach in order to establish an effective interface between cross discipline research programmes and the needs of industry. To this purpose, the Commission will consult representatives of industry, research bodies and users. The Commission will also coordinate the activities in the different cross discipline research programmes.

Eureka will remain the principal vehicle for supporting RTD activities which are nearer to the market. The synergy between the Community's activities and Eureka will be improved. To this end, while preserving the specific features of each framework, the following objectives will be pursued: flexible and active cooperation between representatives of Eureka projects and of Community projects through regular exchange of information, guidance of proposed R&D projects towards the most appropriate framework and improved interaction between Community policies and Eureka projects, in particular through greater Community participation in these projects whilst respecting Community procedures.

Particular attention will be paid to the research, development and innovation capacities of small and medium-sized undertakings, of institutes of higher education and of research centres. Partnerships between them will be encouraged.

Particular attention will be given to encouraging access to Community programmes by small and medium-sized undertakings by extending the approach whereby a rapid response can be given to their spontaneous proposals (technology stimulation) building on the experience of the Craft action and of the Brite-Euram feasibility awards.

With respect to demonstration projects, the objective is to prove the technical viability of a new technology, together with, as appropriate, its possible economic advantages. The projects will be pre-competitive, and should as such focus on the application of new technologies and involve participation by both producers and users.

Within the different activities attention will also be given to basic research where appropriate.

Within each research area, particular attention has been paid to the opportunities for cooperation and coordination between national, Community and, where appropriate, European activities. Other than shared cost action centred on selected research, increased use of concerted actions will allow promotion of this cooperation in a wider range of areas, while always respecting the criteria listed in Annex II. Similar attention must be given to ensure complementarity between JRC institutional research activities and shared cost ones.

Moreover, the JRC will progressively compete for the funds available under the activities of the framework programme other than direct action, including support activities which are suited to a competitive approach. In the framework of the transnational character of Community research, the JRC institutes can cooperate with one or more partners situated in any Member State.

Closer consultations will be held with bodies representing scientific, technical and industrial circles in the Community, particularly to define the science and technology policy options at European level.

In addition to targeted socio-economic research under the first activity, research in the human and social sciences under every theme in the first activity, and also under the second, third and fourth activities, will be coordinated with research in the exact sciences, natural sciences and engineering with a view, in particular, to exploring the socio-economic context of the activities planned and possible consequences thereof.

Research activities which may also be of interest to the coal and steel industries will be incorporated into the relevant themes under the first activity, on condition that they comply with the eligibility criteria of the framework programme, in particular as regards their precompetitive and multisectoral nature.

Scientific and technological cooperation with third countries and international organizations on subjects of mutual interest will be organized partly on a centralized basis (as the second activity) and partly under the individual themes in the first activity, in so far as they help to attain the relevant objectives of these themes. International scientific and technological cooperation can be one factor determining the economic efficiency of the Community's RTD activities. Consistency must be ensured in this area between national and Community policies.

The Council will lay down the rules governing dissemination of the know-how acquired under the specific programmes and the other arrangements for implementing the framework programme. Within this legal framework, the dissemination activities must be consistent and coordinated. This implies not only centralized management (as the third activity) but also dissemination arrangements within the specific programmes under the first activity.

The dissemination activities also include measures to provide small and medium-sized undertakings and private or public research laboratories with greater access to information on Community programmes and activities. To the same end, the third activity will encourage the establishment or expansion of national or regional relay centres to disseminate and optimize the results.

Although application of the results is clearly primarily up to businesses and laboratories, in certain cases it will require concerted action by the Community and the players involved and by the relevant public- or private-sector organization, particularly at national or regional level (including, in particular, the abovementioned relay centres) in order to protect certain results and to facilitate the absorption of technologies and to ensure the best possible degree of transfer of innovations. The third activity also includes *ad hoc* scientific services on a competitive basis for the benefit of other Commission services in support of Community policies and which are not covered by the first activity.

Activities on the training and mobility of researchers will be carried out within each theme in the first activity in order to provide users in priority areas for the Community not only with the RTD results they need but also with the human resources capable of using them. Such activities will allow an increase in the economic impact of work undertaken within these priority areas.

However, the European dimension must also be used for more general measures to develop the human resources which make it possible to react in real time to scientific and technological developments in emerging areas. The fourth activity, addressing advanced training and mobility in laboratories throughout the Community, will therefore be open-ended and will also focus on partnership between universities, research institutes and industry.

Two main avenues will be used for the implementation of research supported by the Community; first, focusing financial resources on a limited number of subjects selected on the basis of the criteria detailed in Annex II (shared-cost activities), and secondly improving the coordination between national RTD programmes and between national and Community RTD programmes by appropriate means.

In particular, alongside the traditional networks established in the context of Community, activities hitherto, the following means could be used:

- thematic networks bringing together for a given technological or industrial objective manufacturers, users, universities and research centres to facilitate the integration and transfer of knowledge and technologies and to ensure that fuller account is taken of the needs of the market. They would be organized, with support from the Community, along the lines already tested during the implementation of the third framework programme in areas such as microsystems, linguistics and flexible manufacturing. Their conception and management will be left to the initiative of researchers,
- concertation networks organized with the support of the Commission along the lines of what has already been carried out in the past, for instance in the biomedical programmes,
- consortia for integrated projects along the lines, in previous framework programmes, of the fusion programme. The Member States will help the Commission in identifying the laboratories or institutes which will be associated in an integrated project supported through the pooling of financial resources within the Community. Major European research bodies such as CERN, ESA and EMBL may apply for participation, on the understanding that there will be, in principle, no transfer of funds from the Community.

The JRC can make a contribution towards the implementation of this new approach. As it is itself actively engaged in research and is closely involved in the formulation and implementation of Community policies, it could play a role, in the scientific and technical areas which it covers, in the organization of networks or consortia bringing together public and private laboratories in the Member States.

The following paragraphs set out the scientific and technological content of the activities to be conducted and the reasons for including them in the framework programme for 1994 to 1998.

FIRST ACTIVITY ^(*)

Implementation of research, technological development and demonstration programmes, by promoting cooperation with and between undertakings, research centres and universities.

This activity covers a major part of Community activities in the field of research and technological development. The basic approach is the participation of transnational groupings of organizations, research centres — including the Joint Research Centre (JRC) —, universities and enterprises. It will develop in the fourth framework programme along the following lines.

General objectives: three fundamental objectives form the basis of the fourth framework programme: support for the competitiveness of European industry; the contribution of science and technology to the satisfaction of society's needs; support for the various common policies. In addressing these three objectives, an appropriate combination of continuity and novelty will be sought. Moreover, research activities currently scattered either in common policies or in the category of activities currently carried out outside the framework programme, will be unified in the single scheme of the framework programme.

1. INFORMATION AND COMMUNICATIONS TECHNOLOGIES (ICT)

The horizontal role of information and communications technologies in all industrial and societal activities has become a factor of crucial importance for RTD policy. The boundaries between ICT and other industrial sectors, between suppliers and users, and between the professional and consumer markets are constantly being eroded, as ICT increasingly underpins all service and production industries. A new 'digital industry' is emerging. In the societal dimension, administration, health, education, transport, environment and entertainment, the workplace and the home, all become increasingly dependent on ICT. As regards the ICT industries themselves, the pace of technological advance demands ever greater efforts from suppliers if they are to remain competitive, but the costs of RTD spiral out of reach of even the largest companies. At the root of these changes is the emergence of a new information and communications infrastructure, bringing together information content, information storage, computation capacity, communications, services, and applications.

The broad twofold objective of Community RTD in ICT in the 1990s is the improvement of the competitiveness of all industry within the favourable environment created by the internal market, and the satisfaction of societal needs for a better quality of life. To achieve this objective, and leading on from the technology driven policy of the 1980s directed at a growing ICT industry, there will be firmer emphasis on a user and market-led policy geared to the development of the new infrastructure. At the same time work will draw on the results of the second and third framework programmes, where the programmes, including Esprit (information technology), RACE (communications) and Drive, AIM and Delta and other telematic applications, have furnished a solid scientific and conceptual basis for the integration of information and communications technologies into society and for the building of the new infrastructure. Activities will continue to be precompetitive in nature, and will emphasize demonstration, validation, and integration of technologies, specifications and standards. They will be reinforced by an effort in longer-term advanced research, especially interdisciplinary research addressing issues of relevance in several industrial areas.

The new focus of RTD on the generic technologies and applications essential to the pan-European information infrastructure, together with careful coordination with national initiatives, ensures respect for the principle of subsidiarity.

Furthermore, the growth and spread of the infrastructure strengthens economic and social cohesion by bringing information, services and advanced communications to enterprises and citizens in outlying regions. It enables small and medium-sized undertakings to realize their full competitive potential. The requirements of the infrastructure gives us a yardstick for assessing R&D priorities, and so ensuring effective use of resources.

^(*) Nuclear research and training activities are covered by the Euratom framework programme decision.

The information and communications infrastructure can be seen as consisting of four main domains: applications, integrated systems, communications, and underpinning information technologies. The generic information technology and communications technology domains encompass those technologies which lie at the heart of the infrastructure, including components, computers, software, data banks, information highways, and video displays, and which are also essential for the technologies for digital TV, in particular high-definition. They provide the building blocks for the complex integrated systems bringing together technologies such as language engineering, high performance computing and multimedia interfaces. These in turn are the basis for the implementation of applications in areas such as health, transport, open learning, statistics, libraries and business organization.

The increasing convergence of information technologies and communications in the information infrastructure leads to greater complexity of systems, which in turn relies upon the availability of technologies for the integration of systems.

There are inevitably close links between RTD activities in the different domains, reflecting the increasingly integrated nature of ICT. Furthermore the widespread application of ICT means that there are links with many other themes within the framework programme.

