COMMISSION OF THE EUROPEAN COMMUNITIES

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WORKING DOCUMENT OF THE COMMISSION

CONCERNING THE S&T CONTENT OF THE SPECIFIC PROGRAMMES IMPLEMENTING THE 4TH FRAMEWORK PROGRAMME FOR COMMUNITY RESEARCH AND TECHNOLOGICAL DEVELOPMENT (1994-1998) AND THE FRAMEWORK PROGRAMME FOR COMMUNITY RESEARCH AND TRAINING FOR THE EUROPEAN ATOMIC ENERGY COMMUNITY (1994-1998)

INTRODUCTION TO THE WORKING DOCUMENT

This Commission working document shows, with rather more detail than the proposal for the Fourth Framework Programme (1994-1998) and the Framework Programme for the European Atomic Energy Community (1994-1998), the Commission's current plans concerning the scientific and technological content of the activities needed to carry out the Community RTD effort.

The Commission considers that the presentation of a working document on the specific programmes will help both to advance the discussions on the Framework Programme and to establish a constructive dialogue on the scientific and technological content of the specific programmes between interested partners similar to that already established on the level of the Framework Programmes.

However, the Commission stresses the fact that these are only overall guidelines and plans for the scientific and technological content to be assigned to the specific programmes, and in no way is it a proposition within the meaning of article 130 Q §2 of the EEC Treaty (130 I §3 of the Treaty on European Union) or article 7 of the EAEC Treaty. The provision of these texts should not allow the decision-making authorities of the Council and the European Parliament to make the continuation of their work on the Framework Programmes conditional on an agreement on the texts circulated today: on the contrary, these texts are designed to be completed and amended by the Commission when it presents its proposals for Specific Programmes, to incorporate them into the necessary legal form while taking into account the changes (in direction and substance) that might be agreed for the Framework Programmes.

The following information about each of the four activities and each of the themes of the first activity has been established taking into account the general orientations defined in the introduction to Annex 3 "Scientific and Technological Objectives" in the proposal for the Fourth Framework Programme. In particular, this is so for the coordination of work identified in the various horizontal programmes to respond to the needs of industrial users, as well as for the promotion of SME participation in Community programmes. In addition, RTD activities on themes that run across several lines (for example transport) will be subject to the close coordination necessary in order to maintain the coherence of the actions being carried out with the relevant common policies and the activities of Member States.

Finally, the information provided is consistent with the financial framework indicated in the Financial Statements included with the Framework Programme proposal (cf Part III).

Table of Contents

I. PROGRAMME SUMMARIES

FOURTH FRAMEWORK PROGRAMME

FIRST ACTIVITY, LINE 1

INFORMATION AND COMMUNICATIONS TECHNOLOGIES

This note explains the bridge between the ICT line described in the Fourth Framework Programme proposal and the three sub-lines of the working document. The issues of the general approach followed, the changes proposed and their motivation, and the impact of the sub-lines are covered in the introductory sections of each sub-line.

In the proposal for the Fourth Framework Programme, the first line of the first activity "Information and communications technologies" covers four domains of RTD:

- Information technologies
- Advanced communications technologies
- Telematics applications of common interest
- Technologies for integrated information and communication systems

The first three domains reflect the natural breakdown of technology areas in information and communications technologies (ICTs). The work described in the fourth domain, identified on the basis of an analysis of the structure of the emerging European information infrastructure, cuts across the whole field of ICTs and reflects the growing convergence of information technologies and communications technologies.

As regards the execution of the work described within the four domains, the first three domains correspond clearly to the three sublines of the ICT RTD line: "Information Technologies", "Advanced Communications Technologies" and "Telematics Applications of Common Interest". The fourth domain, on integrated information and communications systems, cuts across the technological areas covered by the three sub-lines, reflecting its relevance to all fields of ICTs. The way in which the work of the fourth domain is addressed within the three sub-lines is shown in what follows.

Language and information engineering: work on generic and enabling technologies and processing techniques for language engineering and database systems is proposed within the information technologies sub-line. The telematics sub-line proposes R&D on the application of information and communication technologies to language engineering (for example translation, language resources, general linguistic problems) and to information engineering (especially ease of access, information content and usability).

High performance computing and networking: work in the information technologies sub-line covers the exploitation of high performance computing technologies and the special needs of the use of high speed networks for high performance computing applications. RTD on high speed networking technologies is handled within the advanced communications sub-line. The telematics programme will perform development work on the application and validation of results with advanced categories of users, notably the research and the medical communities.

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Multimedia systems: work on tools and standards for basic multimedia processing is proposed in the information technologies sub-line. The advanced communications sub-line covers technologies for multimedia transmission and service management, and those relating to digital video services. The telematics sub-line addresses the issue of integrating such research results into multimedia systems and services applicable to domains such as health care, traffic management, education and training, libraries or administrations.

Integrated personal systems: the information technologies sub-line proposes work on technologies for integrated personal systems, with communications aspects dealt with in the advanced communications sub-line.

Integration in manufacturing is dealt with in the information technologies sub-line, and security of information systems under the advanced communications sub-line.

In running these research and development activities, the Commission will ensure that proper coordination mechanisms are in place and that the potential relationships between the topics covered will lead to greater synergy, more rapid transfer of results, and more effective research and development as a whole.

Specific procedures will be explored to stimulate the participation of SMEs in the programmes ("technological stimulation"), building on successful past initiatives and the use of feasibility grants. Outline proposals may be accepted at any time (open call for proposals); selected bidders could receive feasibility grants for seeking partners and for developing detailed proposals. These proposals would then be evaluated to determine the funding to be allocated to the research projects themselves.

The indicative breakdown of effort between the three ICT sub-lines is as follows:

Information technologies	55%	
Advanced communications	20.5%	
Telematics	24.5%	
Total	100%	(3888 MECU)

INFORMATION TECHNOLOGIES

Since the emergence of digital computing in the late 1940s, the use of information technologies has been extending ever further into economic and social life. Information technologies now increasingly underpin all production and service industries, as well as the provision of societal services such as health, education, transport and entertainment. We are at the beginning of the transition to a new information infrastructure of society and industry.

The information infrastructure is the set of services and technologies providing easy access to usable information for any citizen or enterprise, at any time, in any place. It brings together information processing, information storage and retrieval, information transmission and the information content itself.

At the same time the information technology industries themselves find margins squeezed and profits falling even while the application of information technologies becomes ever more widespread. Boundaries are being eroded, between supplier and users, between the professional and the consumer markets, and between the IT industries and other industrial sectors. A new "digital industry" is growing up.

The return to a strong economy and fuller employment, not just in the information technology sector but in all industries, will be heavily influenced by the speed and success with which the new information infrastructure can be put into place and the structural adjustment of industry can be completed.

Under the Fourth Framework Programme the IT programme proposes new approaches and orientations in order to meet the new requirements of the 1990s, while building on the past achievements of ESPRIT. With a new focus on the development of the information infrastructure and an emphasis on access and usability, the programme must to a greater extent be led by the needs of users and the market. The overall objective is to contribute to the healthy growth of the information infrastructure so as to improve the competitiveness of all industry in Europe and to help enhance the quality of life.

To meet these changing requirements the IT programme proposes new orientations both in technical content and in implementation. The programme proposes to put an emphasis on Networks of Excellence, and to make use of supplier-user collaborations and streamlined management procedures. It will introduce a number of Focused Clusters, a new R&D modality which builds on the experience of the Open Microprocessor Systems Initiative (OMI). A cluster is a set of activities covering a number of technology areas but with a single well-defined goal. As well as collaborative research projects, a cluster may incorporate other kinds of activity, as its specific needs dictate. Selected and focused international collaboration, training, and dissemination activities will be carried out as an integrated part of the research and development programme to complement the corresponding centralised actions.

The technical content of the programme focuses on the areas which are most important for the development of the information infrastructure, and where, taking account of the principle of subsidiarity, Community action will make the best use of the resources available. The work of the programme is directed both at more the basic or underpinning technologies, and at selected topics which integrate technologies into systems. In addition long term research is proposed where effort at a European level has the potential to lead to future breakthroughs.

Software is a major element in the information infrastructure, and already represents over half the value of computers and embedded systems. There is a pressing need to understand, develop and promote the technologies which will enable Europe to produce reliable, correct, efficient and

user-friendly software. The programme concentrates on a limited number of software technologies crucial for meeting this need.

Electronic components and subsystems are the physical building blocks of the information infrastructure. Research and development in the programme concentrates on three topics: semiconductors, with a particular emphasis on advanced integrated circuits for specific applications; peripherals, and in particular the flat panel displays and compact memory systems; and microsystems.

Multimedia technologies are a third key domain. The programme aims to concentrate on the technologies needed for the creation, manipulation, display, and storage of multimedia information, with a specific effort directed at the development of integrated personal systems, an area of major application of multimedia technologies.

In addition to these three domains of underpinning technologies, the programme proposes four focused clusters which integrate more fundamental technologies into complex systems. The emphasis will be on access and usability.

The high performance computing and networking cluster aims at the enhancement of Europe's capability to exploit computing technologies offering the highest performance, a capability which is indispensable both for embedded systems in the infrastructure as well as for maintaining competitiveness in a growing range of industries.

The open microprocessor systems initiative continues the work begun under the Third Framework Programme on the development of standards and technologies for open microprocessor systems, an area also of major importance for embedded systems.

The cluster technologies for business processes focuses on the integration of enterprises into the information infrastructure, and the effective use of IT in business. This is an area where major gains in competitiveness are just beginning to be seen.

Finally the cluster on integration in manufacturing concentrates on the integration of IT into manufacturing processes, in support of new competitive modes of operation such as flexible, lean and just-in-time manufacturing.

Indicative breakdown of the effort between areas

Software and multimedia technologies	22 %
Components and subsystems	23 %
Technologies for business processes Integration in manufacturing	20 %
Open microprocessor systems initiatives High performance computing and networking	25 %
Long term research	10 %
Total	100 %

RTD in the area of advanced communications

Summary

Advanced communications technologies and services are crucial for consolidation of the internal market, for Europe's industrial competitiveness and for balanced economic development. The services are a vital link between industry, services sector and market as well as between peripheral areas and economic centres. They are also a pre-requisite for social cohesion and cultural development.

Work in this subline will build on the achievements of the RACE programme, but with a stronger focus on stimulating **innovative** use.

The objective will be to develop advanced communication systems and services for economic development and social cohesion in Europe, taking account of the rapid evolution in technologies, the changing regulatory situation and opportunities for development of advanced TransEuropean networks and services.

The work will consolidate European technological leadership in digital broadband communications and enable effective network management and service deployment in a diverse and competitive communication environment. In particular, the work will stimulate and coordinate the emergence of digital multimedia services and integrated photonic systems with a view to their wide-spread introduction in Europe from 2000, including development of the technological basis for deployment of optical fibre networks. It will ensure mobility on fixed networks and through advanced wireless, radio and satellite systems across Europe, with particular emphasis on user access in both public and private networks, and develop and demonstrate technologies for the integrity, confidentiality and availability of information in integrated systems.

In all areas, a leading role will be taken by user groups with common requirements, both to ensure that the R&TD activities are relevant to their needs, and to focus the technology developments in key areas for Europe's economic and social development. The lead given by users will also ensure that the technology development activities respond quickly to changes in economic and social conditions and to new scientific discoveries and breakthroughs.

A key role will be given to system integration, usage trials and demonstration of advanced services, and a close link will be maintained with TransEuropean Network developments. These will enable common interest groups to experiment with emerging technologies, to address structural and regulatory constraints to better use of advanced communications, to identify "best practise" and to evaluate the impacts of societal evolution to an "information economy", with de-centralised collaborative working and small business networking.

The technology development activities will be in the following six areas.

1. Interactive digital multimedia systems and services	**22-26%**
2. Photonic technologies	**17-19%**
3. High-speed Networking	**11-13%**
4. Mobility and personal communications networks	**18-20%**
5. Intelligence in networks and service engineering	**15-17%**
6 Quality, security and safety of communication services and systems	**6-8%**
Horizontal actions	**4.5-5.5%**

The horizontal actions will concern consensus development and concertation of National and regional activities; International co-operation; dissemination and exploitation of results, and professional training in advanced communications technologies and service management.

RTD on telematics applications of common interest

Summary

The information and communication technologies (ICT), which are rapidly and continually developing, can be used in often complex set-ups to offer various categories of users, particularly public services and private individuals, new ranges of products and services to meet basic economic and social requirements. The term "telematics applications" is used to refer to all the systems (hardware and software) and services (distance training, teleworking, telemedicine, remote management of road or air traffic etc.) resulting from combinations of these technologies.

The research in the field of telematic applications in areas of common interest will have two aims. One will be to promote the competitiveness of European industry, which is nothing new. The other, which is a new feature contained in the Treaty on European Union, is to promote research activities necessary for other common policies. In view of the nature of the research, which must be geared towards users, this new aim will be given priority.

RTD will be based on the experience gained under the third framework programme, but the emphasis will be shifted from data telematics to the new "multimedia telematics", which includes all distributed and interactive multimedia applications. In addition, more importance will be attached to user requirements and the search for the most efficient and economical solutions possible. These three new guidelines will not only apply to the subline as a whole but also to each of the projects it will run.

By promoting the development of telematic systems and services which are both well suited to user needs and technically and economically efficient, the research will help strengthen the competitiveness of the European economy and promote the investment necessary to provide Europe with an effective information and communication infrastructure - or "infostructure" - and help ensure that this investment bears fruit.

Three main application fields will be covered:

- ***Infostructure for services of public interest (40% to 52%)*, with telematics for transport, health care and administrations;**
- ***Knowledge infostructure* (16% to 22%) for researchers, education and training, and libraries;**
- ***Infostructure for improving the quality of life (13% to 19%),* with telematics for elderly and disabled persons, urban and rural areas, and environmental protection.**

A fourth field will consist of horizontal RTD activities (16% to 22%), with telematics engineering, language engineering, and information engineering.

INDUSTRIAL TECHNOLOGIES

The globalization of markets, greater international competition with the emergence of new industrial centres, the increase in the cost of developing new technologies and the shortening of product lifespans call for a strengthening of cooperation on a European scale in order to master a sufficiently broad spectrum of technologies and make RTD efforts cost-effective.

In this context, the Community's technology strategy has an important role to play as a catalyst and in support of national activities and the initiatives of businesses, since a combination of national and Community activities is essential in order to stimulate industry's capacity to develop competitive new products and processes meeting the needs of consumers and of society in areas such as transport, housing, health-care, environment, sustainable resource-management, employment and working conditions.

Action at Community level should also contribute towards the establishment of the scientific and technical bases needed to prepare and apply standards (prenormative research).

In accordance with the Community's new industrial policy and taking into account employment concerns, Community action should focus on areas of technology the applications of which will have a rapid impact on a sufficiently broad field of industrial activities. Within this context the Community research action on Industrial Technologies will endeavour to integrate the development of new approaches to human and organisational aspects within production systems of enterprises.

Against this background, the Industrial Technologies programme will aim at promoting, through multidisciplinary and multisectoral collaboration, the development, integration and application of critical generic technologies applicable at the various stages of the life cycle of products and materials, since one of the most striking features of current technological developments is the co-development of product and process technologies.

The research will focus on four areas:

1. **Design, engineering, production systems and human-centred management:** The shared-costs projects will concern the development and application of new design, engineering and production methods, including applications of new computer-assisted technologies, the rapid construction of prototypes, new inspection and diagnostic systems, failure mode analysis, health and safety problems analysis, research into mechatronics and the miniaturizaation of components, and the integration of new technologies in production workshops, taking account of the new organisational models.

   The coordination projects will concern in particular methods of modelling the behaviour and processing of products and research linked with new models for the organisation of production.

2. **Materials and materials-related technologies:** The shared-costs projects will concern research into new techniques for designing synthesis materials (alloys, composites, intelligent materials), high performance materials engineering,

molecular engineering, and in particular supramolecular chemistry and nanotechnologies, control of processing modes, and new technologies for the recycling and reuse of industrial products and waste.

Basic research relating to the understanding of the properties and behaviour of materials will be the subject of coordination projects.

3. **Advanced propulsion technologies:** Among the various generic technologies needed to improve means of transport, and in particular motor vehicles and aircraft, activities will focus on propulsion. Emphasis will be placed on the application of new design and manufacturing techniques, reliability, modelling and simulation, pollution abatement, energy efficiency and energy conservation.

4. **Research concerning standards, measurement and testing:** The activities will be designed to underpin the preparation and application of Community policies and improvements in quality control methods in industry. Scientific bases will be established to develop measurement methods needed to apply directives and regulations, particularly concerning the internal market, foodstuffs, agriculture, health, security on the workplace and the environment.

   In consultation with CEN/CENELEC, the prenormative research will focus on measurement questions concerning the new approach directives (construction, machinery, medical devices, etc.), product testing and the adoption of new manufacturing and advanced materials techniques. Concertation networks will be used to develop a European metrological infrastructure and support the establishment of the mutual recognition arrangements.

Given that the ECSC Treaty will shortly expire, research activities focusing on steel product and process innovation will gradually be covered by the programme.

Where the implementation of the programme is concerned, emphasis will be placed on transnational projects which are multidisciplinary and multisectoral, so as to encourage synergy between different sectors of industry, and on projects involving suppliers, manufacturers, end-users, universities and research centres. Also the programme will take into account the need for organisational changes within enterprises aimed at stimulating the efficient management of human resources and the integration of new technologies.

Research for or by SMEs and training through industrial research will be stepped up.

Dissemination and application aspects will also be reinforced and taken into account right from the start of the projects to ensure optimum exploitation of RTD results, in close cooperation with the general dissemination and application activities.

With regard to the management of the projects selected, effectiveness will be increased by coordinating projects concerning a given topic (clean technologies, flexible manufacturing, new propulsion methods, measurement and calibration methods). This will make for greater synergy between all those involved and better coordination with other complementary

Community projects and with other European initiatives, in particular EUREKA.

Following on from the conclusions of the Edinburgh European Council and the last Eureka Ministerial Conference in Paris (which reaffirmed the principles set out in the Eureka medium-term plan 1992-96), synergy with Eureka will be strengthened, in particular by organizing joint conferences and stepping up the exchange of information on projects.

Thematic networks of excellence will be set up to promote synergy between national activities on topics such as flexible manufacturing, motor vehicles and aircraft.

JRC direct activities in the field of industrial technologies will concern new advanced materials, non-destructive inspection techniques, prenormative research (structural mechanics, measurement and reference materials) and scientific and technical support for Community industrial policy and internal market policy.

Indicative breakdown of the effort between the different areas

Design, engineering, production systems and human management	34 - 39%
Materials and materials-related technologies	33 - 38%
Advanced propulsion technologies	10 - 12%
Standards, measurements and testing	12 - 16%
TOTAL	**100% (1573 million écus)**

ENVIRONMENT

Environmental protection and sustainable development are the subject of a well-established Community policy (Fifth Programme of Policy and Action in Relation to the Environment and Sustainable Development). This policy seeks to improve the quality of life, in particular by ensuring that the environment is taken into account in the various Community policies and by establishing a Community legislative framework based on solid scientific and technical knowledge. It also contributes towards increasing the competitiveness of businesses and creating new job opportunities. The preparation and implementation of this strategy necessitate ongoing research.

On the one hand, it is necessary to continue to study, understand and monitor the at times unpredictable development of the various segments of the environment. This entails developing appropriate diagnostic means and observation, monitoring and modelling systems. On the other, it is necessary to develop technical means to prevent or remedy environmental damage.

The physical and social dimensions of the problem necessitate intervention on a continental scale. In particular, the globalization of environmental research and its political and geostrategic implications (Earth observation, protection and management of natural resources) necessitate ever greater coordination of the Member States' efforts so as to ensure that the results of European research are better exploited and disseminated. To this end, in accordance with the subsidiarity principle, it is necessary to integrate and supplement the Member States' efforts by Community activities.

The Community R&D activities will focus on three topics:

- **the natural environment, environmental quality and global change.**

- **environment-related technologies.**

- **Earth observation and the application of space technologies.**

For each of these topics, priority objectives on which Community resources should be focused have been identified. These priority objectives will be achieved by establishing scientific networks of excellence operating on the basis of concerted and shared-costs activities.

1. Research concerning the natural environment, environmental quality and global change

Research will focus on the following objectives:

- understanding and modelling of natural systems, the climate and their interactions with human activities, and in particular the impact of socio-economic activities on the environment (biogeochemical cycles, forecasting of climate changes, processes controlling the atmospheric system, etc.);

- impact of environmental changes on natural systems, society and economic activities.

2. Research concerning environment-related technologies

Efforts will focus on the following objectives:

- technology development aid in the field of environment observation and monitoring (instrumentation technologies).

- development of effluent and waste treatment technologies (remedial technologies) and prevention techniques on the basis of the cost-benefit ratio (to supplement the Industrial Technologies programme); the socio-economic aspects will of course be taken into account.

- development of technologies for the restoration of deteriorated sectors of the environment and technologies and methodologies for monitoring, warning of and managing natural hazards.

These aspects of environmental research, which are particularly important from the point of view of increasing the competitiveness of businesses, will be coordinated with the research activities concerning environmentally sound technologies carried out in the context of other RTD programmes such as the Industrial Technologies and Energy programmes.

3. Earth observation and the application of space technologies

Efforts will focus on the following objectives:

- assistance for research into advanced technologies in the field of sensors and the pre-competative development of instruments of Community interest.

- development of a decentralized European network for management and access to space data.

These research activities will, among other things, enable:

- the intensification and efficient use of satellite data in information systems needed for the implementation of Community policies (agriculture, environment, regional development, developing countries, etc.).

- The promotion and development of application markets and hence the development of industries with a high value added.

In order to focus the Community research effort and make it more prominent in the world context of global change research, the research activities envisaged in this area will be carried out in the framework of the ENRICH network (European Network for Research on Global Change).
Efforts in this context will be targeted in such a way that (a) the results of the research further the objectives of the world programmes IGBP, WCRP and HDP and (b) the results can also be used in order to implement the abovementioned Fifth Action Programme.
The research activities carried out in the context of the ENRICH network will consist of concerted activities on specific topics, shared-costs research projects and the corresponding JRC activities. The aim is to integrate the national research efforts in order to maximize the research potential and focus the Community efforts on a small number of large projects.

The JRC's contribution will concern in particular the fields of prenormative research, research relating to global change, and the development and coordination of centres of data relating to environmental observation (Earth and space segment).

To provide an appropriate response to Community needs with regard to the environment, the progamme will aim to pool and strengthen the European research infrastructures needed to pursue the Community RTD objectives in this area (data bank and networks, observation systems such as ships, etc.).

Indicative breakdown of the effort between the different areas

Natural environment, environmental quality and global change	55-65%
Environment-related technologies	20-30%
Earth observation and the application of space technologies	15-20%
TOTAL	100% (625 MECUS)

LIFE SCIENCES AND TECHNOLOGIES

In the field of life sciences and technologies, an area in which Europe has made so many important discoveries and inventions, the research effort is far smaller than in the United States, and Europe is not as effective as its competitors when it comes to the industrial exploitation of scientific results, partly because of the fragmentation of the market and barriers affecting cross-frontier or cross-disciplinary collaboration and cooperation between universities and industries. In addition, biotechnology makes an important contribution to the two dimensions of the quality of life, namely health and environment.
Last but not least, the Community has institutional responsibilities in the field of industrial, environmental and health regulations: it is vital that this regulatory activity should be supported by an up-to-date scientific and technological base recognized by all, especially its world partners. Community research in the field of life sciences and technologies is therefore needed.
The Community needs to replace or adapt its own research methods and infrastructures in the light of the various scientific breakthroughs that have regularly been made over the last 20 years, breakthroughs to which earlier Community activities have moreover fact contributed substantially.

The programme should encourage global approaches bringing together numerous disciplines and involving users, consumer groups, professional associations and industrial centres, with the emphasis on the socio-economic application of scientific and technical achievements, in particular by small and medium-sized enterprises (SMEs).

Three areas will be addressed:

- biotechnology
- biomedical and health research
- the application of life sciences and technologies to agriculture and fisheries (including agro-industry, food technologies, forestry and rural development).

In each of these areas efforts will focus on certain topics. For other topics, a Community value added will be created through Community concertation networks based on the existing national activities.

In the case of biotechnology, the focused activities will concern:

- cell factories, with contributions from cellular biology, biochemistry, process engineering and computer science;
- sequencing of model genomes with a view to more effective exploitation of biological resources, with special attention being paid to the development of methodologies;
- plant molecular biology targeted on technologies generating new agricultural products;
- cell communication in neurosciences, in order better to understand the functioning of nerve cells and the networks formed by them. The research in question will help to design new drugs to remedy certain cellular and organic dysfunctions.

Concertation networks will be set up to bring together the scientific communities in the following areas:

- animal physiology, immunology and structural biology;
- prenormative research, biodiversity and social acceptance
- infrastructures (bioinformatics, etc.).

In the case of biomedical and health research, the focused activities will concern the following topics:

- prevention, epidemiology, diagnosis and treatment of diseases such as AIDS and cancer;
  development of antiviral drugs and of vaccines, needed for public health purposes;
- development of new clinical test and trial models in the field of pharmaceutical research (prenormative pharmacology) concerning nervous, mental and immunological disorders. This is a rapidly expanding area with a considerable socio-economic impact. This activity will be conducted on the basis of collaboration between scientists, industry and the regulatory authorities;
- brain research, taking into account other international cooperation programmes, with a view to improving the treatment of neurological and cerebrovascular disorders.

Concertation networks will bring together national expertise in the following areas:

- prevention, occupational health, risk factors and public health
- epidemiology of illnesses with major socio-economic impact;
- cardiovascular illnesses
- human genome analysis;
- health services research;
- biomedical technology and engineering;
- biomedical ethics.

In the case of the application of life sciences and technologies to agriculture and fisheries, including agro-industry, food technologies, forestry and rural development, research activities will be focused on:

- integrated production and processing chains, in order to obtain products with a higher added value;
- scaling-up and downstream processing, with a view to the use of new methodologies in agro-industrial processes;
- advanced technologies to provide more nutritious food and drink;
- activities to complement Community policies in the agriculture and fisheries sectors, together with the identification of new prospects for the sectors concerned further to their restructuring. Priority should be given to:

  * within the agriculture, forestry and rural development sectors: adaptation of production systems and chains, product quality, production diversification, balanced forestry, and support of rural development programmes;

* within the fisheries and aquaculture sectors: preservation of the original raw material quality in order to increase its added value, the impact on the resources, the environment and the socioeconomic aspects; improvements in aspects of the genetics and pathology of aquacultured species.

Concertation networks will be implemented to support research concerning primary production, food processing, and development of rural and coastal zones.

Direct activities will be carried out by the JRC relating to the analysis of certain food products and the use of remote sensing data for the application of the CAP.

Horizontal activities (demonstration activities, and ethical, social and legal aspects) will be carried out in the three areas of life sciences and technologies.

Indicative breakdown of the effort between areas

1.	Biotechnology (of which 3-7% for area 2 and 14-18% for area 3)	46 - 50 %
2.	Biomedicine and health	15 -19 %
3.	Application of life sciences to agriculture and fisheries, including agro-industry, food technologies, forestry and rural development	33 -37 %
TOTAL		100% (1265 MECUs)[1]

It is foreseen that biotechnology will be one of the key technologies to be applied throughout Life Sciences and Technologies (LST). Accordingly, activities which concern Biomedicine and Health (3-7 %) or Application of Life Sciences in Agriculture and Fisheries, including Agro-industry, Food Technologies, Forestry and Rural Development (14-18 %) will be carried out within each of those areas.

[1] Between 4 and 8 % will be allocated to horizontal Demonstration Activities; between 1 and 3 % will be allocated to the horizontal activities on Ethical, Social and Legal Aspects.

CLEAN AND EFFICIENT ENERGY TECHNOLOGIES

Energy will remain a vital problem for society: a substantial increase in world energy needs over the next century could have unacceptable consequences for the economy, employment and the environment unless appropriate measures are taken; energy and environment are in fact at the centre of the new growth model needed over the next decade and following decades.

Three major principles will guide the Community energy RTD strategy:

- Energy security in the broadest sense, i.e. providing reliable energy services at acceptable costs and under acceptable conditions, remains a major concern and should constitute the principal motive for supporting RTD on a European scale.
- Environmental concerns, and in particular the strategic objectives relating to the reduction of CO_2 emissions and acceptability, constitute the main driving force for change.
- To be effective and consistent, the RTD strategy must consider the entire technological process embracing research, development, demonstration, dissemination and the deployment of technologies on the market.

The proposed RTD activities will be divided between two technological objectives: on the one hand, the improvement of energy production from conventional energy sources and the rational use of energy, and, on the other hand, the development of renewable energy sources and their introduction into Europe's energy balance.

Specific activities for the formulation, implementation and coordination of an overall strategy for energy RTD will also be developed in support of the technological activities. They will include the development and use of new models to prepare consistent scenarios of the development of the energy scene in the medium to long term, to evaluate the interactions between energy, the environment and economic development and to analyse the impact of the energy RTD programmes.

The RTD activities will include both research and development and demonstration. The work proposed in the different categories will of course vary depending on the criteria applied, the importance of which may differ depending on whether R&D or demonstration is involved.

For example, the approach to research and development projects will be very selective in order to encourage projects which are potentially capable of playing a genuinely catalytic role in areas considered to be strategic for energy security and the reduction of polluting emissions by improving the efficiency of fossil fuel conversion and consumption in the short to medium term and introducing renewable energy sources in the longer term.

The demonstration projects, which are upstream of R&D, will be more diversified, since they represent an extension of RTD efforts not only at Community level but also at national level, and they are designed to provide more direct support for the various aspects of energy policy (security of supply, industrial competitiveness, economic and social cohesion).

Improved conversion and use of energy

The priority projects will concern the conversion of coal into electricity by improving combustion and gasification techniques. They will also be aimed at acquiring a better scientific and technical understanding of the exploitation of oil and gas resources. They will mainly be integrated projects.

The priority projects concerning advanced technologies for the rational use of energy will mainly concern fuel cells for a broad range of applications in various sectors, advanced combustion and batteries for transport and in combination with renewable energy sources, energy savings in industry and buildings, technologies for producing and using hydrogen (in conjunction with fuel cells) as an energy source in the long term. The development of these advanced technologies will be part of a systems approach (e.g. urban transport).

Other projects which are less important in terms of the Community strategy or which are already well-established in the Member States will be the subject of concerted projects, e.g. heat pumps.

Introduction of renewable energy resources

The renewable energy programme will comprise the development of a substantial range of high technologies: biomass conversion using numerous innovative thermodynamic cycles; photovoltaic systems using sophisticated solid-state physics techniques; windmills involving leading-edge engineering sciences; solar architecture combining optical and electro-optical technologies. Preliminary projects will also be proposed for tidal energy, wave energy, solar hydrogen, etc.

These projects are of strategic importance for the introduction of renewable energy sources on a significant scale and will therefore mainly be carried out as integrated projects.

Major initiatives carried out elsewhere in Europe would also be coordinated in the form of concerted projects aimed mainly, in conjunction with the companies concerned, at incorporating systems for the production of electricity from renewable energy sources in the grids of municipalities and regions to implement local plans for the introduction of biomass and windmills, and at coordinating networks of major urban development and architecture projects to incorporate advanced solar technologies. These initiatives must of course be consistent with and complement the Community programme.

All the activities will be part of a single strategic approach; they will be administered on a decentralized basis by the relevant departments, including the JRC.

Indicative breakdown of the effort between the different areas

Improved conversion and use of energy:	45-55% [1]
Introduction of renewable energy sources:	45-55% [1]
TOTAL	**100% (1,005 MECUS) [1]**

[1] 2-3% of the total programme budget will be assigned to activities in support of the formulation and implementation of energy RTD strategies (including modelling).

NUCLEAR SAFETY AND SAFEGUARDS

Although nuclear energy has reached considerable maturity in the Western world, it is far from being universally accepted by our society. Community action should therefore aim to promote broad collaboration to strengthen a new overall and dynamic approach to nuclear safety. This R&D collaboration will show that nuclear energy can benefit from further developments, in particular with a view to solving the problems which remain.

In this context, by pursuing a dynamic overall approach, the Community programme will seek to improve the understanding and quantification of the overall risk associated with the use of nuclear energy, considering the whole cycle, exposure to ionizing radiation, accidental and normal conditions, the historical liabilities associated with its use elsewhere (e.g. in the CIS), and the possibilities as regards technological developments.

The activities proposed will help to acquire a better understanding of the three main aspect;

- Reactor safety in relation to severe accidents.
- Management and storage of long-lived radioelements (including plutonium).
- The risk of diversion of fissile material.

To this end, projects will be carried out in relation to the following topics:

- Exploring new concepts.
- Reactor safety.
- Closing the nuclear cycle.
- Understanding, measuring and reducing the effects of exposure to ionizing radiation.
- Historical liabilities.

Where exploration of new concepts is concerned, the programme will identify and investigate promising conceptual solutions relating to reactor design and new fuel cycle options such as partitioning and transmutation processes.

Where reactor safety is concerned, R&D will be aimed at acquiring a better understanding of severe accidents, the integrity of the primary containment system by investigating the aging of structures and failure modes, accident prevention and accident management equipment and the probabilistic assessment of the reliability of safety systems.

To close the nuclear cycle it is necessary to acquire a common understanding of the scientific issues concerning the storage of long-lived waste (in particular spent fuel and vitrified high-level waste). Support for Community regulatory activities and the decommissioning of nuclear facilities and site restoration will also be covered in the activities proposed.

Where understanding, measuring and reducing the effects of radiation exposure are concerned, it is imperative to reduce the remaining uncertainties surrounding the quantification of irradiation risks arising from the use of ionizing radiation in energy production, industry and medicine and exposure to natural radiation, even though the current safety standards are very effective.

Last but not least the Community's historical liabilities and its own interest, given its geographical location, necessitate action concerning reactor safety in Central and Eastern Europe and to analyse the consequences of Chernobyl and other accidents. One of the priorities of the programme will therefore be to establish cooperation networks between Community institutes and those in Central and Eastern Europe and the CIS concerning radiation protection, waste management and site restoration.

The programme will be implemented on the basis of shared-costs projects (with particular attention being paid to large integrated projects such as underground waste-storage laboratories, and an experimental facility for the study of severe reactor accidents) complemented by activities concerted with those of the Member States and their industries (e.g. development of decommissioning strategies, land restoration following an accident, and Chernobyl collaboration).

Indicative breakdown of the effort between the different areas

Exploring new concepts	7-8%
Reactor safety	28-30%
Closing the nuclear cycle	28-30%
Understanding, measuring and reducing the effects of radiation exposure	28-30%
Historical liabilities	2-3%
TOTAL	100% (202 MECUS)

Controlled Thermonuclear Fusion

Aims and Objectives The long-term objective of this Community action, which integrates in a single programme all activities undertaken in the Member States (plus Sweden and Switzerland) in the field of controlled thermonuclear fusion by magnetic confinement, is the joint creation of safe, environmentally sound prototype reactors.

This objective, common to the four large world fusion programmes (EURATOM, Japan, Russia and the USA) which are of similar size, has a time-horizon measured in decades. Within Europe, integration of research activities on fusion by magnetic confinement in a single Community programme has been essential in optimizing the use of available human and financial resources. The quality of the research activities and the experience gained in collaboration within Europe place the Community in a strong position in the world-wide cooperation for an experimental reactor centered around the ITER project.

Safety and environmental criteria will be essential elements governing the realization of the large devices which, after JET, are included in the strategy envisaged towards the prototype commercial reactor. For the period 1994-1998, the proposed strategy necessitates the simultaneous development of three themes of activities : the Next Step activities aiming at completing the engineering design of ITER; concept improvements in plasma physics and engineering for the step following ITER, the demonstration reactor; long-term technology developments essential for progressing towards the exploitation of fusion as an energy source.

Integrated Actions Research will continue to be focused on the approach towards fusion by magnetic confinement in toroidal geometry; international cooperation will be developed, in particular in the context of the ITER project. Studies in support of ITER as well as those oriented towards the demonstration reactor (in particular concerning concept improvements and long term technology) will continue to be undertaken in the integrated frame of the Community Fusion Programme (Associations, JET, JRC and industry), mainly through shared-cost actions.

Concerted Actions The research activities carried out within the Community on approaches to fusion other than by magnetic confinement, such as by inertial confinement, will form the subject of co-ordinated actions which will include, if possible, extra-Community cooperation.

Indicative breakdown of effort between areas[1]

	(%)	
Area 1 : Next Step	40-50[2]	
Area 2 : JET Joint Undertaking	19-23[3]	
Area 3 : Concept Improvements	24-30	
Area 4 : Long-term Technology	5-9	
	100	(930 million ECU)

[1] This breakdown does not exclude that a project could relate to several areas.

[2] Including design proper and the necessary R & D support in physics and technology.