More attention will be paid to projects involving supplier-user collaborations. This, together with streamlined procedures for small projects, will facilitate in particular the participation of small and medium-sized undertakings.

In order to strengthen the industrial and social impact of RTD results, RTD actions will be embedded in a set of coherent industrial policy actions. Consequently, accompanying measures will be systematically identified, in particular through a continuous analysis of market, industrial and technological evolution. These analyses will provide guidelines for future actions and pave the way for the implementation of appropriate industrial policy measures.

RTD activities across the domains of the information and communications infrastructure will be organized into three sub-lines.

A. Telematics applications of common interest

This sub-line covers RTD activities on applications of information and communication technologies that will contribute, on the one hand, to fulfilling requirements resulting from existing Community policies as well as fundamental needs of modern societies in sectors such as health care, transport or training, and, on the other hand, to the positioning of European industry for the new markets that will emerge as a result of research activities. The general objective is to improve the effectiveness of telematics applications engineering and to ensure the interoperability of systems and telematics networks, by means of prenormative research and development activities and trials for technical validation. The work will draw upon the experience gained in the third framework programme, but emphasis will shift from data telematics to multimedia telematics. Activities will be focused around seven topics and will be closely coordinated with other relevant Community activities. RTD on telematics applications will closely involve potential users and will also aim at maximizing the generic content of each project and the commonalities between applications pertaining to different domains, taking into account the needs emerging from activities carried out in the relevant programmes (e.g. transport) and maintaining proper coordination with those programmes in order to facilitate the transfer of results.

The aims of activities within the topic language and information engineering are to develop technologies for processing spoken and written language within information and communication systems, and to demonstrate their integration into a variety of application areas. Work also covers electronic languages resources, including dictionaries and corpora, and general linguistic research. Information engineering will cover advanced electronic publishing systems, new database structures to ease information access, improvements in the usability of information and in information management, cooperative RTD networks, and standard work.

Development and upgrading of trans-European telematics applications. Today, to be more efficient, European research needs advanced trans-European networks and services. In addition, the internal market has set important requirements in the field of services and information exchange between administrations. The need for enhanced telematics services will be supported by RTD activities aiming at developing and validating cost-effective solutions based on the constantly evolving pool of new technologies and on the upgrading of European telecommunications networks. In particular, work will concentrate on applications integrating distributed services for information exchange and

video-conferencing. The results of the RTD work in this first area, which deals exclusively with trans-European applications, will be made available to the remaining telematics application areas.

Applications for health care will aim at the stimulation of telematics technologies for delivery of health care, including medical diagnosis and surgery, irrespective of location with a focus on information access, interchange and management of data, telemedicine and security and privacy issues, whereas applications for disabled and elderly people will develop and validate systems and services allowing the integration of elderly and handicapped people.

Work in the area of flexible and distance education and training and information exchange between libraries will promote the provision of efficient education and training services, widely available and able to meet the needs of individuals, industry and researchers. The activities will encompass technology and systems development for the design and delivery of learning products and services, and their integration into experimental networks. Work will also cover technology development creating a generic scientific and technological base for European library resources and for a networked library infrastructure.

RTD for telematics transport applications will develop and validate common functional specifications, practices and guidelines for telematics systems and services developed for all transport modes, including multimodal transport. Particular attention will be given to telematics systems as a contribution to the traffic management of railways, shipping and road traffic including inter- and intra-city traffic and multimodal transport as well as for the creation of a harmonized, and finally unified system for European air traffic management. The implementation of these applications imply the development of geographical information systems (GIS) applied to transport.

Applications for urban and rural areas will validate solutions, such as teleworking and teleservices, that will bring work and services to citizens and will reduce unnecessary movement of people. It will also combat the migration of companies and citizens from rural areas and improve the conditions of daily life. Particular attention will be paid to the ease of use of these telematics services by citizens and small and medium-sized undertakings.

Finally, exploratory actions will assess the potential of telematic solutions in new areas such as environment (pollution monitoring), surveillance and control, advance warning for major natural catastrophe, management of environmental hazards and tracing of dangerous material) as well as other needs for telematics services which may usefully be developed in the course of the fourth framework programme.

B. Technologies for advanced communications services

Telecommunications networks are an indispensable part of the information infrastructure. The overall objective of this sub-line is to develop advanced and more cost-effective communications systems and services for the consolidation of the internal market, economic development and social cohesion in Europe, taking account of the rapid development of technology, the changing regulatory situation, and opportunities for development of advanced trans-European networks and services. An effective framework will be provided for usage innovation and the wide dissemination of European technologies and expertise. Activities will concentrate on five topics.

Work on digital multimedia services aims to stimulate advanced technologies and standard exchange formats for the retrieval and dissemination of multimedia electronic information (text, voice, image, audio and video). Work will include technology development for terrestrial radio, satellite and fibre, including cable, transmission of interactive digital video services. It will also cover switching, processing and recording developments, for service providers, network operators and users, including new technology development for image compression, variable bit-rate coding, wireless networks, network interfaces, and recording. Work on digital audio and video will cover the development of technologies concerning the whole range of processing and transmitting operation of the signal. The objective of work on photonic technologies is to stimulate and accelerate European development of integrated photonic systems, and involves the development of integrated optical subsystems, free packaging and mass-manufacturing techniques, and optical cross-connects, as well as key technologies for the 21st century: 3D holographic displays, life-images recognition and new signal compression techniques.

Mobile communications activities are directed towards ensuring mobility on fixed networks and using advanced radio and satellite systems across Europe. The work will involve technology developments in signal coding; access systems; channel, network and service management; the development of new signalling protocols; and system development to ensure compatibility and interoperability of networks through protocols for transparent network interoperation. The objectives of work on intelligence in networks and service engineering are to develop technology for flexible and real-time management of communication assets, to enable the fast and flexible introduction of new services in advanced networks and effective network management and service deployment in a diverse and competitive communication environment. The work will focus on the development of tools for service integration and will support the development of protocols and standards. It will involve the development, enhancement and prototyping of service creation environments and the development of advanced 'operating systems' for communications services.

Work on security of information and communications systems covers the development and demonstration of technologies for the integrity, confidentiality and availability of information in integrated systems. The work will include research on new technological opportunities to assure security, the development of software, protocols, and components and their integration into secure systems and services followed by validation and testing within integrated systems. Particular attention will be given to the requirements of electronic payment, health-care and remote-working systems.

C. Information technologies

Work in this sub-line focuses on the technologies underpinning the information infrastructure, selecting activities which are most essential and add most value at the European level. There is a strong feedback relationship with the other three domains of ICT: activities in information technologies provide important inputs to the other domains, and conversely are conditioned by the other domains' requirements. Work is divided into six topics.

The objective of the topic semi-conductor technologies, including application specific integrated circuits (Asics) is to provide essential microelectronic components which underpin the competitiveness of all high technology industries. Work will concentrate on those semiconductor technologies likely to be in major use towards the end of the decade including digital CMOS and CMOS based analog, mixed A/D circuits, smart power and smart sensors, as well as technologies based on III-V materials, such as GaAs, in view of their use in future ICT systems. It will also address passive components and power components, so as to contribute at the same time to identifying the characteristics of these components; this activity will focus on reduction of size, integration of components, improvements of their performance and lowering of costs. All aspects of the process, including design, equipment and production, will be supported. Systems integration of advanced components into ASICs is a key area of emphasis. The open microprocessor systems initiative aims to provide Europe with a recognized capability in microprocessor systems, and to promote their broad acceptance in applications systems world-wide. The work includes the provision of an open library of hardware building blocks which can be integrated into on-chip systems for a wide range of application, open systems software, and both hardware and software integration tools. The objectives of the topic integrated microsystems is to provide technologies for the emerging domain of microsystems, in which microelectronics will be integrated with other microtechnologies such as micromechanics and microoptics. The work will focus on multitechnology systems, and integration and packaging methods. Applicability of microsystems will be demonstrated for selected applications.

Activities within advanced peripheral technologies concentrate on the technologies needed for the low-cost high-resolution thin-screen display components and memory sub-systems required by computers, televisions, and intelligent systems in areas such as avionics, cars, telecommunications, manufacturing, and retailing. Work on displays focuses on visual quality, screen size and flatness, with an emphasis on LCD technology. Memory sub-system development will include increased capacity, compactness and read/write performance. The objective of the topic software best practice is to improve productivity, quality and reliability in European software production by fostering the best use of advanced software tools and techniques, including aids for reuse and portability in a distributed environment. In addition to further development of current techniques, work will include industrial experiments, dissemination aimed at raising awareness of best practice, training for the introduction of new practice, associating where appropriate the European Software Institute. Distributed information processing activities concentrate on tackling challenges generated by the convergence of information processing and communications technologies, and will focus on distributed database management, distributed statistical systems, open distributed processing, and advanced human-computer interactions.

The topic high performance computing and networking has as its objective the exploitation of high performance and distributed computing technologies for the benefit of a broad range of users in fields such as manufacturing, engineering, and commerce, on applications ranging from non-destructive simulation of car collisions, drug design, and advanced imaging for earth observation, to very high performance databases. Activities include the transfer of applications and the implementation of user environments for the use of parallel, distributed and embedded systems, and the development of selected new applications and technologies, such as simulation and real-time processing.

Work on integrated personal systems is directed at the development of systems supporting personal access from any location to services in the information and communications infrastructure, and the local manipulation of information. Work will include miniaturization, new multimodal user interface paradigms, high levels of systems integration, integration of smart card technology, personal applications. Applicability will be demonstrated in systems such as the personal digital assistant and systems for personal and group working.

Multimedia systems work will cover hardware and software productivity tools for authoring and development platforms, multimedia information servers, hypermedia presentations, the management of documents, advanced compression algorithms, copyright protection software, virtual reality techniques, and pilot applications, particularly in the area of business processes.

ICT support for function integration in manufacturing aims at the development of new ICT solutions in support of manufacturing and engineering operations, in order to achieve increased competitiveness as well as greater efficiency and environmentally clean and safe operations supporting a lean manufacturing approach. A specific ICT infrastructure and advanced ICT technologies for distributed multi-site operations will be developed to support innovation. Activities will be targeted at exploiting new organizational approaches integrating basic technologies of software engineering, open systems, data modelling and database design, computer aided design, microelectronics, microsystems and, selectively, mechatronics.

2. INDUSTRIAL TECHNOLOGIES

The globalization of markets, newly emerging competitors, the internationalization of processes for new technologies and the essential improvement in environmental protection are forcing European industries to adapt their structures, their cooperation and their competition strategies. In the developed countries the share of manufacturing is declining and accounts for about 30 % of GDP (including the building and construction industry). It must be stimulated in order to improve its competitiveness through a better collaboration with 'knowledge-related' activities (e.g. services, engineering, training, health and safety). Despite past efforts, Europe is still in a difficult situation; industrial R&D expenditure and the number of researchers are still significantly below those of Japan and the United States of America (1,3 % of GNP against respectively 2,2 and 1,9 %) and there is a risk that this difference will increase. In this context, the strategy of the Community has to play an important catalytic role to support industrial initiatives, to stimulate the development of technological innovation, and to help the establishment of European standards.

The growing requirement to master a large spectrum of technologies for industrial competitiveness justifies the reinforcement of Community actions in this field.

The proposed research actions are a continuation of previous activities but will be concentrated on the development and application of generic sciences and technologies (such as mathematics and physics applied to industrial systems, new design and organization methodologies, high performance material engineering, rapid prototyping or molecular engineering) operating within multidisciplinary and multisectorial projects. In addition, the development of harmonized methods for measurement and testing and prenormative research will reinforce industrial competitiveness while offering support to European legislation.

Following the lines of the new European industrial policy, the research actions on industrial technologies will be aimed at industrial technologies the application of which could have a rapid impact on the wide range of industrial activities. Research on new technologies for 'clean manufacturing' or 'flexible manufacturing' is a clear example and their global economic impact is important. Numerous industries, including small and medium-sized undertakings, could benefit from these research activities, concentrated as they are around strategic objectives and consortia of suppliers, manufacturers, end users, universities and research centres. Proposed actions, especially those dealing with coordination, will stimulate technological networking improving the consistency between projects and the diffusion and exploitation of RTD results,

in particular through standards and industrial specifications. Research activities for and by small and medium-sized undertakings, and training activities within an industrial context will also be reinforced.

The proposed actions cover four areas: the first three areas address the integration needs of technologies related to the materials and product life cycle (including applications of available information and communication technology), whilst the fourth area is more specifically related to prenormative research.

A. Design, engineering, production systems and human management

This theme is of major importance and covers the whole of the manufacturing and process industry, including traditional industries. The objective is to develop and apply, within a perspective favourable to the environment and to the improvement of the quality of life and of working conditions, new methods, techniques, new processes and tools in each phase of industrial production essential for competitiveness (design and engineering, production and maintenance, quality of products); such diffusing technologies will be integrated and applied in production systems so as to fit the needs of networks of companies and human management in production.

In particular, emphasis will be placed upon the adaptation and application of generic solutions available for computer integrated technologies (CIT), (including computer integrated manufacturing and engineering — CIME), for micro-system technologies, man-machine interfaces, lean production/just-in-time manufacturing, the development of rapid prototyping and the technologies required for clean manufacturing (such as bioprocessing, and other technologies minimizing consumption of energy and natural resources) and for the rapid emergence of new products, particularly in the field of industrial machines, transport, chemical processing and human habitat.

B. Materials and material-related technologies (including processing and recycling)

The objective is twofold: first, to improve the existing processes commonly used by the material-related industries (mining, metallurgy, chemical processing, construction) and, secondly, to make sure that the most advanced materials are ready for supply to both manufacturing industry (electro-mechanical, machine-tools, transportation, etc.) and high-tech industries (e.g. aeronautics and electronics) and that high-tech processes are applied to traditional materials. Priority will be given to research topics related to high performance materials (structural materials but also on bio-materials, magnetic, optical and super-conducting materials), and to research into the improvement of the quality, reliability and the performance of materials and products and into longer-term research whose exploratory character may quickly yield practical applications thereby strengthening European industry's technological lead. The programme will obviously cover the recycling and treatment of waste and the recovery of materials at the end of product life, including the necessary quality assurance. Special attention will be given to the technologies required for the rational management of primary raw materials and the reuse of secondary materials and products in order to contribute to the development of clean processes and technologies. With respect to clean and safe manufacturing, attention should be paid to the substitution of dangerous materials.

C. Technologies for transport means

European integration and the trends in the economy are creating a growing demand for flexible and efficient transport systems designed and implemented by European competitive firms to meet the needs of increased personal mobility and movement of goods. Transport means will have to meet strong objectives to allow for comfort, quality, safety, cost efficiency, volume, speed and environmental friendliness in the context of the European transport policy. The research tasks will encompass in priority design, engineering and production of new products.

Research will concern the implementation of advanced equipment and systems through the application and integration of various technologies, such as design, production and maintenance, modelling and simulation, advanced material applications, and the reduction of the environmental impact. Particular attention will be given to propulsion, aerodynamics, monitoring and control systems, and on board equipment.

In allocating resources within this area, research will be undertaken for the automotive, railways and shipbuilding industries, but special emphasis will continue to be given to aeronautics research both to ensure continuity with the activities undertaken in the third framework programme and to reflect further the essential advanced technology requirements of this industry and its capability for proving feasibility of advanced generic technologies which can then be spun off to other transport or industrial sectors.

D. Research linked with standards, measurement and testing

The main objective is the research necessary to develop new measurement and testing methods and to accelerate the establishment of European directives and standards for the reinforcement of the internal market, especially those related to aspects of health, safety and consumer protection, agro-food and the realization of the other Community policies, in particular environment. Within the industrial field the emphasis will be placed on the improvement of the interface between standardization and regulatory issues and the design, assembly and the quality of products. The development of test procedures and more effective measuring systems and a better system for mutual recognition of conformity certificates, will facilitate recognition of accreditation and audit systems set up in the framework of partnership with industry or sub-contracting. The organizational infrastructure will be strengthened at the European level making maximum use of existing arrangements. Coordination with the work carried out in CEN/Cenelec will be strengthened. Coordinated and cost-shared actions will be undertaken with networks of national laboratories. Workshops and training courses will permit the diffusion of codes of good practice within Member States.

All these actions will be principally undertaken through collaborative research projects. On the basis of the experience of the third framework programme (Craft, feasibility awards) specific activities to stimulate research for and by small and medium-sized undertakings will be improved and reinforced, especially through simplified procedures and the support of a decentralized assistance network. Greater use of concerted actions, when this mode of action is sufficient to attain the Community added value, will permit greater selectivity in cost-shared actions (concentrated on strategic fields, needing a minimum critical mass). Procedures will be established such that the necessary flexibility is achieved in order to guarantee maximum efficiency and a quick reaction to emerging needs.

Accompanying measures aiming at strengthening the impact of Community actions will be optimized: studies, evaluation of impacts, training, support to diffusion and exploitation of RTD results, joint activities with assistance networks for small and medium-sized undertakings, measures for decentralized management, and coordination of industrial research on common objectives, to facilitate integration of technologies and transfer of knowledge between projects, sectors and other European initiatives such as Eureka.

JRC actions will complement these efforts through research on advanced materials, ceramics and composites (especially for high temperature applications) and non-destructive testing techniques. Prenormative research will cover work on structural mechanics and research on measurement and reference materials. These actions will also cover all scientific and technical support activities of JRC to the Community industrial policy and the internal market.

3. ENVIRONMENT

Environmental research makes major contributions to commercial competitiveness and to the improvement of quality of life in the Community. These are essential elements in the definition and the execution of Community environment policy and to the expectation of an economic boost based on sustainable development in the sense of the objectives of the Community's fifth action programme on the environment. This programme provides a new strategy to determine, in a spirit of sharing of responsibilities, the actions which affect natural resources or which affect the environment. This strategy aims at reducing the tendencies and practices which have a negative effect on the environment with a view to improving both the quality of life and socio-economic development for the current and future generations by enlarging the range of instruments available aimed at changing the behaviour of actors in the field. It will also take into account what the Community has accepted to do as a result of the UnCED in Rio de Janeiro.

Environmental research and its economic and social implications have acquired a world-wide dimension. As it becomes ever more multi-disciplinary and requires more money and resources, environmental research needs a strongly integrated and coordinated international effort that, in certain cases, exceeds the capability of any one Member State. The participation of the European Community in this effort is clearly justified by the political and geostrategic stakes in areas such as global change and the management of natural resources.

In this context the Community's initiative with regard to RTD on the environment has the following priority objectives:

- (a) continuing the development of a scientific base permitting the definition and execution of a Community environment policy that will achieve a high level of environmental protection;
- (b) contributing to improving industrial competitiveness by (i) the stimulation of the development of generic technologies integrating environmental constraints within the scope of sustainable development and (ii) improving ability to cope with and anticipate environmental problems;
- (c) contributing to the observation of the behaviour and the understanding of the processes taking place within the earth's systems, and examining the effects of human activities on these characteristics and processes;
- (d) identifying technologies for the restoration of polluted areas;
- (e) continuing to develop research and technologies in order to describe, monitor, forecast and protect the marine environment.