[3] The activities of the JET Joint Undertaking, which has its own legal personality, are principally oriented towards support of the Next Step.

RESEARCH FOR A EUROPEAN TRANSPORT POLICY

The transport sector, in the Community, will undergo major changes due to the development foreseen in the demand for mobility of persons and goods. This increase comes at a time when the growth of transport needs has, since the 70's, been subject to chronic congestion in road and air transport and significant malfunctions with an estimated cost of several tens of million ECU/yr. The objectives of industrial competitivity, quality of life of citizens, the achievement of the single market, protection of the environment, the rational use of energy and the development of transport itself - which is an important part of the European economy - requires a European transport policy to be put into place with the support of new technological solutions.

The main objectives of this research programme concern:

- the integration of each transport mode (road, air, urban, rail, maritime, multimodal and inland waterway) into a coherent multimodal trans-European network)

- the optimisation of the transport networks.

This whole research will ensure the interoperability of networks on the basis of a systematic approach, based on modelling, scenarios, evaluation and demonstration of the integration of technological innovations, including pilot projects. For example, in the area concerned with the development of common information and traffic management systems for maritime transport and with an integrated experimental testbed for air traffic control.

A concentration of means will be required to support the research on optimisation of the different modes of transport. It will be carried out through research, a major part of which will be on the design and integration of technological innovation in traffic management systems for all modes of transport, for example the areas related to: control/command for high speed rail, air traffic management (ATM) and maritime (VTS), etc.. Other research will be conducted notably for : - safety (man-machine, infrastructure and in particular human factors) which is always a critical factor in the emergence of innovation - reliability (e.g. improvement in port services, airports, public transport, etc.) and quality (e.g. modal split) under the best environmental and energy efficient conditions.

Pre-normative research activities (e.g. aircraft certification, cargo units and transshipment and crew certification) and experiments concerning the development of operational network architectures as well as organisational and human factors, logistics and other operational factors (e.g. man/machine task sharing) will be developed, integrated and validated.

A close interaction with other Community programmes will be established. Significant contributions will be made by innovations from generic technology programmes such as telematics tools for traffic management, industrial and materials technologies, propulsion systems, energy and environment (e.g. technologies to reduce energy consumption and pollution).

The actions will be carried out mainly as shared cost due to the nature of the work which is linked to efficiency and profitability (which particularly interests operators and their

suppliers) with a very targeted scope. However, in some cases concerted actions are also foreseen (e.g. air transport safety, reduction of pollution in ports and a common operational electronic marine chart display system).

Indicative breakdown of the effort between the different areas

A.	**Strategic research for a multimodal trans-European network** (Definition, demonstration and validation, including pilot projects)	**18-22%**
B.	**Optimisation of networks**	**78-82%**
	- Rail (traffic management, safety, interoperability)	**16-18%**
	- Integrated transport chains (transshipment and logistics)	**5- 7%**
	- Air (Air Traffic Management (ATM), safety)	**16-18%**
	- Urban (traffic management and optimisation)	**10-12%**
	- Road (traffic management, logistics, safety)	**8-10%**
	- Maritime and Inland Waterways (traffic management (VTS), safety, human factors)	**19-21%**
TOTAL		**100% (280 MECU)**

TARGETED SOCIO-ECONOMIC RESEARCH

The objective of the programme is to promote cooperation and coordination between Member States in areas of socio-economic research of major importance for science and technology policy decisions at both Community and national level in accordance with Articles 130f, 130h, 130a and 126 and 127 of the Treaty on European Union.

The programme will be in three sections each of which will focus on a limited number of research topics:

- evaluation of science and technology policy options;
- research on education and training;
- research on integration in Europe and social exclusion phenomena.

The evaluation of science and technology policy options through the cooperation between European researchers, is aimed towards the establishment of a common knowledge and information base of use to decision makers at all levels: regional, national and Community. The knowledge base will allow these decision makers to develop mutually compatible or unified approaches to the problems facing research in Europe and will therefore facilitate its coordination. This technology assessment activity will help to place European research in a world context. It will be aimed at identifying the critical technologies for industry in Europe and evaluating the benefits and risks of the changes in progress. Technology assessment research at Community level will therefore focus on three subjects:

- analysis of RTD in Europe in the world context with the help of appropriate indicators and research following geographical or sectoral approaches. It will result in the publication each year of an overview of the RTD situation in Europe and the production of papers on individual topics;
- evaluation of the socio-economic impact of emerging or cross-domain scientific and technological developments;
- medium-term forward analyses to identify the major socio-economic and cultural challenges (population growth, social structures, behaviour and value systems) which will influence the European research system and which it must meet.

The programme will coordinate its activities with the national efforts in this area. An open European technology assessment network (ETAN) will bring together the Commission departments and in particular the JRC's Institute for Prospective Technological Studies with the main national organizations active in the assessment of science and technology policy options, the European Parliament's STOA and the European Parliamentary Technology Assessment network (EPTA) and the social partners.

Research on education and training will be aimed at developing and disseminating innovative approaches in the educational system and will focus on two subjects:

- problems of mutual concern to Member States: the Single Market, new skills requirements, and demands of endogenous development;
- innovations in education and training methods: tools, psycho-pedagogical and organizational aspects, quality management;

Research on integration in Europe and social exclusion phenomena: the aim will be to analyse social fragmentation phenomena in connection with the European integration process, economic reorganization and globalization, resulting in new forms of exclusion, poverty and conflict, the research will be performed in support of Community intitiatives against social exclusion and will provide a framework for the comparison of actions taken in this domain throughout Europe. Urban areas will constitute the main focal points for the analysis as it is at that level that the phenomena in question are most significant and the consequences for the future are most serious. Efforts will focus on two areas of research:

- social and cultural aspects of European integration and successful social integration initiatives;
- contribution of technological developments to social integration.

Indicative breakdown of the effort between the different domains

Evaluation of science and technology policy options (technology assessment)	45 - 55%
Research on education and training	20 - 30%
Research on integration in Europe and social exclusion phenomena	20 - 30%
TOTAL	**100% (ECU 90 million)**

PROMOTION OF COOPERATION ON RESEARCH, TECHNOLOGICAL DEVELOPMENT AND DEMONSTRATION WITH THIRD COUNTRIES AND INTERNATIONAL ORGANIZATIONS

Activity II is the vehicle for international cooperation with third countries and international organizations on RTD. Cooperation will be based on the principle of mutual advantage, meaning not only direct or short-term advantage, as perceived by those involved in a project, but also the long-term or indirect advantage for the Community. The Community RTD cooperation activities will also seek to strengthen the coordination of Member States S&T cooperation with third countries.

OBJECTIVES

The general goal of this activity is to enhance Community RTD and support the implementation of other Community policies through targeted RTD cooperation and synergy with other Community measures. These objectives can only be pursued at Community level. The spin-offs from this cooperation, the aim of which is to ensure access to complementary resources in a spirit of mutual interest, will be of various kinds, e.g. scientific, technological, social or related to the quality of life, both as regards the international cooperation under Activity I and that resulting from the research proper under Activity II.

Firstly, the knowledge and knowhow of the European scientific community will be enriched by greater cooperation with third countries and, consequently, category I activities will be reinforced and their area of investigation enlarged. The aim is to extend to other themes and to intensify the approach initiated in the Third Framework Programme of opening up specific programmes under Activity I to non-Community countries.

Secondly, RTD's contribution towards resolving regional or general problems affecting developing countries (including Mediterranean third countries), Central and Eastern European countries and the new independent States of the former Soviet Union allows Community science policy to underpin other Community policies while being itself reinforced by this synergy. In this respect, Activity II supplements programmes such as PHARE, TACIS, the Lomé Convention and the cooperation programme with the ALAMED countries, which are more geared towards development aid.

The cooperation activities will be backed up by systematic monitoring and analysis of developments in R&D policies and implementation mechanisms in third countries so as to adjust Community cooperation policy and to derive maximum benefit for the Community and its partners.

LINKS BETWEEN ACTIVITY II AND THE OTHER ACTIVITIES

The other activities are primarily aimed at intra-Community cooperation. However, there are openings for various forms of cooperation with third countries and international organizations: association in the context of the European Economic Area; bilateral association, either programme by programme or for the entire Framework Programme; cooperation in connection with international projects covered by the programmes and

participation, project by project, in specific programmes opened up either on a geographical basis or on the basis of a specific S&T cooperation agreement.

However, there is no provision for Community funding for non-Community partners for these other activities.

Activity II, on the other hand, is the centralized framework for international cooperation, supplementing the cooperation activities in the other areas of activity and giving a Community dimension to international cooperation in areas not covered by these other areas of activity. It primarily concerns cooperation with non-Community bodies, and there is also provision for resources for them in cases where the Community can derive benefit from harnessing the research capacities in the countries in question (developing countries, Mediterranean countries, Central and Eastern European countries, new independent states). This cooperation may take the form of shared-costs projects or concerted projects.

THE ACTIVITIES PROPOSED

A. SCIENTIFIC AND TECHNOLOGICAL COOPERATION IN EUROPE

1. Collaboration with other forums for European scientific and technological cooperation

Stimulation and coordination activities are concerned, in particular in conjunction with EUREKA, in the COST framework, and in conjunction with European research organizations. There is no provision for Community funding for projects in this connection, except for secretariat and coordination expenses.

2. Cooperation with the countries of Central and Eastern Europe and the new independent States of the former Soviet Union

The objectives are to help safeguard the scientific and technological potential of these countries, rehabilitate their production systems and improve the quality of life, while avoiding duplication of Member States' efforts (coordination), and supplementing their efforts and other Community initiatives (TACIS, PHARE). This activity includes research objectives which are important to the Community and which can only be pursued in collaboration with the non-Community countries concerned which in the present situation do not have sufficient resources.

To the extent that other activities under the Framework Programme are opened up to participation by S&T bodies in these countries, if the non-Community partners wish to avail themselves of Community funding they will do so under Activity II.

Apart from this, Activity II will cover activities aimed at resolving specific or regional problems (e.g. concerning the environment, energy, or communications networks); the Community effort will be focused on the most useful areas. Shared-cost projects will be carried out under Activity II, given that the countries in question have hardly any financial resources and that solving their problems is of importance to the EEC (or even of global importance).

B. COOPERATION WITH INDUSTRIALIZED NON-EUROPEAN THIRD COUNTRIES

Exchanges of information, and coordination and promotion of cooperation on topics under Activity I, carefully selected on the basis of Community interest, are the activities concerned.

C. SCIENTIFIC AND TECHNOLOGICAL COOPERATION WITH THE DEVELOPING COUNTRIES

One objective is to maintain and strengthen European expertise in areas of importance to developing countries so as to be able to devote Community S/T resources to the solution of problems which, while being specific to the DCs, concern us on humanitarian, economic and socio-political grounds. The other, equally important objective is to strengthen the latter's research capacities and increase their involvement in research of general importance.

The specific areas relating to developing countries which are not covered by Activity I will be managed in the context of Activity II. This concerns in particular all aspects of the scientific problems of the tropical countries, focusing on agriculture, health and the tropical environment. Priorities will be set within these broad topics region by region. Shared-costs projects will be carried out concerning topics related to the solution of the specific problems of these countries and those where a solution is of importance to the EC (or even of global importance). Concerted projects will be carried out in other areas.

To the extent that some of the other activities under the Framework Programme are opened up to S&T bodies in these countries, if the non-Community partners apply for Community funding in order to be able to participate this could be provided under Activity II.

As a result of the approach described above, it is proposed that the resources for this activity should be focused on topics A2 and C as follows:

Indicative breakdown of the effort between the different areas

A	Scientific and technological cooperation in Europe	47-54 %
	1 Collaboration with other forums	6-7 %
	2 Cooperation with Central and Eastern Europe and the new independent States	41-47 %
B	Cooperation with non-European industrialized third countries	4.8-5.3 %
C	Cooperation with developing countries	41-47 %
TOTAL		100 % (790 MECUs)

DISSEMINATION AND APPLICATION OF RTD RESULTS

The economic and social impact of research and technological development activities depends to a large extent on the effective dissemination of scientific and technological knowledge and the effective use of this knowledge by economic operators.

That is why the dissemination and utilization of results is of such strategic importance, all the more so since European businesses are often less effective than their rivals at applying research results by incorporating them into innovations leading to the successful marketing of new processes, products and services.

The policies implemented by the Community Member States are insufficient, on their own, to overcome this handicap. In addition, more often than not they are nationally or regionally orientated rather than Europe-orientated.

Action at Community level is therefore needed. It must aim not only to further the dissemination and optimum exploitation of the results of Community research but also, because this is necessary to achieve this objective, to create conditions and instruments facilitating, at Community level, better transnational dissemination and exploitation of research results and a more effective transfer of technologies, whatever their origins.

In addition, special attention must be paid to industrial and service SMEs, whose competitiveness depends on their access to new technologies but which do not have the necessary capacity or resources to conduct research or exploit research results directly. Their ability to absorb new technologies needs to be strengthened. To this end, the Community should act as a catalyst and as a driving force and help to consolidate the European infrastructure for the dissemination of technologies and create a favourable environment, relying, in order to carry out its activities, on the competent bodies in the Member States, technology transfer intermediaries, and information media, etc.

Incorporating the continuation of the SPRINT programme in the third area of activity under the Fourth Framework Programme should help to achieve this ambitious objective.

The new approach proposed takes account of the cumulative, interactive and complex nature of the innovation process, the variety of categories of parties involved, and the specific needs of SMEs, which represent a major target of this operation. It alters the objectives and the scope of the dissemination and exploitation activities of the last two framework programmes and calls for wider-ranging action necessitating methods, skills and instruments different from those generally used in the specific RTD programmes.

The activities proposed in the area of dissemination and application should also contribute towards better transnational dissemination and application of the results of research conducted in the Community countries. They are in three areas: area A covers the dissemination and exploitation of research results, area B concerns the dissemination of technology to businesses, and area C relates to the financial environment for the dissemination of technologies.

* The main objective of area A is to promote the cross-sectoral and transnational dissemination and exploitation of research results.

  It covers the general services such as the Community network of relay centres and the public service for the provision of information and dissemination of specialized services providing assistance with the protection and exploitation of results and measures aimed at improving the economic and social effectiveness of the utilization and transfer of research results.

* The objective of area B is to improve the Europe-mindedness, quality and professionalism of national, regional or sectoral competent bodies by promoting the establishment of cooperation networks, the exchange of good practices, training, and support for joint schemes. The action by the Community should also help to create an environment conducive to the take-up of technologies by SMEs by carrying out business awareness schemes, demonstrating effective methods and promoting modern innovation management techniques. Last but not least, it should improve the general understanding of the mechanisms in question, and the appropriate policies and instruments, and facilitate the dissemination of good practices, in particular to local and regional operators, by organizing the exchange and evaluation of experience.

* The purpose of area C is to improve the financial environment for the dissemination of technologies through Community action comprising indirect support measures, and pilot schemes to promote the transfer and exploitation of technologies by SMEs. It also includes an experimental instrument for mobilizing funding for the use of research results and technologies by SMEs.

Indicative breakdown of the effort between the different areas

Area A	48 - 55%
Area B	40 - 45%
Area C	7 - 10%
TOTAL	100% (530 MECUs)

STIMULATION OF THE TRAINING AND MOBILITY OF RESEARCHERS

The development of human resources by means of training through research and more effective utilization of human resources through transnational mobility and cooperation are essential means of strengthening the very basis of European industry and improving its international competitiveness while contributing to its sustainable development.

To supplement the research training activities in the context of the targeted programmes under Activity I, it is necessary to encourage researchers to put forward unsolicited proposals for transnational cooperation and training activities in other areas of generic or fundamental scientific and technological research (bottom-up strategy). That is the role of this programme.

Action at Community level in this area is designed to supplement national efforts by offering young research scientists a spectrum of opportunities extending far beyond national horizons and by making it possible to establish thematic collaboration networks between high-level centres the diversity of which will produce new synergy.

The programme will consist of three types of measures:

- **training through research**, resulting in the training of approximately 5 000 scientists/year;
- **establishing** networks bringing together laboratories in different countries on joint projects or subjects, the number of laboratories concerned totalling about 1 500;
- **access to and support for large-scale facilities;** support will be granted to some 50 large-scale facilities to ensure access for 800-1 000 groups of users during the course of the programme.

The programme will also give rise to a series of flanking measures (university-industry communication, scientific prizes, dissemination of results) intended to improve the effectiveness of the programme.

Priorities

In a programme of this kind, which is open to all disciplines and pursues a bottom-up approach, it is impossible to set thematic priorities. A uniform approach, essentially based on the quality of the proposals, is envisaged so as to spread the Community budget evenly over the whole range of exact and natural sciences, economic and management sciences and social and human sciences of European interest. However, in the case of the "large-scale facilities" activities, the intention is to restrict the aid for infrastructures and coordination initially to topics concerning the development of detectors, ultra-high vacuum and ultra-clean technologies, optical systems and the development of data-display methods.

Indicative breakdown of the effort between the different areas

Training	30-40%
Networks	40-50%
Large-scale facilities	13-17%
Flanking measures	4-6%
TOTAL	**100% (785 MECUs)**

JOINT RESEARCH CENTRE

1. The JRC's contribution towards the implementation of the Fourth Framework Programme, as proposed by the Commission, is based on an analysis of the Centre's present position with regard to carrying out the current Third Framework Programme and on the strategy prepared in conjunction with the Board of Governors for the development of the Centre in the run-up to the year 2000 (JRC 2000 strategy).

2. The current JRC programmes for the period 1992-94 are based on four types of operation:

- EEC and EAEC specific research programmes (59% of the total funding);
- scientific and technical support provided at the request of other Commission departments (21%);
- exploratory research programmes (4.5%);
- work for third parties and the HFR supplementary programme (15.5%).

These four types of operations will be maintained, with a gradual increase in activities on behalf of other Commission departments, in line with the increased support which the JRC is to provide in connection with the formulation and implementation of Community policies.

3. The JRC's activities under the specific research programmes focus at present on safety (nuclear and non-nuclear), standards (scientific and technical contribution to their preparation), advanced materials and environmental protection and observation activities.

4. In the light of the general guidelines set out in the Fourth Framework Programme, for the period 1995-98 activities in these areas will be reviewed on the basis of the following criteria: subsidiarity, selectiveness and identification of the end-user of the research. The activities under the Fourth Framework Programme will provide a specific contribution to the implementation of Community R&D policy and support for the formulation and implementation of other Community policies. Where the latter are concerned, both research activities and scientific and technical support activities will in future be included in the Fourth Framework Programme (at present only research activities appear in the Framework Programme).

5. Outside the Framework Programme, vigorous efforts will continue to be deployed to ensure that work is carried out for third parties on the basis of the experience built up since 1988; new ways of working with industry will also be explored.

6. The exploratory research activities, which are essential to ensure the Centre's scientific vitality, will be continued at present levels; they will

be funded by means of a levy (of around 6%) on all JRC resources (under and outside the Framework Programme).

7. Where activity I is concerned, the scientific and technical content of the activities can be summarized as follows:

- Information technologies: prenormative support in connection with the security and reliability of data-processing systems and in the area of high-performance computing.

- Materials: prenormative research focusing on ceramics and composites, surface engineering, and the development of non-destructive test methods.

- Measurement and testing: prenormative research into structure analysis, measurement and reference materials.

- Environment: research relating to environmental protection (global change and new environmental technologies, industrial hazards), application of remote sensing techniques, S&T support for environment policy, in particular through the European Chemicals Bureau and the European Centre for the Validation of Alternative Methods.

- Life Sciences and Technologies: activities in support of the common agricultural policy and environment policy: remote sensing applications, European Bureau for Wine, Alcohol and Spirits, etc.

- Technologies for cleaner and more efficient production and use of energy: research relating to materials used in these technologies, prenormative research into energy conservation in buildings, prenormative research into the performance of photovoltaic systems.

- Nuclear safety and safeguards (fission): research into the control of fissile materials (safeguards), the safety of the fuel cycle and reactor safety. Scientific and technical support activities relating to the control of fissile materials in the Euratom and IAEA framework.

- Fusion: research focusing on safety and environmental aspects (use of the tritium laboratory) and support for the ITER (materials and remote handling).

- Assessment of science and technology policy options: research aimed at establishing a technology monitoring centre, scientific and technical support for Community policies through forward studies and technology assessment studies.

8. The JRC's contribution to activity III concerns the utilization of the results obtained through research activities for the specific needs expressed by other Commission Directorates-General.

THE JRC'S EEC SPECIFIC PROGRAMME

Indicative breakdown of the effort between the different areas

ACTIVITY I	MECUS
. INFORMATION AND COMMUNICATIONS TECHNOLOGIES	12
. INDUSTRIAL TECHNOLOGIES	227
. ENVIRONMENT	345
. LIFE SCIENCES AND TECHNOLOGIES	60
. ENERGY	45
. TARGETED SOCIO-ECONOMIC RESEARCH	35
ACTIVITY III	70
	794

THE JRC'S EAEC SPECIFIC PROGRAMME

Indicative breakdown of the effort between the different areas

	MECUS
NUCLEAR SAFETY AND SAFEGUARDS	293
CONTROLLED THERMONUCLEAR FUSION	50
	343

II. TECHNICAL ANNEXES OF THE SPECIFIC PROGRAMMES

INFORMATION TECHNOLOGIES

ANNEX I

OBJECTIVES AND SCIENTIFIC AND TECHNICAL CONTENT

CONTEXT

Since the emergence of digital computing in the late 1940s, the use of information technologies has been extending ever further into economic and social life. For the first three decades this was largely a matter of individual computers with limited local networking, installed in companies and administrations to do specific tasks. They were small islands of information technology, difficult to use and expensive to run. In the last ten years, with the emergence of the personal computer, digital communications networks, international standards, and open systems, all driven by the sometimes astonishing pace of technological advance, the islands have grown and are beginning to merge.

Information technologies now increasingly underpin all production and service industries, as well as the provision of societal services such as health, education, transport and entertainment. In addition to professional workstations, servers, and mainframes, there are an estimated 140 million personal computers in the world today. But around three times as many embedded computers bring competitive advantage to conventional products like telephones, televisions, toys, cameras, cars and washing machines as well as to high technology equipment and enterprise processes.

We are at the beginning of the transition to a new **information infrastructure** of society and industry, a point which marks the onset of a qualitative transformation in the impact of information technologies after forty years of quantitative growth. The information infrastructure is the set of services and technologies providing easy access to usable information to any citizen or enterprise, at any time, in any place. For the citizen it is the long-anticipated "global village", for the enterprise it is the "global workbench". The infrastructure brings together information processing, information storage and retrieval, information transmission and the information content itself. The most crucial aspect of the infrastructure will be the usability and manageability of information: IT has enabled us to make very large amounts of information available — the next challenge is to enable us to make sense of it.

This new stage in the growth of the information society compares in some of its aspects with the transition in the 1930s to a new industrial-economic system based on cheap oil and mass production, and before that in the 1880s from craft production to cheap iron and bulk production. As on those two previous occasions, the transition is accompanied by economic downturn, unemployment, and drastic restructuring in industry.

The information technology industries themselves find margins squeezed and profits falling at the same time as the application of information technologies becomes ever more widespread. Boundaries are being eroded, between supplier and users, between the professional and the consumer markets, and between the IT industries and other industrial sectors. A new "digital industry" is growing up.

The return to a strong economy and fuller employment, not just in the information technology sector but in all industries, will be heavily influenced by the speed and success with which structural transformation can be completed and the new information infrastructure can be put into place.

Behind the growth of information technologies, and of the information infrastructure of the future, lies a massive research and development effort. As technological development accelerates and competitive pressures increase, as the complexity and cost of R&D grow, enterprises and institutions need to look more widely to find the expertise and critical mass they need. The Community programme for precompetitive R&D in IT, ESPRIT, has since 1984 helped address these needs at a European level.

Under the Fourth Framework Programme the IT programme proposes new approaches and orientations in order to meet the new requirements of the 1990s, while building on the past achievements of ESPRIT.

In the 1980s the programme followed a technology-push policy aimed at a growing IT industry. In the 1990s, with the new focus on the development of the information infrastructure and the emphasis on access and usability, the programme must to a greater extent be led by the needs of users and the market. The overall objective is to contribute to the healthy growth of the information infrastructure so as to improve the competitiveness of all industry in Europe and to help enhance the quality of life.

The IT programme needs to be focused and selective in order to ensure the cost-effective use of resources and to avoid dispersal of effort. Focus comes not only from a careful selection of technical content, but also from the way in which R&D is carried out. In terms of content the R&D areas chosen must be those which give most leverage in building up the information infrastructure, which emphasise access, usability and best practice, and which foster Europe's command of generic technologies. At the same time the programme must give the right stimulus to the European IT industries.

The new technologies, processes and techniques to be developed within the proposed IT programme are selected on the basis of their potential for contributing to competitiveness by helping increase the productivity of European industry. They have an indirect effect on productivity through their capacity for improving the working environment and so creating a more effective workforce. They provide the basis for the transition to new business processes and new modes of industrial operation — a transition that European enterprises must master to remain globally competitive. The technologies and processes are an essential element in the creation of the high value-added economy. In addition, by stimulating technology transfer and the training of engineers the programme helps generate the skills and human resources needed for the emerging information society, and prepare Europe's workforce for the jobs of the future.

Activities concerned with the analysis of technological and industrial évolution will be reinforced. They will provide a general framework of understanding permitting a better articulation of the relationship between RTD policy and industrial objectives and strategy.

The programme will have to be responsive enough to keep pace with rapidly evolving user needs and with the accelerating rate of technological development. It is difficult to predict in detail all R&D needs several years ahead, and consequently there has to be the flexibility to adjust and adapt.

The programme will seek to be cohesion-friendly by providing interfaces for the use of structural funds in R&D. To add the maximum value to its R&D activities, the programme proposes where appropriate to pursue coordination with Eureka, offering the scope to bring results closer to market, as well as with relevant initiatives in Member States.

MEANS AND IMPLEMENTATION

To meet these changing requirements the IT programme proposes new orientations both in technical content and in implementation. Turning first to implementation, the programme proposes to put a greater emphasis on networks of excellence, and to make use of supplier-user collaborations and streamlined management procedures. It will introduce a number of focused clusters, a new R&D modality which builds on the experience of the Open Microprocessor Systems Initiative (OMI). In all R&D activities a strong commitment on the part of industry to exploit the results of collaboration will be expected.

A number of **networks of excellence** have already been launched as part of ESPRIT in the Third Framework Programme. A network of excellence brings together industry, users, universities and research centres focused on a common research objective. A network combines the critical mass of centres of excellence with the benefits for training and technology transfer deriving from geographical spread. Networks of excellence can be particularly beneficial for groups in outlying regions through the channel they provide for training, technology transfer, and access to expertise and resources.

Supplier-user collaborations supplement joint research projects. Supplier enterprises and users between them form a consortium to pursue demonstrably new R&D, with the users having a particular interest in taking up and exploiting the results of the collaboration. This can help circumvent the problems high technology companies with innovative products face in reaching customers.

Participation in the programme will be further facilitated by the introduction of **streamlined procedures** in accordance with proposals under discussion within the Commission. The aims will be to simplify the call and evaluation process, and reduce the cost of preparing proposals.

Focused clusters represent a major innovative modality in this specific programme. A cluster is a set of activities covering a number of technology areas but with a single well-defined goal. As well as collaborative research projects, a cluster may incorporate other kinds of activity, as its specific needs dictate. These may include networks of excellence, association of suppliers and users, cooperation with Eureka, coordination with national initiatives, international cooperation, dissemination of results, or training initiatives. Individual activities within a cluster may have a duration shorter than the life span of the whole cluster. Activities initiated at the outset will terminate while the cluster is still active, and new activities will be started up. Flexibility will be provided by initially retaining a percentage of the total cluster funding for use at a later stage, giving participants, industry, governments and the Community the opportunity to refine or redefine options in response to changing needs or a new understanding of needs.

The infrastructure and best practice approach that characterises the new programme provides SMEs with readier and more open access to R&D activities. To make effective use of this improved access, specific procedures will be put in place to stimulate SME participation in the programme, taking into account the complexity and cost of forming consortia and preparing

proposals, and drawing upon successful past initiatives aimed at SMEs. Networks of excellence, supplier-user collaborations and focused clusters provide further stimulus for SME participation.

R&D ACTIVITIES

The technical content of the programme focuses on the areas which are most important for the development of the information infrastructure, and where, taking account of the principle of subsidiarity, Community action will make the best use of the resources available. The work of the programme is directed both at the more basic or underpinning technologies, and at selected topics which integrate technologies into systems. In addition long term research is proposed where effort at a European level has the potential to lead to future breakthroughs.

Software is a major element in the information infrastructure, and already represents over half the value of computers and embedded systems. The programme concentrates on techniques and best practice in a limited number of software technologies enabling the production of reliable, correct, efficient and usable software. Electronic **components and subsystems** are the physical building blocks of the information infrastructure needed for systems and applications across all industrial sectors. The programme concentrates on R&D into semiconductors in areas where European industry needs the capability and can be competitive, with a particular emphasis on advanced integrated circuits for specific applications; peripherals, and in particular the flat panel displays and compact memory systems; and the emerging field of microsystems. **Multimedia technologies** will provide the human interface of the future to the information infrastructure. The programme concentrates on the technologies needed for the creation, manipulation, display, and storage of multimedia information. Multimedia data transmission and applications will be covered in the telecommunications and telematics programmes.

The focused cluster **technologies for business processes** addresses the integration of enterprises into the information infrastructure, and the effective use of IT in business. This is an area where major gains in competitiveness are just beginning to be seen. R&D in ICT for **integration in manufacturing** and microsystems has as its objective the development of new ICT solutions for the support of advanced and innovative manufacturing and engineering processes. It draws upon and integrates basic IT technologies in software engineering, open systems, computer-aided design, data modelling, database design, and microelectronics. R&D in the Industrial Technologies programme draws upon information technologies as well as other generic technologies in an effort directed towards innovation and concrete application in specific manufacturing domains, and, in turn, provides inputs, knowledge and expertise for future R&D in information technologies. For the complementarity between the two programmes to be operationally assured, coordination and an active interface will be maintained throughout their execution.

The **open microprocessor systems initiative** continues the work begun under the Third Framework Programme on the development of standards and technologies for open microprocessor systems, an area also of major importance for embedded systems. The **high performance computing and networking** focused cluster aims at the enhancement of Europe's capability to exploit computing technologies offering the highest performance, a capability which is indispensable both for embedded systems in the infrastructure as well as for maintaining competitiveness in a growing range of industries.

The rationale and content for each domain is described in what follows.

SOFTWARE TECHNOLOGIES

The objective of work is this domain is to enhance Europe's software production capability, by stimulating the spread of software best practice with a view to improving productivity, quality and reliability, and by fostering European capabilities in emerging software technologies and in distributed information processing.

Software is increasingly becoming the major cost component in IT systems, a trend further emphasised by IT users, who produce 70% of all software and exert a growing influence in this area. The demand for developing and monitoring software intensive systems is growing much faster than the supply. In consequence all industrial countries are facing the need for improved productivity and higher quality. Methods and tools for the production of adaptable and evolving software intensive systems at an affordable price are now an essential requirement for all enterprises. Furthermore, all industrial countries are suffering a shortage of skills and a lack of well established industrial approaches. New applications introduce a continuing stream of new technical challenges for the professional software producer.

Modern information processing systems exhibit an increasing tendency towards the distribution of function and information, so as better to match the nature of the organisations that the systems serve. This evolution is evident not only in business data processing but also in industrial control and embedded systems. However the development of dependable, extensible and usable systems with these characteristics presents a special challenge. Such systems are already radically reducing the cost of computing for users. For hardware and software vendors and service suppliers, this segment of the IT market is now forecast to become a key battleground by the mid 1990s. It is an arena in which, at this stage, no company dominates and in which Europe has strongly developed capabilities. Action in this area will help position European industry in this highly competitive and strategic market, as well as providing essential elements of the European information infrastructure. It will contribute to bringing the benefits that can be offered by the progressive "digitalisation" of the social infrastructure to the individual citizen and to the less favoured regions of the Community.

To address these issues work will concentrate on a number of areas: technology transfer and dissemination of software best practice; methods and tools for best practice; emerging software technologies; open distributed computing platforms; technologies for distributed database systems; and advanced techniques for human-computer interaction. There will be close coordination with related work in other specific programmes. According to needs work will be reinforced by accompanying measures to accelerate the take up of new technologies, to maintain awareness of new potentialities, to develop synergies with other European and national initiatives, to promote participation in the standardisation process, and to establish international collaboration.

Technology transfer initiatives will be deployed to promote the take up of new software production technologies and to increase skill levels on a broad scale. Industrial experiments will be targeted at improving and upgrading software development practice through incorporation of new processes, methods and support tooling. Dissemination actions aimed at raising awareness of best practice by establishing communities of common interest across industrial sectors and national boundaries will also be put in place as will training for the introduction of new practice aimed, in particular, at the management level. The European Software Institute will contribute to upgrade leading edge development process and to establish conditions for continuing process assessment and improvement. The activities will be

closely coordinated with, and complementary to, existing dissemination mechanisms, wherever possible.

In the area of **methods and tools** RTD will be undertaken to improve integration techniques for open and distributed systems, paying particular attention to quality, reliability and safety of software intensive systems. Techniques and tools will be addressed to support process modelling and rapid evolution of requirements and technologies. Work on emerging development paradigms such as concurrent engineering and cooperative development will be carried out to provide packaged methods and tools for enterprise wide software support. In addition work will be carried out on the organisation of the software development process.

A third area will aim to develop and experiment with **emerging software technologies** providing reasoning capabilities, allowing intelligence, flexibility and adaptation, and supporting modelling, reuse, and sharing of various levels of knowledge. Frameworks and integration techniques to build cooperating or distributed intelligent systems and to model enterprise wide or application sector knowledge assets will be addressed. This RTD mid-term work will be driven by generic needs such as the development and demonstration of complex, distributed decision intensive applications which are present in every sector of human activities and which will have a positive impact on European competitiveness as well as on integration and cohesion.

Work on **open distributed computing platforms** will address the architecture of open distributed systems with particular reference to issues of portability, dependability, interoperability and standards; the development of key components, in particular, middleware components for the management of information, access, and distribution of function. Special attention will be paid to the development and promotion of packaged software. To complement the RTD activities, actions will be initiated to establish dialogues with key user and standards groups concerned with open systems, including X/Open and EWOS. Major applications demonstrators will be developed and improvements in the practice of building open, distributed systems will be achieved via specific themes in the Software Best Practice activity. The Open Systems movement is global and will be based on the establishment of internationally accepted standards. Links will be made with the key activities in both the USA and Japan. Cooperation with developing countries and those of Eastern Europe will be promoted.

A further area is concerned with advanced technologies for **distributed database systems**. Activities will cover technologies for large scale object based repositories; techniques for knowledge embedding in and extraction from such repositories; interoperability, resilience and recovery of distributed systems; and methods and tools for supporting and applying these advances. Work will be carried out on tools for the management of distributed statistical data and on the way in which advanced technologies could benefit the collection, analysis, diffusion and representation of data.

The final area addresses technologies that will offer increased **human comfort and security** in dealing with information technology systems. In achieving this new opportunities are opened up with the promise of increased and wider markets for IT based products. RTD work will be carried out to better understand the user-system interaction, such as cognitive modelling, interaction models, media and metaphors, and cooperative work. The development and consolidation of emerging technologies will be pursued. These activities will be closely related

to upstream research, and will build on and contribute to standards and awareness of the potentialities of the new technologies will be maintained.

TECHNOLOGIES FOR IT COMPONENTS AND SUBSYSTEMS

The objective of this domain is to provide European industry with the technologies and capabilities to design and produce components and subsystems in three key areas: semiconductors, microsystems, and peripherals.

The on-time availability of low cost, high performance and high reliability integrated **semiconductor** components and subsystems represents an essential requirement for system houses to develop competitive electronic systems in markets such as consumer electronics, data processing, and the automotive and telecommunications industries. In addition to providing the technology foundation to traditional electronic and electrical sectors, microelectronics is increasingly extending its impact on a wider range of processes, products and services, in virtually all other industrial sectors, with an major impact on industrial innovation and competitiveness overall in the Community. The maintenance of European expertise is particularly important in the field of advanced integrated circuits for specific applications, where local sources of supply are vital for ensuring short design and production time scales and for protection of the applications know-how which gives competitive advantage.

The potential economic impact of **integrated microsystems** technologies rests both on the direct market segment it addresses and on the leveraging effect it creates on other industrial sectors. Products incorporating microsystems will range from hearing aids, analytical and medical instruments to CD players and automotive subsystems, and will cover both mass produced goods and a wide variety of specialised microsystems for high added value applications where the combination of performance, size, flexibility and robustness are critical factors of success. Medical diagnostic systems, artificial organs, environment monitoring and control, safety and security and reduction to energy consumption requirements are the main application fields where the impact will translate into improved quality of life.

Flat panel displays have wide application in portable and high definition projection television sets, in graphic and multimedia systems, and in interactive CD. In the semi-professional field, flat panel displays will be found in video phones, automotive applications and electronic workstations. They will become a fully integrated part of new products, requiring a close cooperation between components and device manufacturers. **Memory subsystems** represent a second field of peripherals technology which is crucial for the whole of the electronics industry. They are associated with all the applications mentioned above. High resolution displays, graphics systems and multimedia systems in particular demand very high capacity high speed memories. Digital memory subsystems are currently used for audio, image and video information including in portable applications. The third field is that of **home system peripherals**, which will have a major impact in the home consumer market. The introduction of such low cost home system peripherals will allow the integration of home automation devices and appliances into a unified system, so for example helping to rationalise energy consumption.

Work on **semiconductors** will concentrate on those technologies likely to be in major use towards the end of the decade and to have the major impact on applications. These include silicon-based technologies and the most promising compound semiconductor technologies, in

particular gallium arsenide. All aspects of the process, including design, packaging, testing and manufacturing, will be supported. Some work may be undertaken in conjunction with the Eureka initiative. Integration of advanced components into advanced integrated circuits for specific applications will be emphasised.

RTD tasks will focus on the following areas: generic technologies aimed at lower size, lower cost, higher functionality and complexity, as well as higher speed, lower power millimetric and microwave integrated circuits for high frequency applications; generic system integration technologies with an emphasis on electrical and optical interconnectivity and packaging, for systems consisting of active and passive components; advanced system design methodologies and tools, for digital, analogue and mixed applications; electronic device technologies and system integration, in particular for advanced peripheral and storage systems, communication networks, optical computers, and microsystems; effective manufacturability of next generation ICs for small and large volume production; flexible fast turn around manufacturing facility for advanced integrated circuits for specific applications, in particular providing easy and cheap access for SMEs; integration of design and technology capabilities in pilot demonstrations aimed at specific applications of significant economic and social impact, or at extending the impact of microelectronics to more traditional industrial sectors; microelectronics aspects of microsystems; and multifunction system applications.

Technology transfer and dissemination activities will be directed at the reinforcement of links between equipment/materials and IC manufacturers, through working groups, industrial associations or networks; and at the establishment of closer relationships between IC manufacturers and users, through a network of centres of competence in circuit/system design, manufacture and testing. In support of training, networks of research institutes and academia will be established, providing qualified personnel to industry, for the fabrication and use of innovative manufacturing tools and methods, and in circuit and system design and testing. Training initiatives will also be established to increase the awareness of potential users of advanced integrated circuits for specific applications, notably SMEs, and to provide them with expertise in particular in the translation of their system requirements into hardware specifications. International collaboration will be established in specific fields.

Work on **integrated microsystems** will focus on multidisciplinary design, manufacture and test of microsystems, and integration and packaging methods. RTD will be directed towards the technological needs of three major application fields: automotive, where microsystems will have a key role in the realisation of the clean and safe car of the future; medical engineering, where microsystems are needed for portable intelligent medical diagnostic systems; the monitoring and control of processes influencing the cleanness of the environment.

Work will start from conceptual and detailed microsystems design, through the integration of existing basic technologies to of industrial prototypes. Small and large scale manufacturing aspects will also be addressed. Activities of special importance will include: design of microsystems; integration of components such as optical, biochemical, sensors, and actuators, with microelectronics subsystems and components; packaging and interconnection of integrated microsystems; interfacing to other micro-and macrosystems and to the physical world; software integration (system and application); specific equipment requirements; manufacturing requirements and routes; and testing and quality assurance. Know-how and experience obtained in the course of the focused RTD will be used as the basis for other application spin-offs.

To support work directed towards the three application fields, additional activities will be carried out on the integration of a wide range of technologies which form the basis of microsystem production, among them microelectronics, microoptics, micromechanics and microchemistry, drawing on results developed elsewhere in the Framework Programme.

The potentially wide applicability of microsystems, the inherent difficulties in mastering microsystems technologies, and the fact that not all technologies may be present in all Member States, necessitates the creation of efficient Community-wide mechanisms for dissemination and technology transfer. Of particular importance is the stimulation of conditions for SMEs to develop innovative microsystems at low cost and incorporate them into their products. These needs will be addressed by the dissemination and transfer of technology through technical interest groups and networks of excellence. Access to low cost manufacturing and other assistance, particularly for SMEs, will be provided through the creation or enhancement of specialised mini-fabrication facilities combined with appropriate service mechanisms.

Interdisciplinary training for the development and utilisation of microsystems is of key importance. Use will be made both of existing mechanisms in some of the contributing basic technologies (for example the VLSI design training action) and of new mechanisms. Industrial training schemes will be organised through the existing industrial and trade associations with the help of centres of excellence.

Work in the area of **flat panel displays** will build on results achieved in the Third Framework Programme, in particular in the field of Active Matrix LCD for applications needing large full-colour displays. Activities will be directed towards the development of low-cost high-resolution thin-screen display components, emphasising improvement in visual quality of displays, especially for portable equipment, and increased screen size and flatness. Active matrix LCD technology is of particular importance, exhibiting the most attractive features in term of colour and resolution, but other display technologies will also be addressed, such as Field Effect Displays and Ferro Electric Displays for very low cost and low power applications. Requirements will be defined through co-operation between the user and supplier industry. In the field of **memory subsystems** work will cover increased capacity, compactness and read/write performance to support multimedia systems and real-time high definition video. Technologies to be addressed include magneto-optic and magnetic disks. Work on **home systems peripherals** will concentrate on technologies for the devices required to link home appliances into a domestic system and for the peripherals needed to support user interactivity.

Supporting activities will include and industrial training programme in the field of display and memory subsystem design, a Special Interest Groups involving industrial and consumer representatives, and a special action to encourage European production of strategic materials and components for the peripheral industry. Coordination with national initiatives will be established to increase the overall value to the Community. International cooperation will be particularly important in the field of display technologies, where joint ventures bringing together the interests of several industrial partners are essential for success.

MULTIMEDIA TECHNOLOGIES

The objective of this domain is to support strategic RTD in generic information technologies which underpin multimedia end-user systems and applications. Specific work will be undertaken on technologies for integrated personal systems, which represent one of the main market opportunities in the area of multimedia systems.

The emergence of a market for multimedia systems, allowing the seamless integration of voice, video, text, sound, animation and graphics has been predicted for a decade. Only now have advances in microelectronics performance, software techniques, standards and digital communications allowed multimedia systems to become a reality. It is expected that multimedia systems will be taken up first in customised applications in business and the home, in education, manufacturing, financial services, medicine, transport, insurance, retail, tourism and entertainment, including games, movies and television. New levels of productivity are expected to be achieved in business and education as a result of multimedia techniques.

The market for personal systems is just beginning to emerge and offers considerable scope for expansion. There are as yet no clear market winners. Europe is already strong in the technologies needed, such as smart card technology, secure protocols, embedded systems and application-specific software, and has the lead in low power components and in secure, smart encryption devices. The European ARM chip is being used in US developments. This new market offers an opportunity for Europe to cover most of the production cycle, from micro-components, through systems to applications development, providing a basis for boosting competitiveness in other application fields.

Activities in the domain will be coordinated with work in other specific programmes, particularly in multimedia communications, and high definition television and broadcasting. It is expected that over the period of the programme there will be considerable convergence of the IT, communications, consumer electronics, information publishing and entertainment industries, a trend which will be fully taken into account.

The domain will provide generic and enabling technologies to allow the creation, manipulation, display, and storage of multimedia information. RTD includes the specification of appropriate components, for example video compression/decompression chips, high capacity optical memory and processors, liquid crystal displays, and their integration into advanced multimedia systems; standards for multimedia storage, representation, and compression/decompression; and generic multimedia software. The area of software includes multimedia extensions to existing system software and tools; creative tools providing software objects in the various media — video, audio, animation, painting and drawing; and authoring tools which allow multimedia user-friendly custom applications to be built from the individual media objects. The integration of hardware and software elements will be demonstrated in systems for a variety of end-user applications.

Work in the domain will build on strong European results already developed under the previous Framework Programmes, including CD-I, MPEG video standards, and multimedia systems and tools. Challenges are presented by intellectual property issues, including copyright of the media objects, ease of use, current network limitations, and the integration of technologies for multimedia applications, particularly with existing hardware and software.

Work on personal systems will concentrate on two topics: the development of technologies for multi-function, integrated user access devices capable of handling multimedia data, including the electronic wallet and personal and group communicators; and the application of technological advances in the information provider industry to enable them to satisfy this ever increasing user demand for efficient services. These two aspects cover the application sides of the complete system solution that, for its full deployment, will rely on existing wireless network and telecommunication infrastructures, and will take into account new development activities in these areas which are covered in the telecommunications and telematics programmes.

Supporting activities include the training of designers and authors of multimedia applications. A Special Interest Group involving both technology suppliers and the authoring industry will provide information dissemination in both directions to support industrial co-operation, and to achieve consensus on standards. Close links will be established with other generic technology initiatives, particularly those on peripherals, microelectronics, software engineering and microprocessors.

LONG TERM RESEARCH

The intensive RTD effort needed to increase the turnover from the laboratory to the market, in a rapidly changing technological scene, engenders the risk of "short-termism". A long term industrial vision providing a frame of reference for shorter term research is essential but difficult to achieve when the pressure is great to bring the next product to market immediately. At the same time, concentration on shorter term research risks depriving industry of those human resources which are needed to make the next wave of innovation possible and to respond to specific industrial needs for advanced research. A Community investment in advanced and long term research will promote strong and targeted industry/academia cooperation and will ensure that by improving our competitiveness in the short term we do not mortgage our medium and long term technological future. Activities will thus be aimed at ensuring that at any one time:

- the potential for "the next wave of innovation" is maintained, compatibly with the shorter term views dictated by rapid technological change;

- scarce expertise underpinning European information technology RTD is replenished in those areas where it is most needed.

These goals will be achieved through *networks of excellence* and *upstream RTD projects*.

Thematic networks of excellence will ensure that, in any one theme, a framework for coordinating RTD, technology transfer, training, as well as a common infrastructure is dynamically maintained by the technological community itself (suppliers, users and researchers). These coordination frameworks, in which the vision of industry would be the key determinant, are expected to play a central role in focusing RTD activities of both long and short term nature.

Upstream RTD projects will fall into two categories:

- **Advanced** projects involving a high but assessable technological risk whose success would have a direct impact on industrial competitiveness. Projects in this category would often contribute to the solution of specific downstream projects identified in a framework of RTD coordination — a short term action can provide an important contribution to a long term goal. A project does not in itself need to result directly in a product or service if it can contribute to such products or services being generated in several projects downstream.

- Projects characterised by their potential to produce breakthroughs with **long term** but clear industrial implications and, therefore, by definition unconstrained by the downstream work carried out at any one time.

Projects in both categories will also be selected on their ability to induce the generation of human resources in fields with identifiable shortages, as well as on the complementarity of the skills brought together, especially in interdisciplinary fields.

The technological areas to be addressed will not be circumscribed because proposals will be expected to respond both to opportunities and to needs as they arise in other parts of the programme. It is thus expected that most activities would be related to upstream aspects of RTD activities undertaken in other parts of the programme, ensuring their maintenance and expansion in time.

FOCUSED CLUSTER
OPEN MICROPROCESSOR SYSTEMS INITIATIVE

The objective of the Open Microprocessor Systems Initiative (OMI) is to provide Europe with a recognised capability in microprocessor systems, and to promote their broad acceptance in applications systems, both within Europe and world-wide.

Microprocessors with their associated software form the intelligence of electronic systems. Their application ranges from sophisticated control systems for aerospace, robotics, industrial control and telecommunications, to mobile telephones, consumer electronics and automobiles, and general-purpose computer systems from supercomputers to notebook PCs. The microprocessor market is currently dominated by US suppliers, who provide microprocessors based on CISC technology (Complex Instruction-Set Computing) used in more than 80% of current systems, and in almost all computers. However new markets are emerging in embedded systems, that is, systems not programmable by the end-user. Strength in advanced RISC (Reduced Instruction-Set Computing) microprocessing, the leading edge technology, represents a significant opportunity for European industry to improve its competitive position and provide new employment by the end of the decade, not only in the microprocessor and systems software business but in a broad range of user industries, particularly in embedded systems.

OMI will build on work started under the Third Framework Programme, which itself draws on activities supported by a number of Member States, and on results in microelectronics, software, applications systems integration, and standards from all parts of ESPRIT and elsewhere. Its aim is to concentrate and co-ordinate efforts in microprocessor systems RTD

throughout the Community in order to provide the critical mass which will enable European industry to compete effectively world-wide.

OMI aims to succeed by providing components for use in embedded systems applications, but with the intention of also supporting eventually the computer industry. The whole range from very high performance to very low power microprocessor systems is addressed. OMI concentrates on an intercept strategy with existing non-European technology, as well as on the next generation of technology beyond (to year-2000). Given the major use by European companies of microprocessors, a viable European alternative should be provided as well as a smooth migration path from currently available to new technology.

OMI will make use of results from all parts of the Community's Framework Programme and elsewhere. Within OMI longer term generic RTD will address work in advanced microprocessor systems components and tools, both hardware and software. This includes high-performance microprocessors of a range of architectures, digital signal processors, fuzzy logic, analogue to digital converters and other on-chip functions; advanced technologies for new kinds of processors; design, debug and test environments for on-chip systems; systems software including software portability mechanisms; and standards.

Additional activities will integrate the results of the previous generation of projects started under the Third Framework Programme, aiming to speed uptake of the OMI results through applications pilots of on-chip systems in the user industries. The work will concentrate on the electronic and software subsystems needed for the application, and not normally on the entire application system. The latter may be supported by EUREKA, ESA, Member State initiatives or other Community programmes. Applications pilots will be selected based on committed industrial interest and broad social and economic benefits.

Potential fields of application include automotive control systems for pollution and energy control, for communications and for geographic vehicle positioning; communications systems ranging from advanced switching to portable telephony; customised systems for process control and robotics in manufacturing; advanced multimedia systems; aerospace and other high performance embedded applications. User industry participation will be an integral part of all RTD work, to provide user requirements to the technology suppliers, and to seed early uptake of the results in industry. The aim is to speed up the systems integration process, through "vertical integration" (microprocessor producer, software supplier, systems integrator, all working together), leading both to stronger systems supplier and user industries and to more high technology employment.

Efficient mechanisms will be provided to disseminate and transfer results throughout the Community and world-wide. This will be achieved by conferences, technical interest groups and networks of excellence; by regional design and conformance testing centres to assist particularly SMEs in the exploitation of OMI technology; and by an OMI portability action, which will promote on-chip microprocessor systems standards as well as the virtual binary interface standard, demonstrating value in portability experiments.

Both industrial training schemes and training through the universities and centres of excellence, for example by enhancing existing mechanisms such as the VLSI training action, will be supported. International co-operation is envisaged, both in the USA and Japan, particularly in the field of open standards for supercell libraries and systems software.

FOCUSED CLUSTER
HIGH PERFORMANCE COMPUTING AND NETWORKING

The objective of this focused cluster is to exploit the opportunities provided by high performance computing and networking, to expand its application potential, and so to speed the pace of innovation and serve the economy as a whole.

Recent technological developments in computing and networking promise revolutionary qualitative and quantitative changes in the use of the new generation of computing and communications systems. Shorter time to market and better product quality will be the main motivation for uptake by industrial users. A thousand fold improvement in the cost/performance ratio for computing and networking systems will make feasible an increasing number of new applications, previously impossible, and will emerge as major demand driver. Experiments will be substituted by computer simulation in an increasing number of industries, including traditional ones. Moreover, the use of HPCN systems for commercial applications is expected to be taken up vigorously in the second half of the decade. High-speed networking at affordable cost will allow distributed image-based applications and bring multimedia systems to full fruition. Existing scalar/vector systems will be complemented with parallel systems in the shorter term and parallel systems and clustered workstation technologies are expected to converge to provide scalable heterogeneous multi-computer networks before the year 2000.

The priorities of the cluster are as follows:

- to overcome barriers to the exploitation of the underlying technologies, notably in the field of HPCN applications and software, by improving programmability, ease of use, and portability. Standardisation will pay a key role for market acceptance of these new applications;

- to stimulate the development of the underlying information and communication systems technologies towards the provision of flexible heterogeneous multi-computer networks satisfying a broad range of user requirements, on the basis of the principles of scalability and interoperability;

- to build on existing European strengths in terms of application focus, human resources, scientific and technological capability; take advantage of existing infrastructures and programmes, and, where appropriate, provide Community added value through catalytic action.

The work of the cluster will be organised around five co-ordinated sets of activities, where possible drawing together and building upon other activities in the Framework Programme, in the initiatives of Member States, and elsewhere. The first three sets address applications of major industrial relevance. The underlying generic systems and software technologies will be addressed in a fourth co-ordinated set. The fifth addresses complementary concerted actions. Co-operation between users and suppliers of systems and services will help to specify evolving user requirements for future generation HPCN systems. The essential RTD on communications and on network management is addressed telecommunications specific programme.

The first set of activities concerns simulation and design applications. The objective is to demonstrate new applications which need HPCN capabilities for cost-effective solution, and which have a clear impact on industrial performance, shorter time to market and better product quality. The emphasis will be on computational fluid dynamics, materials dynamics, electromagnetics, molecular modelling and other chemical-pharmaceutical applications. The rapidly increasing flow of skilled personnel able to use HPCN systems will make possible distributed applications in accordance with user requirements. A longer-term objective is to address advanced complex, and ultimately complete, simulation systems combining several disciplines.

Activities in information management applications aim to demonstrate the economic viability of HPCN techniques in the fields of complex decision support and high performance online transaction. The focus of activities is determined in view of complex multi-functional adaptable, highly reliable and safe solutions. The activities include the application of HPCN to complex data analysis, storage and retrieval of information in large and distributed bases and the application of image-based human-computer interfaces. Sensitivity to new solutions and approaches at management level need to be developed through specific actions.

The third set aims to promote the use of generic HPCN technologies for embedded systems applications of particular economic relevance, such as quality control, advance surveillance, complex control and intelligent machinery. The activities include complex signal processing, pattern recognition, image processing and understanding and applications with specific real-time requirements. Emphasis will be placed on the use of commodity components and subsystems and on the specification of architectures suitable for standardisation.

A fourth set on software and systems technology will support the development of this new generation of user oriented HPCN systems. Work will draw upon activities in software, semiconductor and multimedia technologies. It will ease the use of a wide range of applications, user environments for the use of parallel, distributed and embedded systems, advanced systems architectures, and subsystems such as computation and information servers and advanced human-computer interfaces, generic system aspects of distributed database management and distributed processing. Proof of concept and economic viability of new ways of computing, including optical computing and neural networks, will also be addressed. The emergence of heterogeneous multi-computer networks will be stimulated by the development of computer-to-computer and computer-to-network interfaces, including their operational protocols and associated demonstration and validation protocols. Standardisation and common practices amongst a widespread group of users and vendors will be encouraged.

Supporting activities will complement the work to support the development of a pan-European HPCN environment and infrastructure by achieving appropriate coordination with complementary activities and programmes. In this context, concerted actions will be organised in the form of networks which aim at spurring training by research and technology transfer to industrial users. Applications experiments normally building on existing infrastructures and requiring a Community dimension will be supported and will help users to evaluate the opportunities and facilitate the accelerated uptake of HPCN technologies.

RTD activities will be coordinated with relevant Eureka projects, and national and regional programmes. To accelerate the emergence of widely accepted HPCN products and technologies, links and, where appropriate, specific international cooperation will be established.

FOCUSED CLUSTER
TECHNOLOGIES FOR BUSINESS PROCESSES

To increase productivity and ensure competitiveness in the 1990s and beyond enterprises need to change their organisational practices, aiming at flatter organisations, more responsive and flexible, and with much quicker decision-making. Many of them are re-engineering their business processes, resulting in new work arrangements. A major feature of the re-engineering is the integration of business processes across the business functions such as sales, product development and finance. Another feature is more group working, often across departments. A third feature a move from the high level of division of labour that has been common up to the 1980s, to an integration of tasks, with several of the tasks being carried out by the same individual. One example is a loan approval, previously involving 20 steps but now reduced to just three, with the approval time reduced by a factor of ten. Information technology is an essential underpinning for most of these new arrangements, which either are not feasible or are uneconomic otherwise.

The new business processes often involve complex decisions, are knowledge intensive, require rapid response, and are related to work flow. Many of the new processes need to be supported by new technologies or new combinations of technologies; integration of technologies is the central support required. Tools to support cooperative working and document management are of particular importance. Considerable scope exists for improvement in the efficiency of document management services in particular. To take a specific example, studies showed that design engineers in a US aerospace company spent 45% of their time on producing, exchanging and managing documents, just 5% was spent on CAD-based design work, and 50% on meeting and other activities.

The objective of the focused cluster is substantially to increase the contribution of IT to the effectiveness of organisations by, first, improving the level of understanding of best practice in the use of IT in business processes, and second, developing the underlying technologies that will support the new organisational developments. The cluster will be application-driven, and will use this focus to integrate technologies from several areas of the Specific Programme, as well as developing complementary new technologies. Users will have a key role in the cluster, providing the orientation for the effective use of IT. It builds on the work done on IT support for business processes in previous Esprit phases. There will be close coordination with work carried out in the telematics and telecommunications programmes.

Research into IT for business processes is multidisciplinary, and includes modelling of business processes, organisation "engineering", architecture of information and communication processes in the enterprise, integrating software components for business requirements, and integrating document management into multilingual organisations and administrations. Differences between countries in business organisation and business practices as well as in styles of organising IT will also be incorporated into the research.

RTD on technologies supporting business processes will have an application-driven approach, which will result in the integration of several technologies. Methods of integration with companies' existing applications and data will also be pursued. Complementary research will be done on computer-supported cooperative work and document management.

New approaches to integrating and developing software are required to support the new forms of business process automation, including the integration of object-orientation, knowledge-

based systems, graphical user interfaces, and distributed computing. The integration with other technologies of teleconferencing, of spatial information systems such as geographical information systems, and of mobile technologies, is also required. This necessitates a strong relationship to the work on methods and tools and on knowledge-based systems in other parts of the IT programme. Work will also be done as appropriate on standards.

In the area of computer-supported cooperative work (CSCW), research aims to apply IT to the enhancement of interpersonal interaction and collaboration in the business enterprise. CSCW applications support users working jointly on projects in a distributed environment, on heterogeneous hardware and software systems, simultaneously or sequentially. The RTD covers tools, standards, and object libraries for the generation and tailoring of CSCW applications, taking into account user mobility, flexible forms of working, and the use of existing information systems. Specific fields of research include collaborative authoring, group decision support, electronic meetings, and shared distributed work.

A number of research activities will be undertaken in the area of document management. Work on document creation will address the creation of multimedia documents in a cooperative and distributed manner, using disparate tools and systems, incorporating existing documents including conversion of old paper documents to electronic form, and building composite documents. Aspects of software development techniques are relevant for version control, consistency management and concurrent engineering. Work will also address flexible and just-in-time document production and printing, and the relationship between documents and distribution mechanisms such as electronic mail and fax services. In the area of document storage and retrieval, new more user-friendly forms of access will be developed, along with new ways of organising the storage, archiving and clustering of documents, and techniques for the retrieval of parts of documents, such as illustrations, citations, subparagraphs, and annotations.

Pilot experiments will be undertaken, together with activities in the field of best practice. The work will aim at speeding up learning on the optimal forms of integration of the various technologies in business processes. Learning both by the users and the technology providers is envisaged, with the users playing the leading role. Methods of minimising the user's perceived risk in adopting and deploying the new technologies will be investigated.

FOCUSED CLUSTER
INTEGRATION IN MANUFACTURING

For a high-wage economy, employment in the productive sector relies on the rapid shift towards technology-based products of high engineering content or added-value, and on the ability of manufacturers to operate in an optimal way in a dynamically changing global network of business partners, suppliers, customers, and researchers. The profound restructuring which is taking place throughout industry creates both the climate and the opportunity for change. New manufacturing paradigms are emerging to support a more lean and agile approach: collaborative supply chains, intelligent manufacturing, collaborative working. All are predicated on the availability of advanced IT and Communications.

Previous work was based on the concept of integration of traditional engineering functions. These "computer integrated" technologies of the 80's are now sufficiently mature to be able to

be exploited downstream in an industrial environment. A new culture of work is emerging which pervades all business processes including manufacturing and engineering; this needs advanced ICT and, correspondingly, determines new upstream ICT developments. Advanced ICT developments must be influenced at their inception, so that European industrial competitiveness and the quality of life for the industrial worker are well-served.

The objective of activities in this domain is, through the development of advanced information technologies, to act as a catalyst in these changes and to contribute to increasing competitiveness in the manufacturing, engineering and process industries through improvements in product quality, cost and time-to-market, while meeting the environmental challenges of the 21st century.

Basic generic technologies in the field of ICT are evolving separately at high speed and their uptake will be limited by the speed with which they can be integrated in a business environment. The architecture of future systems must be continuously redrawn in order to enable users to reap the benefits of advanced IT developments while at the same time migration paths must be defined in order to protect the investment already made up to the present. Work will draw on and integrate basic technologies in software engineering, open systems, computer aided design, data modelling and database design, microelectronics, microsystems and selectively mechatronics.

For individual companies, implementation of business strategies based on new manufacturing paradigms requires a redefinition of the building blocks used to develop IT support systems for the manufacturing and process industries. Cross-sectorial and multi-disciplinary initiatives will be supported in order to tackle generic problems, while at the same time taking account of specific industrial requirements and the quality of life. These will result in benefits across the full spectrum of industry.

Work will concentrate on new ICT solutions in three technical areas supported by prenormative and cooperative activities.

Work on the **enterprise integration framework** will concentrate on the provision of methods and tools to support modular system design for the IT systems supporting manufacturing and production enterprises. Users and vendors will be encouraged in their efforts of reaching consensus on requirements and functional specifications for the components for such systems and support will be given to advanced implementations aimed at validating and testing the results.

Work in the field of **integrated product data modelling** will concentrate on formalising and standardising the data structures used to describe products and their components, thus extending the functionality of product data modelling systems to a higher level of semantics, including knowledge representation and sharing. This will enable the engineering functions of the entire life-cycle of products and processes to be supported from a common platform.

Both the productivity of manufacturing and production systems and their ability to operate safely and without hazard to human life or the environment depend on the quality of their control systems. Work on **intelligent control** will concentrate on the development and integration of distributed hierarchical control systems, beginning at the level of sensors and actuators, extending through the control of the production process, and at a higher level

dealing with the flow of goods and orders through complete factories or plants and also through the entire logistics supply chain.

The rate of uptake of the technology developed in the three areas above is largely dependent on the speed with which agreement can be reached on standards for the use of emerging technologies. Measures will be taken to enable experimentation with emerging standards, and a close linkage between users and vendors will be established to accelerate this process. Measures to support the diffusion of best practice to all regions of the Community will be undertaken in order to support European enterprises collaborating and competing internationally.

ANNEX II

Indicative breakdown of the effort between areas

Software and multimedia technologies	22 %
Components and subsystems	23 %
Technologies for business processes Integration in manufacturing	20 %
Open microprocessor systems initiatives High performance computing and networking	25 %
Long term research	10 %
Total	**100 %**

RTD in the area of advanced communications

Annex I: Scientific and technical objectives and content

Introduction

EC support for research and technology development in this area started in 1988 under the 2nd Framework Programme and was reinforced in 1991 and 1993 under the 3rd Framework Programme. This industrial sector has considerably changed in recent years, and the focus of Community RTD support in the 4th Framework Programme will be different, but it is vital that the Community continues to support RTD activities in advanced communications technologies and services for three reasons.

Firstly, the harmonised development and introduction of new generations of communication systems and services is vital to the consolidation of the internal market: Research and technology development is an essential underpinning to the development of transEuropean networks and services. Secondly, the telecommunications sector is of major economic importance in its own right and as a support for all other sectors of the economy: New integrated communications services are the key to increased productivity, industrial competitiveness, economic growth and the creation of new employment; innovative use of new communications services underpins the development of more flexible working patterns and the convergence of the media, television and telecommunications sectors in provision of interactive video services. Thirdly, decisions on liberalisation of telecommunications services by 1998 will pose new challenges in technology development for both network and service inter-operation and service management in a competitive environment. Continued support for RTD at Community level is therefore an essential part of Community policies for the internal market, industrial development, new employment creation, and telecommunications itself.

The context

Advanced communications technologies and services are crucial for consolidation of the internal market, for Europe's industrial competitveness and for balanced economic development. The services are a vital link between industry, services sector and market as well as between peripheral areas and economic centres. They are also a pre-requisite for social cohesion and cultural development.

Advanced communication services will multiply the benefits of more traditional services. Some major corporations have already realised the advantages that can accrue: lower costs, improved productivity, competitive advantages and reduced environmental impact. However, in Europe, there is still a gap between the potential of technology and the reality of applications.

The activities to be pursued will not only be a basis for innovation and a key to competitiveness, but will also make a contribution to answering European society's needs. The research will concentrate on the interworking, integration and verification through trials of high-speed, photonic and mobile communication systems, and the distribution of network and service intelligence. However, the actions will also include a number of "high-risk", "high potential" concepts from which the economic and social benefits could emerge in the longer term.

The two phases of the RACE programme focused on integrated broadband networks and demonstrations of how services could exploit such networks. This research will build on the achievements, and contribute futher to the success of European actions in this area. However, in the period to 1998, a paradigm shift is needed towards a stronger focus on stimulating **innovative use.** This will require a multi-disciplinary approach, and strengthened collaboration between users of advanced communications in the public and private sectors.

Community support for technology development is still needed in selected areas where no one player can act alone, and where common European specifications and standards are neccessary. These are the areas covered in this programme.

The work will capitalize on the results achieved, and the collaboration frameworks established within the RACE programme. The emphasis on common functional specifications and standards is still vital. The actions will give greater emphasis to the interaction between technology development and regulations, in collaboration with National regulatory bodies, to support the continuing harmonisation of regulatory regimes in Europe, and to allow National authorities to manage the industrial and social impacts of new technologies and services.

Objectives

The objective will be to develop advanced communication systems and services for economic development and social cohesion in Europe, taking account of the rapid evolution in technologies, the changing regulatory situation and opportunities for development of advanced TransEuropean networks and services.

The aims will be to support European policies for early deployment and effective use of advanced communications in consolidation of the internal market, and to enable European industry to compete effectively in global markets. The work will enable the re-balancing of public and private investments in communications, transport, energy use and environment protection, as well as experimentation in advanced service provision. In conjunction with the work in the area of information technologies, it will provide a common technological basis for research and development in telematics applications and will prepare the ground for the development of a European market for information services.

The areas of work

The work will consolidate European technological leadership in digital broadband communications and enable effective network management and service deployment in a diverse and competitive communication environment. In particular, the work will stimulate and coordinate the emergence of digital multimedia services and integrated photonic systems with a view to their wide-spread introduction in Europe from 2000, including development of the technological basis for deployment of "Transparent Highways": (all-optical networks). It will ensure mobility on fixed networks and through advanced wireless, radio and satellite systems across Europe, with particular emphasis on user access in both public and private networks, and develop and demonstrate technologies for the integrity, confidentiality and availability of information in integrated systems.

In all areas, technology and service demonstrators will allow users of generic advanced communications services to evaluate the applicability of new technologies and to focus technology developments on their needs and on key areas for Europe's economic and social development. The lead given by users will also ensure that the technology development activities respond quickly to changes in economic and social conditions and to new scientific discoveries and breakthroughs.

A key role will be given to system integration, usage trials and demonstration of advanced services, and a close link will be maintained with TransEuropean Network developments. Application trials will serve to demonstrate the capabilities of advanced communications in a variety of business and public service sectors, and will allow the advantages in terms of efficiency, reliability, and environmental impact reduction to be evaluated. They will enable common interest groups to experiment with emerging technologies, to address structural and regulatory constraints to better use of advanced communications, to identify "best practise" and to evaluate the impacts of societal evolution to an "information economy", with de-centralised collaborative working and small business networking.

It is expected that the main technology development activities will fall in the following six areas:

1. Interactive digital multimedia services.

Multimedia services, including television, have a strong impact on the socio-cultural life of society. European standards and multi-lingual services are essential for social cohesion in Europe, and a strong multimedia sector will create new employment opportunities. Digital systems will allow better use to be made of existing infrastructures for TV distribution, and will enable the provision of increased image quality and definition (to HDTV and beyond). They will make it possible to increase the number of programmes, to increase the number of sound channels for multi-lingual programmes, and to create advanced interactive audio-visual services.

The objectives of the work will be to stimulate and co-ordinate the emergence of European interactive digital multimedia communication services with a view to their wide-spread introduction from 2000.

The aims will be to enable the integration of existing broadband services, including terrestrial, cable and satellite TV distribution, with the public switched digital services (ISDN and GSM) for interactive multimedia services, and to enable network development towards fully symmetrical interactive multimedia services. The work will aim to increase the efficiency of frequency spectrum use, increase the number of channels and quality of service available on all TV distribution networks, and develop technologies for flexible use of digital video communications, including ultra-high definition video, for a range of different purposes.

The work will make it possible to introduce new services: from specialist and professional telework support to public entertainment services. Enhanced interactivity is a prerequisite for "pay-per-view" TV, more selective public information dissemination, on-demand training support, electronic information services for the general public, on-line feature-film access, "video dial" (to view a recent TV programme) and viewer-profiled advertising and direct marketing. Switched video services will allow high-quality videotelephony and videoconferencing to be provided to a wide range of organisations, including small businesses and private individuals. By enabling the linking of multimedia workstations through high-speed digital networks, it will allow full motion video to be received and transmitted.

The work will involve development of digital technologies for cost-effective transmission and reception of different image resolutions for large screens and portable receivers, in a coherent digital image hierarchy. The provision of a powerful, flexible multiplex scheme will enable the different configurations of image and sound streams within one channel; it will provide means for access control at programme and channel level, and it will enable more efficient use of the frequency spectrum. Technology developments will include work on image and channel coding, service and component multiplexing, network management and access control. It will include development of systems for efficient frequency allocation; multi-media communication architectures; an interoperable set of source-coding systems for storage, transmission and display; common channel-coding and modulation techniques for digital transmission, and advanced operating systems for management of multimedia communication services. The source- and channel-coding systems will be based on a digital hierarchy offering flexibility in service provision to match the viewing situation.

The work will also involve the development of advanced image compression systems for communication on bandwidth-limited media, and image analysis, understanding and generation for advanced services such as 3D-video communication and "Virtual Presence". It will involve development of stereoscopic and 3D presentation technologies; advanced image capture, editing, storage and retrieval; and advanced interaction techniques for digital video services.

The work will make a major contribution to European common functional specifications and standards, particularly in the area of multimedia communication protocols, and image coding, and will permit the economies of scale that are needed for European industry to stay competitive in world markets.

2. Photonic technologies.

The objective will be to stimulate and co-ordinate the introduction of integrated photonic systems, including development of the technological basis for deployment of fully optical networks ("Transparent Highways") in Europe by year 2000.

The work will exploit and build on the outstanding progress that has been made in optical communications in the last decade. Technology will be developed to use optics throughout the network, for both switching and transmission, avoiding unnecessary conversion between photonics and electronics.

The work will include development of techniques for multigigabit bandwidth provision (at minimal cost, bit-rate and distance independent), optical switching technology, optical signal processing and control. Migration paths and timescales will be established for the evolution from present-day networks, based on electronic switches, to the future hybrid and all-optical networks. Radically new concepts in design, network management and control of photonic networks will be developed. The fundamental advantages in physical properties that photons possess compared to electrons will be demonstrated in realistic applications, at the laboratory level and in field trials.

New concepts in quantum optics, nonlinear dynamics, femtosecond technologies and optical processing will be exploited to achieve the next generation of technological breakthroughs and to provide terabit bandwidth capability beyond 2000. The necessary cost reductions for broadband access will be made, to take full advantage of the "Transparent Highway", particularly for customer network interfaces and interfaces between the fixed network and mobile services. The design and development of the new network infrastructure and interfaces will be closely linked with the broadband services they will support.

3. High-speed Networking

The objective is to provide integrated high-speed multi-gigabit networks by 2000 to leading-edge users in European industry, research organizations and universities, and to prepare for the Europe-wide mass deployment of these networks.

The technology and system development will support broadband services, including videophones, teleworking, multimedia and social care. It will cover customer premises networks, public networks, and corporate networks; from basic technology development through to pilot implementation of advanced services.

It will involve a phase of **user-led definition activities** to outline the network services and the network infrastructure essential to support advanced applications. The activities will include a thorough analysis of usage planning, system design, implementation, management and supervision issues. The different technology and economic options will be mapped with network topologies and architectures. This will be followed by a second phase, **developing** the missing elements and integrating them with the results of R&D in the other areas. It will cover all the networking issues required for high-speed communications (protocols, routing and congestion management). The ATM (Asynchronous Transfer Mode) technologies developed in RACE will be a starting point, but they will be extended to higher speeds and capacities.