The nature and scale of these issues requires a thematic focus of Community effort on priority areas of research: the natural environment and global change, the new technologies for the protection of the environment and marine sciences and technologies.

Concerted actions as well as shared cost actions will be the main operational mechanisms, as in the third framework programme. However, in the area of research on the quality of the environment and global change, in order to focus Community efforts actions will, where appropriate, be incorporated into thematic networks, integrating the potential of the national research institutions. These networks will be developed in cooperation with the JRC and in close cooperation with international organizations and research programmes (ESF, IGBP, WCRP and HDP) and the space agencies.

Interdisciplinary regional research networks will be established to address the distinctive problems of particular European regions, both terrestrial and aquatic.

At the same time the socio-economic aspects inherent in the three priority themes and linked with the general topic of sustainable development will be tackled. These aspects will be important with regard to changing the behaviour of actors in the field and will be treated simultaneously within each action and with specific measures for methodological and conceptual developments.

A. Natural environment, environmental quality and global change

In this area Community efforts will be concentrated on prenormative and pre-legislative aspects to facilitate the implementation of the fifth Community programme of policy and action in relation to the environment and sustainable development.

Community effort, including the activities of the JRC concerning the risks associated with chemical products (European Chemical Bureau) and the validation of alternative testing methods (European Centre for the Validation of Alternative Methods), will concentrate on the following objectives:

- providing a scientific basis for evaluating the state of the environment and improving the timely awareness of environmental problems, which will require the identification of indicators and environmental parameters, of advanced systems for surveillance and evaluation of effects of human activities and natural phenomena, constituting a risk for man and society,
- a better understanding of the fundamental mechanisms which are active in the environment and the effects of human activity. Here there is a need for a long-term research strategy allowing the Community to establish its policy as to global change, taking into account the conclusions adopted by UnCED at Rio as well as at European level. Due attention will be given to the protection of fragile ecosystems, to biodiversity and to the integrated management of threatened natural resources.

Within this framework Community activities will be concentrated on: (a) observation of the behaviour and understanding of the basic processes and changes of natural, terrestrial, oceanic, climatic and atmospheric systems, putting the emphasis on the European context and dimension, but within a

planetary perspective; (b) identification and evaluation of the impact of human activities on this behaviour and processes, and (c) evaluation of the impact of the possible climatic, biospheric and atmospheric changes on man, the environment, society and economic activities. These tasks will be achieved through thematic networks consisting of concerted actions and consortia for integrated projects and the activities of the JRC. The thematic networks will be coordinated to ensure coherence of the whole, particularly in the diffusion of results and model development. The JRC will be closely associated with these actions. They will be developed within the framework of the Enrich (European network for research on global change) network and in collaboration with CEO (Centre for Earth Observation).

B. New technologies for environmental protection

Community effort will be concentrated on three priorities: instrumentation technologies, technologies relating to industrial processes and products and technologies relating to the restoration of the environment and the prevention of natural hazards.

Within the area of instrumentation technology, the objective is to contribute to the technological development necessary for observation, surveillance and environmental research. This requires in particular a contribution to earth observation technologies from space. This includes sensors, observation technologies and monitoring of the various biosphere behaviours, further development of environment analysis technologies and technologies relating to the treatment, validation and dissemination of data. Instruments related to early warning concerning natural hazards and to the monitoring of contamination from industrial facilities will also be included. This effort is also viewed as support for other Community policies.

Within the area of technologies relating to industrial processes and products, taking into account the specific needs of small and medium-sized undertakings, the objective is to contribute to: (a) the development of techniques, including risk assessment, to reduce or prevent the negative impacts of industrial, including agro-industrial, processes and substances on the environment, (b) the development of methods of analysis for product life-cycles and impact evaluation methodologies for industrial processes and products, (c) the development of technologies to treat, recycle and eliminate waste, with the objective of achieving as far as possible a closed circle economy, (d) the development of technologies to treat waters with a view to protecting and restoring the environment and fight against pollution, (e) the development of technologies for the habitat and for transport that integrate environmental constraints and improve the quality of life in close coordination with the activities of other pertinent topics, (f) the development of value-adding techniques in the area of earth observation.

Finally, within the area of restoration technologies, the accent will be placed upon the restoration of environmental quality, while in the area of natural hazards the emphasis will be placed upon monitoring and response.

Networking of European seismological research should be encouraged.

For technological research, in the areas where the organization of the research potential on a Community dimension is necessary, recourse will preferably be made to concertation networks and consortia for integrated projects. The JRC will contribute within its specific areas of competence. These actions can be managed in coordination with Eureka. Industrialists and product users will be associated. The effort will concentrate on multisectoral and diffusive techniques. Complementary stimulation actions are envisaged to improve technology transfer to companies.

C. Marine sciences and technologies

Notwithstanding the need to understand the interaction of the oceanic system with other global systems in the study of climate change processes and its impact, Community effort will be directed to the further development and strengthening of the European marine community through a further phase of activities of the marine science and technology programme.

These activities will concentrate on understanding and describing biological, chemical and physical processes mainly through multidisciplinary process studies of special relevance to the European seas. This will extend from the coastal zone to the deep sea, with extension northwards to the Arctic Ocean to include marine and ice interactions.

The objectives include the development of methodologies and basic technologies, in particular those applying to hostile conditions, in order to describe, monitor, forecast, protect and manage the marine

environment as a resource. This will encompass coastal zones as well as deep sea and arctic marine areas, and will contribute at Community level to international activities, *inter alia*, the global ocean observation system (GOOS). Specific projects will be devoted to the study of European regional seas.

The activities will promote cooperation between Member States in relation to large facilities (oceanographic vessels, remotely operated vehicles, hydrodynamic channels, etc.), including their more efficient use through improved coordination between national and Community activities.

4. LIFE SCIENCES AND TECHNOLOGIES

A consideration of the specific difficulties facing European agriculture and industry, the needs of Member States' health care services, and the technological aspects of the implementation of Community policies suggests that there is much to be done in mobilizing the research potential in life sciences and technologies in order that the socio-economic partners in the Community could be more readily given access to the anticipated technological benefits. Furthermore, Community resources are limited. It is therefore of the utmost importance that the supply of science and technology matches the economic and social demand, as expressed in Community policies and actions.

The scientific supply-side is characterized today in Europe not only by the excellence of fundamental research, but also by the excessive fragmentation of expertise into too many disciplines, whose respective contributions are often unbalanced. At the same time, social demands for a response to the needs of protecting and managing the living world are unprecedented in their strength and clarity. In a society undergoing dramatic demographic changes, increasing therapeutic, and thus economic, demands will be made which will impinge on disease research in a wider geographical and cultural context. The liberalization of trade and the global scale of problems affecting the biosphere pose anew the issue of competitiveness for the many industrial sectors which have traditionally exploited biological resources.

The novelty at this stage lies in the abundance of new scientific challenges which can be met, in particular by the advanced methods of biotechnology, integrated as appropriate with other industrial technologies. Now that life sciences and technologies have clearly demonstrated their societal role, a more precise vision must be developed of where and how mankind should arrange its way of life for the greatest social and economic common good. The obligation of using life sciences and technologies in the most harmonious way possible in relation to current practice, with a view to meeting the basic needs of society, is the overall purpose of this research theme.

Wherever possible, experimentation and testing on animals should be replaced by *in vitro* or other methods. No research modifying, or seeking to modify, the genetic constitution of human beings by alteration of germ cells or of any stage of embryo development which may make these alterations hereditary, nor research seeking to replace a nucleus of a cell of an embryo with a nucleus taken from a cell of any person, embryo or subsequent development of an embryo, known as cloning, will be carried out under this framework programme.

Member States' capabilities are now much more developed than they were only a decade ago, but remain very heterogeneous. In some key areas these capabilities are so fragmented that a critical size has not been reached and the value added deriving from the integration of complementary approaches cannot be realized, while other efforts are wasted through redundancy. The operation of scientific networks has revealed the validity of this approach without, however, being sufficiently developed. The operational choices indicated under this take into account, above all, the opportunities for facilitating the interplay of complementary national activities. These considerations will be addressed in the following three fields:

- biotechnology,
- biomedicine and health,
- agriculture and fisheries (including agro-industry, food technology, forestry, and rural development).

The most important activities will have to be upgraded through a range of measures aiming to promote a more positive environment for the timely application of life sciences and technology. Use will be made of demonstration activities to raise the profile and increase the attraction of alternative technological approaches. The selection of demonstration projects must be particularly rigorous in order to ensure the

expected impact. Where appropriate, links will be established with the Eureka programme. Attention will be given to studies and debates which bring technological innovation within the scope of ethical and regulatory issues. Other measures will be implemented: training bursaries, special arrangements for the participation of small and medium-sized undertakings (e.g. on the model of the Craft initiative).

A. Biotechnology

A specific European weakness when faced with biotechnology breakthroughs is the dispersion of responsibilities and the lack of social consensus on what scientific tasks to undertake. This extreme reluctance to identify and mobilize relevant activities must be overcome by a more systematic consideration of the broad range of available scientific opportunities and by a concentration on those which relate to major issues of industry and society.

The Community programme should promote global rather than reductionist approaches and the integration of disciplines rather than excessive specialization. The programme should take into account the needs of industry while paying careful attention to the views expressed by various interest groups including consumer groups, regulatory bodies, professional associations. In that respect, Eureka projects and national programmes will also be taken into account. It is clear that in this area the need is to restrict the number of topics selected to those where all the above conditions for a cooperative process at Community level are met.

In an attempt to focus biotechnology on where it differs fundamentally from alternative technologies, primacy must go to reaching an understanding of how the living cell itself manages to be so productive and how industry can learn from cellular processes.