In a third phase, **interconnection trials and demonstrations** will be supported. They will promote the use of reliable, high quality and secure broadband network services and stimulate timely and coordinated infrastructure deployment. These activities will also nurture progress towards the resolution of trans-border regulatory issues. The trials will be used to evaluate network management and operation, reliability and flexibility parameters. They will form a comprehensive test infrastructure based on the interconnection of islands and support a wide range of advanced applications and services. Throughout, the various technologies will be aligned with evolving user requirements to raise user-acceptability.

4. Mobility and personal communications networks.

The objective will be to accommodate the foreseeable demand for personal communications beyond the year 2000 and to permit the European industry to retain its leadership position in this area.

The dominant aspect of future telecommunication networks will be their capability to provide a wide range of telecommunication services to an ever increasing number of mobile users. It is expected that future requirements for personal communications will reach unprecedented levels, and the demand for a "Personal Communications space" will require radically new, expanded and spectrum-efficient networks, infrastructures and equipment.

The work will focus on operational trials and on the technological aspects of integrated fixed and mobile broadband networks that have a direct bearing on the provision of enhanced personal communication services.

The trials will validate the wireless sub-system and network components in a variety of environments (office, residential, and factory). It will demonstrate cost/effective applications and services in such environments, validate the integration of different networks and services, and prove interface effectiveness. It will also involve the development and proving of maintenance procedures, reliability testing and end-to-end quality-of-service management. The work contribute to development of common specifications and standards, as well as to the identification of new market opportunities and needs for changes in regulatory procedures and equipment specifications.

The work will specifically address the following two main areas:

For mobile broadband systems and services, technological developments will concern minaturization, component integration and packaging techniques for low-power portable transceivers, for transmission, reception, display and local processing of multimedia information. Broadband radio technologies will be developed for cost/effective transmission/reception of interactive and distributive multimedia information over wireless networks, including satellite and local area networks, with optimum use of the frequency spectrum. Advanced electrical/optical technologies will be developed to permit "radio-over-fibre" and the development of novel mobile network architectures using low power distribution points and base stations. Novel multiple-access techniques will be developed, together with associated coding and compression technologies, to meet the requirements for the reliable and secure transfer of very large volumes of information at speeds commensurate with those of fixed broadband networks. Critical technologies will be developed for integrated satellite and terrestrial networks; signalling and transmission protocols will be developed, and assessments will be made of their capacity and coverage requirements. Standardisation will be supported through development of common functional specifications for the integration/interworking of mobile broadband networks (land and satellite based) with fixed networks.

To develop the concept of a "Personal Communications Space", advanced technologies will be investigated for personal authentication, security and privacy through the use of voice recognition schemes and/or personal smart cards. Advanced broadband integrated network management techniques will be developed for location/registration management and subscriber database management. Man/machine interfaces and common operational procedures will be developed for personalized service profiles, service and network access, call connection, service control and billing.

5. Intelligence in networks and service engineering

The objective is to develop technology for flexible and real-time management of communication assets, reflecting the requirements of users, service providers and network operators for solutions which can evolve organically with user needs, market evolution and technology changes.

The specific aim of the work on *intelligence in networks* is to equip the communications networks with the build-in features required for real-time communications management, including networks, services and user access.

The R&D on service engineering will advance the concepts of modular standardisation of service components and building blocks, as a basis for cheaper, quicker and more responsive development of services. Modular standardisation is the basis for re-usability and sharing of assets. It is also the pre-requisite for future-proof investments as it de-couples the technology from the functions and its integration in the realisation of a given service or application.

This work will therefore contribute to the fast and flexible introduction of new services in advanced broadband networks, and effective network management and service deployment in a diverse and competitive communication environment. The expected impact will be to speed up new service provision by at least one order of magnitude, thereby creating early market opportunities for new services. For the user, the impact of service engineering will be the ability to have more control over the services and communication media used: to combine voice, data and video in the form needed at a given time.

The software and system development will be carried out in the context of application trials, involving end users, service providers and network operators. It will involve the development, assessment and validation of architectures, methods and tools, the integration of service components, and network and service management techniques. Self-learning and self-healing management systems for "adaptable networks" will be developed and tested.

Work on the *reduction of the service development cycle* will focus on the whole provisioning cycle, from the identification of needs to the creation and deployment of services in the network. Particular attention will be given to transparent and reliable service introduction in real operational environments. The work will involve the development and testing of new service concepts which take advantage of increased bandwidth and intelligence in networks and increased mobility of users. Application programming interfaces will be developed and their validity tested. The work will take account of the heterogeneity of networks, migration to integrated networks, user mobility, the evolution to re-usable service components, and resource-hungry services, such as Virtual Presence. Techniques will be developed for rapid service conformance testing.

Work on *service engineering* will address new needs in an environment characterised by a rapidly growing diversity. The work will involve development of common functional specifications and codes of practise for integrated service engineering. Work on service creation environments will involve development of organisational frameworks and technologies for re-use of service components. Work on user issues will involve development of technologies and systems to increase user control of services, their integration, and use of resources; ergonomic research on use of services, and techniques for adaptive user-service interaction

The work will be carried out in conjunction with that in area 6 on communications system safety, and security aspects of access to resources. Functional specifications and codes of practice arising from this work will support the standardisation process.

6. Quality, security and safety of communication services and systems

The objective is to investigate and develop technologies for economically viable and operationally satisfactory solutions to requirements for services and systems that are of high quality, secure and safe.

Quality of Service, security and safety are closely related. Easy to use, reliable and maintainable solutions must be developed, within which security is one essential component. Information services require positive attention to the protection of information assets, both directly through the technology employed (functionality) and indirectly through the quality of the system design, development and operation (assurance).

The work will concern the public unclassified domain. It will therfore be relevant to most business sectors, public administrations and the public at large. It will be concerned with traditional requirements for integrity and reliability of communications (relating to the certainty that the information is as intended) and confidentiality (or privacy), as well as other features, such as non-repudiation (whether or not the originator is whom he claims, or that the addressee cannot subsequently deny receipt) and electronic signatures. This set of features, once publically available, will allow the business community to perform most of their transactions electronically. In the area of confidentiality, it is recognised that solutions are required that are compatible with national security and the maintenance of public order.

The strong common links between Quality-of-Service, security and safety implies the development of a consistent technical approach. Trustworthiness implies both secure and safe networks and services. The work will concentrate on technology developments to improve quality of service, security and safety throughout distributed information systems, paying particular attention to cost-performance. It will explore built-in early warning and fault/risk reporting techniques, as well as flexible response mechanisms. These will be developed, where appropriate, as a means of protecting public network-based services and applications against interference and loss of availability.

For better *Quality-of-Service*, technology development is a prerequisite for improved usability and reliability in multi-media and distributive services. The R&D will address new architectures for delivery of safe and secure broadband services. For *secure communications*, R&D will address the flexible management of security in an open, world-wide network and service environment. For enhanced *safety*, technology development will be related to fail-safe mechanisms, self-healing and self-repairing networks and services.

The work will complement that in other areas of this subline and in other sublines and will include investigations, demonstrations, experiments and trials of integrated systems. The results will include Common Functional Specifications, Codes of Practice and contributions to standardisation.

Horizontal actions:

Consensus development and concertation of National and regional activities for stimulation and promotion of broadband infrastructure and service development.

These actions, which will bring together work in each on the six areas, will include concertation between RTD projects, concertation with European standardisation and strategic planning bodies[1)], co-ordination with COST and EUREKA activities, and co-ordination with actions funded under the ERDF, EIB, EIF and Cohesion funds.

Concerted actions and accompanying measures will focus on social and economic impacts of advanced communications. These actions will highlight opportunities for re-balancing of investments in both the public and private sectors between telecommunications and transport for energy saving and environmental protection. They will involve the identification and definition of advanced services for Europe-wide deployment, as well as their impact assessment. Special actions will be taken to increase the awareness of the advantages derived from the availability of new services.

Special actions in International co-operation.

Most business activities are world-wide, and telecommunications must therefore operate globally. The mergers that are going on in major industries, including telecommunications, emphasise this global dimension. Special actions to support international co-operation will focus on applications development and network management, and will be limited to areas of clear mutual and balanced interest. Particular attention will be given to synergies with the National Information Infrastructure initiative in the USA and with similar activities in Japan.

[1)] ETSI, CEN/CENELEC, EURESCOM and ETNO

These actions will also provide a framework for stronger co-operation with initiatives in eastern and central Europe, including those funded under PHARE, TACIS and EBRD initiatives. At a time when eastern and central Europe is going through a very critical reconstruction, support for advanced communication experiments based on 'appropriate' technology, linking organisations in eastern and western Europe, will help speed up transfer of know-how, stimulate idigeneous economic development and open up new opportunities for European businesses. Special measures will also be taken to facilitate the exchange of scientists and researchers between eastern and western Europe in the framework of some R&D projects and trials.

Special actions for dissemination and exploitation of results and for professional training in advanced communications technologies and service management.

These actions will include the organisation of summer schools, seminars, workshops and support for selected international conferences. Provision will also be made for professional exchanges of scientists between the Member States of the Community, for limited periods of research in the projects.

An increased effort will be made to stimulate the effective exploitation of emerging technologies and services through a programme of public demonstrations and exhibitions.

ANNEX II

Indicative breakdown of the effort between areas

AREA	% funding
1. Interactive digital multimedia systems and services (Including interactive digital video/TV systems)	22-26%
2. Photonic technologies	17-19%
3. High-speed Networking	11-13%
4. Mobility and personal communications networks	18-20%
5. Intelligence in networks and service engineering	15-17%
6. Quality, security and safety of communication services and systems	6-8%
Horizontal actions	4.5-5.5%
TOTAL	100%

This breakdown does not exclude that a project could relate to several areas.

RTD on Telematics Applications of Common Interest

Annex I
Scientific and technical objectives and content

Three main reasons justify the continuation and the strengthening of RTD activities in the area of telematics, which had been introduced in the third framework programme.

- *Employment*
  Given the extremely difficult economic and social situation of the European Community at the present time, high priority must be given to RTD activities which are the most likely to sustain current employment and to create new jobs in areas with high labour requirements. This is the case of RTD in the field of telematics applications. Indeed, such RTD aims at meeting social needs of crucial importance through the use of new telematics services allowing, for instance, easy access to continuous and distance education or training; a more efficient management of road traffic and a better utilisation of transport infrastructures; and, also, more independence for elderly or disabled persons. These are all new markets with high growth potential. It should also be noted that the risk of migration of activities away from Europe is less likely to occur as these new telematics services are, generally, by their very nature, local services.

- *Competitiveness*
  In the context of an international competitive environment characterized notably by the globalisation of productive activities and the relocation of employment, RTD in telematics applications could contribute to the strengthening of competitiveness of EC industry in many ways. Firstly, such research provides concrete prospects, in terms of both markets and employment, from the research carried out upstream on bearer-networks to that on generic equipment and services in the fields of computers and communications. In other words, RTD on telematics applications should allow a return on the RTD investment already made, or planned, in the context of research on information technologies or advanced communications. Secondly, the newly developed telematics applications will allow a better utilisation and a higher profitability of the existing and future information and communication infrastructures. Thirdly, RTD in the field of telematics applications of common interest should result in innovations which can control the operating costs of administrations and of a number of social services which are specific to the "European social model", for instance in the area of education and training and, above all, in the area of health care. Indeed, the anticipated advances in medical telematics may actually reduce the need to have recourse to hospital care, thanks to the medical care and advice which can be provided to the patients at their home.

- *The implementation of the Mid Term Review Report concerning the first phase of the programme, Telematic Systems in Areas of General Interest*
  This report, completed in Autumn 1993, recommends the continuation of RTD activities in the field of telematics applications. This would require, the report states, a 10 year time perspective as well as a very substantial increase in the budget for the programme.

I THE CONTEXT

The information and communication technologies (ICT), which are rapidly and continually developing, can be used in often complex set-ups to offer various categories of users, particularly public services and private individuals, new ranges of products and services to meet basic economic and social requirements. The term "telematic applications" is used to refer to all the systems (hardware and software) and services (distance training, teleworking, telemedicine, remote management of road or air traffic etc.) resulting from combinations of these technologies.

Research and technological development (RTD) in the field of telematic systems makes it possible to establish a link between progress in ICT and user needs. It also enables telematic systems and services to develop in parallel with technological progress, thus making them easier to use. The repercussions of research of this kind can be considerable provided that the telematic systems developed are well suited to user requirements and that account is taken of the need for European-level interworking, since the successful introduction of telematics throughout Europe could lead to an improvement in the quality of life and working conditions, better organization of work by businesses and administrations, a new impetus for growth favouring employment based on new products and services, consolidation of the internal market and the strengthening of the economic and social cohesion of the European Community.

In addition, by drawing on the results of other ICT research programmes, Community RTD on new telematic applications will also help to make the financial investment already made in programmes such as ESPRIT or RACE bear profit.

The research and technological development in the field of telematic systems in areas of common interest will have two aims. One will be to promote the competitiveness of European industry, which is nothing new. The other, which is a new feature contained in the Treaty on European Union, is to promote research activities necessary for other common policies. In view of the nature of the programme, which must be geared towards users, this new aim will be given priority.

RTD will be based on the experience gained under the Third Framework Programme, but the stress will be shifted from data telematics to the new "multimedia telematics", which includes all distributed and interactive multimedia applications. In addition, more importance will be attached to user requirements and the search for the most efficient and economical solutions possible. These three new guidelines will not only apply to the subline as a whole but also to each of the projects it will run.

Project guidelines

Each project will be implemented in five phases, with close involvement of users at every stage.

First, priority will be given to identifying specific user needs, either latent or expressed. The users comprise a very wide range of bodies, such as administrations or businesses which need to make use of telecommuting, and several categories of individuals, such as researchers, librarians, members of the medical profession, air-traffic controllers or handicapped persons, who need to use networked multimedia workstations.

Secondly, translating these needs into telematic terms will lead to the definition of a set of functional specifications which will have to take account of the common requirements of all the users. These specifications will also have to ensure that the telematic equipment and services can interwork at European level.

Thirdly, the specifications will be used as a basis for precompetitive, prenormative and prelegislative demonstration systems following RTD work on integrating four elements, the first three of which are general, while the fourth is specific to the project. The generic elements are networks (e.g., high-throughput optical fibre or satellite communications networks), hardware (multimedia workstations, portable data storage and processing equipment etc.), services (e.g. multimedia electronic mail, remote access to data or knowledge, possibilities for interactive simulation and virtual environments). The specific elements will be hardware and software specially researched for the project in question so that the entire system corresponds well to user requirements. However, in order to ensure the economic efficiency of the application developed, maximum use must be made of the generic elements resulting from other research programmes - particularly RACE and ESPRIT. In this way, there will be close interaction between all the research areas covered by the first line of the fourth framework programme and close links will be established with the operators of public and private communication networks, bodies providing services and the electronics and computer industries.

Fourthly, the demonstration systems developed in this way will be validated by representative user groups, with even closer involvement of the competent public and private institutions than in the past, with a view to facilitating the subsequent dissemination of these new telematic applications. These validation tests will very often result in backtracking both in order to review the functional specifications adopted previously and do further RTD on the specific components, or to make use of the other ICT research programmes further upstream.

Finally, after this backtracking, the applications which are finally validated will be accompanied by a plan for the exploitation of the results obtained, recommendations to the standard institutes and legislators, and a guide to the successful implementation of these new telematic applications.

General guidelines

The research will strive to take better account of user requirements and to achieve greater economic efficiency. This will particularly involve avoiding expensive duplication of effort between projects and ensuring that similar applications from different RTD fields use a maximum of common elements. These aspects of overall consistency and economic efficiency are the whole point of a multisectoral telematics research programme.

The third framework programme was mainly based on an empirical approach. In all the sectors covered, frequent meetings between people working on different projects stimulated exchange of information, thus avoiding unnecessary duplication of effort in the development of demonstration projects. In addition, the exchange of experience between projects at the validation stage with representative user groups facilitated the development of practical recommendations for bodies needing to introduce these new telematic applications.

This pragmatic approach will be continued. It will be improved by organizing interdisciplinary or "horizontal" consultation meetings between people working on projects in a variety of sectors but dealing with similar subjects, such as the development of teleworking (for researchers, doctors or officials in either a rural or urban context), man-machine interfaces and ergonomic aspects, or the improvement of trans-European telematic networks and services (used by researchers, administrations, organ banks or air traffic controllers etc.).

Finally, this empirical approach will be backed up by telematics engineering research as part of the horizontal RTD work under the programme.

By promoting the development of telematic systems and services which are both well suited to user needs and technically and economically efficient, the research will help strengthen the competitiveness of the European economy and promote the investment necessary to provide Europe with an effective information and communication infrastructure - or "infostructure" - and help ensure that this investment bears fruit.

Three main fields will be covered:

- **infostructure for services of public interest**, with telematics for transport, health care and administrations;
- **knowledge infostructure** for researchers, education and distance training, and libraries;
- **infostructure for improving the quality of life**, with telematics for elderly and disabled persons, urban and rural areas, and environmental protection.

A fourth field will consist of horizontal RTD activities. Finally, there will be accompanying measures concerning international cooperation, the dissemination of results and the training of researchers and users.

II THE AREAS OF WORK

1. INFOSTRUCTURE FOR SERVICES OF PUBLIC INTEREST

The European infostructure should also contribute to the smooth running of the internal market and make it possible to meet the new obligations resulting from the Treaty on European Union. This will require new telematic services. Research will concentrate on three fields of vital political, economic and social importance, i.e. the administrations, health care and transport. It will be based on previous Community activities in these fields.

Administrations

Systems for processing information and exchanging it between administrations will be implemented under the TNA/IDA programme (Telematics Network for Administration/Interchange of Data between Administrations). A set of guidelines have been drawn up for telematics networks for administrations (TNA) and they will be used as a basis for feasibility studies and pilot projects as part of the multiannual Community action project known as IDA. Consequently, research, development and demonstration activities need to be carried out in support of the TNA/IDA programme so as to ensure that technological advances in the area of multimedia telematics will become available for the administrations.

Aim

The aim is to permit the implementation by administrations of relevant results of telematics research as they become available in order to bring about a swift and economical improvement in the efficiency of the public services at European level. In this way the administrations will be able to introduce new telematic systems and services while rationalizing existing infrastructures and capitalizing on investments already made with a view to improving the public service. These RTD actions will also make it possible for open standards, which can be used in specifications for public contracts in connection with telematic applications, to be defined and promoted.

Nature of the work

Two aspects will be covered. The first will involve the development of telematic applications facilitating the exchange of information between administrations. This work will make the new technologies available for use in the administrative areas which have become vital for the operation of the single market and the implementation of the Treaty on European Union. It will concern subjects such as image transfer (e.g. in order to update the hydrographical or geographical maps required for the remote management of sea or road traffic), or the use of multimedia and video conferencing systems between administrations (e.g., to permit teleworking between national and Community administrations and thus avoid translation and interpretation resources becoming overconcentrated on Brussels).

Great importance will also be attached to the methodology for implementing telematic applications. In order to ensure a maximum of efficiency and security in the links between administrations, research will also cover questions of security of public telematic networks - notably as to financial, economic and social statistics -, the effects of language differences, the use of electronic signatures and the legal implications of data transfer between countries. The work must also involve the development of appropriate tools and methods for analysing the quality and performance of the services offered to administrations.

Validation tests and pilot projects

In order to help administrations introduce new telematic systems rapidly and, where appropriate, adapt their internal structures accordingly, the validation tests will comprise projects involving the migration of existing telematic applications to advanced telematic services, which will be made available to the administrations as the need arises. Businesses in the computer and telecommunications sector and the administrations concerned will be closely and actively involved in this work. By making a direct contribution to the validation of the arrangements provided for in the programme, they will clear the way for swift dissemination of the results obtained in their own circles and consequently the application by these administrations of technological progress.

Health care

There are two challenges facing the public health systems in Europe. On the one hand, operating costs need to be reduced while at the same time all citizens must be offered equal and guaranteed health care at any place and at any time. On the other hand, the medical professions need to take account of the explosion in knowledge and the increasing complexity of their tasks. Work under the Third Framework Programme has shown that telematics could help them meet these challenges.

Aim

The aim of this action is to continue this research, enabling the entire health sector to benefit from access to telematic services at European level. Particular attention will be paid to the relevance, quality, confidentiality and security of medical data.. There will be close coordination with the Biomed RTD programme and Community activities on public health, particularly the "Europe against Cancer" programme.

Nature of the work

Four fields will be covered. The first area concerns the entire set of medical records, particularly the "image" component, its computerization and transmission, in a structured and standardized form, between the various health-care institutions and centres concerned (hospitals, specialists, general practitioners, medical analysis laboratories, social security departments etc.). In this way, the work will contribute to the establishment of a uniform and reliable health system for the entire population at local, national or European level.

Secondly, work will concern increasing the diagnostic and therapeutic capacities of the medical professions and improving health-service management through the development of telematic applications enabling the members of the medical profession to communicate and exchange information concerning a patient or to consult a colleague. The RTD work will be aimed on the one hand at automating certain diagnostic procedures, the results of which can be directly communicated, with comments, via the telematic networks and, on the other hand, at integrating the hospitals' information systems, diagnostic equipment, expert systems and specialized systems for transmission of medical images. The equipment will be interoperable, compatible and modular, and the emphasis will be placed on an open systems architecture, transferability of data and harmonized methods of connection to the telematic networks. The rapid progress made in interactive simulation and virtual environments will also be used in order to develop "virtual organs" for training surgeons or preparing for operations.

In particular, the development of a prototype virtual brain could make a significant contribution to the "decade of the brain".

Research will also concentrate on remote assistance for surgeons by means of virtual environment technology ("telepresence"). Finally, telematics will also be developed to facilitate the management of medical resources, quality control for health care, processing and communication of epidemiological data and the implementation of surveillance and alert programmes.

Thirdly, the RTD work will concentrate on telemedecine with a view to providing isolated patients with an adequate level of care and to permit teleconsultation between doctors at different locations on difficult cases. New telematic services, based on interactive multimedia communication, will make the diagnostic and therapeutic competency of appropriate centres available to patients in peripheral areas or at sea. This will require the development of telematic applications guaranteeing total security in the exchange of biological signals and animated images via broad-band land networks or satellites. It should also be possible to carry out remote diagnosis e.g. the interpretation of medical examinations, or to provide remote supervision of treatment, such as renal dialysis, while maintaining total security. These telematic applications will also be extended and adapted for monitoring patients at home or the victims of serious accidents in situ.

Finally, telematic applications will be developed, on the basis of Community activities concerning the prevention of diseases, in order to provide health workers and citizens with appropriate information concerning tried and tested rules for the prevention and identification of major serious diseases.

Validation tests and pilot projects

The validation tests will be conducted in close cooperation with the entire health-care sector. Particular emphasis will be placed on the integration of local health-care operatives into the regional, national and trans-European telematic systems. This networking will primarily involve the interconnection of European centres of reference and excellence.

Transport

The Third Framework Programme showed that telematic systems could help reduce road congestion, improve road safety, reduce pollution and protect the environment - in other words they could contribute towards achieving the general objectives of the common transport policy.

Aims

Research on telematics in road transport would therefore be continued and intensified, and Community RTD would be extended to other modes of transport in order to make a greater contribution to the achievement of the aims of the common transport policy while strengthening the competitiveness of European industry. A close coordination will be established with those research activities related to transport, and especially to a European transport policy, which are carried out in the other programmes.

Nature of the work

The RTD work will cover the entire telematics set-up in the transport sector in order to ensure that all the elements are compatible and to establish compatible specifications and interfaces permitting the interconnection of networks and the interworking of equipment and services. The main emphasis will be in two areas, i.e. the use of common telematic tools for various modes of transport, thus permitting a more integrated picture to be obtained of the transport system as a whole, and the development of new telematic approaches likely to lead to significant progress as regards transport capacity and safety. Transitional strategies will also be devised for the implementation of different generations of telematic systems.

As far as *road transport* is concerned, research on powerful and efficient telematic systems for the monitoring and management of urban and interurban road traffic will continue. Other research will concern the coordinated use of "smart vehicles" with advanced communication systems, systems for improving vision, tools for monitoring the behaviour of the vehicle, driveralert systems and collision-prevention systems. All these elements taken as a whole should provide a telematic solution for "automatic" motorway driving which will particularly benefit commercial vehicles. Some of these elements may be adapted for urban traffic. These research activities will continue to be closely coordinated with EUREKA and the research programmes of the national transport ministries.

As regards *air traffic*, the emphasis will be on the development of telematic applications with a view to establishing a standardized air traffic control system for Europe. Firstly, telematic applications using satellites and advanced communications networks will be developed in order to improve the localization, monitoring and navigation of aircraft and for perfecting inflight or ground anti-collision systems and aids for all-weather landing. Secondly, work will make a contribution to the modernization of existing air traffic control systems by developing the trans-European telematic aeronautics network and easing the task of air traffic controllers and pilots by means of multimedia telematic tools incorporating aids to decision making. Recent progress on virtual environments will also be exploited. All these activities will be coordinated with existing work by the European institutions such as Eurocontrol or the ESA and the national civil aviation organizations.

With a view to extending the use of telematic tools common to the various modes of transport and reducing costs, research will also concern *sea transport, inland waterways and railways*. In particular, where the latter is concerned, work will cover, on the one hand, a new generation of control and communication systems with a view to increasing capacity and, on the other hand, the access of passengers to multimedia services.

As regards *combined transport*, new integrated real-time information systems will be developed and connected to the European infostructure in order to improve understanding of the transport systems as a whole and facilitate the choice of the best possible combination of modes of transport. This work will concern not only goods transport, but also passenger transport, where the emphasis will be placed on public transport systems. Telematic applications will also be developed to optimize the use and management of combined freight transport, which will also require research into means of direct communication with customs and health authorities and other administrative bodies.

Finally, particular attention will be paid to controlling the impact of transport on the environment. This will involve the development of telematic applications permitting the monitoring of pollution produced by vehicles and keeping track of movements of dangerous substances. These telematic networks will also be connected to alert systems.

Validation tests and pilot projects

These actions will be conducted with the active participation from the local or national transport authorities and in close coordination with the validation activities developed in the context of other research activities on transport pertaining to RTD programmes on environment and on the European transport policy. They will make it possible to check the technical performance, operation and acceptability of the telematic systems introduced for optimizing air traffic control, integrated management of urban and motorway traffic, "automatic" motorway driving, automatic control of railways and management of maritime and combined transport.

2. KNOWLEDGE INFOSTRUCTURE

In order to ease the changeover towards the new information society, Europe needs to develop an infostructure permitting remote access to and the sharing and continual updating of knowledge. Research centres, universities, company training departments and libraries represent the main categories which both produce and use knowledge. The telematics applications component in this infostructure must closely correspond to their requirements and this is the aim of the research to be conducted in the three fields described below. These activities will be based on previous Community action on these subjects under the Third Framework Programme.

Telematics for research

Research workers in Europe increasingly need efficient channels for exchanging information. They also need remote access to experimental installations, scientific databanks or high-performance computers in various parts of the European Community.

Aim

The aim is to develop advanced telematic applications to enable European researchers to work together regardless of where they are in the Community and to facilitate user access to research results. National or specialized networks admittedly already exist, but we must now enable them to take advantage of the progress which has been achieved in high-performance networks and, in particular, to interlink them by means of a very-highthroughput European backbone, which has become vital if Community research is to maintain its position in the world, and this will also have a decisive effect on the future of European industry.

Nature of the work

Two aspects will be covered. First, solutions must be found to the problems arising from the use of large computer networks which have to operate in an open environment, with a range of different systems and high-throughput communication services. The questions to be dealt with will particularly concern the interworking of these systems, the quality of services available on the networks, and their reliability, availability and security. The research will cover the architecture and protocols for computer networks and the management, monitoring and protection of these networks. Particular attention will be given to improving the European backbone, which already interlinks a large number of national research networks and has since 1993 permitted trans-European exchange of data at a rate of two megabits per second. Over the period 1994 to 1998, it should be possible to increase this rate to 34 and subsequently 155 mega bits.

Secondly, the work will concern the advanced distributed services supporting cooperative research and facilitating user access to results. It will particularly involve developing telematic tools which permit access to knowledge on the large scientific computer networks of the future and remote cooperation, particularly through remote monitoring of experiments, teleworking or videoconferencing in scientific circles.

Work will also need to be done on the procedures for selecting, searching and presenting scientific information or results of research in progress in order to make them easily accessible to users wishing to exploit them, while taking account of the question of intellectual property rights. Obviously, this European research infostructure will be one of the most important ways of coordinating national RTD efforts in the Community.

Validation tests and pilot projects

With its 700 000 scientists and engineers, a large proportion of whom work in the physical and natural sciences, the research community is an ideal population of leading users for validating advanced telematic applications which they will be the first to use, some years ahead of the rest of the potential users. These validation tests will use the experimental national broad-band networks and the European backbone developed under this programme. They will be of particular benefit to the user community involved in the first action under the Fourth Framework Programme (RTD on industrial technologies, the environment, life sciences and technologies, energy, and information and communication technologies). These activities will be carried out in close coordination with initiatives in other parts of the world, particularly central and eastern Europe, so as to strengthen the links between scientists in the Community and in the rest of the world.

Education and training

In a world undergoing major changes, the education and training systems must also be drastically reformed in order to make a substantial contribution to the competitiveness of the European economy. All businesses, particularly the SMEs, will in future have to keep training their staff in order to keep abreast of developments. At the same time, an increasing number of students and employees - particularly of the younger, computer-literate generations - are calling for new types of initial and continuing training which are able to meet the needs and limitations of each of them, and which correspond to developments in knowledge and know-how. The work carried out under the Third Framework Programme has shown that telematics can greatly help the universities and training departments of businesses in taking up the challenges facing them.

Aim

The aim of this action is to extend this research, making use of the continuous progress in multimedia communication via broad-band networks or satellites, and advances in interactive simulation or virtual environments, in order to make the services on offer more interactive, to facilitate remote access to multimedia documents and services, and to personalize education and training programmes. There will be close coordination with the new line "finalized socio-economic research" and the fourth action in the framework programme on the training of researchers, as well as with the other Community activities in connection with education and training.

Nature of the work

Three fields will be covered. Firstly, following up the work under the Third Framework Programme, work will continue on developing telematic services using the most appropriation combination of existing communication networks (satellites, ISDN, interactive cable networks) following an in-depth technical and economic study of each type of service. These decentralized training networks will also be connected to the European library network in order to provide people receiving training with the possibility of accessing a larger knowledge base.

Secondly, a new generation of telematic applications will be developed to permit distance teaching and group training by means of videoconferencing, computer-assisted conference networks and multimedia electronic message systems. These applications will be particularly based on telewriting, group work via networks, and access to distributed course banks, multimedia libraries and "virtual laboratories", which permit experiments to be carried out remotely.

All this will entail supplementary research on multimedia application using broad-band experimental networks and digital satellite networks.

Thirdly, work will concern the personalization of training and new types of learning. In particular, training systems will need to be integrated into individual workstations - either stand-alone or networked - for in situ vocational training. Methods for designing personalized interactive teaching programmes will also be investigated, particularly those used for producing electronic books allowing the student or the person undergoing training a high degree of interactivity and enabling him to follow personalized courses. Particular attention will also be given to finding personalized telematic methods for the training of researchers in Europe and great importance will be attached to language teaching, which is of vital importance for Europe, by using voice-recognition techniques and voice mail, for example.

Finally, research will also concern the new forms of education and training made possible by virtual-environment techniques, with the possibility of exploring "micro-worlds" for educational purposes.

Validation tests and pilot projects

The applications developed will be evaluated in a real-life situation, with particular attention being given to the technical feasibility and implementation process, with special emphasis on user reactions, ergonomic aspects, pedagogical efficiency and the impact of telematics on the organization of education or training. These validation tests will be based on university or professional training networks aimed at individuals with a high a degree of specialization - particularly researchers and engineers receiving individual or group training, and other categories of potential users affected by this telematics research, such as librarians, doctors or officials. Particular attention will be paid to the validation of telematic applications geared to the needs of SMEs. The competent local or national authorities will be closely involved in those activities. These validation tests will also permit the networking of training institutes so that they can share their resources. These various experiments will also provide the basis for a European source of distance teaching and training services.

Libraries

The libraries of Europe represent an enormously rich resource which is still underexploited, although the future of our modern societies and economies depends more and more on knowledge and information. The European Community is at a disadvantage in this respect, largely because most libraries do not yet make full use of the opportunities offered by the new information and communication technologies and are not linked up with telematic networks. Admittedly, more and more of them are now equipping themselves with advanced technology for the internal management and exploitation of their documentary and bibliographical resources, but it is not yet possible to access these resources easily or to use the catalogues of more than one library at a time. Only a small core of libraries so far have solid experience in the field of developing and using telematic applications, which means that users are unable to use telematic networks for easy access to vital sources, whereas the libraries should be the hub of the European infostructure.

Aim

The aim of this action is to contribute towards the establishment of a "European library area" preparing the ground for making library resources more accessible and permitting their interconnection with the European infostructure.

To this end, the work will concern interconnection at Community level of libraries able to act as network nodes at national level, promoting the introduction of telematic applications in the less-advanced libraries and supporting the efforts to train library staff and make them more aware of the possibilities by exchange of good practice and experience.

Nature of the work

The RTD work will be based on the results of the exploratory work carried out under the Third Framework Programme, which enabled suitable forms of computerization for libraries to be defined and an initial set of specifications for their interconnection to be drawn up. Two fields will be covered.

The first concerns the development of advanced telematic systems facilitating access to library resources. This work will particularly involve perfecting the methods for establishing and exchanging automated bibliographies and making catalogues and other resources accessible on-line via public networks. Subsequent work will involve developing systems for electronic input, storage and consultation suitable for documents in an extremely wide range of formats. Finally, electronic archiving techniques must be developed permitting the conservation and consultation of rare or fragile works.

Secondly, the RTD will concern the interconnection of libraries, both with other libraries and with the European infostructure. The main aim of this work will be to ensure interworking of applications designed for different types of systems. They will also concern establishing "virtual libraries" permitting users to access a set of networked libraries from a single point in the Community. Finally, the work will aim to develop electronic links between libraries permitting the prompt delivery of the documents from different sources (databases, libraries, booksellers, publishing houses etc.).

Validation tests and pilot projects

The validation of this work will involve very advanced user categories such as researchers, who need to be able to access large European scientific libraries in this way. It will also involve companies in the computer and telecommunication sectors, libraries, publishers, booksellers and users of results of scientific or technological research. These validation tests will be accompanied by measures aimed to ensure the widest possible dissemination of the results and to support the efforts necessary for making library staff aware of the possibilities afforded by telematic systems and training them in their use.

3. INFOSTRUCTURE FOR IMPROVING THE QUALITY OF LIFE

Telematic services should also make it possible to improve the quality of life by raising the degree of autonomy of the less-favoured social groups, such as old people and the handicapped, promoting better use of land and permitting more effective protection of the environment.

Elderly and disabled people

The exploratory project known as "TIDE" (Technology for the Socio-economic Integration of Disabled and Elderly People) has shown that information and communication technologies could provide appropriate responses to the specific needs of these categories of people.

Aim

The aim of this RTD activity is to use information and communication technology in order to improve the autonomy and quality of life of disabled and elderly people and facilitate their social integration. Particular attention will be paid to the identification to the needs of these categories and the validation by users of the applications developed.
Finally, close coordination will be established with other Community research programmes in this field such as Biomed or Brite-Euram, which also aim at using generic technologies, such as the biotechnologies or new material technologies, for the benefit of disabled and elderly persons. There will also be a close link with the HELIOS programme.

Nature of the work

The research work will concern two main topics: access to telematic services and compensation for functional deficiency. In the first case, it must be made possible for disabled and elderly people, particularly those with cognitive and sensory handicaps, to play a full part in economic and social life. The work will concern developing equipment - particularly audio-visual aids - and interfaces which will permit these categories of people to use multimedia telematic systems and services to facilitate their access to teleworking, information and distance training, or to cultural programmes. The work will also involve the development of "intelligent systems for managing the working or private environments of these categories, such as remote control, alarm systems or systems for guidance outside the home. Finally, appropriate systems will be developed for training these categories of people in the use of the aids developed.

As regards compensation for functional deficiencies, the work will involve developing applications using information and communication technologies with a view to restoring all or part of the functional capacities of disabled and elderly people. Particular emphasis will be placed on systems for improving mobility, interpersonal communication and the ability to cope with the immediate environment. This work will also be based on recent progress in virtual environments and remote control by robots ("telepresence").