Significant progress will be expected from four priority integrated actions where national and Community efforts could converge. These will concentrate on:

- the understanding of the 'cell factory' concept and its extension to the design of new industrial bioprocesses. This will require the promotion of a multidisciplinary vision of biochemical engineering, underpinned by research into biochemical engineering sciences,
- the analysis and sequencing of model genomes, the exploitation of comparative approaches to mapping genomes, including the genome, and the development of appropriate technologies and infrastructures,
- the development of plant molecular and cellular biology, including protein engineering and plant and animal physiopathology, notably with agricultural and agro-industrial applications in mind,
- research within several disciplines such as pharmacology, cellular biology, molecular biology and medical chemistry in order to understand the inter- and intra-cellular events by which nerve cells manage information, and with a view to promoting neurosciences using the combined support of these disciplines.

Three other objectives will be addressed via R&D projects and concertation networks supporting national efforts. They will consist of:

- the development of scientific and technological research in animal physiology, immunology and structural biology,
- the maintenance of a coherent framework for prenormative research, as well as biodiversity, bioethical studies, taking into account work on the European Bioethics Convention, and environmental aspects,
- the provision of informatics resources, telematics and genetic collections to serve the research described above, ensuring proper coordination of the objectives of informatics and biotechnology.

These activities together will produce knowledge indispensable for industrial progress in the targeted fields supported by the Community participation, and they will achieve this goal by applying the multidisciplinary approach which characterizes biotechnology. Their success will depend on how much attention can be given to the continuity of efforts on the generic activities developed in this area in relation to the other areas of biomedical or agro-industrial applications.

B. Biomedical and health research

Health, so highly valued by every European citizen, is one of the most important sectors of the economy, absorbing 6 to 8 % of GNP and creating work for more than six million people; the challenge for research is to control the greatest scourges. AIDS represents one of the most worrying epidemics which need a strengthening of the coordination of research activities. Cancer, cardiovascular disease, mental and neurological disorders, other chronic diseases and the problems of the aged and handicapped also require serious attention. Rising costs have become a concern for all countries, while citizens in every Member State are demanding high-quality health care. New health technologies and health care systems are expected to face these common problems. A major challenge for Europe is to ensure a positive relationship between basic and clinical research in the interest both of health and European industry, including health care. The following objectives will be addressed:

- development of the scientific and technical basis required for the evaluation of new drugs, notably for the treatment of neurological, mental, immunological and viral illnesses (these actions should also underpin the activities of the European Medicines Agency). New *in vitro* tests, cell lines and, where necessary, animal models, their validation and multi-centre clinical tests and drug safety checks will be included. Research will be conducted through collaboration between industry, research centres, hospitals, universities and the authorities responsible for verifying the efficacy, safety and quality of new drugs,
- development of biomedical technology and engineering, particularly through research concerning medical devices for minimally invasive surgery, imaging techniques, biosensors, biomaterials and modelling of human functions,
- participation in the 'Decade of the Brain', by the use of molecular, cellular and clinical approaches to diseases of the human brain and nervous system, and by the development and use of methodology, of instrumentation and of the most advanced technologies and infrastructures considered necessary for the study of the nervous system. This approach will integrate the contribution of several disciplines,
- integration of basic and clinical research to improve the prevention, diagnosis and treatment of illnesses with major socio-economic impact (such as cancer, AIDS, cardiovascular diseases, chronic diseases, occupational illnesses, etc.) and the 'orphan' illnesses including collection and analysis of statistical and epidemiological data,
- analysis and sequencing of the human genome, exploitation of comparative approaches to mapping, development of appropriate technologies, and application of knowledge to the improvement of human health, including somatic gene therapy; sharing and harmonization of the databanks on genetic diseases comprising Community participation in the management of the international database of the human genome,
- research on health systems and technologies, and on information and education on health matters. This will concentrate on primary care, the evaluation of health needs, performance measurement of health policy initiatives and the evaluation of health technologies. The impact of the internal market on the supply of health care across internal frontiers will be examined, as well as the following: regulation and de-regulation, the balance between health systems financed by the private and public sectors; the need to define a European approach for the introduction of new technologies in health systems,
- research on bio-medical ethics, to address general standards for the respect of human dignity and the protection of the individual in the context of bio-medical research and its clinical application.

C. Agriculture and fisheries (including agro-industry, food technologies, forestry, aquaculture and rural development)

In the field of agriculture, forestry, rural development, agro-industry and fisheries, the objectives and challenges are to provide an RTD base for competitive, efficient and sustainable primary production (agriculture, horticulture, forestry, and fisheries) and agro-industries (food and non-food, including bioenergy and bioplastics); support the evolving Community policies (agriculture and fisheries especially); respond to the needs of society for a wide range of healthy and nutritious foods and environmentally friendly non-food products; and contribute to sustainable rural development and to the

preservation and enhancement of the rural and coastal environment. In order to meet the different objectives of the programme, four priorities have been identified and will be addressed by RTD projects and thematic and concertation networks in support of national efforts. They will consist of:

- integrated production and processing chains that gather all the necessary skills and technologies relating to the use of biological raw materials (including those of aquatic origin) in a specific sector and with the focus on production lines with significant market potential and economic feasibility,
- development and improvement of methodologies (e.g. structured models and simulation methods) used for scaling-up, design and testing of agro-industrial processes,
- generic food science and advanced technologies to better meet the consumer's needs for a safe and health-promoting diet; research will concentrate on generic food processing technologies which take account of the molecular basis of the conversion of biological raw materials into finished foodstuffs and integrate new advanced technologies for the food sector,
- agriculture, forestry, rural development and fisheries in support of the reform of common policies and to identify solutions appropriate to the transformations in rural areas. The need is to develop new systems and chains of production which are economically viable in this area, which are protective of the environment and which maintain an adequate level of employment. An improvement in the economic situation of agriculture and of fisheries will also be sought by means of quality products, diversification of products (food and non-food) and activities, and by cost-reductions, which presuppose the introduction of new technologies and the better utilization of more effective inputs. The demands of consumers and the completion of the internal market require an effort to be made with regard to animal and plant health as well as to animal welfare. New land uses will be developed, for example for set-aside land. As regards forestry, the need is to develop multi-functioned forestry management (production, leisure, protection). Finally, increased attention will be devoted to rural development, in line with the strengthened Community policy in this area. The same will apply to coastal development.

In line with Community policies and in order to provide means for primary production (including of aquatic origin) which respond to the demands of the consumer and industry for a supply of raw material in adequate quantity and quality, and at the same time serving the interests of producers and benefiting the rural economy, priority coordination/network actions will be carried out in support of the substantial existing efforts of Member States, as regards in particular:

- primary production in agriculture, forestry, fisheries and fish-farming with the main emphasis on sustainability, quality, security of supply and interactions with the environment,
- rural and coastal development with particular attention on training and alternative economic activities,
- food production and processing integrating socio-economic, health and food safety aspects.

Activities will be carried out in this area by the JRC which will lend its support through:

- the use of a laboratory for analysis of pharmaceutical and food products,
- by establishing a technical support project for the management and control of the application of the common agricultural policy (CAP), using data transmission by satellite,
- by continuing the teledetection project for agricultural statistics, and by promoting teledetection of plant diseases.

The aim in this area is to extend the application of the basic technologies developed in biotechnology, biomedicine and teledetection.

5. ENERGY

(Technologies for cleaner and more efficient production and use of energy)

Energy policy, which seeks to ensure security of supply (notably through the promotion and better use of indigenous resources and technologies and the diversification of usable sources) now faces a new challenge: that of compatibility between energy and protection of the environment. Present and future uses of different

energy sources, on a European and global scale, carry local, regional and global risks to man and the environment: increased pollution; greenhouse gases, etc. The aim of Community activities is to develop and demonstrate effective, cleaner and more reliable technologies guaranteeing compatibility between energy usage, the equilibrium of the biosphere and economic development under its various headings (competitiveness, economic and social cohesion).

During the period covered by the second and third framework programmes, Community activities of R&D and of demonstration/dissemination relating to energy have established networks of cooperation for research and networks for promotion and diffusion for those energy technologies which have achieved maturity (notably the OPET network).

These activities will be continued, while strengthening the integration between R&D and demonstration (in succession to the Thermie programme), thus contributing to the achievement of the Community's major goals in the energy field, sustainable development and support of competitiveness. This work of integration will contribute to better evaluation of the relative efficiency of R&D and demonstration for each strand of technology and to better achievement of the synergies and adjustments required between upstream and downstream activities. Complementarity will be sought between shared-cost actions in these areas and the JRC's direct action.

As regards R&D, actions will be centred on critical scientific and technical aspects so as to achieve significant techno-economic breakthroughs in the medium to long term. The European and global dimension of this new energy question and the solutions which could be applied will also be taken into account. Modelling and systems studies aimed at better understanding of the energy-environment-economy interfaces will contribute to the analysis and to the definition of the Community energy strategy and will permit better definition of the work to be undertaken. Due attention will be given to the themes of energy-saving, renewable energy sources and clean use of fossil fuels notably in the light of the objectives of environmental protection and security of supply.

As far as demonstration and dissemination are concerned, special effort will be devoted to the areas of the rational use of energy, renewable energies and clean combustion of coal. This Community action will be necessary to ensure a stable supply at an acceptable price. It will also improve exploitation of resources in the different regions of the Community and will contribute significantly to cooperation, in terms of technology transfer, with developing countries.

The Community's work on research (including pre-normative aspects), technological development, demonstration and dissemination/valorization will be focused on three principal axes. It will deal with the rational use of energy, the introduction of renewable energies on a large scale and with more effective and cleaner production from the burning of fossil fuels.