Validation tests and pilot projects

There will be a demonstration, in a real-life situation, of the technical feasibility and functional appropriateness of the systems and services developed under this action. The rehabilitation technology networks will be involved in the validation of the results.

Urban and rural areas

The exploratory project known as "ORA" (Opportunities for Rural Areas) have shown that the rural areas which no longer have an economic, social and cultural infrastructure which is attractive to the business world and the general public could make up for this to some extent by means of telematic systems and services which would enable them to obtain remote access to such amenities. In addition, several urban areas in economic decline or the less-favoured areas of large cities are at present suffering from comparable handicaps and could consequently also benefit from telematic solutions.

Aim

The aim of this action is to permit the decentralization of economic activities and public services in the interests of rural and urban areas without appropriate socio-economic infrastructures by means of telematic solutions permitting teleworking and remote access to basic services for businesses and private individuals. This would result in a reduction in unwanted migration of populations and the quality of life and job opportunities for the populations concerned should improve.
This action will be closely coordinated with other Community activities and programmes on structural policy.

Nature of the work

The RTD work will concern the development and adaptation of telematic applications for two major purposes. The first is teleworking, the main advantage of which is that it facilitates access to the employment market for a workforce which is spread over a wide geographical area. Work will concentrate on the use of generic technologies such as multimedia workstations, videoconferencing, ISDN - which permits transfer of large files or still images - or the future broad-band network. These technologies particularly facilitate working in a network in various professional situations and increasing productivity of local units, particularly the SMEs, whose economic efficiency is a determining factor for employment.

The second area of activity is public teleservices. The emerging technologies such as mobile digital telephones, interactive compact disks, very small aperture terminals (VSAT) and interactive television will be combined to produce information-server networks. Private individuals, businesses and local authorities will be able to use these networks to consult databases and libraries, to obtain information verbally and to access new telematic services offered by various municipalities in the field of culture, social action or tourism. The work will also involve the development of systems using wireless communication (radio and satellite) in order to enable areas with land telecommunication infrastructure deficiencies to benefit from telematic services such as distance training and education or telemedicine. The possibilities for interconnecting these local networks with the national networks and the European infostructure will also be studied.

Validation tests and pilot projects

The principal areas for the validation tests will be in the networks of partners already set up under the ORA project and other existing networks for cooperation between European cities (Eurocities, Polis etc). They will be coordinated with the pilot projects implemented under the land-use plans of certain Member States or Community regional programmes. Particular emphasis will be placed on ease of use and user acceptability of telematic applications.

Exploratory action: telematics for the environment

Exploratory actions to assess the potential for telematic solutions in other areas will also be conducted, the environment being the priority.

Aim

The aim of this action is to investigate the appropriateness of telematic solutions for protecting and improving the environment, in close association with the corresponding Community policy.

Nature of the work

The research work in this field will concentrate mainly on telematic systems for monitoring levels of pollution in the atmosphere, rivers or the sea, and on automatic alert systems. Applications will also be developed to keep track of dangerous products in transit, monitor nuclear power stations and manage natural risks. Research will also concern the development and interconnection of information networks and centres for the prevention of these risks. The centres will have remote access to automatically updated databases and expert systems for aid in decision making. The extension of these networks to cover central and eastern Europe will also be examined.

Validation tests and pilot projects

The validation tests will be conducted in the most exposed urban areas, industrial and port areas, coastal areas and river basins which are most exposed, in close collaboration with the competent local or national authorities.

4. HORIZONTAL RTD ACTIVITIES

The success of telematic applications with users depends on several across-the-board factors. These particularly include the language aspect and ease of use. The dissemination throughout Europe of telematic services will be hampered if users are not able to use them in their own language. The vast documentary resources available in the databases will be underexploited if the consultation methods are not simplified. The integration of language-processing tools and technology facilitating access to databases are therefore priority issues for telematic systems.

In addition, such a recent development as telematics requires the production of appropriate tools and methods to make the new systems and services easily absorbed by users and developed as efficiently as possible.

These questions cannot be tackled efficiently under any one of the separate fields covered by the programme. For this reason, they are the subject of horizontal lines of action, the results of which will benefit all the fields across the board.

Telematics engineering

Aim

The studies and research under this heading have two ends in view. First of all, work will involve devising tools and methods enabling telematic applications to be developed as efficiently as possible through optimum integration of generic equipment, networks and services with specific equipment or software (applications engineering). The next task will be to identify and analyse changes to be made to the user environment so that a new telematic application can be successfully introduced (process engineering).

Nature of the work

The process engineering work will involve an evaluation of the socio-economic impact of old or new telematic applications, such as teleworking, telemedicine or distance training. In particular, comparative studies will take stock of the efficiency of administrative procedures, management practice and work organization in various types of body, public or private, before and after the implementation of telematic systems with a view to deriving practical recommendations which are as general as possible. It should thus be possible to identify general methods which will permit a restructuring of organizations under the optimum conditions as regards economic efficiency and social acceptability and an analysis of the advantages and savings resulting from the new telematic systems. Particular attention will be paid to ergonomic aspects so that the systems can contribute to the improvement of working conditions.

The RTD work on application engineering will concentrate on ways of integrating generic and specific elements, either hardware or software, so that the telematic applications developed in the various fields covered by the subline may have fundamental characteristics such as adequate functions and reliability, greater flexibility of use, exploitation and management, and the possibility of incorporating subsequent technological progress. Special attention will be given to the search for modular and generic solutions. This work will be based on the results of programmes such as ESPRIT, RACE or similar initiatives.

Language engineering

Language is a vehicle for scientific and technical knowledge, the basis of our culture and an essential tool for communication in administration and commerce. Telematic systems use a simplified language which is often far removed from the language normally spoken by the users. The integration of language engineering techniques into telematic systems is becoming vital for making them user-friendly. In addition, the modern tools for processing spoken and written language may help overcome the language barriers hampering the use of telematic systems at European level. This action will extend the field of research covered by the Third Framework Programme.

Aim

The aim is to facilitate the utilization of telematic applications in Europe and to simplify the possibilities for communication in a wide range of languages by integrating new language-processing methods.

To this end, the research and development work will concern three broad categories of telematic applications, i.e. documentary information services, including systems for the processing and management of documents, transactional teleservices (such as telebanks or electronic directories) and electronic mail and teleconferencing services.

Nature of the work

The RTD work will fall into three sections.

Firstly, the results of previous research will be used to develop systems facilitating the integration of language technologies into fields where language processing is important.

The work will first concern the development of language tools to improve the creation and management of electronic documents in a variety of languages. These will particularly comprise advanced multilingual aids for editors, improved techniques for indexing and searching free-style documents, and automatic methods for extracting and combining information from different documentary archives and databases. The work will then concern natural-language interfaces which will make it possible to adapt the transaction services aimed at business, the professions and the general public to fit in with the requirements of users in different Member States. In addition, with a view to improving the linguistic quality of teleconferences and electronic mail, techniques will be developed for converting the spoken word into the written word, automatic routing of messages and real-time access to machine translation during teleconferences.

The work will also concern improving tools, methods and systems for machine and computer-assisted translation with a view to integrating them into the final user's working environment.

Finally, methods and tools will be developed to facilitate language learning.

Secondly, the work will involve developing and harmonizing language resources such as electronic grammars or dictionaries with a view to facilitating the portability of these resources from one computer system or another so that more use can be made of them.

Finally, the research will concern general linguistic topics which might generate applications in the medium and long term. Work of this kind is necessary if progress is to be made in mastering linguistic complexities and improving the methods for language analysis by computer. Three sectors will be accorded particular priority: the representation of concepts in different languages with a view to facilitating computer analysis of texts and man-machine dialogue, the use of progress in computer technology for the processing of natural language and the most advanced methods applicable to the processing of the written or spoken language, such as processing of free texts, advanced speech recognition systems and simultaneous machine interpretation.

Validation tests and pilot projects

Pilot projects, particularly covering telematic application developed under other parts of the programme, will be launched in order to verify the technical feasibility, operation and applicability of the language solutions developed. In addition, comparative test methods and objective evaluation criteria will be produced for the language tools. Finally, quality control processes will be developed for language systems and services and recommendations addressed to the standards bodies.

Information engineering

The volume of information stored in electronic form and disseminated via telematic systems is increasing substantially. Access to these resources is still difficult, however, because of the number, geographical spread and heterogeneity of servers and databases, which means that telematic systems are underused and there is less selectivity for different categories of information users. In order to rectify this situation, the framework programme should include a new line of action on information engineering.

Aim

The aim of the action is to permit easier and more selective access and more user-friendly use of electronic information in all its forms, by means of methods and systems using information and communication technologies.

Nature of the work

The RTD work will deal with every link in the value-added electronic information chain.

As regards electronic publishing, the research will deal with systems permitting the creation of "information products" (e.g. databases and electronic manuscripts), usable on any type of equipment, with any kind of software and for any types of publication so that the requirements of the different categories of users can be met without difficulty. To this end, advanced tools will be developed to enable authors and publishers to describe the structure and format of the information in a generic fashion regardless of the technology base used. It must be possible to integrate these systems smoothly into an existing "information-producer" environment.

As regards the dissemination of digital information, new database architectures will be developed so that the user can find the information required without having to know anything about the structure or the contents of the databases in question. Research will particularly concern the design of very large databases containing different forms of digital information (text, images, sound). Another aim will be to increase the modularity of the information blocks in long texts using the most up-to-date database methodologies, such as object-related structures or distributed architectures.

Advanced digital information search techniques will be developed in order to improve user access to an increasing number and range of sources at an increasing number of locations. These methods will help the user to find the sources of information required by means of on line aids and intelligent gateways, to make the same search in a number of databases while avoiding redundancy, to review the contents of a database by association of ideas, to extract information and to download it straightforwardly into his own applications.

Validation tests and pilot projects

Validation will take account, by means of pilot applications, of the requirements of all the parties concerned in the information-production chain, from beginners in the use of computerized information to highly experienced users. It will include the development of quality control and system performance measurement and lead to the promotion of standards for information exchange formats.

ACCOMPANYING MEASURES

The activities under this subline will also involve accompanying measures in the fields of dissemination of results, international cooperation and research training to supplement the centralized action provided for in the other three sections of the Fourth Framework Programme.

Dissemination of results and promotion of telematics

In order to promote the dissemination of results, the organization in the Member States of workshops, seminars, conferences and exhibitions will be supported with the aid of the Community network of relay centres for the exploitation and dissemination of research. The research teams working on the various projects will be invited to give an idea, right at the outset of their work, of how they might take part in activities for the dissemination and utilization of the results of their research throughout the Community.

International cooperation

International activities (conferences, study visits, demonstration of marketable results) will be undertaken in most of the research areas whenever mutual and equitable interest for the European Community has been clearly identified. Great importance will be attached to cooperation with the countries of central and eastern Europe. Exchanges of research workers might be possible in connection with certain projects and links will be established with telematic activities under the PHARE and TACIS programmes or BERD. Finally, there will be close coordination between this Community research and similar national or European RTD programmes (COST, EUREKA, ESA, EUROCONTROL).

Training

Exchanges of researchers working on telematic applications and the networking of existing research centres will be encouraged. Finally, Community aid may be provided for exchanges of experience concerning training in the use of telematics.

Annex II
Indicative distribution of the RTD effort among the various domains

Area	Percentage
Infostructure for services of public interest	40%-52%
Administrations Health care Transport	
Knowledge infostructure	16%-22%
Telematics for research Education and training Libraries	
Infostructure for improving the quality of life	13%-19%
Elderly and disabled people Urban and rural areas Exploratory action (environment)	
Horizontal RTD activities	16%-22%
Telematics engineering Language engineering Information engineering	
TOTAL	**100 %**

This breakdown does not exclude that a project could relate to several areas.

INDUSTRIAL TECHNOLOGIES

(1994-1998)

ANNEX I : AIMS AND SCIENTIFIC AND TECHNOLOGICAL CONTENT

RATIONALE

The globalization of markets, the increased international competition with newly emerging industrial poles, the increased cost for developping new technologies and the reduction of product life time are forcing European industries to revise their cooperation strategies in order to master a large spectrum of technologies and to ensure the cost effectiveness of RTD efforts. This being the case Community programmes may act as a catalyst in spurring medium to long-term R&D and in supporting national activities and industrial efforts.

As indicated in the Commission documents on industrial policy, the boosting of industrial competitiveness is also one of the most effective means of maintaining and even increasing employment, this being one of the most urgent problems to be overcome if jobs are to be guaranteed for the coming generation. Technological research may be a major factor in stimulating innovation of products, processes and organisation of enterprises, and underpinning and prompting new industrial activities which will ease the transition from traditional sectors to new, emerging sectors, for which European export capacity is currently still limited.

The RTD Community activity is particularly well placed to provide assistance where the best means of conducting research is to do so on the basis of multidisciplinary, cross-frontier cooperation, aimed at generic technologies with potential for a quick diffusion towards Members States and industrial sectors. In order to boost the effectiveness and impact of Community action a concentration of efforts is made on :

a) Objectives : The programme, which is multi-sectoral in nature and open to the various types of industrial activity, is focussing on the four following aims:

- support for research conducted by the processing industry to improve productivity and the safety of the processes used, and the organization thus paving the way for the *factory of the future*;
- *stimulation of product innovation* through research on advanced materials and technologies which can be used economically and ecologically by manufacturing industry (products for the future, rational use of resources) and especially important for the development of the single market (key technologies for transport means);
- *incorporation of technologies* in support of both the *social* aspects, positive impact on jobs), *health and safety* for the workers (working conditions) and the *ecological* aspects (clean technologies, rational use of energy) taking into account of their industrial and economic impact ;
- support to other *Community policies*, in particular through pre-normative research (product quality, quality of life, support to trade).

b) Content of the programme : research concentrates on technologies which are linked to the critical stages of the production systems and the quality of products upon which the competitiveness of industry depends.

- *Design, engineering, production systems and human management* : The research covers new design methods for products and processes and application of computed-aided technologies, fast prototyping, new fabrication techniques, new inspection and diagnostic systems, failure-mode analysis, research into component miniaturization within specific industrial systems and the incorporation of new technologies, especially (ICT) available Information and Communications Technologies[1], into production processes taking into account the new production organizational models.
- *Materials and material related technologies* : the research will concentrate on new ways of devising synthetic materials (alloys, composites, smart materials), high-performance materials engineering, molecular engineering, and in particular supra-molecular chemistry, and the nano-technologies, process control, new recycling technologies and the reuse of industrial products and waste.
- *Advanced propulsion technologies:* withing the different generic technologies required for the improvement of automotive, aeronautics, maritime and rail transport means, concentration is given on propulsion. Emphasis is placed on the application of new design and manufacturing techniques, reliability studies, modelling and simulation, pollution reduction, efficiency and energy saving, research which the transport industry requires in order to boost its competitiveness;
- *Research relating to standards, measurements and tests* : The resultant activities are intended to support the drafting and implementation of Community policies so as the improvement of industrial quality control methods. Research is concentrated on elaboration, improvement or harmonization of standards, measurement methods or norms for quality products, support to trade, health and user safety. Research also covers the ecological impact of industrial processes so as the support to the adoption of advanced materials and technologies.

c) Programme implementation : An integrated approach is defined to consider all steps linked with the whole product lifecycle. Cost shared actions are concentred on priority technologies identified via a cross-reference approach involving industrial and social needs, the generic technologies, and the EC industrial policy.
Stress is placed on putting forward projects diplaying multidisciplinary and clear multi-sectoral characteristics in order to ensure the development and optimum transfer of know-how and technologies, and in particular those developed and used in the high-technology sectors such as defence or aerospace, into basic industries adding further to GDP or related to industrial policy - transport, civil engineering and building, chemicals, clothing and textiles, etc. Many companies, including small and medium-sized firms, may benefit from this research, which will grow around consortia of suppliers, manufacturers, final users, universities and research centres. The programme will take into account the need for organizational changes within enterprises aimed at stimulating the efficient management of humain resources and

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[1] The RTD programme in Industrial Technologies draws upon information technologies as well as other generic technologies in an effort directed towards innovation and application within the manufacturing industry domain. In turn, it provides inputs, knowledge, and expertise for future RTD in the Information Technologies programme which has as its objective the development of new ICT solutions for advanced manufacturing and engineering processes. For the complementarity between the two programmes to be operationally assured, coordination and an active interface will be maintained throughout execution.

the integration of new technologies. Research conducted for and by small and medium-sized enterprises and training via industrial research will also be stepped up. Also in order to help the steel making sector, due regard to its critical situation and in view of the expiry of the ECSC treaty, research activities linked with product and process innovation will be gradually taken over.

The dissemination of knowledge on the other technologies where action at national or European level is already in progress, will be promoted by the setting up of coordinating networks especially for diffusion of codes of practice, new industrial organisational methods or modelling of processes ; for measurement and testing coordination will be done for intercomparison or mutual recognition of conformity certificates.

d) Project management : a major concentration of efforts concerning the management of selected projects is obtained by means of "vertical coordination", which takes account of certain industrial sectors, and the "targeted-research" approach, which is aimed at coordinating all of the projects about a given set of topics (product of the future, factory of the future, clean technologies, flexible production, rational management of resources, measures and calibration methods). This will make way for improved synergy between those involved and better coordination with the various other complementary Community programmes and other initiatives at European level, and in particular with EUREKA, more market oriented, with which common seminars and exchange of information on a pre-competitive basis will be organized.

SCIENTIFIC AND TECHNOLOGICAL CONTENT

First Part : "ADVANCED PRODUCTION TECHNOLOGIES"

Area 1 : *Design, engineering, production systems and human management*

1. Background

This topic covers all of the processing industry and its processes. The challenge is to develop and apply generic industrial methods and technologies to design, engineering, organisation, production and the maintenance of high quality and high added value, thus enabling European industry to remain in the forefront of technological innovation and to clear the way for the factory of the future. The incorporation of new, advanced technologies into production systems will, by cutting costs, improving reliability and shortening lead times, help to boost industrial competitiveness and create new jobs. It will also help to improve the environment and quality of life at the workplace.

2. Proposed RTD activities

The research will aim at developing and incorporating the most advanced design and engineering tools. These permeating technologies will be applied within production systems in such a way as to meet the needs of inter-company networks, of the optimization of industrial plants, of cost/effectiveness, and of product quality and human management. Productivity , flexibility and quality will be major aims where there is a middle way between full automation and the use of labour research will look for a proper balance. Stress will be placed on integration of smart and computer-aided techniques, the latest developments in rapid prototyping, on application of cognitive engineering and micro-system technologies, on the development of new organisational approaches, on human-machine interfaces and on the technologies required to deal with the critical aspects of production systems, and in particular those associated with "clean", flexible and JIT manufacture.

Topic 1.1 : <u>New approaches in design and engineering</u>

The competitivity of the manufacturing industry will be improved through optimum use of new technologies and improved synergy with "knowledge-based" activities (such as services, engineering and training). The challenge in particular is also to reduce the lead time between the design and marketing of a new product or process. Competitiveness on the markets is increasingly a matter of time. By being able to market a new vehicle a month earlier, for example, the motor vehicle industry earns roughly an extra 30 million ECU. This means that engineers must deal with the design and planning of production and marketing at one and the same time. However research for optimisation of performances has also to consider the entire life cycle of products and processes, and thus has to aim at solving the totality of related problems. Design of very-high-value-added products and the products of the future therefore needs research actions centred on the following points :

- the devising, application and incorporation of new design and engineering *methodologies*, in particular via the use of recent developments in cognitive engineering and computer-aided technologies (CAD), and rapid prototyping, account being of the critical stages of production systems and of the whole life cycle of products;

- research and coordinated actions on *Modelling methods* for product behaviour (eg deformation), phenomena linked with their transformation (eg solidification) or industrial processes (eg product or material flow);

- support to product innovation by development of *multidisciplinary approaches* involving comprehensive research into materials, production methods, effects on employment and health and safety in the work place, quality control and product recycling in order to improve their cost-effectiveness and their environmental and social impact;

Topic 1.2. : Incorporation of new technologies into productions systems (factory of the future)

The main vehicles for progress are the operational use of new technologies, the adoption of information and management systems, and improved environmental awareness by companies. Moreover, the use of computer-aided technologies (CAM), the trend towards microsystems and their embodiment in industrial products and processes are changing the traditional industrial practices. Industry also needs research on new technologies aimed at boosting the competitiveness of high added-value products such as passenger cars, aircraft, trains and ships. Finally, the optimization of performance, quality, ecological impact, employment, training and health and safety aspects must be taken into account alongside these, while the technical requirements deriving from that need must be tackled and met by research in the following areas:

- generic approaches drawing upon the entire potential of the new technologies, in particular computer-aided technologies (CIME), new control systems or mechatronics, for their *incorporation* into production systems, for example in machine tool or construction sector.

- research for new manufacturing *technologies* (forming, assembling, microfabrication) which are better matched to user needs in terms of reliability and flexibility, and which may be used more efficiently for the building, maintenance and reuse of industrial systems, and facilities.

- research and development for application of *integrated and expert systems* intended to inspect and monitor products and industrial processes in particular by developing technological knowledge, improving the performance and reliability of "mechatronic" systems and by the efficient integration of decision support systems.

Topic 1.3. : Production-system and infrastructure diagnostics, maintenance and reliability

Within the Community one of the main industrial objectives is to ensure the safety of factories, buildings sites, offshore installations, etc. so as for the work force or their families and their health protection. That is why a prime field of technical research must that of safety in industry, with emphasis on new methods of diagnosing potentially dangerous faults and constant monitoring of the condition of plant, buildings, infrastructures and machinery. Also, reducing maintenance needs and the ability to intervene at a suitable time, which are important targets for the economy, must be ensured. The most urgent research tasks will be:

- to carry out basic research in order to *control the service life* of products and processes linked with the safety and reliability requirements and based on an analysis of the failure modes and optimization of inspections, diagnostics, maintenance and repair techniques;

- research of new *inspection systems* incorporating smart materials, sensors and actuators and on the use of advanced technologies, especially vision systems and available ICT, which typically display better performance and reliability, in order to monitor and perform diagnosis on large facilities, and to monitor production within the "clean factory";

Topic 1.4. : Industrial technologies and human factors within production systems

One of the major challenges facing the industrial world is to improve the organisation of enterprises and human/machine and human/factory interfaces. There are, in process control, many situations where the use of a system is restricted by its operator's level of confidence - or otherwise - in the information given to him. The solution is not only more automation, but systems which the operator can understand and on which he can easily be trained. Likewise it means that operators must be freed from repetitive or unsafe work and be redirected towards more added-value activities. A major effort is needed to provide a degree and form of automation which is suited to the wide range of skills in the workforce and which will ensure that the operator at any level feels confident that he and not the machine is in control. New approaches to human and organizational aspects within production systems will be taken into account and research into innovative ways of improving working conditions will also continue. The aims of the research are as follows :

- improving *reliability of industrial process* via research into *ergonomics, technologies and organization of work*, account being taking of cultural factors, operator competencies and the essential requirements of the job itself;

- coordinating activities for the improvement to *working conditions, human/Machine and Human/Factory interfaces*, by means of harmonization of codes of good practice in company organization and the optimum harnessing of advanced manufacture, production and construction technologies;

Area 2 : *Materials and material-related technologies (including processing and recycling)*
1. Background

The industrial sectors covering materials and material-related technologies is a key component of European industry. As an example the advanced-material sector alone will by the year 2000, represent a market worth 200 thousand million ECU worldwide. Europe must stay strong in this strategic area, firstly by improving the processes generally used in the material-working or processing industries (metal working, chemistry, biochemistry, building, textiles etc.) , secondly by ensuring that the most advanced materials can be used economically by both manufacturing industry (electrical, engineering, machine tools and transport) and the high-tech industries (aerospace or electronics, for example) in producing the products of the future, and, thirdly, by contributing to the competitiveness and balance of the system as a whole. Based as they are on the experience from the earlier programmes the proposed activities will concentrate more on the development and processing of new and advanced materials

which are open to economic use in products where research and coordination at European level is genuinely needed in order to ensure that industrial projects are effective. A complementary activity, especially towards prenormative aspects, will be done by the JRC though its direct research actions.

2. Proposed RTD activities

Priority will be given to research topics relating to material design (and in particular that of smart materials), clean processing and to long-term research of an exploratory nature which may quickly yield practice applications - thereby Strengthening European industry's technological lead, above all in identifying the products of the future. One may quote, by way of an example, molecular engineering and bio-processing, which are new technologies which did not exist 10 years ago, which are expected to play an important part over the next 10 years. The programme will also cover the treatment of waste, recycling and product reuse and will include for that purpose quality-assurance and projects work on product life cycles. Special attention will be given to the technologies required for the rational management of primary resources and the re-use of secondary materials and products.

Topic 2.1: Material design and engineering for the products of the future

Advanced materials are not an end product in themselves. They are used in industrial components and their characteristics often determine the critical threshold for those increasingly complex systems, such as propulsion units, or electronic or medical devices. Account must be taken of their behaviour throughout the product life cycle. Often the progress made in materials research sets the highest speed at which the key sectors of the economy may develop. This is particularly true for the high-tech sectors such as aerospace, but it applies equally to the basic industries such as chemicals or mechanical engineering. Therefore, RTD in advanced materials design and engineering (eg molecular-engineering), or in more perspective domains such as nano- technologies, is essential to the future welfare of industry. Research and development should be focused on the following areas:

- research into *new high-performance materials* using, for example, computer-aided technologies in order to build specific properties into materials by designing their structures from the molecular and atomic scales upwards, and minimizing their impact on the environment and health, more particularly as regards their biodegradability and capacity for recycling and reuse;

- new alloys, composites and ceramics displaying *improved mechanical properties* such as stiffness, toughness, strength-to-weight ratio, corrosion and high-temperature resistance, especially for the transport and energy sectors;

- new higher-performance *superconducting* materials, and the devising of a design methodology for increased component reliability, especially for the production of strategic equipment and industrial systems;

- new *functional "smart" materials* in order to obtain higher-performance products in multi-sectoral applications such as electric motors, actuators, sensors and other electrical or mechanical devices;

Topic 2.2: Chemical engineering and materials processing

The European chemicals industry represents one of the most successful high-value European industrial sectors, with a turnover of roughly ECU 200 000 million. Despite its leading position it is under constant threat and still requires RTD - mainly in the field of environmentally friendly processes. In an integrated production system the total quality of materials, products and processes and the structure of the labour force depends more and more on advances in material science, process modelling and process control.

The processing of materials is at the centre of production systems and is a crucial factor in fitness for purpose, product reliability, cleanliness of the environment, cost effectiveness and industrial flexibility and productivity. Up to 60% of the cost of manufactured products can arise from the cost of materials and their associated processing. In this light it is necessary to advance the understanding needed in order to design and control increasingly complex processes, and in particular to develop and apply innovative and "clean" techniques. The priority of research topics should therefore be as follows:

- improvements in the increasingly complex *material processing design and control*, while taking account of progress made in artificial intelligence, including the use of operating strategies, increasing productivity and safety, and reducing the need for waste management.

- developing innovative *chemical and biochemical engineering* techniques, as applied to industrial processes, which boost productivity and performance through a better understanding of basic phenomena, while taking account of pollution prevention, recycling and process safety.

- innovation and integrated approaches to *synthetic-material development* (e.g. structural-gradient materials, powder metallurgy, etc.) intended to improve process reliability, productivity and total product quality.

- Coordinated actions for *technologies applying to materials treatment*, largely studied in Europe such as surface treatment, intended to improve performance and likely to be widely used in industry.

Topic 2.3 : Materials reliability

Linked with the need for increased reliability, safety, health, cost-effectiveness, the need for a deeper knowledge of material, component and product behaviour is of growing importance. This area, largely studied in the past, is still crucial to the economic, social and environmental challenges.

The research topics in this field - mainly in the form of coordinating activities - should be:

- *basic studies* combining microstructural and macrostructural modelling, improving detection of micro-defects and enabling improvements to and the phenomena involved in material reliability to be understood;

- *Multidisciplinary approaches* in order to control material deterioration (corrosion, fatigue etc..) based on the modelling of the true behaviour of products, structures and industrial systems and a better understanding of the relationship with the properties of the constituent materials;

Topic 2.4 : Rational management of primary and secondary Raw-materials and recycling techniques

By adopting an approach that takes account of the entire product life cycle, it is necessary to ensure that the best and most appropriate means are mobilized in order to ensure that resources are not squandered and that consumer requirements are met in order to produce quality products at a reasonable price and meet environmental responsibilities. Thus industrialists are increasingly taking an interest in matters that go far beyond the will to find the most cost effective solution to a given technical problem. Henceforth full account must be taken of recycling, ecological aspects and energy matters. For this purpose, research into new raw materials and the relevant processing techniques are a key factor. The prevention of pollution, which improves productivity and at the same time allows for more efficient allocation of resources, has become a crucial industrial parameter. With this mind attempts will be made, in particular, to make progress on technologies intended to dispose of "problem" wastes or to reuse advanced-material waste. This means viewing industrial systems not in isolation but as part of a greater system which seeks to optimize the total material cycle from virgin material to end product. The research will concentrate on the following :

- *new technologies* to ensure a sustainable supply of raw materials, especially deep exploration technologies;

- research on new *processing techniques* used in the various forms of ore treatment e.g. in mines and metal-processing facilities in order to trim production costs and diminish safety, environmental and energy problems;

- multidisciplinary approaches to the production, use, scrapping, reuse or disposal of primary and secondary *raw materials* in order better to manage the economic and environmental constraints and the health requirements.

- multi-disciplinary research into *new materials* that is aimed at enabling natural materials to be used cost effectively in industrial products, toxic materials to be substituted avoiding any harmful products, increasing their suitability for recycling and predicting the effects of multiple recycling on the structural and functional characteristics of those materials;

- new *methodologies for the recycling and reprocessing* of industrial products at the end of their services lives where existing techniques are inadequate, and search for new approaches (chemical, biological or physical) to the separation, concentration, reduction, refining and recycling of industrial wastes.

Area 3 : *Advanced-propulsion technologies*

1. Background

European integration and current trends in the economy are creating a growing demand for flexible and efficient transport systems. The progress made by the various modes of transport is doubtlessly contributing to the economic development of most European countries, but at the same time it is increasingly exacerbating current environmental and mobility problems. The use of advanced propulsion modes in transport-system vehicles is the key to improvements in energy consumption, comfort, quality, safety, volume, speed and environmental friendliness in conjunction with other European policies on industry, transport, the environment and energy. This is particularly true as regards the European motor vehicle, maritime and aircraft industries.

2. Proposed RTD

Preference will be given in the motor vehicle, aircraft, railway rolling stock and shipbuilding industries to research into the design, engineering and production of new, advanced motive power and power-transmission systems in order to improve their quality, performance and lead times. The principal aim consists of maintaining, or even increasing, market share worldwide. The research topics will aim at applying and incorporating any generic technologies which can be used in transport, and to develop specific technologies for advanced transport systems. Particular attention will be given to incorporating command and control technologies into specific propulsion systems and optimizing their use in means of transport.

Topic 3.1 : <u>New higher-efficiency propulsion technologies</u>

The competitiveness of each transport mode will depend upon the ability of the power train to propel the vehicle and its payload at optimum speed, range, reliability and running efficiency. Therefore RTD support is required for research and development in the following areas:

- research on NC tools, simulators and engineering techniques for advanced *propulsion systems* in order to speed up the design and raise the efficiency and manufacturing-cost-effectiveness of those systems.

- *reliability* studies and the mapping of *maintenance* strategies that take account of total life-cycle duration and, at design level, tackle the aspects enabling maintenance costs to be reduced.

- *design* of lighter, more efficient propulsion and traction systems critical components, combined with advanced transmission, energy-accumulation or braking systems enabling overall transport-system performance and cost-effectiveness to be improved.

- *incorporation* of advanced command, diagnostic and control systems for propulsion and traction systems offering a friendly, ergonomic environment in order to achieve suitable, reliable and economically attractive conditions for the use of transport vehicles.

- research into appropriate *methodologies* for marrying power units and vehicle structures in such a way as to raise overall transport-system efficiency as much as possible.

Topic 3.2 : Reducing environmental impact and improving safety

The impact on the environment of the various means of transport is a limiting factor for the growth of that industry. Social acceptance of future transport modes will be secured by providing medium and long term solutions to both local and worldwide pollution problems. The areas considered to be of specific importance in removing the barriers mentioned above are as follows:

- research into low-energy-consumption, low, ultra-low or zero-emission *propulsion systems* through improved design techniques, and of improved production methods and integral engine management systems;

- further work on noise and *vibration-reduction* techniques combining the progress made on power units and incorporation of the improvements made in fluid dynamics (aerodynamics, aerothermodynamics, hydrodynamics), and active and passive safety.

- supporting the development of design technologies and monitoring systems aimed at increasing the *passive safety* of propulsion systems and means of transport, including fireproofing.

- coordinating activity for developing *environmental monitoring* techniques for in-situ detection of failures producing pollution from propulsion systems.

Second Part : "EUROPEAN ACTION ON MEASUREMENT AND TESTING"

Area 4 : *Research linked with standards, measurement and testing*

1. Background

Sound, reliable measurements, whether physical, chemical or biological in nature, are essential to the functioning of modern society. Without them industries, and above all high-technology industries, cannot operate, trade is hampered by disputes, health care becomes a hit-and-miss affair and legislation, ranging from environmental and worker protection to the operation of the common agricultural policy and the single market, cannot be implemented successfully. For these reasons the advanced nations spend up to 6% of their GDP on measurements and measurement-related operations. Community action directed towards the establishment of harmonized systems of measurements, standards and norms is thus fully in line with the principles of subsidiarity and cohesion.

The activities under Framework Programmes 2 and 3, such as the development of reference materials and new or improved measurement methods, will continue. Greater emphasis will, however, be placed on the pre-normative research and the development of generic measurement and test methods required for the operation of the single market and support for the competitive position of European industry. New activities will include support for customs laboratories, forensic science and the protection of Europe's cultural heritage.

The main objective is the research needed in developing new measurement and testing methods and accelerating the drawing of European directives and standards in order to buttress the single market and implement other Community policies, especially those dealing with health, safety and security. The metrological infrastructure will be strengthened at European level. Coordinated and shared-cost activities will be carried out with networks of national laboratories. The shared-cost activities will take place where the research is intended to devise methods, standards or new or upgraded instruments, whereas coordinated action will take place in other instances such as comparative studies. Consultation networks will be used to set up a European metrological infrastructure and support the introduction of the system of mutual recognition. Within the industrial field the emphasis will be placed on improving product definition and quality control - via shared-cost activities - and on the mutual recognition of certificates of conformity via concerted action. The resultant reference materials will be disseminated by the JRC's Geel establishment. Workshops and training sessions will enable codes of good measurement practice to be spread throughout the Member States.

In the domains which are within it competence, complementarity activities will be performed by the JRC, especially on standardisation for the construction sector and on the setting up of new measures and reference materials, in close collaboration with national laboratories.

2. Proposed RTD activities

The various activities conducted as part of this project may be placed in three target-based categories. However, since, in view of the diversity of the needs to be met flexibility is essential, certain subjects may be dealt with under several different headings.

Topic 4.1 : Metrology for European quality products

- *Development of measuring instruments to study and apply physical, chemical and biological phenomena underlying future products* : coordinated at European level this activity would enable the reference data of excellent quality to be plotted which are essential in constructing scientific theories and model systems, and would improve the piecing together and traceability of the measurement scales used in the laboratories, trade and industry. Equally important are the final touches to the analysis and utilization of the data, and in particular of the expert systems used in decision making.

- *Development of the generic measuring methods and instruments needed to perfect products* : the measurements at issue are essential in optimizing product design and experiments in operational, ergonomic and ecological terms, and from a safety standpoint. Improvements in characterizing the raw materials components and finished products will enable the waste due to breakdowns and poor design to be avoided. Likewise improving measurements will help to soften the ecological impact of industrial processes and product use or disposal (recycling, degradability). The drawing-up of generic standards and norms for products or processes will raise efficiency and thus enhance the competitiveness of European industry.

- *Development of the generic methods, standards and instruments that are essential in improving product quality versus cost of production* : the stress will be placed on the use of advanced calibration and traceability methods relating to process control and quality assurance (QA). These activities will extend to metrology applying to detection, diagnostic monitoring, automated production and non-destructive testing under actual production conditions. Special attention will be given to enabling SMEs to acquire new metrological technologies and QA systems that are tailored to their needs.

Topic 4.2 : Pre-normative research and technical support for trade

- *Support for legislation* : the research into measuring methods and instruments is essential for legislative purposes where technical requirements are drawn up for draft directives. Pre-normative research will be essential to the "new approach" directives, for which CEN/CENELEC and ETSI have been made responsible by the Commission for drawing up harmonized standards, if the scientific and technical substrate is inadequate for this type of standardization. Support will also be needed in solving the possible problems raised by the implementation or adaptation to technical progress of existing directives. This category of activities embraces the measurements and standards required in order to detect any fraud in the implementation of the Community's policies and in particular those relating to agriculture. If necessary the prenormative research will be conducted in order to enable industry to comply with Community law, in particular with regard to consumer safety and waste management

with a view to protecting the environment, or with regard to transport.

- *Support for industry* : although not governed by Community law, certain industrial sectors may, in consultation with the CEN or CENELEC, find that harmonized standards must be drawn up in order to prompt innovation, incorporation or trade, or indeed the adoption of high-tech production methods or materials.

- *Promotion of a European metrological infrastructure* : full advantage can only be taken of the single market if an efficient, reliable European metrological infrastructure is set up which is based upon traceability to agreed physical, chemical and biological standards. This requires a coordinated approach to research and development on measurement standards, reference materials and traceability in order to avoid a duplication of effort within Europe. The creation of a structured system for metrology and chemistry via coordinated European action would enable such measurements to be traceable to internationally recognized standards, as is currently the case with physical measurements. The promotion of traceability between Member States will be of particular benefit to the smaller members, whilst the provision of training in less favoured regions will promote cohesion. The international cooperation with bodies such as the BIPM, WHO and NIST would be expanded where this supported European interests.

- *Technical support for mutual recognition and accreditation* : technical support is required for the operation of the European calibration, testing and accreditation systems into networks (e.g. WECC, WELAC and EOTC) which conduct certification, conformity and proficiency testing, and industrial quality assurance.

Topic 4.3 : Metrology serving the needs of society

- *Health and safety* : the implementation of Community law requires that the exposure of human beings to certain physical, chemical and biological agents be measured, and that the associated hazards and the effectiveness of the measures taken to reduce them be assessed. Thus new methods or improved calibration means will required. Similarly, through prenormative research, improvements are required in measurement and tests used to assess public and animal health, food hygiene, safety products and safety of workers in the working place.

- *Monitoring of the environment* : the implementation of the laws on the environment and the activities of the European Environmental Agency require new and improved measurement techniques in order to determine the quality of the environment (ambient air, fresh and sea water, soil, waste, toxicity and microbiological action, etc.).

- *Customs laboratories* : the protection of the external frontiers of the Community against the import of illegal substances, sub-standard goods, falsified trademarks or fraudulently labelled materials requires the development of new and improved harmonized methods of measurement. In addition measurements are required to determine any duties to be levied or refunded. Following the removal of the internal frontiers, customs laboratories are playing an essential part in achieving these aims by adopting official sampling methods and inspecting imported products.

- *Justice system* : coordinated activities are needed in order to develop and harmonize the specialist measurements used in forensic science and narcotics control in support of the newly-established cooperation in the fight against crime. Whilst relatively few laboratories are involved, the advanced nature of the measurements and the consequences of the results warrant coordinated action.

- *Support for Europe's cultural heritage* : in order to preserve Europe's cultural heritage it is necessary to be able quantitatively to assess the condition of physical objects and the effectiveness of the methods proposed in order to protect them against environmental pollution and the ravages of time.

Where necessary all of the above activities will include the development of reference materials and support for the setting-up of laboratory networks.

IMPLEMENTATION

In view of the lessons drawn from the third Framework Programme all of these activities would, in the main, take practical form via cooperative research projects. Greater use of coordinated action, when this is sufficient to obtain Community added value, will enable shared-cost activities to be selected on a more stringent basis (i.e. concentrated on strategic areas needing minimum "critical mass"). Consequently, the concerted action already devoted to industrial R&D in the various Member States will be able to extend its results and boost its synergy. The intended financial incentives will cover coordination, training and staff exchanges. The overall background to the activities will be optimized in order to obtain the flexibility required for maximum efficiency and in order to be able to react quickly to emerging needs.

The accompanying measures that are intended to boost the effect of Community activities will be conducted as a supplement to and in cooperation with the corresponding activities under the Third Activity of the framework research programme: studies, impact assessment, training, support for dissemination and utilization, activities conducted jointly with the SME-assistance networks, management-decentralization and industrial research coordination with strategic aims in mind such as the factory of the future, zero-pollution vehicles. The work will be stepped up in order to ease the use of technologies and the exchange of know-how between projects and sectors, and with other European initiatives such as EUREKA or the ESA programmes. Workshops, symposia and training courses will be held in order to promote good practice, in particular metrological practice, above all in the less favoured regions.

Projects will be selected after independent assessment of proposals received in response to calls which will be published at least annually in accordance with the Commission's normal procedures. However, as periodic calls for proposals may cause unacceptable delays to research intended to support urgent Community rules or where these deal with SMEs, a continuously open call for proposals, effective throughout the lifetime of the programme, will operate for projects of this type.

1. Shared-cost RTD projects

These projects will be directed towards the preferred technologies as defined during calls for proposals. There are three such types of project:

- industrial research projects;
- basic research projects;
- pre-normative research projects.

2. CRAFT - Specific scheme to promote research both by and for SMEs

An open call for proposals and a single two-step procedure embodying the features of CRAFT and feasibility awards will be implemented in order to encourage SME

involvement in the programme and to support projects driven by innovative SMEs or centred on the technology needs of SMEs with little research capacity but an ability to absorb advanced technologies.

In comparison with the third framework programme the rules and procedures will be amended in order to:
- enable a wider range of SMEs to participate and a greater part to be played by industrial research and the dissemination of technology,
- shorten the lead times between proposals submission and project start.

At step 1 selected proposals receive an expansion/feasibility award to prepare a detailed project proposal to be submitted either as an industrial research project or as a SME-centred project within the CRAFT scheme. Projects eligible for CRAFT step 2 support must satisfy a number of conditions, including that of being smaller and shorter (normally not exceeding two years) than industrial research projects.

Decentralized activity by assistance networks operating at local, regional or national level will be promoted and maintained in order to inform and assist SMEs during the preparations for step 1 (information campaigns, subject workshops, the payment of "assistance awards" under specific conditions, etc.), in coordination with other activities (Euro-Info Centres, Value relay Centres, Euromanagement, etc.).

The call for proposals will be continuously open throughout the programme. The target budget for CRAFT is 10% of the total project.

3. Coordinated Actions

- Coordinated action: consists of coordination by the Commission of research conducted by various organizations in specific areas - in several Member States. Those involved may be funded of the coordination costs (travel, symposia, sampling, publications).

- Networking (ESA, COST, EUREKA, national programmes, etc.): joint action intended to deal with certain strategic areas in cooperation and concert with other European programmes. This may also include the joint financing of conferences, workshops or symposia and possibly that of research projects after common screening.

- Targeted research: following the experience of the previous programme, the underlying principle of this type of coordination is the provision of added value by helping those conducting projects which supplement a specific programme or other European programmes to coordinate their various activities about a specific strategic aim (factory of the future, clean technologies etc.). That form of cooperation will be of great importance to a range of industries made up of users and producers, and including SMEs.

4. Accompanying measures

The accompanying measures are intended to raise the efficiency of the programme by making it more accessible and enhancing its impact. They build upon the experience gained from past research programmes. There will be no lack of budding new ideas and these accompanying measures will dovetail continuously throughout the programme. They will take the following practical form:

- research fellowships awarded to individual researchers who carry out additional work as part of ongoing research contracts;
- subsidies for host institutions within existing contractual partnerships in order that they may accommodate the holders of the above mentioned fellowships;
- specific training (training of technologists, familiarization with operating strategies, codes and standards, health and safety, industrial-property rights);
- help in financing courses, symposia, workshops and European conferences dealing with technical topics covered by the programme;
- assessment of the scientific and strategic aspects and of the economic and industrial impact of the projects and programme;
- meetings of ad hoc groups of experts;
- study contracts;
- assistance for information exchanges and proposers; this applies in particular to SME-assistance networks;
- promotion of results of research and support for their use, in association with the Third Activity of the Framework Programme.

ANNEX II

Indicative breakdown of the effort between the different areas

Type of activity	Total
Design engineering, production systems and human management	34-39%
Input materials and technologies	33-38%
Advanced propulsion technologies	10-12%
Standards, measurements and tests	12-16%
Total	100% (1573 MECU)

ENVIRONMENT

1994-1998

ANNEX I

OBJECTIVES AND SCIENTIFIC AND TECHNICAL CONTENT

THE CONTEXT

The implementation of the 5th Community Programme of Policy and Action in relation to the Environment and Sustainable Development will allow, in a spirit of the sharing of responsibilities, trends and practices damaging to environment to be changed so as to improve the quality of life and to create the conditions for a relaunching of the economy founded on a model of sustainable development. This strategy will contribute to an improvement of the competitivity of industry and employment perspectives in the Community.

The identification and the evaluation of the impacts of human activities on natural resources and on the environment will provide a scientific basis for the formulation of Community environment policy. The observation and precise knowledge of the way in which the different parts of the environment function and the way in which they react to man-made influences as well as the understanding of socio-economic factors responsible for environmental change and the consequences of these changes on natural systems, society and its economic activities are in effect the ground rules for the development and implementation of an integrated environment strategy which allows a high level of protection.

The prenormative and prelegislative aspects of research on the environment are thus intimately linked to the observation and understanding of fundamental natural processes as well as to a knowledge of socio-economic implications of environmental change.

On the other hand the complexity and interdependence of these processes and changes as well as the multidisciplinary character and the trends towards global scale environment research imply a concentration of Community research effort on areas where the joint use of infrastructures and national research capabilities, in addition to the coordination and integration of Member States' research, is indispensable to give optimum value and prominence to the Community contribution to research on a worldwide scale. This is particularly true in the field of research on global change.

Research on the natural environment and global change requires a considerable effort in certain technological areas. In depth study of natural processes and environmental changes in effect presupposes that substantial progress can be achieved in the field of instrument technologies linked to the observation and monitoring of the environment. These technologies allow a precise diagnosis to be made of changes and perturbations arising from natural causes or from human activities. A specific initiative is envisaged in the field of marine instrument technology. Similarly the stimulation of the application of space technology in the field of Earth observation by means of some support to the development of the space sector (instrumentation) and a more marked contribution to the ground sector and to data use would improve the capacity to diagnose and evaluate environmental change.

Of course R & D interest in earth observation is not limited to the environment but also allows logistic support to other Community policies, such as the Common Agricultural Policy, to be reinforced.

Finally remedial technologies aimed at protecting the environment are envisaged, as well as horizontal aspects of clean technologies related to industrial processes and products. The latter area is undertaken in a complimentary fashion to the work envisaged in the framework of the programme on "Industrial Technologies".

THE ACTIVITIES OF RTD

A. OBJECTIVE AND SCIENTIFIC CONTENT

The Community R&D effort is concentrated on 3 themes: (1) the natural environment, environment quality and global change, (2) technologies in relation to the environment and (3) Earth observation and the implementation of space technologies.

1. RESEARCH ON THE NATURAL ENVIRONMENT, ENVIRONMENTAL QUALITY AND GLOBAL CHANGE

a) Natural systems, climate and the effects of human activities

The objective is to observe the characteristics and to understand the fundamental processes of the climate and of natural systems (continental, oceanic and atmospheric) as well as to identify and to evaluate the effects of human activities on these characteristics and processes. It is appropriate to take into consideration the effects of industrial activity, transport, tourism, uncontrolled waste disposal, urbanization, abuse of water resources, land use and management, and of agricultural and forestry practices.

The socio-economic factors responsible for environmental changes will be examined, from the point of view of the implementation of an effective environmental policy based on the principle of sustainable development. A thoroughgoing analysis of human and societal behaviour and of the more traditional economic processes of development, responsible for undesirable effects on the environment, should be conducted in parallel with the study of the natural processes. This analysis has to cover the social dimensions of resource usage, in particular demographic growth, population movement, economic growth and technological development, as well as on ethical, institutional, legislative and cultural factors likely to give rise to detrimental situations, practices and behaviour. An analysis of the perception of the risks, in relation to the risks themselves is essential.

In the same way, because they interact with the climate and involve the continental system, the ocean, and the atmosphere, disturbances of the biogeochemical cycles, of the hydrological cycle and of energy flows as well as the mechanisms which control them will be the subject of detailed investigations. They interact equally with the structures and the attributes of the ecosystems, including biodiversity and influence the operation and dynamics of it: their comprehension and their modelling on the European scale are therefore essential.

On a large scale, flows and interactions between the systems will be considered.

Within systems, cycles and processes will also be taken into consideration, in the measure that their understanding, their modelling and the prediction of the manner by which they will be perturbed by human activities on the European scale, are all necessary for the realisation of the aims of research on the planetary scale as well as the establishment of the scientific basis underpinning the implementation of the 5th Action Program.

With regard to the continental and oceanic systems, the accent will be put on the dynamics of the elements (mainly C, N and S), of water and of energy, characterised by the flows internal to the systems and the physio-chemical and biological processes which control these flows.

Studies on the horizontal and vertical transfers between the compartments of the oceanic system in the European seas (including the northern Atlantic and Arctic) will be envisaged.

Similarly, the exchanges between the different compartments of the continental system (terrestrial system, aquatic systems, wetlands and coastal areas) will be taken in consideration.

With regard to the atmospheric system, research should concentrate on the physical and chemical processes which control the composition of the stratosphere and the troposphere with particular attention on the transformation processes of natural and anthropogenic compounds, the transport of the derived compounds and their deposition. The work covering the stratosphere and the upper troposphere will aim, as in the past, at detecting, understanding and predicting modifications of the chemical composition.

Research on the climate will be, in itself, concentrated on the endpoint of modelling, making it possible to monitor and predict climatic changes on the scales of a decade to a century and with a spatial resolution appropriate for the detailed evaluation of the climatic repercussions (with the stress laid on the "European region"). With regard to the climatic processes, priority will be given to the study of the variability and the distinction between the changes of natural and anthropic origin. The fields of research will include the roles of clouds and aerosols, of ocean currents, of atmosphere-oceans-cryosphere interactions, as well as the role of the hydrological and biospheric processes and of minor atmospheric components (greenhouse effect). Reconstruction at a high resolution and the modelling of ancient climatic regimes will be continued. In this regard, a specific effort will be made in the field of the boreholes of the old glacial caps (the Antarctic) and in that of the glaciological studies conducted there. Of course, a constant effort will be made in the field of validation and amelioration of climate models.

b) Consequences of environmental change on natural systems, economic activities and society

The objective is to evaluate the consequences of the possible change in climate and of disturbance of the processes in the continental, oceanic and atmospheric systems on: the attributes of the ecosystems; man, society, and economic activity, by taking account, as far as possible, of interactions between the possible changes of the climate and the amendments of the cycles and of flows. Priority will be given to projects which try of evaluate the consequences of combined effects, e.g. the consequences on the attributes of terrestrial ecosystems of climatic (or meteorological) changes combined with changes in the cycles of carbon and/or of nitrogen.

In the continental environment, an important objective is to determine the natural state of the ecosystems in relation to physical, chemical, sedimentological factors, etc and to evaluate their sensitivity and resilience vis-à-vis anthropic influences. Biodiversity will be taken in consideration insofar as it interacts with the functioning and the dynamics of the ecosystems.

Taking account of the dominant role of the oceans on climate change, particular attention will be given to the fundamental processes within marine ecosystems, including coastal ecosystems. The research effort will also cover the role of biodiversity in the mechanisms which regulate primary and secondary productivity.

The programme aims also to strengthen the capacity to predict, in the medium- to long-term, the response of coastal environments to climate change and to human influences. This objective requires the detailed investigation of the physical processes (hydrodynamic and morphodynamic), chemical and biological, particularly in the most dynamically active areas, where these processes strongly interact - this in order to evaluate the relative importance of these processes on a broad range of temporal and spatial scales and to allow their modelling.

The consequences on natural resources (availability, geographical distribution, etc.) will be evaluated as far as possible concentrating particularly on water resources, agricultural production and forestry as well as on fisheries.

Lastly, the consequences for society, the economy, international relations, trade and technological development will be considered. Scenarios aimed at evaluating the socio-economic implications of strategies of adaptation to change and of strategies of reduction of the adverse effects will be studied. Alternative strategies of development will be considered. This involves the formulation of precise indicators for the evaluation of the sustainable character of these alternative strategies.

Generally, the projects and actions envisaged within the framework of the field "natural environment, environmental quality and global change" will have to contain a specific aspect facilitating the incorporation of new scientific knowledge into the implementation of Community environment policy. The projects envisaged under this programme will be implemented in coordination with those developed, on similar subjects, under other Community programmes (for example, the energy programme). A tight coordination will also be developed with the 5th Programme of Action on the Environment. The projects will cover not only the pre-normative and pre-legislative aspects but also the methods of evaluation of the risks engendered by human activities and the elaboration of the standards and of the means of preventive management and of restoration of the natural environment.

Specific projects will be envisaged in order to:

- develop the methodological approaches which would make it possible to incorporate the environmental and quality of life parameters into economic performance indicators (for example "green accounting"),
- to optimize the instruments of environmental policy taking into account cost-benefit relationships,
- developing methods allowing the integration of environmental concerns into sectoral policies and,
- in a general manner, improving the links between environmental research and policy.

Other particularly important examples of pre-normative and legislative research on the European scale are:

- the scientific support for the definition of effective standards (in terms of cost-benefit) for the quality of air, water, and soils,
- establishment of scientific criteria for the quality of the soils, elaborating criteria and standards for the qualitative and quantitative evaluation of water resources,
- the elaboration of an effective policy and of instruments integrating management and protection of ecosystems taking into account the criteria of ecosystem functioning and of the important "endpoint" concept (together with the attributes of the ecosystems that one wants to protect or to restore); this involves a correct estimate of the physical, chemical, biological and ecological parameters of reference and of the characteristics of the ecosystems and of the habitats),
- development of evaluation and management methodologies for toxicological and ecotoxicological risks taking into account cost-benefit relationships and

- scientific support for the actions of the European Environment Agency. This support will consist of developing the scientific basis for environmental surveillance methodologies (guidelines on the choice of the parameters, harmonization of the measurement methods, guidelines on the choice of observation sites). In a global perspective, these projects should also take account of the progressive development of the systems of earth observation: GOOS (Global Ocean Observation System); GCOS (Global Climatic Observation System); GTOS (Global Terrestrial Observation System).

2. RESEARCH ON ENVIRONMENTAL TECHNOLOGIES

a) Instrumentation

In the area of instrumentation, the general objective is to contribute to the technological development needed for observation, surveillance and environmental research, and to methodologies for their application (observation of the state of the environment; diagnostics and prediction of changes). This implies in particular, contributions to the development of Earth observation technologies, notably from space, observation and surveillance technologies for various parts of the biosphere and technologies for environment analysis. In addition this includes technologies for the treatment, the validation, and the dissemination of data. This effort is also envisaged as support for other Community policies.

In the area of oceanic instrumentation, the object is to contribute to research on global change and its effects. This will also contribute to the strengthening of the technological base of the European marine industry. The development of new technologies and the adaptation of existing technologies to environmental constraints and to the needs of research is envisaged as is long term surveillance. Particular attention will be given to the development of generic technologies that do not perturb the environment (biosensors, techniques for calibration and reference standards, component systems for sub-surface vehicles, manned benthic laboratories, instruments and sampling systems for research and operational surveillance, especially in hostile environments - deep sea, glacial and coastal waters).

b) Remedial Technologies

In this domain there are two objectives: to contribute to the development of original and effective (in terms of cost-benefit) technologies in the area of effluent treatment (waste water, gases emitted from fixed and mobile sources); to contribute to the development of technologies for industrial waste and products. This second objective has two important aspects: the Commission will favour the development of recycling technologies for industrial materials and products, whilst on the other hand aiding the development of technologies for the treatment and elimination without risk of wastes which cannot be recovered or recycled, taking cost-benefit into account.

c) Technologies for industrial processes and products ("clean" technologies)

The development of clean technologies is envisaged within the specific programmes "Industrial Technologies" and "Non-nuclear Energies". The Environment Programme will concentrate on two horizontal aspects:

i. Analysis of product life-cycles and methodologies for the evaluation of the impact of products and of technologies

The objective is to develop methodologies to analyse life-cycles for synthetic and industrial products. The effects on natural resources and energy consumption will be taken into account as well as the effects of the products on the environment at different stages of their life cycle, from the stage of primary materials to their final use, their recycling, their recovery, or their elimination. Equally, methodologies for the evaluation of the impact of industrial processes will be tackled.

ii. Complementary socio-economic aspects

To take into account environmental constraints on technological development, Methodologies in two areas have to be established: studies of interactions between industry and environmental policies. These studies must include analysis of cost-benefit. studies of interactions between environmental policies and structural changes, commerce, employment and the transfer of technologies to SME's.

(d) Technologies for restoration of the environment and natural risks

The objective is to contribute (a) to the development of effective restoration technologies for environmental compartments (soils, sediments, ...) degraded by chronic pollution or by accidental emission of products or of dangerous substances; (b) to the development of methodologies and technologies for surveillance, for warning and for the management of natural risks including volcanic risks, land slip and other massive movements, storms, floods and forest fires. In this area the accent will be put on the development of sensors and observation systems based on new technologies, on the establishment of instrumentation systems in situ and on the setting up of integrated systems for risk management. The work will equally address the development of technologies and methodologies for the rehabilitation of territory and the development of techniques for improving the resistance of constructions (both structures and infrastructure) to natural hazards.

3. EARTH OBSERVATION: APPLICATIONS OF SPACE TECHNOLOGY

a) Specific actions related to the space segment

The Commission, having a special concern to encourage the development of permanent operational services, will actively participate in the definition of future space missions to help ensure that the space segment meets users' needs, notably in the field of the environment.

In particular, the Commission wishes to include, in support to the activities mentioned under points A and B, aid towards research on advanced sensor technologies and towards the pre-competitive development of those instruments of Community interest which cannot be financed by Member States alone.

Community participation in the development of the "Vegetation Monitoring Instrument" (a satellite-borne sensor of relevance to applications of Community interest planned for integration into the SPOT satellite system), will be considered by the Commission as a test case for supporting the development of new instruments. In the same way, it is foreseen that the Community will participate in the development of an advanced atmospheric sensor operating in the millimetre wavebands, (AMAS), capable of measuring temperature profiles and trace gases in the upper troposphere to the mesosphere (including ClO, H_2O and CO). Other instruments could be developed in cooperation with the Community according to needs expressed by the users.

b) Specific actions related to the ground segment and data utilisation

In a complementary manner, in support to the actions envisaged for the implementation of the programme on the natural environment, environmental quality and global change in the framework of the ENRICH (European Network for Research on Global Change) network, the Community will encourage and support the development of a European decentralised network for space data management and access, with particular focus on data needed for the study and monitoring of climatic and environmental change.

Based on the results of a feasibility study on the concept of a Centre for Earth Observation, the Commission will make proposals for a Community network including the Joint Research Centre (JRC), to support the coordinated development of data centres in the Member States (including validated data bases, archiving facilities, catalogues and standards). This initiative is being prepared jointly with ESA (European Space Agency) and the national bodies concerned. It will be coordinated with and will support, notably, the activities of the planned European Environment Agency.

Furthermore, the Commission intends to intensify and to extend the cost-effective use of space-derived data in the information systems needed for the implementation of Community policies in the areas of agriculture and forestry, environment, regional development and cooperation with developing countries. In particular, it will take action to integrate space-derived data into the European Statistical Information System. The JRC and the Statistical Office will play an important role in supporting this development. This action will also be coordinated with those national and regional authorities directly involved in the implementation of relevant Community policies.

The Commission will include actions to encourage and support the development of Earth observation applications in its proposals for future Community research, development and demonstration programmes.

The overall aim will be to develop new applications and to improve the quality and cost-effectiveness of information derived from the data.

The proposed actions will include research on the technical feasibility of new applications, and pilot projects to demonstrate the operational use of Earth observation for applications of public interest.

These actions will be closely coordinated with the relevant activities of the JRC to ensure synergy and the optimal use of facilities such as the European Microwave Signature Laboratory and the European Airborne Remote Sensing Capabilities project. They will also encourage user involvement in projects, and cooperation between universities and industry.

In addition to fulfilling the objectives mentioned above, the activities will be aimed More specifically at the stimulation of the applications market and, in so doing, the development of the industrial value-added sector.

B. THE MEANS

In a general way prenormative and prelegislative actions are carried out according to need either as shared cost projects or as concerted actions or accompanying measures. Nevertheless, in order to concentrate Community research and to increase its visibility in the overall context of research on global change, research actions in this field will be pursued in the framework of the ENRICH network.

The work developed in this frame will oriented so that: the research results will contribute to the objectives of the world-wide programmes, IGBP, WCRP and HDP so that the results will be equally applicable to the implementation of the 5th Environment Action programme previously mentioned. Specific attention will be given to multidisciplinary research projects bearing on interactive processes between the above mentioned systems, understanding and modelling of them, as well as the incorporation of data and results in better models so as to contribute to world-wide research.

Research actions developed in framework of the ENRICH network will include concerted actions on specific themes, shared cost projects and corresponding JRC activities. The objective is to integrate national research efforts in order to obtain sufficient research capability and to concentrate Community research actions on a limited number of large projects. A particular attempt will be made to put existing infrastructures, Community as well as national, on a common basis and to develop those Community infrastructures which are necessary to pursue the objectives of the programme. By way of example these Community infrastructures could cover the shared use of the means of observation or experiment (oceanographic ships, planes, ...); the joint development of means for collecting, processing and using data; the concerted development of the means for climate modelling at Community level; instrumentation for experimental transects or for measurement campaigns at Community level. These activities would be steered by scientific steering committees which include representatives from the centres of excellence participating in them, which would ensure scientific management and cohesion. These activities would be coordinated so as to ensure the cohesion of the programme as a whole, the consolidation, processing and the distribution of results as well as the development of interdisciplinary projects and the development of models.

Community work would be concentrated on five major actions:

I Climate research and modelling;
II Ocean research;
III Atmosphere research;
IV Research on the terrestrial system;
V Socio-economic research and modelling.

In the framework of *action I*, European climate modelling centres will be associated in order to give all European climate research groups access to the most advanced instruments and models. This action will aid the integration of the results of studies on historical and current climate processes and will allow cooperation with the corresponding worldwide programmes (PAGES [Past Global Changes]; WCRP [World Climate Research Programme]...).

Equally in the framework of *action II*, the integration of national activities is envisaged for the modelling and management of data at a European level. These research and coordination activities will contribute to provide a European "service" on a global scale with a view to facilitate the use of synoptic observations, access to models, etc. Various support initiatives or foreseen to achieve this end. This action will be pursued in synergy with relevant global programmes (GEWEX [Global Energy and Water Cycle Experiment], WOCE [World Ocean Circulation Experiment], JGOFS [Joint Global Oceans Flux Study]).

Action III will contribute to the integration of national research in the field of atmospheric physics and chemistry and will coordinate this work in the framework of the global change programme IGAC and in cooperation with EUREKA-EUROTRAC. In this respect it will be necessary to reinforce the initiative managed by EIPO (European IGAC Project Office).

Action IV will contribute to the coordination of national research work in the field of terrestrial ecosystems in collaboration with the global programme GCTE (Global Change in Terrestrial Ecosystems). To implement this TERI (Terrestrial Ecosystems Research Initiative), which is currently in a preparatory stage, will be made operational. *Action IV* will also coordinate European research work on coastal ecosystems in collaboration with the global programme LOICZ (Land Ocean Interactions in the Coastal Zone).

Finally *action V* will organize environment socio-economic research on a European basis with the combined objective of aiding the development and implementation of the concept of the 5th Environment Action Programme and of contributing in a significant way to the global change programme HDP (Human Dimensions Programme).

Work within these 5 actions will be integrated with that of the JRC in relevant areas. Care will be taken to ensure coordination with the activities of other Commission services, in particular those linked to the definition of Community environment policy, in conformity with the principle of the ENRICH network.

In the field of technological research the JRC will contribute its competencies and its infrastructure, for example the European Microwave Signature Laboratory is a large unique facility at European level for validating the techniques of monitoring environmental changes using advanced teledetection systems. These actions could be managed in collaboration with EUREKA as appropriate. For example in the field of marine technology (EUREKA/EUROMAR), work will be concentrated on techniques of a multisectoral nature with potential spin off. Complementary stimulating actions will be envisaged to improve the transfer of knowledge to industry.

IMPLEMENTATION

Projects which are the subject of shared cost actions will generally have a limited numbe of participants (5-10) so as not to overburden the administrative and financial management Nevertheless projects will be regrouped and coordinated around the 5 principal action mentioned in the chapter on means, with the object of consolidating research work, c developing a multidisciplinary approach and of increasing the visibility of the Communit initiative, in particular in global change research. Scientific management will be ensured b scientific steering committees, advisory bodies formed from representatives of the centres c excellence involved in these projects.

A specific procedure will be implemented in order to stimulate the participation of SMEs i the programme ("technological stimulation") in drawing on experience from the CRAFT an feasibility grant actions.

It will be possible to submit outline proposals (open and continuous call for proposals) an those proposers which are selected will receive a feasibility/expansion grant to seek partner and to draw up a detailed proposal. This detailed proposal will then be evaluated with a vie of deciding on the financing of the actual research project.

ANNEX II

INDICATIVE BREAKDOWN OF THE EFFORT BETWEEN AREAS (%)	
AREAS	BREAKDOWN
Natural environment, environmental quality and global change	55-65 %
Environmental technologies	20-30 %
Earth observation, application of space technologies	10-20 %
Total	100 % (625 MECUs)

LIFE SCIENCES AND TECHNOLOGIES

ANNEX I

SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES AND CONTENT 29.09.93

INTRODUCTION

The present specific programme fully reflects the orientations of the fourth framework programme, applies its selection criteria and further defines its scientific and technological objectives. The sector of Life Sciences and Technologies is characterized today by a vast diversity of potential applications within agriculture, fisheries, industry, health and the environment, preceded by effective breakthroughs, which still increase in number. Despite the fact that small research companies are not as widely established in Europe as they are in the US, it remains a genuine European strength that large chemical, agro-chemical, pharmaceutical and seed companies give to life sciences and technologies a substantial share of their research budget, comparable if not superior to that given by equivalent US companies. In general, the private effort may now exceed the public effort financially. The level of industrial expectations stems from the value of markets to be preserved, as well as markets to be gained. The most likely biotechnology products with the highest relative growth before 2000 are vaccines, new drugs and seeds. It is vital that European companies which are in the front line can draw upon an adequate science base that is both innovative and responsive to problems.
The new mission of research within Life Sciences and Technologies consists of harmonizing scientific progress with industrial expectations and social demand, with respect to biological processes which affect the largest number of European citizens. This necessary harmonization points to specific requirements.
In the field of Life Sciences and Technologies, the European research potential is fairly well developed. National programmes have become bigger and numerous Member States have started to organize intensively their networks of excellence, to reinforce their pilot research centres and to upgrade the quality of their infrastructures. In the framework of EUREKA, the effort to bring new biological products or processes closer to the market has been growing significantly over recent years. The corresponding previous Community programmes raised the level of awareness of the opportunities across national boundaries very early on. They contributed to setting up research projects which were attractive to industry. Community research in Life Sciences and Technologies is thus about to add a second phase, one which will stress the exploitation of acquired benefits and promote the returns to interested socio-economic participants.

This Community programme will encourage global approaches rather than reductionist approaches, the integration of disciplines against excessive specialization, a careful attention to users' needs such as those expressed through consumer groups, the regulatory levels, and from industrial platforms or professional associations. This programme establishes the need to restrict the number of selected topics to those whereall the above conditions for an integration process at Community level are met.

Particular attention will be given to the needs of Small and Medium-sized Enterprises (SMEs) and to the effective use of fellowships. For SMEs, a specific procedure will be implemented aiming at increasing their participation in the programme (technology simulation), based on the experience of CRAFT activities and feasibility awards.

Outline proposals may be submitted at any time (a continuously open call for proposals) and those proposals selected will receive a feasibility award to search for partners and to prepare a detailed proposal. That proposal will then be evaluated in order to decide on the funding of the research project itself.

Attention will be given to three areas with promising developments under way, namely:

- biotechnology
- biomedical and health research
- application of life sciences and technologies in agriculture and fisheries (including agro-industry, food technologies, forestry and rural development).

Europe has not been able, unlike the US with their Presidential initiatives, to spell out an explicit priority for biotechnology. Its specific weakness lies in a dispersion of responsibilities and a lack of social consensus on scientific missions. This reticence in identifying and mobilizing relevant activities must be overcome by a more systematic consideration of the range of scientific opportunities which can be set against present societal needs. Biotechnology can remain at the source of innovation if it concentrates on the understanding and control of the mechanisms which determine the functioning and productive performance of living matter. It is a fact that it has been possible to mimic successfully living processes for applied purposes and it will be more so in the future if the blueprints of these processes become accessible. Optimal operational conditions will be created which can best help lift this limiting step. Biotechnological research will be promoted in so far as creating the links by which certain basic disciplines and new emerging technical skills enter a real partnership towards the understanding of biological phenomena.

The same holds true in biomedical and health research, which is in need of more knowledge of the basic mechanisms which maintain normal functions in an healthy body and whose disruption results in diseases. Understanding the pathways is a necessity prior to identifying novel drug targets. The key to progress is interdisciplinary research involving, for example, pharmacologists, cell biologists, molecular biologists and medical chemists. In view of the limited contribution which the EC will add to national governments' and industrial R & D expenditures, an emphasis will be put on larger ambitious long-term projects which will contribute to keeping the social burden of health care tolerable, while laying the ground for a single European market for pharmaceuticals, medical devices and health services. Attention will be given to research related to prevention and public health.

The advances in life sciences will, together with innovations in other disciplines such as engineering or chemistry, form the scientific basis for developing new processes and applications in agriculture, fisheries and related processing industries. Special attention will be given to research activities supporting the evolving Community policies (Common Agricultural Policy - CAP - and Common Fisheries Policy - CFP - especially) and responding to the needs of society for a wide range of healthy and nutritious foods and environmentally friendly non-food products.

Although the Life Sciences and Technologies constitute a rapidly expanding field, utilization of new technologies by industry and services continues to be hampered by specific hurdles such as competing technological alternatives, compliance with regulatory requirements, variable public perception and shortage of interdisciplinary resources. Appropriate demonstration activities will be required to give a higher profile and attractiveness to the biological route leading to new products and processes.

Research potential and industrial expectation within Life Sciences also elicit strong social demands. This is expressed through ethical concerns, consideration of safety principles, food habits and acute needs for health care which are adapted to ways of living and demographic evolution. A lack of public acceptability is one of the limiting factors for both research and its successful commercialisation.

RTD AREAS

AREA N° 1 : BIOTECHNOLOGY

The Background

The economic sectors whose competitiveness significantly depends on biotechnology (agriculture, food, chemicals, pharmaceuticals) account for the employment of 16.4 million people in Europe and for exports worth ECU 132.8 billion.

Europe has roughly 300 companies involved in some aspect of biotechnology, including a number of world-scale chemical and pharmaceutical companies. The sustained growth of this sector will depend on the innovation capacity of the life sciences, the efficiency with which novel techniques and established practices will be combined with the required multidisciplinary vision, the validation of scientific principles to underpin a unified market of biotechnology-derived products, and the harmonious application of bioprocesses as beneficial alternatives to promote the environment, human health and welfare. Progress along those lines will ensure that the estimated sales of non-food biotechnology products of ECU 26-41 billion in the year 2000 can be realized and that this goal is achieved with a prominent European participation and a high degree of social acceptance.

Particularly relevant to realizing the desired partnership of the life sciences and the European society will be the arrival on the market, under the period covered by the IVth Framework Programme, of the first generation of transgenic plants endowed with useful new properties, of novel vaccines deriving from rDNA work or of natural antimicrobial substances preventing microbial spoilage of food products.

This situation is historically novel, as it makes biotechnology now a reality for scientists, policy-makers and industry to base their forward thinking on, whereas earlier programmes had been geared to mere projections into the anticipated future. It will be the responsibility of the Community to promote under this programme further research work where the society would expect the highest returns. This points to privileged areas for the exploitation of new knowledge, all of which do experience in common an acute need for cross-linking connected topics and/or integrating large groups of experts on an international scale. The same integrative effort will be required for putting living cells safely to work, for raising the profile of the European contribution to the international genome projects, for achieving the new deal of modern agriculture and environment via the genetic design of crops, or overcoming academic distinctions between neurobiology, endocrinology and immunology until the principles of cell and molecular interactions are unravelled.

The Proposed RDT Activities

The centre of any biological process in nature or in systems domesticated by man really is the living cell, which functions as a minute factory.

Each cell consumes its raw materials, converts energy, produces high value molecules as well as wastes, and has learned through evolution how to carry out those constructive processes in equilibrium with its environment. An infinite number of cells in living organisms bred for agricultural purposes, or in fermenters conducted for the industrial supply of valuable molecules, all behave as populations of clean productive units which can be exploited in a sustainable manner. In an attempt to focus biotechnology where it genuinely differs from alternative technologies, all efforts must start with a thorough understanding of how the cell manages to be so successfully industrious.