Rational use of energy will focus principally on the transport and industrial sectors. For the transport sector, work will concentrate on integrated projects relevant to urban transport and research and development on technologies such as batteries, fuel cells and advanced fuels. In the industrial sector, the development and demonstration actions will focus on technologies which can reduce energy consumption substantially. For the residential and tertiary sectors, the work should especially concentrate on developing, testing and preparing more effective technologies for the market, on alternatives to energy-intensive systems, on adjusting the behaviour of consumers to a more restrained use of energy and on pre-normative research on the use of energy in buildings. Targeted projects aimed at stimulating a more efficient use of energy (the intelligent house) and integrated projects bearing on the pattern of consumption (combined heat and power, and planning of industrial zones) should reinforce this activity.

The objective of the second axis is to contribute, in a coherent and integrated approach, to research, development and demonstration of renewable energies, which are clean indigenous resources, in order to ensure better integration of the energy system with the environment and much greater security of supply. The planned activities are designed to establish a European industrial and technological framework favourable to a significant uptake of renewable energies. The programme should also encourage thematic networks including specialized research centres, electrical power generation companies, towns, regions and islands, architects and building engineers.

The programme is characterized by a balance between continuity and novelty. In order to follow-up and accelerate the work already in hand, research, development and demonstration on the most promising technologies will be emphasized: solar photovoltaic; technologies for solar heating, cooling and

natural-lighting for buildings; wind energy; biomass. Other exploratory options could also be investigated, such as marine energy, solar electricity using thermodynamic cycles, geothermal (hot dry rock), clean production and use of hydrogen.

The JRC will take part in these activities mainly through prenormative research in the field of photovoltaic energy and the conservation of energy in buildings.

New initiatives will be aimed at easing the integration of renewable energies from the technological, economic and social points of view. Large-scale integrated projects such as the development of electricity production from renewable sources, especially biomass, or better integration of renewable energies into future electrical systems are priority targets.

Large scale integration of renewable energies into the rural setting, in regions, towns and islands, is also very important; there is a huge potential for the use of renewables in rural development in the Third World and this has major implications. The efficient execution of these integrated projects will require that close links be established with other Community policies and programmes.

The third axis concerns the production and transformation of energy from fossil fuels. Combustion, which is an essential generic research topic common to the field of rational use of energy and to that of the conversion of fossil fuels, will be given priority. In the area of conversion, we will be looking for cleaner and more cost-effective disposal of the proceeds of conversion of fossil fuels. The work will concentrate on key technologies such as integrated combined cycles ('hot gas cleaning' and pressurized combustion) or fuel cells for the decentralized production of electricity. Substitution of fossil fuels by biomass or combustible waste will also be studied.

Complementary work should ensure better energy security in the much longer term. For hydrocarbons, the work will focus on development and demonstration of more efficient techniques of reservoir exploration (geophysics), exploitation, conversion and transport. In this context, a basic programme of research in the earth sciences will complement this action.

6. TRANSPORT

Mobility of people and goods and the concomitant flow of capital and information across Europe, its countries, regions and islands as well as within urban areas has become a phenomenon of our modern society which it is increasingly difficult to master. In this context, the development of trans-European networks for transport which facilitate the interconnection with and the interoperability of national networks and the access to these networks will be key questions in achieving an open and competitive market.

In this respect, the communication from the Commission to the Council over the future developments for the common transport policy specifies that the essential aim of research for a European transport policy is to contribute to the development integration and management of a transport system which is more efficient, safer and compatible with the environment and with quality of life, promoting sustainable mobility of people and goods.

In order for this goal to be achieved, a European approach will be developed to exploit the synergy between the different Community and national activities, as well as those of other international organizations. The research activities will be developed at two levels:

- a European strategic level,
- a network optimization level.

Research will be conducted within a coherent and coordinated framework, taking into account the results available from other programmes, in particular industrial technologies, telematics, environment, energy and targeted socio-economic research in order to achieve the objectives of the common transport policy.

The activities under this theme will focus on the conditions for interoperability and the interconnection of networks, notably with regard to intermodality and accessibility. This will facilitate the design and management of infrastructures so that they are more compatible with the environment, safer for their users and more cost-effective.

In this sense, the research activities will principally address the identification of needs requiring new technologies, the evaluation, and the overall integration and validation of technological innovations developed in the other themes.

The objective is to contribute towards the optimization of the trans-European transport networks, to the improved performance of transport modes and of individual operators, to the capacity of each to cooperate with the others, to accessibility for users as well as support for the development of a multimodal transport system at urban, rural, regional and trans-European levels.

With this aim in view, the RTD activities will follow a systems and integrating approach, taking into account the strategic orientations of the European transport policy and the results of research conducted within other themes of the first activity, so as to develop specific solutions applicable to the transport sector.

This work could lead, if necessary, to demonstration projects. The research will place emphasis on the optimization of transport systems, including from the point of view of users, the improvement of safety, the reduction of harmful emissions, and on social acceptability. In particular:

- for combined transport, research should lead to the specification of requirements for multimodal integrated routes, as well as pilot concepts to integrate and evaluate new technologies for interchanges, their management and control,
- for rail transport, research will, notably, set out to ensure the interoperability of rail networks, including those which operate at high speed, eliminating progressively the technical, regulatory and operational barriers,
- for air transport, research will focus on reducing congestion of airspace and of airports, particularly taking into account the results of transport telematics, as well as on further improving human safety and reducing the negative impact on the environment,
- for urban transport, it will permit, through the integration of results achieved and tested in other research programmes on generic technologies, the development of specific solutions within a systems approach and appropriate modelling with the aim of improving demand management, reducing congestion and energy consumption, and improving the balance between different modes, particularly between collective and individual transport,
- in the maritime area, integrated research and demonstration projects should permit optimization of the performance of short sea shipping systems, new sea/land/river interfaces, which include new port facilities, making use of manpower in a way which respects the needs of safety and the protection of the environment with an efficient traffic management system;
- for road transport, the development of the appropriate methodologies to define the instruments necessary for the realization of a common policy for road safety, including for pedestrians and cyclists, and the optimization of inter-urban travel modes and traffic avoidance, while integrating and evaluating technological solutions concerning, in particular, traffic management and the design of infrastructure.

With all these activities, particular attention will be given to ergonomics and human factors in an operational framework, as well as the protection of the environment.

These activities will be accompanied, at the European strategic level, by research focused on modelling and transport scenarios. Research in this area will be undertaken with the objective of reaching a better understanding of the generation of transport demand and of the impact of transport systems for Europe.

It consists of the development of harmonized methods at the Community level for analysing the development of transport and movements, the flows and their interactions. It also includes determination of the impact on demand of industrial location and distribution networks, the identification of changes in industrial structures, of logistic constraints and of the choice of modes of transport within the enlarged European economic area.

Moreover, in line with the European transport policy, technological innovations will be accompanied by research concerning their integration into new operational and institutional frameworks (including those associated with technical standards and the definition of trans-European transport networks).

Finally, a new harmonized methodology for the evaluation of the global impact of European transport systems is necessary for this purpose and particularly to optimize trans-European networks.

The JRC will participate in these activities, essentially through the analysis of the safety of transport systems as well as their impact on society and on the environment in general.

7. TARGETED SOCIO-ECONOMIC RESEARCH

The close inter-relationship between economic, political and social conditions on the one hand and technology, growth and employment on the other hand is the essential feature of the context in which RTD activities in this line should be carried out. This new research topic will allow the renewal and enlargement of the knowledge base for decision-making through activities to assess scientific and technological policy options, taking account of developments in technology and know-how.

The latest developments in the Community also indicate an increasing need for public understanding of science and for strengthening the interface between science, research and society.

Taking account of research carried out under other relevant themes of the first activity, in particular in the field of industrial technologies, attention will be given to the comprehension of socio-economic factors which can promote safety and health protection of workers at work and contribute to general improvements in this area.

As well as these horizontal activities of targeted research, socio-economic research will be carried out within each topic of RTD in the first activity (evaluation of socio-economic impact and risks), in the second activity (socio-economic aspects of international scientific and technical cooperation), in the third activity (improvement of the efficiency of the uptake of results of RTD) and in the fourth activity (training and mobility of researchers in the social and economic sciences). Close contacts will be continued with the COST project in the field of social sciences and with European organizations working in this field.

A. Assessment of scientific and technological policy options

The assessment of scientific and technological policy options for Europe will provide the common knowledge base for policy makers in the fields of science and technology policy at both the national and Community levels and also for those people responsible for other fields of Community activity within which science and technology play a role.

These activities will build upon the activities of the Monitor programme (FAST, SAST, Spear), by the work of the Institute for Prospective Technological Studies of the JRC, by the activities in the framework of the Value, Sprint or Eurostat programmes and on the base of the experience acquired through the specific programmes (evaluation of the socio-economic impact of research) in fulfilment of a decision taken at the time of the approval of the third framework programme.

The object is to put at the disposal of actors, policy makers and users of RTD a consistent framework for the assessment of the scientific and technological policy options linked to the activities undertaken at the regional, national and European levels.

It will involve prospective studies of relationships between science, technology and society, economic, scientific and technological monitoring, strategic analysis, principally of generic technologies, and the evaluation of RTD programmes and policies, with special accent on industrial competitiveness, taking into account the worldwide dimension. Emphasis will be placed on networking. In implementing these activities, proper use will also be made of concerted actions and support activities (studies, methodological research, open databases, collections of indicators, directories of 'technology assessment', etc.). Due attention will be paid to dissemination (workshops, seminars). These activities are to be undertaken in close collaboration with governmental organizations, parliamentary offices and scientific networks for the assessment of scientific and technological policy at regional, national and European level (in particular with STOA and the European Parliament technology assessment network), with public sector organizations and those of the private sector which specialize in these fields as well as with the representatives for these questions of the various socio-economic actors in the field.