OBJECTIVES REQUIRING CONCENTRATED MEANS

Cell factories :

Industrial and environmental exploitations of living cells would hardly be achievable without integrated contributions from biochemistry, process engineering and computer sciences which they have to depend on. New interfaces between biotechnology and advanced technologies offer opportunities for the integration of biology with other science and technology fields. A multidisciplinary vision of cell factories must be promoted, with the intertwined participation of academic and industrial laboratories. The objective is to combine biological concepts (particularly cell biology and signalling, macromolecular interactions, microbial physiology and genetics), and bioengineering methods aimed at solving industrial problems. Bioprocess engineering activities will be complementary, and closely coordinated with the contributions invited under area 3 of this programme, and under the programme on Industrial Technologies, to cover interrelated work applying processing, end-use and scaling-up technologies adapted to industrial conditions. It will be shown that bioprocesses (such as fermentation, cell culture, biotransformation and downstream processing) can be optimized to yield novel molecules which can meet the economic, societal and environmental specifications of the present and future markets. The biosafety of vector systems, cell lines and microbial cultures will be an important consideration of any project selected for this action.

Genome analysis :

The participation of European networks in the worldwide genome programmes will be facilitated via the further analysis and sequencing of model genomes, the exploitation of comparative approaches including those associated with the human genome, and the development of appropriate technologies and infrastructures with the required operational compatibility. Methodologies will be set up and applied to render possible the association of detailed biological functions with newly unravelled genes. Particular attention will be given to systematic approaches leading to the functional identification of sets of genes contributing to specific biological processes of interest and their regulation. Relevant transcriptional and replicative mechanisms will also be investigated for an effective exploitation of genomic resources. Alteration of germ cells or any stage of embryo development with the aim of modifying human genetic characteristics in a hereditary manner is excluded from the programme objectives. Accompanying measures on ethical, social and legal aspects will be included and coordinated with corresponding horizontal activity elsewhere in the programme.

- Plant molecular biology :
  Plant molecular and cellular biology, physiology and pathology, at the crossroads of agricultural, industrial and environmental issues, will be developed by integrated action. Particular attention will be given to the molecular surgery of relevant crop species as a technology leading to new tailor-made market-relevant agricultural products, and to production methods compatible with the environment, health and consumers' demand. Biological traits of agricultural or industrial relevance and their corresponding genes would be the main target for such activity.

- Cell communication in neurosciences :
  Neurosciences will be promoted by the combined support of several disciplines such as pharmacology, cellular biology, and molecular biology including molecular genetics and biochemistry in order to understand the inter- and intra-cellular events by which nerve cells manage information (communication within and among cells). The research will provide new insights into the understanding of the molecular and cellular functions or dysfunctions.
  Special attention will be given to developing new cellular and multicellular systems applicable, for example, in new drug design and in vitro testing. International collaboration with the Human Frontier Science Programme will be strengthened.

The four actions above will benefit from a range of specific measures aiming at the achievement of increased harmony between scientific progress and realities of the economic world, namely : the systematic combination of advanced biotechnology with the whole spectrum of established disciplines and techniques, to increase the control which the practitioner may have over biological processes; the close interaction of scientific teams with the users of research results and with expert groups looking into new indicators of welfare; the accompanying assessment of lateral effects which arise with the recognition of economic and social constraints (provisions for safety, ethical issues, education, public information, targeted training to link research and industry).

OBJECTIVES ADDRESSED BY CONCERTATION

Three other activities will be approached by setting up research projects or concertation networks. The objective in this case will be to share work and information in fast-moving fields, and to pool data or methods which may provide unequivocal bases upon which science policy and regulatory measures could be developed further.

To be addressed mainly via research projects, not excluding some thematic networks :

- Animal physiology, immunology and structural biology :
  These are key disciplines from the point of view of industrial interest and potential applications, which would benefit from the mobilization of scientific

communities. Attention will be given to newly developed biotechnologies which can prevent or control major human and animal pathologies. Research will concentrate on transdisease vaccinology, on somatic gene therapy, on transgenic animal models of human diseases and on reproductive mechanisms as far as being connected with farm animal welfare and animal diversity. The role of macromolecular structures in normal and pathological developmental processes will be investigated. Methods to predict and determine structure / function relationships and to pick up or design molecules with specific functions (e.g. including in vitro directed molecular evolution) will be developed.

To be addressed mainly via thematic networks and concertation networks :

Pre-normative research, biodiversity and social acceptance :

Community efforts will be brought into closer harmony with national efforts when this leads to methods or data that would consolidate the rational basis of regulatory approaches and would support the development of internationally accepted standards and systems of risk assessment. This activity will be encouraged in three fields: the development of toxicological/pharmacological in vitro tests, the biosafety evaluation of biotechnology-derived products, and the development of processes solving environmental problems. As far as in vitro testing is concerned, priority interest will be in the reproducible expression of neurological, immunological and developmental traits, e.g. cells maintaining their normal metabolism, with a view to providing methods and data usable in particular by the European Centre for Validation of Alternative Methods at the Joint Research Centre (JRC).

As far as the biosafety evaluation of biotechnologically-derived products is concerned, special emphasis will be given to the risks possibly associated with releases of genetically modified organisms into the environment and to the scientific support of the implementation of the Community's regulatory framework ensuring safety for man and the environment. Finally, a series of biotechnological methods and processes should be developed for the detection, prevention and remediation of compounds hazardous to the environment. Molecular and cellular biology will be put to the service of biodiversity studies, either for conserving existing genetic resources or for exploring unexploited diversity. Particular emphasis will be put on analyzing lateral issues such as public perception and the acceptance of biotechnology in general, in liaison with the horizontal activity on ethical, social and legal aspects of the life sciences and technologies.

To be addressed in the form of a targeted support to European-wide information systems:

- Infrastructures :

  Development of bioinformatics, of information infrastructures and resource centres (databases, genetic collections, etc.) as a service and support to wider scale research by the Community or its Member States, given the required compatibility with arrangements made for established international projects.

AREA N° 2: BIOMEDICAL AND HEALTH RESEARCH

The Background

Health is of the highest value for every European citizen. It is a primary economic sector absorbing 6 to 8% of the GNP and creating work for more than 6 million people or 7% of the active population. There are 850,000 medical doctors, 3 million hospital beds and 0.8% of the population per day is in a hospital bed. Health research is challenged to gain control over the greatest scourges such as AIDS, cancer, neuro-mental diseases, cardio-vascular diseases and problems linked with age and handicaps. Rising health care costs have become a concern for all EC countries, while the European citizen is demanding more and more high-quality health care. New health technologies and health care systems are expected to face these common problems. 20% of all health care costs are related to brain-based problems. Neurodrugs represent the largest sector of drug development worldwide, expected to increase from 4.7 billion $ to 7.4 billion $ in 1996. The development of new drugs has become more expensive in both time and money, mainly due to the need to satisfy increasingly complex regulatory requirements.

On the other hand, certain fundamental health problems may only be resolved by industry, of which the competitivity must be ensured and improved. Rather than adding a minor supplement to substantial investments already made by the Member States and industry, the Community research will bring added value by an integration action and by the coordination of national efforts.

With the launching of the first biomedical and health research programme (BIOMED 1) within the third Framework Programme, a European medical research community has become a reality. More than 3,500 teams are collaborating within 117 concertation networks; 250 more networks are to be created designed to encourage cooperation between teams from all EC and EEA countries and between complementary disciplines, with a view to tackling health-related problems not readily solved in a narrower context. Allocated funds were not for the research itself (except human genome analysis) but for building and coordination of networks. In the fourth Framework Programme it is intended to go beyond networking and to participate in shared-cost research itself, within the following priority fields: AIDS, tuberculosis and other infectious diseases; cancer; research on prevention and treatment; pharmaceutical and clinical research in order to define new, faster and more significant tests for drug development in the field of neuro-mental and immunological disorders; and multidisciplinary brain research by bringing together the most advanced and costly infrastructures.

The Proposed RTD Activities

OBJECTIVES REQUIRING CONCENTRATED MEANS

AIDS, Tuberculosis and other Infectious Diseases

Important progress in the battle against AIDS has been made through concertation of AIDS research on an EC level. Meanwhile, new threats to the general population with its ever increasing cross-border mobility may arise from old diseases, notably tuberculosis, already drug resistant in some areas. The integrated action should concentrate on the development of:

- a European vaccine against AIDS;
- antiviral drugs in AIDS management;
- clinical research, including clinical trials;
- studies on the host response, pathogenesis, experimental models, hospital infections and new pathologies; and
- disease prevention, including concentration on new specific epidemiological projects and screening.

Cancer Research

Improvement in cancer care outcome requires research on the fundamental as well as on the clinical level. Fundamental research is aimed at the development of new biological insights into the mechanisms of the disease which will then allow the development of novel approaches for prevention, detection and treatment. Clinical research has to make the translation of these new possibilities into clinical practice, assessing their potential usefulness in the individual patient, their feasibility in daily practice, and their availability to the general patient population as well as their correct applications.

The four important domains to be addressed are:
Basic Research - Molecular mechanisms, and metastasis/invasion and characterization; mechanism and control, abnormalities in expression and cell death;
Predisposition and Immunology (familial incidence);
Diagnosis and Treatment (new diagnosis and new treatments); and
Prevention and Education - including risk quality of life, after-care, reducing pain and economic factors.

Pharmaceutical Research

The use of biotechnology in the pharmaceutical industry is gaining momentum and will represent for the European pharmaceutical industry an opportunity to increase its innovation capacity. Research in faster and more significant testing for drug development, in order to demonstrate quality, efficacy and safety of new drugs will facilitate their access to the market according to the needs and demands of the users.

This activity can provide the prenormative research outlet of the Community responsibilities in drug approval and registration as foreseen for the European Medicines Agency in order to achieve the pharmaceutical Internal Market.
The integrated action would include research aimed at:

- prevalidation of rapid correlated testing models such as:
  - alternative "in vitro" toxicity testing and
  - improved animal models;

- development of quality, safety and efficacy tests based on advanced biology, this being particularly appropriate for new categories of drugs, e.g. new vaccines, cytokines, monoclonal antibodies; and
- development of a system for multicentre clinical trials and of a high performance surveillance network for early detection of possible undesired effects of new drugs, within an appropriate regulatory framework.

Neurosciences and Brain Research

In the last few years the neurosciences have undergone a major revolution, based upon new capabilities created by molecular biology, genetics, novel instrumentation and information technology. By the transdisciplinary development of new methodologies and by international collaboration with the Human Frontier Science Programme, together with the bringing together of the most advanced infrastructures and costly instrumentation, there will be major opportunities to help persons suffering from the following priority diseases or areas:

- neurodegenerative disorders including research on Alzheimer's and Parkinson's diseases and on accidental injuries including problems related to paraplegia;
- multiple sclerosis and immunomediated diseases;
- psychoses, including child autism;
- fundamental brain functions, the biology of receptors, systems neuroscience and cognitive neuroscience, use of cell and molecular biology methods;
- research on neurological disorders with a genetic component - close collaboration with activities started under human genome analysis will be ensured; and
- cerebrovascular disorders, which should be implemented in close collaboration with activities already going on in BIOMED 1, in particular on cardiovascular diseases.

OBJECTIVES ADDRESSED BY CONCERTATION

Prevention, Occupational Health, Risk Factors and Public Health Research

About 10 million of the 150 million workers in the EC are subject each year to an accident at the workplace or an occupational disease, and about 8000 workers are killed by an occupational accident; some 120 billion ECU per year are spent in the EC on compensation for accidents. In addition, the importance of public health in the EC can now be more clearly demonstrated. To contribute towards ensuring a high level of human health protection, to promote prevention of disease and to increase safety and health protection of workers in all industries, research will be needed both on the causes and transmission of disease and on the avoidance of accidents at the work-place and the prevention of work-related diseases, so helping to contribute to the economic viability and competitiveness of enterprises.

There will be research on risk factors, early detection of diseases and cost-effectiveness of screening systems. Major issues to be dealt with can include:

- Development of standardized registration systems;
- Identification and control of major risk factors, including exposure to harmful agents and to work-stress;
- Interactions between genetic and environmental risk factors in the aetiology of disease;
- Interactions between long-term work facilities, e.g. catering, and the possible development of disease.

Epidemiology of Illnesses with Major Socio-Economic Impact

Europe, with its multicultural communities and the abundance of variations in disease incidence and risk factors (environmental, physical, dietary, occupational, lifestyle-related, etc.) is an ideal field for epidemiological research. The benefit of large population-based studies will allow the detection of the cause of numerous diseases and to study gene-environment interactions. Advances in networking and the availability of computer technology facilitate the analysis of large data sets and will contribute to the development of epidemiological studies of larger and more international dimension.

There is a need for a centralized information database on epidemiological studies, ongoing or already performed, and the pooling of resources, e.g. central data archives possibly including biological materials, should be considered.

This research is aimed at further development of preventive measures and at public health policy.

Research on cardiovascular diseases will focus on research where coherent broadly-based clinical and epidemiological surveys are most useful. This will include : correlation between genetic factors, lifestyle, nutrition, and the incidence and development of cardiovascular disturbances, the effects of prophylactic and therapeutic measures, the development of new regimens for treatment including non-invasive methods of diagnosis, and the clinical testing of drugs.

Human Genome Analysis

Fundamental research will be supported, with its emphasis on functional studies in order to ensure that advances in genetics are used to enhance human health. In particular, attempts will be made to develop somatic gene therapy where the defective gene is identified and when the conditions/acceptance in Europe justify a targeted effort, e.g. cystic fibrosis. Emphasis will be placed on medical applications which contribute to the well-being of patients. The better understanding of the concepts underlying somatic gene therapy will generate novel opportunities for the treatment of many diseases, e.g. the insertion into cancerous cells of genes which induce regression of tumours:

- Mapping and sequencing efforts will concentrate on the production of sequence-ready physical maps.

- Technology development aiming at new methods for significantly faster and more reliable sequencing of long stretches of DNA.

- Research on animal models relevant for a more rapid and detailed understanding of human genetic function, e.g. the mouse and the rat, for the development of sophisticated disease models and for the study of opportunities for diagnostics and therapy, with particular attention to opportunities for the development of novel therapies.

- The further development of an integrated genome database and new algorithms for describing the structure and function of DNA.

- A better understanding of the expression of the information stored in the DNA into functional proteins and the interactions of different DNA motifs.

Health Services Research

The coordination of research in this field will lead to the development of comparable European health data, to the provision of useful insights into the problems and characteristics of European health systems and, where possible, to the development of common methodologies. This information coming from multi- and interdisciplinary research can assist national and European health care decision-making.

Priority will be given to research on prevention and primary care, assessment of health needs, in particular the needs of the emerging dependency groups, equity in finance and delivery of health care, and outcome measures of health interventions including the quality and effectiveness of the services provided.

The single European market has an impact on the development of health systems and will require research on:
- needs and demands for health care;
- health promotion and preventive care;
- improvement of quality of care; and
- health economics and organisational aspects.

Biomedical Technology and Engineering

Within a European-wide unified market, health technology assessment should remain a priority, in order to provide data at all decision-making levels. The facilitation of European-wide clinical testing of new devices represents a good example of subsidiarity. Involving hospitals and clinicians at the early stage of clinical trials also creates favourable conditions which are essential for the rapid dissemination of innovative devices. Facilitating such trials on a European-wide basis creates a potential European-wide market for innovations. Specific areas are:
- minimal intervention techniques, miniaturisation, video techniques and robotics in which Europe has still a lead;
- cellular engineering has emerged as a new research area and should be encouraged on a European level. Cellular engineering includes the role of engineering in both basic cell biology research and in the making of products which use living cells, for instance in the development of biological substitutes for the restoration or replacement of body functions;
- further development and application of imaging techniques will be required in order to improve early diagnosis and follow-up treatment, especially drug treatment. They will also contribute substantially to the improvement of basic anatomical and physiological knowledge, in particular in neurology;

- research on sensors, especially for clinical value, should continue;
- the trend towards replacement in medicine will call for more research on biomaterials and artificial organs;
- research on drug release devices should be promoted;
- further application of information science and technology will remain essential; and
- the growth of the elderly population in Europe, together with increasing concern for the needs of handicapped persons, justifies pursuing efforts in rehabilitation technology.

Biomedical Ethics

This area, being of a horizontal nature, is relevant to all the specific targets within the programme and therefore careful consideration should be given to addressing this issue within all future activities but specifically in target areas such as human genome analysis, somatic gene therapy, confidentiality of genetic information, prenatal or pre-symptomatic screening, organ transplantation, experiments on human beings, and patients' consent in clinical research.

AREA No 3: APPLICATION OF LIFE SCIENCES IN AGRICULTURE AND FISHERIES INCLUDING AGRO-INDUSTRY, FOOD TECHNOLOGIES, FORESTRY, AND RURAL DEVELOPMENT

The Background

The economic sectors encompassed by this programme can be divided into three groups: the primary sector (agriculture, horticulture, forestry, fisheries); the "input" industries (e.g. seeds, juveniles for aquaculture, fishing technology and inputs for fisheries, machinery, chemicals, fertilizers, feed, etc.); and the processing industries (wood, paper, pharmaceuticals, food, sugar and starch industries, etc.) and other rural and coastal activities. These large sectors are sectors which include the large leading companies and numerous SMEs developing and producing "niche" products which would benefit from the programme as well as the 10,000,000 farmers cooperatives and fishermen of the Community.

The major Community policies of Agriculture, Fisheries, Environment, Rural Development and the Internal Market apply from primary production to the final transformation industries. The developments which will arise from activities under this programme will contribute to these policies and the development of European primary production in agriculture, fisheries, forestry and the downstream industries and users.

The major challenge in this area is to contribute to a better match between the production and utilization of biological raw materials in Europe, in particular through the improvement of their original quality. New markets and products will have to be developed for raw materials produced by agriculture, forestry and fisheries which meet the demands and requirements of the end-users.

The overriding objectives for this area are to provide a strong scientific research base for a competitive, efficient and sustainable primary production and agro-industrial sector; to support the evolving Community policies (especially agriculture, fisheries and rural and coastal development) and to respond to societal needs for a wide range of healthy and nutritious food and new non-food products, which are produced with minimum damage to the environment.

Therefore research should seek to remove bottlenecks which are hindering the wider use of biological raw materials for new and improved food and non-food products, and to stimulate the emergence of environmentally safe products and processes within the agricultural, forestry, agro-industrial and fisheries sectors. Research should also respond to socio-economic issues of rural and coastal communities, to safety, quality, health and environmental implications of new food and non-food products for which it is clear that there is a demand from the public.

The Proposed RTD Activities

OBJECTIVES REQUIRING CONCENTRATED MEANS

Integrated production and processing chains :

There is the potential in the non-food sector to create significant new markets which will utilize biological raw materials from Europe. As many bio-based non-food products have to compete with established products, it is essential to optimise the complete production chains in order to develop economically feasible opportunities. To this end all necessary skills and technologies, particularly biotechnologies, related to production chains will be combined in integrated projects addressing those chains for which Europe has a competitive advantage. In terms of participants strong emphasis will be put on the participation of producers and users of biological raw materials in joint projects, closely cooperating with scientists. The wood and biomass production chains, where overall efficiency is most likely to generate significant impact on rural economies, will be addressed. Considerable efforts will also be devoted to higher value-added novel bio-based intermediate- and end-products. Synergistic effects of combining different production lines will be sought, e.g. by optimising the conversion of by-products to energy and other non-food products.

It is the intention to create large projects which will focus on all aspects of a Major Crop Group Lines. These projects will encompass the primary production of the crop group (for example cereals), the processing to the food and/or non-food end-use products. It should bring together the necessary critical mass so as to create a significant impact, within the short- to medium-term, on the development of new technologies and products within each Major Crop Group Line.

Scaling-up and Downstream Processing :

The transfer from laboratory to industrial scale operation is characterised by major problems and bottlenecks. Improved methodologies will be developed for designing and testing innovative agro-industrial processes and the application of biotechnologies while lessening the economic risks currently associated with investing in new technology.

In multidisciplinary projects scientists and engineers will be brought together in order to understand the specific problems directly resulting from increasing the scale from the laboratory to industry. In particular specialised instrumentation, structured models and simulation methods will be jointly developed.

The "green" bio-based chemistry, chemical engineering and fermentation are typical examples for downstream processes which pose technological difficulties in scaling-up to the industrial operational scale.

Based on careful selection and feasibility assessment, up-scaling experiments will be supported. A European infrastructure for pilot-scale experimentation will be developed in order to ensure the optimal use of existing and future pilot plants.

Generic Science and Advanced Technologies for Nutritious Foods :

The food and drink industry ranks second in terms of output in Europe. Research should improve the industry's competitive position but also provide consumers with a safer, more nutritious and health-promoting diet.

Research will concentrate on generic scientific phenomena involved in the conversion of biological raw materials into foodstuffs, and their consumption and metabolism in the human organism. The emphasis will be on multidisciplinary, molecular approaches which will support new advanced technologies for the food sector.

Community activities will concentrate on methods for the quantification of quality and wholesomeness attributes, control methods, basic food science (structures, interactions), food functionality in-vivo and in-vitro, novel processing technologies, equipment and products (emphasizing biotransformation/biotechnology), and implications of these for consumer behaviour.

Nutritional diseases and disorders are an increasing aspect of modern lifestyles. Multidisciplinary research will focus on the relationship between dietary components and health status, particularly food absorption and metabolism, the role of intestinal flora and immunology, and the tailoring of foods for specific nutritional requirements.

Agriculture, forestry, rural development and fisheries :

The research in this area has the goal of accompanying the Community policies and the identification of solutions to face the changing rural world. The need is to develop new production systems which are economically viable, which are both protective of the environment and maintain an adequate level of employment. An improvement in the economic situation of agriculture and fisheries will be also sought by means of quality products, diversification of products (food and non-food) and activities, and by cost-reductions.

- Agriculture, forestry and rural development

In the "classical" agricultural production, research should provide the scientific base necessary to identify and develop, in the context of the reformed CAP, the means, techniques, systems and chains of production corresponding to a less intensive agriculture, compatible with the protection of the environment but economically viable and maintaining a sufficient employment level. New positive uses for set-aside lands for farmers and the community should also be found.

In the area of quality product and the support of new Community regulation instruments, research should identify and characterise the products and quality chains, and define and diffuse the conditions which assure as high as possible income for the producer.

Diversification of production and the farming sector activities require a research effort for the identification and analysis of all possibilities, without exception (food and non-food). Likewise the technical and economic references will be equally defined and contribute to the highest possible development, favouring a multidisciplinary approach in this context.

In the field of plant and animal health and animal welfare, research will be concentrated on the scientific base necessary for the development and the management of Community regulations taking into consideration their different aspects, and on the implementation of the necessary means for the proper functioning of the Internal Market.

In the forestry sector, in conformity with the orientations taken as a result of the Rio Summit, research will be centred on the sustainable multifunctional management of forests, assuring the harmonious development and integration of the three functions of the forest (production, protection and leisure).

In the area of rural development research must provide the scientific support for implementation of the Community policy: analysis of the agricultural structural policies and of rural development, tool methodologies for the assessment, the monitoring and evaluation, and for the mobilisation of local potential, identification of potentials and constraints of rural development, introduction of new technologies and activities in the weak rural areas (particularly Objective 1 and 5b), and the elaboration of models of rural development.

- Fisheries and Aquaculture

The improved use of technologies and inputs should aim at a rational exploitation of natural resources while ensuring the proper conservation of the environs and dependent populations. Fisheries management requires decisions which can only be taken on the basis of scientific analysis. These analyses should be the result of work integrating the different components of fisheries (resources, environment, inter- and intraspecific interactions, socio-economic aspects, fishing technologies and gear, etc.); at the same time methodology innovations which have developed in cellular and molecular biology can be used as complementary instruments.
Aquaculture is of growing importance for the Community. Major problems have to be overcome for developing optimised aquacultural production systems, including pathological and nutritional issues of intense fish farming. Multidisciplinary, integrated research and thematic and coordination networks will be established in order to respond to the needs of the Common Fishery Policy.

OBJECTIVES ADDRESSED BY CONCERTATION

In areas where Member States have extensive programmes, the focus will be on concertation of these efforts in order to optimise the overall efficiency. This concertation will be executed by establishing European thematic networks which will bring together most of the relevant actors in the field. Examples of areas where this is appropriate are:

- Networks for enhanced primary production in agriculture, forestry, fisheries and aquaculture with main emphasis on sustainability, quality, security of supply and interactions with the environment.

- Rural and coastal development: The RTD activities at Member State level, which could be relevant to rural and coastal development, are quite disperse. By providing a European forum for the exchange of experience, know-how and methods, European concertation activities will help to develop innovative approaches to overcome the problems of these regions. Special attention will be paid to the opportunities offered by new economic activities in rural and coastal regions, training, as well as the assessment of their socio-economic and environmental impact.

- Networks of food production and processing: Networks will be created which better integrate research on-going at national level especially bringing together research in food production, safety, health and socio-economic aspects and incorporating this experience with food processing.

This pooling of experience should create synergistic effects of benefit to primary producers, processors, consumers and the other actors in rural and coastal development.

OBJECTIVES ADDRESSED BY DIRECT ACTION

Direct actions will be carried out in area 3 by the JRC in particular on:

- the use of laboratory analysis of wine (in order to bring scientific and technical support to the operators in the framework of Community regulations related to wine). These competencies will be progressively enlarged to cover pharmaceutical and food products;
- a technical support project for the management and control of the application of the CAP, using satellite data, will be established;
- continuing the establishment of a teledetection project for agricultural statistics.

In conclusion the actions under area 3 seek to extend the application of the basic technologies developed in biotechnology, biomedicine and teledetection.

IMPLEMENTATION AND HORIZONTAL ACTIVITIES

The following presents the specific methodology to implement the three scientific and technical RTD areas, as well as two horizontal activities (Demonstration Activities, and Ethical, Social and Legal Aspects) in the field of Life Sciences and Technologies:

1 - CONCENTRATION

Shared-cost proposals for activities where means must be concentrated will usually give rise to integrated projects, highly organised with participants from most Member States, including the EEA, and supplemented with a decentralised management structure. Proposals received may be amended, rearranged and/or fused in order to shape the final project appropriately.

2- CONCERTATION

Objectives addressed partly or largely by concerted action, where the EC contribution is generally about 5% of the total costs and management is decentralised through delegation to a project leader, will be implemented by concertation networks.

In other cases, within such objectives, research projects will require proposals to be submitted for a Community support.

Where appropriate, concertation networks may be strengthened by contributions to facilities rendering unique services to the Community.

3 - DEMONSTRATION ACTIVITIES (DAs)

The general aims of DAs will be to establish the technical feasibility of innovative approaches, together with, as appropriate, their economic advantage. They will provide mechanisms to facilitate the transition of results from technology suppliers to technology users, and the means of ensuring continuity in support for the product-process development sequence. Specific opportunities will be identified through targeted workshops in selected interdisciplinary topics (e.g. biomedical engineering, biomedical technologies, bio-processing). Special promotional measures will be undertaken for Community SMEs.

4 - ETHICAL, SOCIAL AND LEGAL ASPECTS (ESLA)

In order to improve dialogue and understanding between the main national and sociopolitical bioethical positions, whilst recognising the cultural differences which exist in Member States, working groups will be organised to prepare reports and surveys for

the European Parliament and Council. Targeted workshops to identify and debate areas of national and international divergences, and concerted actions using multidisciplinary approaches to such topics (e.g. biodiversity, organ transplantation, confidentiality of genetic information, gene therapy, DNA profiling, xenobiotics) will be carried out. This horizontal activity concerns biotechnology, biomedicine and health, and agro-industrial research.

5 - ACCOMPANYING MEASURES

- Studies will be carried out in close liaison with other Commission services and the Member States to cover lateral and contextual issues, such as technological risk, public perception of new technologies, environmental aspects and technological stimulation to SMEs, in coordination with horizontal activities. Subvention grants may be awarded to international conferences and workshops specifically and strictly linked with the implementation of the programme.

- Diffusion and valorisation: specific mechanisms for SME participation and wide-spread diffusion of the results are envisaged, in particular modelled on the CRAFT scheme, whereby they will receive special support when preparing applications to the programme. While ensuring scientific quality, projects including SME-participants will be favoured. The other measures will include dissemination activities, modelled on FLAIR-FLOW, for specific relevant results from the programme to SMEs and interested organisations.

- Independent evaluation of the projects and of the programme by panels of outside experts.

6 - TRAINING AND CONTINUED EDUCATION

Fellowships and other training activities will be granted for all topics covered by the programme.

ANNEX II

INDICATIVE BREAKDOWN OF THE EFFORT BETWEEN AREAS

1. Biotechnology	46 to 50%
(of which area 2 will contain	3-7%
and area 3 will contain	14-18%)
2. Biomedicine and Health	15 to 19%
3. Application of Life Sciences in Agriculture and Fisheries, including Agro-industry, Food Technologies, Forestry and Rural Development	33 to 37%
TOTAL	100% (1265 million ECUs) [1]

It is foreseen that biotechnology will be one of the key technologies to be applied throughout Life Sciences and Technologies (LST). Accordingly, activities which concern Biomedicine and Health (3-7%) or Application of Life Sciences in Agriculture and Fisheries, including Agro-industry, Food Technologies, Forestry and Rural Development (14-18%) will be carried out within each of those two areas.

[1] Between 4 and 8% of the funds will be allocated to horizontal Demonstration Activities; between 1 and 3% of the funds will be allocated to the horizontal activities on Ethical, Social and Legal Aspects.

CLEAN AND EFFICIENT ENERGY TECHNOLOGIES

ANNEX I

OBJECTIVES AND SCIENTIFIC AND TECHNICAL CONTENTS

Background

The proposed agenda for energy RTD is built on the following main considerations:

The use of energy, its supply, its trade and technologies relevant to all these aspects are interacting in a unique and complex manner and are a determinant factor for economic growth, quality of life and the environment in a modern economy. ENERGY SECURITY in the broadest sense, i.e. the one assuring reliable energy services at affordable cost and conditions is the main reason for concern and must provide the principal motivation for supporting RTD at a European level.

The growing concern regarding the ENVIRONMENT due to the production and use of energy (contribution to greenhouse effect emissions of polluting gas and other harmful emissions, safety, noise) and the public acceptance are today the main DRIVING FORCE for change.

Finally, technology although it is vital, it is not by itself enough. Therefore an effective RTD policy must consider the complete cycle embracing research, development, demonstration and dissemination of knowledge, the introduction of technologies in the market and the behaviour of the economic operators. It must address the different regional dimensions (local emissions, trans-frontier pollution, and global pollution) and must build on concertation with other Community instruments and policies likely to affect the energy scene, such as structural funds, international collaboration (including EUREKA)and fiscal measures.

In this sense, Community action of energy RTD could become an important driving force for economic development in general. Indeed, there is an increasing awareness that economic development is no longer a matter of only single enterprises or sectors, but rather a set of global projects of society as a whole. One of them is to assure sustainable energy supply for all compatible with environment and with the operation of society. This is a global challenge that must be supported if conflict is to be avoided.

The Community action addresses the following distinct objectives:

- reduction of emissions through improved conversion and use of energy;
- introduction of renewable energies into Europe's energy systems;
- safety of nuclear energy;
- pursuit of thermonuclear fusion as a long term option.

The present programme proposal addresses the first two objectives, together with a specific research activity which supports Community action in the inter disciplinary areas of energy-environment-economy. Strategic analyses will tackle medium and long term issues from the technological viewpoint and consider energy and environmental specificities of EC countries and regions, but also of other regions of the world (developing countries and, in particular, Central European countries).

The other two objectives on nuclear fission safety and on nuclear fusion are covered by separated specific programmes.

The proposed RTD activities

The proposed RTD activities will be carried out along two technological axes: one, on the improvement of energy production from conventional sources and the rational use of energy and the other, on the development of renewable energies and their introduction into Europe's energy balance. The contents and objectives of these sub-programmes are described in the two following chapters.

In order to support the technological action, specific activities for the definition and implementation of a GLOBAL STRATEGY for Energy RTD will be developed within the frame of the programme. This will require the use of MODELS to develop coherent scenarios of the evolution of the energy scene in the medium to long term, to analyse the interactions between energy, environment and economic development and to evaluate the impact of the Energy RTD strategy. The projects adopted along these research lines will be designed in a manner as to harmonise results across the Community and to enable international comparisons. Furthermore, care will be taken to ensure the extension of their applicability (given the appropriate adaptations) to less developed countries, Eastern Europe and the CIS. Networks of experts will be maintained or established in all Community member States and close links with international organisations and third countries will be instigated in order to ensure the coherence of methods and approaches. Apart from supporting actions on energy RTD strategy, the efforts will be addressed, amongst others to the following:

- studies concerning the behaviour of economic agents in order to achieve a better understanding of the reasons which favour or hinder market penetration of a large number of cost-effective energy technologies;

- the evaluation of external costs of energy and their integration in a "green accounting" framework harmonised at the European level. This will aim at a better definition of economic instruments associated to the policies of the energy and the environment.

RTD activities will include both research and development actions and demonstration. The work planned in either categories will of course depend on several criteria, which will be weighted differently depending on whether one adopts the R&D or the demonstration viewpoint.

In this sense, research and development actions will be highly selective. Therefore, projects with a high potential for playing a true catalytic role at a European level in the fields considered as strategic for the energy security, with environment as the main driving force, will be favoured.

In return, demonstration actions, which are downstream of the research will be more diversified: on the one hand, they are the prolongation of not only Community R&D efforts but also Member States'; on the other hand, they aim at supporting more directly the different aspects of the energy policy (security of supply, industrial competitiveness, social and economic cohesion,...).

The respective role of R&D and demonstration are clearly stated within each of the following fields.

1. IMPROVED CONVERSION AND USE OF ENERGY

The world energy economy is predominantly fossil fuel based and it is likely to remain so for a long time. This is particularly true for coal where worldwide reserves will guarantee several hundred years of supply. Natural gas is continuing its penetration in the energy market, but its transport from distant places (i.e. North Africa, North Sea, Siberia) in gas form makes it a severe handicap to its utilization. A major problem of fossil fuels is the emission of CO_2 and other pollutants, and so the Community action should, as a matter of priority, provide guidance and incentives to reduce pollution emission and to increase the efficiency of energy conversion and use.
RTD in this section addresses the improvement of coal and hydrocarbon-based energy conversion systems, the development of new energy systems, energy savings in the demand sectors, energy storage and the more efficient exploration of indigenous resources.
Further to these specific activities, an integrated approach will be sought for the application of clean and energy efficient technologies in the relevant sectors, such as in building, industry and transport. In particular, an integrated project on urban transport is envisaged.

1.1 Clean coal technologies

Theoretical and experimental work on coal-firing processes for electricity production will address both the technical feasibility and cost of advanced technologies through:

- development of integrated gasification combined-cycles and advanced (pressurized) combustion processes (supercritical-steam cycles or combined-cycles) for higher efficiencies and increased abatement of pollutants (either at the source or in flue gases) including hot gas cleaning and catalytic combustion;
- development of processes for the combined gasification (or combustion) of coal with biomass, industrial, municipal or agricultural waste, which could entail a 10-20% reduction in CO_2 emissions;
- development and evaluation of methods for CO_2 capture and disposal , e.g. underground storage and deep ocean disposal. This activity will essentially be carried out as concerted action and in collaboration with IEA's programme on the Greenhouse Effect.

An important objective will be the set up of European networks of excellence to ensure an efficient application and utilisation of the best available coal technologies. In the course of the programme, co-operation activities will be established in particular with Eastern Europe and China. Demonstration activities will address similar issues and will be more orientated towards the market.

1.2 Combustion

A generic research action on combustion will be introduced to bring about significant advances in energy efficiency and pollution abatement of combustion processes. The research work will address fundamental and generic research such as: basic RTD to identify causes of pollutant formation, modelling of combustion processes and systems, diagnostic equipment, improvement of systems, and treatment of exhaust gases, etc.

The technologies to cover, by means of a generic approach, include internal combustion engines, including the use of alternative fuels, gas turbines, combustion and gasification of coal and biomass and combustors for stationary applications in buildings and industry.

This action will be carried out as a cooperation between major European manufacturers, oil companies utilities and users with a view to ensure technology transfer from the research community to the users.