A limited group of activities should be foreseen to be able to help with the launching of preparatory actions and definition phases for new Community RTD activities, in particular for the preparation of the fifth framework programme.

The JRC will support these activities through the Institute for Prospective Technological Studies which will establish a technology observatory in order to collect and analyse, taking into account activities carried out in this field by relevant international organizations such as the OECD, information on scientific advances and technological innovations and to undertake forward studies and technological evaluations essentially at the request of Community institutions.

B. Research on education and training

The rate of change of economic, social, scientific and technological knowledge and associated skills on the one hand, and of the education and training system, including the training of instructors, on the other are becoming more and more out of phase and it is becoming extremely difficult to ensure that timely, appropriate and well balanced exchanges take place between the two. Considerable efforts have been made at the national level to try to overcome these difficulties. The recent developments at the European level of networks in research and training and of various industrial and commercial agreements between businesses call for a common understanding and mastery by Europeans of these problems, which are increasingly global in character.

The objective of the Community research activities in this field should be to assist Member States in their efforts to develop links between research, education and training and improve their education and training systems, through dissemination of good practice.

In compliance with the principle of subsidiarity, these activities will complement Member States' activities and will be coherent with Community activities in the field of education and training. Priority should be given to four research areas, taking full account of existing research activities (at local, regional, national and Community level). First, training requirements for the development of a competitive European labour market; second, cost effective and appropriate methods of education and training; third, analysis of the particular future training needs of companies, including management of innovation; fourth, comparative research to examine the key issues influencing the nature and success of systems of education and training, including into regional differences and links with economic development in the regions.

Community research activities in this field will necessarily be closely coordinated with work carried out by existing Community programmes in the area of vocational training in particular Comett, Force and Eurotecnet as well as their successors.

C. Research into social integration and social exclusion in Europe

A new area of research will cover the problems of social integration. Poverty and social exclusion constitute major problems for the Member States. Research in this area is needed to improve the understanding of these issues in order to combat these problems.

The Community will focus its research on the various forms taken by social exclusion, on its causes and on possible solutions with particular attention to exchange of information on these three aspects.

Exploratory activities will be centred around the following topics:

- forms and processes of social exclusion including demographic and regional/urban aspects,
- causes, including unemployment,
- migration,
- experiences at national and Community level with integration policies,
- the contribution of technological developments to social integration.

SECOND ACTIVITY

Promotion of cooperation in the field of Community research, technological development and demonstration with third countries and international organizations

This second activity covers various related forms of Community intervention. Scientific and technical cooperation will be developed and will also include international research collaboration activities hitherto undertaken outside the framework programme. It will cover the industrialized countries, central and eastern European countries, the new independent States of the former Soviet Union and developing countries. Such cooperation can be on a bilateral or multilateral basis; it can take place directly or through international organizations. The objectives of such cooperation are both to reinforce Community capacities in the fields of science and technology and to support the implementation of Community policies *vis-à-vis* third countries and it will be based on the principle of mutual benefit.

The challenge is to increase the added value of RTD activities of the Community and the Member States, as well as of the other Community policies through selective cooperation of mutual benefit with third countries and international organizations, which complements the action of the Member States and can be coordinated with them. An important aspect of this challenge is the scientific contribution to the solution of regional or global problems or to advances in the situation of developing countries and of the countries of central and eastern Europe. It is also necessary to be sufficiently flexible to react to possible developments in third countries. In cases where intellectual property rights are involved, the Joint Declaration of the Council and the Commission adopted in June 1992, which gives guiding principles on the allocation of IPR, will be respected.

The main purpose is to strengthen the scientific and technological capabilities of the Community, support the implementation of Community policies with respect to third countries and contribute to the solution of regional and global problems, through increasing coordination with the Member States. In this context, the development of standards offers a good example of the possibilities of such fruitful cooperation.

A. Scientific and technological cooperation in Europe

1. Collaboration with other scientific and technological cooperation frameworks in Europe

The aim of this activity is to optimize research in Europe through appropriate cooperation, taking into account national efforts, both those of Member States and those of EFTA countries, as well as those of COST, Eureka, and other European organizations.

The resulting objective is to establish closer relations with these frameworks and organizations, including at the practical project level. This will foster the development of networks of scientific and technical excellence, extending beyond the frontiers of the Community.

The COST concerted action projects are complementary to those of the Community programmes, and retain their specific character with respect to the other European research structures.

The links between Community and Eureka activities will be strengthened, in particular in the context of the third activity.

As far as EFTA countries are concerned, account will be taken of the fact that those who have adhered to the European Economic Area take part fully in the framework programme and that others are linked by bilateral cooperation agreements.

2. Cooperation with central and eastern Europe and the new independent States of the former Soviet Union

The objectives of this activity are to contribute to the safeguarding of the scientific and technological potential of these countries and to their reorientation, for instance by encouraging mobility of scientists and strengthening the relation between local university research and industry.

Through cooperation in areas of mutual interest, which could take the form of joint projects, and increased contacts between scientists and researchers, Community science and technology will also benefit.

Complementarity with other Community activities, notably Phare and Tacis, for instance in view of renewing RTD infrastructure, and close liaison with the actions of the Member States, will be sought. In the energy field, use could also be made of the 'energy centres' established by the Community in these countries.

The participation of the countries concerned in the specific programmes within the first activity is envisaged. Community funding under the second activity can be made available to facilitate their participation.

The action will also include specific research themes appropriate to the current critical needs of these countries and not included in the first activity, such as combating environmental and human health problems, particularly those resulting from major accidents.

B. Cooperation with industrialized non-European third countries

The objective of this cooperation is to promote the interests of the Community and to optimize the efforts made in the area of RTD, by facilitating access to sources of science and technology of such third countries.

It is worth emphasizing that these countries are at the same time partners for the Community as well as competitors, notably on the commercial and industrial level. Hence the importance of respecting the principles of selectivity in areas of cooperation, of concentration on a few carefully selected sectors, of flexibility in the modalities of cooperation, of balanced mutual benefit, of non-transfer of financial means.

The modalities of cooperation with these countries include: concertation for certain sectors such as megaprojects, execution of joint research and study projects, as well as the exchange of information and experts.

Scientific and technological cooperation with these countries supports the external activities of the Community, while allowing Member States to have access to sources of science and technology of the third countries in question in an equal manner. Coordination with Member States is necessary to avoid duplication of work and dispersion of financial resources and to give a better definition to the scope of Community action based on the principle of subsidiarity.

C. Scientific and technological cooperation with developing countries (DCs)

Most Member States conduct programmes of scientific cooperation with DCs, the importance of which is often a function of cultural traditions or long-standing relations. This second activity will be primarily a means of bringing together different research initiatives in a global and coordinated way and in synergy with Community development actions.

It will permit a scientific effort relevant to developing country problems to be maintained in Europe and even to be enhanced in certain Member States. At the same time it will facilitate the strengthening of research capacities in DCs through carrying out joint research work under shared cost contracts and the reinforcement of links through networks.

The topics to be covered will focus on issues which are common to all DCs and of prime importance for their economic and social development, such as renewable natural resources, agriculture, environmental protection and health research. A degree of flexibility in the definition of priorities, according to the region and to the needs expressed, should be envisaged.

In addition, DC participation in certain specific programmes of the first activity, on subjects of general interest or of clearly identified mutual interest, is envisaged, particularly for those countries with a scientific potential which is already developed.

Community funding under the second activity can be made available to facilitate participation of DC laboratories in the framework programme.

THIRD ACTIVITY

Dissemination and optimization of the results of activities in Community research, technological development and demonstration

The third activity concerns all Community RTD activities, without giving emphasis to any particular RTD theme. Its objectives are: to ensure a wide dissemination of research results; to facilitate their optimal exploitation by encouraging, with the assistance of the actors concerned, the transformation of results obtained into innovations; to support technology transfer, in particular to small and medium-sized undertakings; to support initiatives at national or regional level in order to give them a Community dimension.

The Community must make a substantial contribution to improving the dissemination and utilization of research results. It should also create better conditions for the transfer and absorption of new technologies, whatever their origin, by industry and especially small and medium-sized undertakings throughout the Community, in particular in those Member States or regions which obtain less benefits from research and development programmes.

The Member States of the Community have implemented at national and regional level a series of policies aimed at research exploitation and the diffusion of new technologies. But, on the one hand, these initiatives vary largely from one region to another and, on the other hand, the Community dimension is not sufficiently taken into account, although it could yield a significant amount of value added in the context of the internal market. Efforts for the dissemination and utilization of research results undertaken in particular within the Value, Sprint and Thermie programmes need to be continued and, if necessary in the light of evaluation, improved through appropriate Community actions in the course of the fourth framework programme.

Activities of dissemination and optimization of results, moreover, have to be carried out in coordination with those implemented and financed by the specific programmes. They reflect the non-linear, complex and iterative nature of the innovation process and the specific character of technology transfer and utilization, which call for special skills and a multi-sectoral approach.

This activity is aimed in the first instance at small and medium-sized undertakings participating in the specific programmes or able to exploit the knowledge resulting from them. It is also aimed at the large body of small and medium-sized undertakings which need to incorporate in their activities the knowledge and new technologies which they require so as to maintain or improve their competitiveness and which, due to their lack of internal RTD capacity, they have to acquire from external sources. It includes measures for improving the financial environment for the optimization of results and the diffusion of technologies.

As regards synergy with Eureka, it is essential to ensure better circulation of information concerning projects and support measures, thus facilitating the taking into consideration in Eureka projects of the results of Community research. Such improved links should facilitate the transfer of RTD results towards the market place and the setting of standards. The optimization of transfer of know-how, possibly in association with Eureka projects, will also be encouraged.

The third activity also includes *ad hoc* support to other Community policies, which can be provided by research institutes in the Community, including the JRC.

A. Dissemination and exploitation of research results

This area is composed of the following activities:

- the strengthening of the activities of the relay centres network, with the objective of improving knowledge of the Community's RTD and demonstration activities, facilitating the dissemination of information and the exploitation of RTD outputs and promoting scientific and technological cooperation. This network is based, *inter alia*, on the reinforcement of the public information and dissemination service (Cordis), with the emphasis on the quality of data and user-friendly access to information,
- specialist services which complement those offered by the relay centres, directed in particular at small and medium-sized undertakings, with the aim of promoting transnational and inter-sectoral utilization of RTD results. They include assistance in the field of intellectual property rights, market research studies, training schemes, the stimulation of know-how transfer, the creation of technology clubs and support for projects on trans-sectoral applications,

- measures to improve the effectiveness of the transfer of RTD results (including acceptability and the evaluation of the social impact, management and economics of research, pilot projects on communication towards society).

B. Dissemination of technologies to enterprises

The objective of this area is to promote the wider use of technologies, especially by small and medium-sized undertakings, and in particular to contribute to the establishment of networks of services in the Community for technology transfer, bringing together the competent organizations at national and regional levels.

Emphasis will be placed on improving the quality and efficiency of innovation and technology transfer support services, as well as on the improvement of the capacity of industry, especially small and medium-sized undertakings and traditional industrial sectors, to absorb new technology, thus reaching a wider range of firms than those participating in Community RTD activities. A coordinated approach will be promoted stemming from the needs of firms and taking into account all the aspects related to the transfer and utilization of technologies.

This area comprises:

- the establishment of transnational networks of technology transfer and diffusion practitioners, involving mainly organizations such as research and development organizations, sectoral technical centres, science parks, etc. in order to encourage the use of technologies in small and medium-sized undertakings and the exchange of best practice,
- the application of measures designed to facilitate the diffusion of technological opportunities and the bringing together of suppliers, users, and intermediaries,
- the demonstration of mechanisms and conditions for the transfer of technologies and their use by new users via the implementation of inter-regional or trans-sectoral pilot projects. These projects will be based on intermediary organizations generating important multiplying effects on the diffusion of new technologies and management methods in small and medium-sized undertakings,
- measures to improve firms' awareness of best practice methods in the management of technological resources,
- improving knowledge of the mechanisms involved and reinforcing exchanges of experiences regarding relevant policies and instruments.

C. The financial environment for the dissemination of technology

Given that the financial environment influences the competitiveness of industry, the third area aims to improve, through an appropriate Community action respecting the subsidiarity principle, the Community environment for the financing of the exploitation, adaptation and dissemination of technologies.

This area comprises:

- indirect measures which aim to improve the communication between financiers and the promoters of technological projects, to support the establishment of effective systems for mobilizing private capital and the exit of investments ('exit'), to analyse and promote the most appropriate legal structures. In this context, schemes like the technology performance financing scheme started under the Sprint programme will be explored,
- pilot actions for the stimulation of transfer and utilization of technologies by small and medium-sized undertakings (for instance grants to small and medium-sized undertakings to enable them to participate in activities for the dissemination and optimization of results of Community RTD),
- technical and managerial assistance to public or private financial intermediaries, selected or to be established in the Member States, and which provide equity co-financing to small and medium-sized undertakings.

These activities will be implemented in close cooperation with the other Community actions in the field (Eurotech capital, European Investment Funds, enterprise policy).

D. Scientific services for Community policies

This activity will provide scientific support to Community policies, at the request of directorates in charge of these policies, where the need or the request is manifested. It will be open to participation of all research institutes in the Community, including the JRC.

These activities, which are in general of a limited and short term nature, do not fit in well, because of their very nature, with long term planning, because they follow the short term requests of the Directorates-General. The opportunity to undertake them only becomes apparent during the execution of the framework programme.

FOURTH ACTIVITY

Stimulation of training and mobility of researchers in the Community

The objective of this activity is to promote the training and mobility of Community researchers in fields, including those of fundamental research, not eligible for support under the first activity. There is a need, also recognized by industry, for training and high quality research which is left essentially to the initiative of researchers themselves and which is both conceived and undertaken at the Community level in research laboratories in Europe. At stake in the longer term is the need to ensure a high level of training for scientists which lies at the heart of the Community's capacity for innovation.

The optimal utilization of human resources is a basic parameter of all socio-economic activity. Although Europe possesses a human capital in research which ranks high in the world, its utilization is often ponderous and slowed down by discrepancies which still exist between Member States and different disciplines. In this context, it is essential to ensure equal opportunities for male and female researchers. The development of human resources in the field of training through research, and their better utilization by transnational mobility and cooperation, are essential means to meet the general objectives of the framework programme.

The fourth activity, which aims to give advanced training in laboratories distributed throughout the Community, will keep its open character and put an emphasis on partnerships with industry.

The general objectives of this activity are the following:

- to stimulate training through research and, by means of cooperation, to foster better utilization of high-level researchers in the Community,
- to improve the mobility of European researchers throughout the Community, encouraging mobility between disciplines and between universities, research institutes and industry, thus better exploiting the research potential in the different disciplines,
- to promote, for instance through networks, transnational cooperation for research activities proposed essentially by the scientists themselves and not eligible for support under the first activity,
- to facilitate the access of all European researchers to existing large-scale facilities which are indispensable for high-quality research,
- to improve the scientific and technological cohesion of the Community and contribute to the attainment of a general level of scientific excellence, by offering research opportunities to scientific institutions and researchers from all regions of the Community. Return of researchers from less-favoured regions to their country of origin will be financed, continuing current practice.

This activity will cover the exact, natural, economic and management sciences, as well as social and human sciences which contribute to the Community's RTD objectives.

The activities foreseen are gathered into three sub-areas:

(a) *Networks of laboratories in different countries*

Networks will allow researchers from as many Community countries as possible to join their efforts in a 'European laboratory without walls' and to constitute, in this manner, groups capable of performing research of higher quality. However, small associations of laboratories from different countries (including twinning) will also be eligible for support when they are considered to form the core of a future larger network. Grants will be awarded to help researchers to meet, to perform experiments in common, to support the exchange of results between researchers, to cover in exceptional cases

additional costs linked to scientific equipment where these are necessary for joint research of the network or to reinforce research staffs through temporary contracts for visiting scientists (preferably from other countries).

(b) *Access to large scale facilities*

Community activities, complementing national and international efforts, will include:

- support for researchers in order to facilitate their access to large installations and large instruments (necessary for research and rare in the Community),
- support for improvement, where necessary, to large scale facilities in order to provide wider access to Community researchers, thus encouraging efficient use of these facilities.

(c) *Training through research and stimulation of mobility*

- Implementation of training activities through research and stimulation of researchers' mobility. This will consist of stays of three months to three years, which should allow European researchers, primarily with a doctoral degree or equivalent level of education, to receive professional training and specialized experience outside their home countries. Grants will cover mobility and subsistence expenditure and provide an adequate contribution to research and management costs, including those incurred by the host laboratories. The arrangements to be made will aim to secure comparable conditions of payment and support for researchers across programmes and across Member States after allowing for local circumstances. Particular attention will be paid to training in the field of the management of changes within enterprises as they relate to new technologies.
- Harmonization of the implementing modalities of the training activities undertaken in the specific programmes defined in the first, second and third activities. The aim is to ensure, without seeking systematic uniformity, that the procedures of selection of research trainees, the conditions of payment and the implementing modalities are comparable for all specific programmes.
- Continuation of the analysis of different rules applying to Community grants in different Member States. Moreover, efforts should be undertaken to avoid too much disparity from one country to another.
- Coordination of all training activities undertaken in the specific programmes, with the aim of increasing their synergies.
- Organization of Euro-conferences, scientific prizes and other similar initiatives, like for instance summer schools.

ANNEX IV

RULES FOR FINANCIAL PARTICIPATION BY THE COMMUNITY

1. The financial participation by the Community in RTD activities undertaken within the specific programmes shall be:

- (a) **Indirect action**

- shared cost actions with third parties ⁽¹⁾:
 - for RTD projects, including consortia for integrated projects: not more than 50 % of the costs of the project and progressively lower participation the nearer the project is to the market place. Those universities, higher education establishments and other research centres which do not use analytical budget accountancy will be reimbursed on the basis of 100 % of the additional costs,
 - for thematic networks and training and mobility of researchers: 100 % of the additional costs,
 - for measures appropriate for certain specific programmes, such as feasibility awards: up to 100 % of the costs of the measure,
 - for preparatory, accompanying, and support measures: up to 100 % of the costs of the measure,
 - concerted action:
 - for concerted actions consisting of the coordination of RTD projects, such as concertation networks: up to 100 % of the costs of the concertation.

- (b) **Direct action**

For direct action carried out by the JRC consisting of RTD programmes or parts of programmes as well as scientific and technical support activities of an institutional character (i.e. which are necessary for the implementation of other Community policies and which require the JRC's neutrality): normally 100 % of the costs.

- (c) **Competitive support activities**

For scientific and technical activities in support of other Community policies which are suited to a competitive approach: normally 100 % of the costs.

There may be no derogation from these general rules, except under the conditions set out in each specific programme.

2. The rules for any possible financial participation by the Community in activities provided for in Article 2 (2) of the Decision will be specified in the measures concerning such activities taken by the Council in conformity with Article 130o of the Treaty.
3. The rules for the financial participation of undertakings, research centres, and universities in the implementation of the specific programmes will be specified in the measures envisaged in Article 130j of the Treaty.

⁽¹⁾ The JRC, in association with partners established in the Member States, can participate in shared-cost actions on the same basis as third parties.