1.3 Fuel cells

The work on fuel cells (FC) will focus on complete systems and pilot plants for different applications (electricity production, cogeneration, road traction, ships and trains) by addressing the following topics :

- stationary applications (particularly cogeneration in buildings and industry): development of 200-400 kW systems with solid oxide (SOFC) and molten carbonate fuel cells aiming at 55-60% efficiencies, 1500 ECU/kW long-term costs and 10-100 times emission reduction. Demonstration will mainly address the phosphoric-acid technology with a view to open the market for stationary applications;

- road traction (electric): development of hydrogen- and methanol-fuelled solid polymer fuel cell (SPFC) systems. The goal is 45-50% efficiencies, 100-200 ECU/kW long-term costs and 100 to 1000 times emission reduction. Demonstration projects will focus on road transport and in particular on buses where cost-effectiveness could already be proved;

A support activity is also planned to develop clean and efficient fuel processors to transform natural gas, methanol and heavy oils (reformers) or coal (coal gasifiers) into hydrogen. The key issues will be their integration with the fuel cell, optimization of energy efficiency and pollutant emission for the whole system and extraction of remaining pollutants with different separation methods. The extension of fuel cell research to electrolysers should lead to the clean and economical production of hydrogen (an electrolyser is the inverse of a fuel cell and basic research is similar). SOFC technology may lead to high temperature electrolysers producing electricty with 30-40% savings over conventional electrolysers. As a spin-off, the work planned for SPFC could enable us to obtain the solid-polymer electrolysers also very economically.

1.4 Energy storage

Energy storage is a common requisite to many fields including transport, load levelling, renewable energy, electronic equipment, etc. The present programme will focus on electricity storage by giving priority to transport (also in support of the activities foreseen by section 1.6). Emphasis will be on Li batteries which are among the most promising options. Also the development of Ni metal hydride batteries is envisaged as replacement for poisonous NiCd. The standardization of battery test procedures will be investigated within a network of battery and car manufacturers. Other forms of energy storage such as flywheels, super-capacitors and heat storage will also be explored.

1.5 Hydrocarbons and new fuels in transport

In this area, emphasis will be on the development of clean transport fuels by improving the efficiency of fuel reformulating processes. The work will concentrate on the catalytic conversion of natural gas into liquid fuels (and fuel additives) which have a higher added value and can be more easily transported.

Given the increased need for light products and the subsequent reduction in the demand of heavy oils, RTD efforts will be pursued on the catalytic conversion of heavy oil fractions. The utilisation of alternative fuels and mixes will also be investigated.
Work will continue on the establishment of the relationships between fuel quality, engine technology and emission of pollutants and this mainly within the framework of the EPEFE project (European Programme on Engines, Fuels and Emissions) launched by the Commission in collaboration with European oil and car manufacturer associations. This action will provide useful information to section 1.2.

1.6 Energy optimization in urban transport

Sections 1.2 and 1.5 address a range of themes related to Transport. These activities together with others arising in other lines will be integrated into a coherent Urban Transport action in close collaboration with the activities of integration developed within the specific programme "Research for a European transport policy". In the context of sustainable mobility under the best environmental, energy efficient and social conditions this will help provide technical solutions to specific transport problems and support the rationale on which to base urban transport policy decisions.
Research and development will address the integration of systems for energy storage, conversion, transmission, and management for guided and unguided vehicles. This will include consideration of chemical, kinetic and electrical energy storage systems; energy converters such as multi-fuel internal combustion engines, fuel cells and hybrid energy converter concepts.

From an energy viewpoint, the investigation of a broad range of generic technologies such as, combustion modelling and simulation, computer controlled energy management systems, development of alternative battery technologies, improved transmission and regenerative braking systems and energy consumption and local consumption atmospheric pollution models will be crucial to enable progress in many of these research areas.

Optimising available capacities will also require the associated application of state of the art telematics to traffic management and control, and transport information systems. The results of the feasibility studies will enable the application areas to be identified for which the different propulsion systems are best adapted, and to define the strategy to pursue the research, either to demonstrate proof of concept, or in the case of more mature technologies, for conduction full-scale demonstration projects. Proper consideration will be given both to vehicle functionality and re-fuelling infrastructure.

As to demonstration, it will address two key issues:

- reducing the consumption of energy in urban transport. In particular: road traffic, technical control, performing fleet of public transports;

- the improvement of the efficiency of traction systems or the development of new systems using conventional or new fuels (valid also for inter-city transport).

1.7 Energy saving in industry and buildings

In the industrial sector, Research and Development will focus on a limited number of generic technologies that are of major importance, for example heat exchangers (e.g. fouling), separation processes, process integration, new process routes, stationary combustion (as per paragraph 1.2). The participation of industry will be strongly encouraged.

Demonstration will focus on technologies and new replacement equipment of production processes, the use of residual heat and the improvement of the quality of products allowing hereby to save energy and replace polluting processes by others which reduce emissions. These technologies would relate to several applications, from industrial heat to power and lighting.

In addition, RTD will allow the development of concepts and applications common to industrial sectors and buildings will be developed, mainly the cogeneration and other integrated energy systems (equipment systems of turbines, of fuel cells, of diesel engines, of heat pumps, of batteries, etc.). In this field, priority will be given to demonstration projects. Furthermore, the technical and non-technical barriers for decentralized energy production will be investigated.

Within the building sector, system approaches will be given priority for RTD and they will be carried out closely to the ones regarding renewable energies in buildings indicated in section 2.2. These approaches will aim at a rational and efficient use of fossil fuels and electricity. They will include research on the "smart" buildings, on heat pumps, etc.. Pre-normative type of work will also be considered.

Demonstration will focus essentially on actions reducing substantially the energy consumption and CO_2 emissions and this for new housing and commercial and public buildings. These actions will refer to the design, optimisation of the building envelope (material and components), the consumption for heating and air conditioning as well as the optimization of electric equipments and HVAC. These actions can also be undertaken for the refurbishment of important buildings (including their heating/conditioning systems).

1.8 Exploration and production of hydrocarbons

RTD actions will address medium to long term issues with the aim of improving the exploitation of hydrocarbon fields and underpinning the European industrial technology base.

The research will focus on:

- development of efficient technologies leading to improved reservoir characterization and management and to more accurate prediction of reservoir production;

- sedimentary basin analysis and three-dimensional modelling to give a better description of basin formation and geo-historical evolution;
- identification of both smaller and more complex deep structures using advanced geophysical and geochemical exploration methods;

Demonstration projects will be targeted on the activities closer to the market, such as the production of hydrocarbons, their transport and storage.
Furthermore, it is planned to follow concerted research action on Earth Science. This action will provide not only the information needed to the exploration of hydrocarbons, but it would also improve considerably the scientific knowledge base of other research programmes such as the one of geothermal energy in dry rock, storage of radioactive waste, raw materials or on the exploitation of marine ressources.

2. RENEWABLE ENERGIES

Renewable energies, in their new and modern forms which go beyond the classical usages of hydraulic power and wood for heating, are far from having realised their full potential because they lack of development. Nevertheless, these clean and indigenous energy sources appear as the best adapted to combat the greenhouse effect and to contribute to long-term energy security. As sources of technological innovation, they could be instigators of new industrial activity and employment at all levels, especially in the less-favoured regions of Europe. In addition, because of their decentralized nature, they are much more accessible to the layman. In the framework of international cooperation, the renewables will also have an important role to play in ensuring that the Third World, which will become the largest energy consumer, does not also become the greatest polluter. Considering the association between quality of life and social impact, they are probably the only sources which will in future allow a sustainable increase in energy consumption, based on total economic growth, while respecting the environment.

The present programme foresees a new dimension for the renewable energies which will permit the introduction of new sources on a significant scale into the European energy system. With this aim, an appropriate strategy will be adopted in order to concentrate the effort on ambitious but realistic objectives for the short to medium term.

In particular, the accent will be put on the aspects of INTEGRATION. In very different ways, the renewable energies involve activities across all sectors of society. Multidisciplinary activities will be initiated among the professions concerned, researchers, industrial groups and future users, to ensure accelerated deployment on as large a scale as possible. The impact of renewable energies will be studied in depth, especially in the areas where they will be developed, such as regions and towns, agriculture and industry, distribution networks; the impact on society and other dimensions will also be analysed. Development agreements and specific and sectorial programme actions will be arranged by means of networks, several of which will be linked in a "major network for the development of renewable energies". It will include among others sub-networks of centres of excellence for RTD, major European electricity utilities, leading architects, pilot towns, regions and islands.

Integration with the Third World and with Eastern Europe will equally require a specific effort to adapt the technologies, prepare their transfer and support European industry for future export markets.

In this line of action, the accent will be put on R&D because the state of the technologies concerned is, except in a few cases, still far from the market. However, demonstration projects will be established in different sectors in association with other Community actions to encourage the market and reduce legal and administrative obstacles.

The financial efforts should be concentrated on the following priority areas:

2.1 Solar photovoltaic electricity

The accent will be put on a three stage vertical approach which will consist first on the continuation of research into crystalline or thin film solar cells, drawing together industry with university and para-university research laboratories.
Other efforts will be devoted to accelerated industrialisation of cells and modules. This is a new Community initiative to support industry, especially SMEs, in aspects of precompetitive development engineering, flexible industrial processes and very large volumes.

Finally, the development and demonstration of pilot photovoltaic systems will be accelerated. The testing and calibration of the new photovoltaic modules and systems will take place at the ESTI Centre in Ispra in order to enable the elaboration of European norms and specifications regarding their utilization by producers and users.

2.2 Buildings

The best approach in this sector is also vertical and will include both R&D and demonstration. First, it will consist in pursuing the efforts on components and integration procedures for active and passive solar, natural lighting and others. The research will be pre-normative but oriented towards the possibilities of standardization.
At the second level, the work on development of pilot buildings will be followed up, with the essential criterion of energetic, aesthetic and architectural success. A new aspect in this context will be the development of bioclimatic habitat and the energy renovation of existing buildings. Finally, a modern urbanisation scheme will be developed in harmony with the specific needs of energy, architecture and social organisation with a new integration of work, life and leisure in the town. This development should promote new pilot clean urban districts with minimum emissions. This last level of activities will best be implemented as a concertation with the networks of towns, regions, experts in solar urbanisation and architects.
These actions will take place in a complementary and coherent way to the ones regarding the rational use of energy in buildings as stated in section 1.7.

2.3 Wind

The activities will be vertically integrated as follows:
First, new materials and components will be developed, particularly blades in advanced composites.
Then, after completing the development programme for the current generation of wind turbines, a programme will begin on the development of a new more powerful generation exceeding 1-2 MW and using new ultra-light blades and other novel components.
Finally, the programme will aim to promote alternative installation sites, especially off-shore.

2.4 Biomass

This sector is particularly important for RTD actions and for their links with the environment and the regional and rural development. The effort will concentrate on energy from solid biomass, in particular, on the utilization of new fast growing forestry and agricultural products which will provide the basis for a second activity, leading to thermal conversion to liquid, gaseous and solid fuels or directly to heat.
Furthermore, pilot and demonstration projects will be developed, notably for decentralised production of electricity using high performance motors and turbines.
In addition, the production of pyroligneous oils will also be pursued, together with their conversion to marketable fuels.

2.5 Geothermal energy

Conventional geothermal energy will be limited to demonstration. The remaining element of geothermal energy R&D which merits continuing support on a European scale is hot dry rock. Work will be focused on the support of a single European pilot plant that could provide the basis for a demonstration "prototype" at a later stage in the work.

2.6 Other options

Some concerted actions will be undertaken on different families of renewable energies which are at different stages of development. These will cover wave and tidal energies, micro-hydro, solar thermodynamics, clean production of hydrogen and others. Technologies associated with renewables will also be considered, notably storage of thermal or electrical energy. Financial support will be focused on the creation of coordination centres and enlarged networks in a maximum number of Member States.

Modes of implementation

The programme will be implemented through both cost-shared and concerted actions. Cost-shared projects will receive EC financial support at different rates according to the nature of the project, i.e. according to the technical field and to the economic and technical risk involved. In absolute terms, the size of the projects would be such as to allow for substantial innovation and technological breakthroughs, in the spirit of concentration of efforts. Whenever appropriate, projects will be grouped into clusters so that better synergy of resources and results can be achieved. Furthermore, special consideration will be given to integrated projects which would tackle social, economic or purely technical problems with a multi-disciplinary approach and/or address issues taking into consideration the path from research to demonstration and to market development. Integrated projects could be carried out in fields such as integrated applications of renewable energies, combustion and urban transport.

These projects will be completed by concerted actions restricted to those fields where a simple coordination of the activities of member States and of relevant industries would render those actions more effective at EC level. For SME's, a specific procedure will be implemented aiming at increasing their participation in the programme (technology stimulation), based on the experience of CRAFT activities and feasibility awards.

Outline proposals may be submitted at any time (a continuously open call for proposals) and those proposals selected will receive a feasibility award to search for partners and to prepare a detailed proposal. That proposal will then be evaluated in order to decide on the funding of the research project itself.

Cooperation activities in many fields of energy technologies will be established whenever appropriate both at international level (e.g. International Energy Agency, United Nations) and at national and regional level (e.g. Eastern and Central Europe, Mediteranean, developing countries) in conjunction with other Community policies.

In order to assure consistency and favour the synergies between RTD and the market, a reinforced action of dissemination will be followed. Such an action aims at spreading, at large, the information on the technologies emerging from RTD and to promote them on the market. The instruments that can speed up the deployment of the technologies on the market will be studied and taken advantage of. Use of the OPET network (Offices for the Promotion of Energy Technologies) established not only in Europe, but also in Eastern Europe, the CIS and the Developing Countries will be given priority by this action. Other instruments may be tested and deployed depending on their efficiency.

Opportunities for training and mobilility of researchers will be created in the course of the programme through financial grants and research secondment schemes at major RTD projects.

ANNEX II

Indicative breakdown of the effort between the different areas

Domain 1

Improved conversion and use of energy: 45-55% [1]
(Slightly larger emphasis will be given to demonstration projects - 60% of the support for this area)

Domain 2

Introduction of renewable energies: 45-55% [1]
(Emphasis will be given to R&D activities including pilot and integrated projects - 60% of the support for this area)

TOTAL **100%**
(1005 millions of ecus) [1]

The allocation between R&D and Demonstration is purely indicative. This is not an a priori allocation but more an orientation. The realisation of this will depend of the quality of the proposed projects, within the framework of the objectives and priorities defined by the programme.

[1] 2-3% of the total support will be allocated to supporting activites for the definition and implementation of RTD energy strategies (including the modelling activity).

SPECIFIC PROGRAMME:
NUCLEAR SAFETY AND SAFEGUARDS

Annex I

OBJECTIVES AND SCIENTIFIC/TECHNICAL CONTENT

1. THE CONTEXT

Although nuclear energy has reached considerable maturity in the Community and elsewhere in the western world - the safety record of its nuclear plants is excellent - it is far from being universally accepted by our society. Community action therefore aims at stimulating broad collaboration to strengthen a new global and dynamic approach to nuclear safety. This implies that the R&D collaboration - the joint setting of priorities and the sharing of results - should contribute to bring all interested parties closer in an understanding that nuclear energy, like other mature technologies, can benefit from further development - it does not stand still - and that new technological solutions may be found to solve problems which today make it unacceptable to some. Of course, it must be understood that new technology will not necessarily be applied simply because it exists, just as we cannot afford to make a definite judgement about its use by future generations on the basis of today's knowledge.

In that sense, a global dynamic approach signifies that we must improve the understanding and quantification of the overall risk associated with the use of nuclear energy: considering the whole cycle, considering all exposure to ionizing radiation, considering normal and accidental conditions, considering the historical liabilities associated with its use elsewhere (e.g. the CIS), considering the possibility of technological evolution just as in other high-tech areas.

To support that approach, the various activities are set out and managed accordingly in one single programme. Consequently, they are deliberately not grouped as a set of individual actions (as in the previous Framework Programme), although they are assembled according to the main emphasis of the respective activity as related to the use of nuclear energy in that global sense.

The important research activities on radiation protection aspects will not only cover the entire field of nuclear energy, but also include the exposure due to medical and industrial applications as well as exposures derived from natural radioactivity.

2. PROPOSED ACTIVITIES

Exploring new concepts

The proposed activities will illustrate a new approach which aims at exploring ways to improve the use of nuclear energy through an integrated initiative addressing the three main issues of common concern:

- reactor safety with regard to severe accidents
- the management and disposal of long-lived radionuclides (including plutonium)
- the risk of fissile material diversion.

This essential activity will be carried out in close cooperation with authorities, industry and the scientific community.

It is proposed to pursue two main lines of approach: on the one hand, the design and concept of reactors and the fuel cycle should be reviewed with a view to identify and investigate promising design-related solutions; on the other hand, the potential of new fuel cycle options based i.a. on partitioning and transmutation (P&T) techniques should be explored.

2.1. Conceptual safety features

With a view to improve safety, industry is examining new safety concepts, in particular so-called passive or inherent systems which could be implemented in future reactors. Prospective theoretical and experimental investigations are foreseen to assess these concepts with regard to their feasibility and their benefit to the overall safety. These investigations will be of generic nature and not refer to specific reactor concepts. The results should provide supporting data for the choice of those features that reply best to future development trends in the Community and worldwide.

Approaches to reduce the amount of long-lived radioactivity in spent fuel by changing the composition of the fissile material could be included in an overall analysis of alternative solutions.

Concepts to reduce the risk of diversion of fissile materials should be investigated in the context of the fuel cycle development studies. To this purpose, the possibility of rendering the plutonium in spent fuel and in fresh MOX[1] fuel unfit for weapons purposes, e.g. by modifying its physical states, its chemical or its isotopic composition could be examined. This may also include considerations on the safe recycling of weapons-grade material from surplus defence stocks in commercial reactors.

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[1] MOX: Mixed (plutonium/uranium) OXide.

2.2. Partitioning and transmutation

The principal source of artificial radioactivity, irradiated fuel, should constitute the first target of research efforts to reduce the long-lived (half life > 30 years) nuclide inventory of nuclear waste. On the basis of present technology, this objective might be achieved by highly separative reprocessing of irradiated fuel (partitioning) and repeated irradiation of waste isotopes in specially adapted fast reactors or other irradiation facilities (transmutation). The feasibility and potential benefit in terms of cost, health, safety and environmental impact of (P&T) schemes should continue to be assessed, while the first technical developments are launched. Such research will be performed in close cooperation with the JRC.

Reactor Safety

The safety features of reactors are continuously upgraded by taking into account the experience from operating plants and new results from research. The promotion of R&D in understanding severe accident mechanisms, assuring the integrity of the primary systems by investigation of ageing and failure modes, by improving accident prevention and accident management measures and by probabilistic assessment of the performance of safety-relevant systems are foreseen.

2.3. Severe accidents

It is of vital importance to improve the understanding of severe accidents in order to prevent the possible radioactivity release under severe accident conditions. This implies for example the study of the core degradation phenomena and the related radiological source terms with emphasis on the behaviour of the fission products, using among others some results of the experimental PHEBUS Fission Product project, previously organized jointly by CEA-Cadarache and JRC Ispra. Molten fuel-coolant interaction and molten core-concrete interaction are also considered of primary interest in this context, together with hydrogen-related problems and the reactor pressure vessel response.

In connection with molten fuel interaction problems, the JRC Ispra FARO facility will continue to provide experimental results.

Besides the study of the accident progression mechanisms, major attention is also devoted to the integrity of the containment systems and the material characterization of the various safety-relevant components under severe accident conditions in order to evaluate the safety margins.

The proposed activities include theoretical and experimental investigations, code developments and validation as well as benchmark exercises.

This activity foresees the joint use of existing and, possibly, new large test facilities.

2.4. Advanced technology

The first objective of nuclear design safety is accident prevention. The application of digitised instrumentation and control systems is foreseen which still need further validation, especially with regard to quality assurance and software reliability.

Another area of interest in connection with accident prevention is the assurance of the integrity of the primary circuit. The effect of ageing and possible failure modes (leak before break) are domains needing further investigations.

Accident management offers the possibility to reduce the consequences of potential accidents. A main objective of additional research should be to improve means to assist the operator in controlling an accident. Of particular interest in this context are human factors which will be considered in conjunction with other R&D programmes (e.g. aeronautics).

To assess the effectiveness of new safety design measures for different accident sequences probabilistic methods (PSA) are used. These methods are still to be improved for example with regard to a better modelling of common cause failures or the human behaviour. Peer reviews are envisaged to evaluate the quality of existing methods. Further, to provide guidance for the application of PSA methods, such to improve the representativity of results and to make their comparison easier, would be another task. JRC will contribute to this research through existing networks.

Closing the nuclear cycle

One of the main objectives of this activity is to contribute to a further integration of the efforts undertaken by the Community and the Member States to develop the technical basis for a common understanding of the scientific issues of the disposal of long-lived radioactive waste, specifically spent fuel and vitrified High Level Waste (HLW). The strategic issues involved are the time horizon to be considered for the analysis of disposal concepts, the retrievability of the waste and the safeguarding of spent fuel.

2.5. Critical issues of geological disposal

The Community's analysis of the long-term safety of disposing HLW, the PAGIS (Performance Assessment of Geological Isolation Systems) study, concluded that - assuming predictable natural evolution - geological disposal can assure adequate protection even tens of thousands of years after the emplacement of the waste if appropriate sites are selected. There are basic questions, however, on which a consensus should be reached at European level at least, e.g.:

- Predictions about the evolution of the environment and the activities of mankind in the vicinity of a repository become less accurate, the more they are projected into the future. This should be reflected in an agreed *long-term time horizon* up to which the safety analysis of disposal concepts has to be elaborated.

- The *possibility of retrieval* of the disposed material and its consequences on safety should be evaluated together with its costs and limitations to determine whether its benefits outweigh those of the present concept of permanently sealed, inaccessible repositories, from which recovery of waste is difficult.
- *Accidental intrusion* implies a wide field of scenarios and a common approach to this problem shall be agreed also with a view to providing safeguards and ways to assure their effectiveness for longer periods.

A common position on these issues would present an essential element for a European safety philosophy on disposal of radioactive waste.
The Community's Plan of Action in the Field of Radioactive Waste should play an important role in reaching agreement on these questions between the Member States and stimulate their participation in the relevant investigations.
The assessments of waste disposal schemes will require further analysis and modelling of the performance of natural and engineered barriers, transfer of radioactivity through the geosphere as well as the validation of long-term predictions concerning the geological environment of repositories. Useful information on the evolution of disposal systems is also gained from natural analogue and geoprospective studies.

2.6. Underground laboratories for waste disposal

Underground laboratories are a necessary prerequisite for meaningful research on crucial phenomena related to geological disposal. As in the previous programmes tests and investigations on geological disposal in the underground laboratories in Asse (Germany) and Mol (Belgium) should be continued. Possible new laboratories could also become part of the Community programme. These facilities should offer important opportunities for participation from all EC countries for performing research projects under representative conditions. The projects shall provide qualitative and quantitative elements for characterizing possible disposal sites, for designing optimized repository concepts and for evaluating the long-term protective performance of disposal strategies.
Research on geological and engineered barriers, development of special mining and waste emplacement techniques and radiological investigations should be carried out in the underground laboratories and in associated research facilities, thus contributing also to demonstrate the feasibility and safety of underground repositories.

2.7. R&D support to fuel cycle strategy studies and to the EC policy

The investigation of advanced fuel cycle strategies will require some experimental research which should be performed in concertation with the JRC. The second object of R&D is the provision of scientific data to support EC policies in the field of nuclear safety standards, and of reliable methods to implement such policies.
Development of effectively controlled advanced waste volume minimization and materials recycling methods are envisaged with a view to introduce safe and effective standard practices.
Actions to enhance the safety culture of nuclear energy and confidence in safety should include the technical application of radiological optimization principles and the introduction of Quality Assurance methodology in conjunction with the EC "Network of Testing Facilities".

2.8. Decommissioning of nuclear facilities and site restoration

In the field of decommissioning and site restoration, close cooperation with European industrial consortia will be pursued with a view to develop the technology and the concepts to reduce the cost of decommissioning and promote the exchange of information and experience. They should also provide evidence of the safety and environmental compatibility of the main decommissioning options, i.e. the early dismantling approach and the staged, deferred dismantling strategy by representative experimental and demonstration projects. Research into the site restoration practices at uranium mining and milling facilities should be associated to these activities.

Understanding, measuring and reducing the effects of radiation exposure

The Euratom Treaty defines the Community responsibility for "establishing uniform safety standards to protect the health of workers and the general public and ensure that they are applied" and for "studying the harmful effects of radiation on living organisms". Although the present radiation protection standards and the underlying scientific information are of high quality, it remains imperative to reduce the remaining uncertainties in the quantification of radiation risks arising from the use of ionising radiation in energy production, industry and medicine, as well as from exposure to natural radiation. This concerns all phases of nuclear cycle where (potential) exposure situations may exist and also considers the consequences of nuclear accidents, the limitation of the extent of possible health effects, the mitigation of environmental consequences and the development of methods for the management of nuclear emergencies.

The priorities set forward here are closely linked with the validation work proposed in the area of historic liabilities which mainly deals with the health and environmental consequences of the Chernobyl and other radiation accidents and of past uncontrolled releases of radioactive materials in the Commonwealth of Independent States.

2.9. Understanding the mechanisms of radiation action

The mechanisms of radiation action on cells need to be known in order to be able to extrapolate the radiation effects determined experimentally to predict, with confidence, the effects at very low doses. A better understanding of the mechanisms at the cell level will be gained by mobilising the most up-to-date techniques from molecular and cellular biology, by studying mutation and chromosomal aberration formation and the role of DNA repair, and by combining this work with recent developments in radiation energy deposition modelling to elucidate a comprehensive biophysical model of cellular radiation action. The extension of this understanding to the radiation induced cancer process will take advantage of new knowledge of oncogenesis, in general, coupled with continuing studies of the early molecular and cellular events in radiation induced cancer. The development of models of the radiation induced cancer process founded on sound biological principles will further contribute to more accurate assessments of radiation risk.

2.10. Evaluation of radiation risks

Risk evaluation depends on reliable assessment of the level of exposure, which in turn depends on an accurate determination of internal and external doses. This necessitates research on environmental pathways of radioactive substances to man and on the metabolism and biokinetics of incorporated radionuclides. Targeted research will include work to develop more sensitive and delicate instrumentation for monitoring external and internal irradiation and the further extension and application of risk assessment models for the health and environmental impact of discharges of radioactive materials to the environment and of nuclear accidents. Risk estimates converting radiation dose to the probability of induction of health effects will be derived from epidemiological studies of exposed populations, taking into account the radiobiological mechanisms.

2.11. Reduction of exposure levels

Criteria, methods and strategies for effectively reducing exposure to ionising radiation from all sources (natural, medical, industrial) have to be developed with a view to further reducing or preventing the induction of health effects. These include aspects of exposure monitoring, techniques for environmental remedial actions, treatment of health consequences, risk management for normal and emergency situations and the implementation of the optimization philosophy (ALARA - As low as Reasonably Achievable) into radiological protection, giving due account to social and economical considerations, and the development of optimisation strategies and techniques in medical radiological diagnostics.

Historic liabilities

The situation in Eastern and Central Europe and in the Commonwealth of Independent States (CIS) presents liabilities in nuclear safety, which the international community must share not only for altruistical reasons. The European Community, geographically situated on the same continent and having the economic and technological capability to provide effective assistance, has more than a humanitarian interest in assuming some responsibility for the establishment of safe conditions in its neighbourhood.

The consequences of the Chernobyl accident, of other radiation accidents and of uncontrolled releases of radioactive materials in the CIS have led to environmental contamination and health hazards which represent unique opportunities for initiating collaborative projects, including extensive training and secondment schemes.

2.12. Safety of Eastern reactors

Cooperation in the field of reactor safety will address some problems typical for existing Russian reactor designs as well as research in areas of interest for future plants. The Russian experience in reactor development and in specific areas, e.g. severe accidents (hydrogen problems) could be of value for the Community. Some Member States already have bilateral agreements on these topics. The progressive inclusion of these Eastern countries in Community nuclear safety programmes is to be seen as an efficient way to develop a wide ranging safety culture.

2.13. Consequences of Chernobyl and other radiation accidents

Environmental issues in the more heavily contaminated terrestrial and aquatic areas will include the analysis of exposure pathways, the evaluation and validation of existing data bases and cartography as well as the validation of radioecological knowledge and data. A special aim of the work will be to use the results from the radioecological studies for predictive assessments and to develop improved emergency management computer codes to provide guidance on the mitigation of the consequences of the accident. They will deal especially with the environmental consequences and applicability of countermeasures in highly contaminated zones, the development of intervention criteria and the development of decontamination strategies.

Health effects studies will concentrate on the development of methods of biological and retrospective dosimetry in close cooperation with epidemiological studies of cancer induction in the more exposed groups of the population. A study of the treatment strategies used for the over-exposed accident victims aims at deriving improved treatment protocols using newly developing methodologies. The occurrence of increased rates of childhood thyroid cancer reported in Belarus and the Ukraine demands systematic research to provide important information on radiation-induced thyroid cancer and an estimate of the extent of this health problem in the future. At the same time the treatment of the thyroid cancer patients will be optimised by the development of therapy protocols.

2.14. Cooperative networks

In the field of radiation protection, a collaboration with institutes of Belarus, the Russian Federation and the Ukraine was initiated in late 1991 which involves some 80 EC institutions and 80 CIS institutions and has led to the establishment of a central laboratory in the Ukraine. It is proposed to strengthen this collaboration by the establishment of a regional network of radiation protection research centres in each of the three republics. Important added values of the establishment of such regional network will be the improvement of radiation safety and radiological protection in these countries and its function as a platform for coordination of the many international and bilateral initiatives.

In the area of waste management and site restoration, similar networks with the Central and Eastern European countries will assist these countries in developing safe solutions for their particular problems. In addition, networks of information exchange would be useful to learn from the Russian experience of waste management. Cooperation could also be envisaged in the area of partitioning and transmutation, studied under the actions presented in para 2.2.

3. IMPLEMENTATION OF THE PROGRAMME

3.1. Cost-sharing and concerted actions

The programme will carry out R&D as shared-cost actions and as concerted actions. Shared-cost activities will be co-funded by the Community at levels reflecting the economic and technical risk as well as according to the respective area of research. Particular attention will be paid to large integrated projects which will be defined in consultation with the main partners. Other partners selected from a call for proposals will be associated.

The shared-cost activities will be complemented by concerted actions in matters where mere coordination of the efforts of Member States and their industries could render the Community programme more efficient.

3.2. Dissemination and valorisation of results

The rapid and effective dissemination of results will be assured by direct communication of progress reports among network participants, specialist meetings and multi-disciplinary conferences, as well as by systematic publication of annual programme reports, final reports and proceedings of scientific meetings.

In addition, the collection and processing of R&D results in computerized data bases managed under the respective networks will provide readily accessible scientific and technical information.

Public communication and information on the programme activities and results should constitute an important element.

3.3. Training and mobility

Opportunities for training and mobility of scientific and technical staff will be assured by activities such as "*European Radiation Protection Education and Training*" scheme (ERPET) and the Eurocourses organised together with JRC Ispra. Mobility of researchers will be promoted by staff secondment schemes at the major R&D projects and research grants to bursaries.

3.4. International cooperation

Close cooperation with national and international organisations competent in the fields of nuclear safety, waste management and radiation protection will enable the Community to contribute worldwide to an improvement of nuclear safety and the protection of man and his environment against the effects of ionizing irradiation. It will enhance the integration of national efforts to improve the competitivity of the European nuclear industry and will give essential input to the regulatory responsibilities of the Community.

Cooperation and integration of research on Nuclear Safety and Safeguards has been well established with third countries such as the USA, Canada, Japan and with some EFTA countries. Together with the collaboration with Central and Eastern European countries (PECO), including the Commonwealth of Independent States which is of particular importance, this will lead to the further harmonisation of national approaches for developing safety standards. Close interaction has also been achieved and will continue with the International Atomic Energy Agengy (IAEA), the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA) and the World Health Organisation (WHO), as well as with non-governmental international organisations involved in standardisation and recommendations, such as the International Commission on Radiological Protection (ICRP), the International Commission on Radiation Units and Measurements (ICRU) and the International Standards Organisation (ISO). This international cooperation is the main instrument for achieving worldwide consensus on the fundamental issues of nuclear safety and radiation protection.

Particular close and extensive cooperation with research institutes and universities of the CIS will be implemented through collaborative projects on the consequences of the Chernobyl accident, and will help validating the basic research results obtained from the other actions. The information to be gained on environmental contamination and population exposure is enormously important for bridging between theoretical approaches and real contamination situations. Co-funding of the collaborative activities in this area should be drawn from Action 2 of the Framework Programme (see Annex).

Annex II

ILLUSTRATION OF THE ESTIMATED EFFORT BETWEEN THE DIFFERENT AREAS

Exploring new concepts	7 - 8 %
Reactor safety	28 - 30 %
Closing the nuclear fuel cycle	28 - 30 %
Understanding, measuring and reducing the effects of radiation exposure	28 - 30 %
Historic liabilities[1]	2 - 3 %
TOTAL	100 % (202 million Ecu)

(1) The work undertaken in the area of "Historic Liabilities" will be closely linked to activities supported within Action 2 of the Framework Programme.

Controlled Thermonuclear Fusion

ANNEX I

Scientific and Technical Objectives and Content

Introduction

The long-term objective of the Community Fusion Programme, embracing all activities undertaken in the Member States (plus Sweden and Switzerland) in the field of controlled thermonuclear fusion by magnetic confinement, is the joint creation of safe, environmentally sound prototype reactors (Decision..../EURATOM/EEC/ concerning the Framework Programme 1994-1998).

Progress towards this objective, common to the four large world fusion programmes (EURATOM, Japan, Russia and the USA) which are of similar size, has a time-horizon measured in decades. Within Europe, integration of all magnetic fusion research into one Community programme has been essential for optimum use of the available human and financial resources. Individually, no one of the Member States could have undertaken a project the size of JET nor could it be recognized as an equal partner in the world-wide collaboration on the ITER project for an experimental reactor. Indeed, the quality of the research and the experience gained in collaborating within Europe place the Community in a strong position in the ITER cooperation.

The long span of time and the large human and financial efforts required before reaching this objective make necessary the concentration of the Community action in serving its objectives, together with the total cohesion of the network of organizations associated in the Community action and the full exploitation of co-operative actions with the large fusion programmes outside the Community. Safety and environmental issues will be central in the realization of the following large devices which, after JET, are included in the strategy envisaged towards the prototype commercial reactor:

- an experimental reactor (Next Step), the overall programmatic objective of which is to demonstrate the scientific and technological feasibility of fusion energy for peaceful purposes;

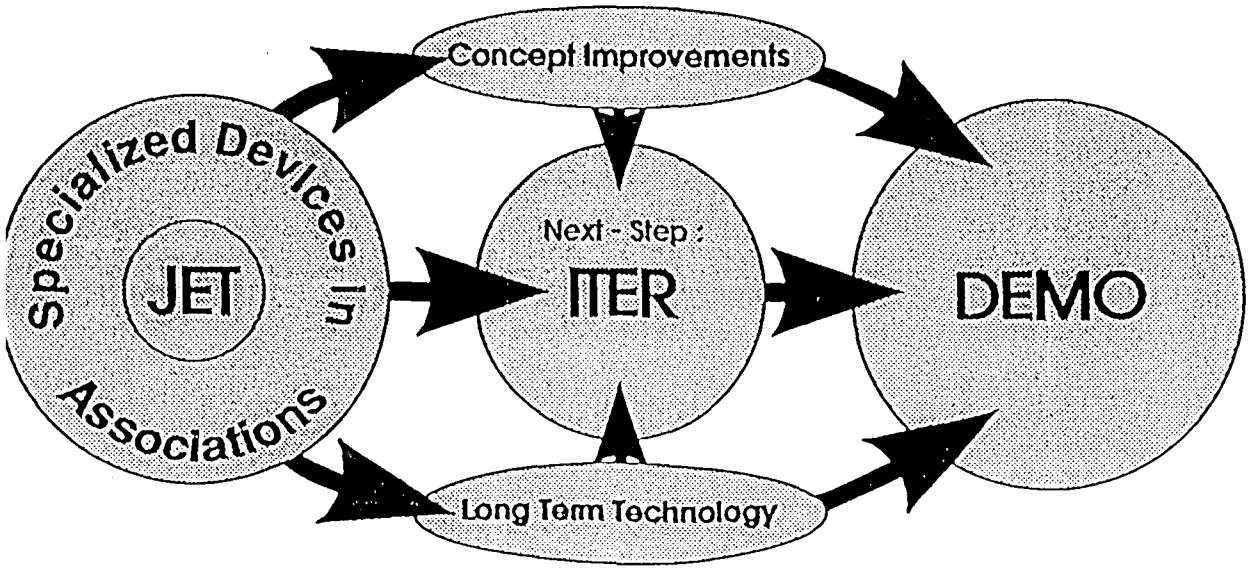
- a demonstration reactor (DEMO) capable of producing significant quantities of electricity.

For the period 1994-1998, the priority objective is to complete the engineering design of the Next Step in the frame of the quadripartite co-operation between EURATOM, Japan, Russia and the USA on the International Thermonuclear Experimental Reactor-Engineering Design Activities (ITER-EDA).

Specialised studies are also needed, in order to address further possible improvements on concepts in plasma physics and plasma engineering, as well as to perform the long term technology developments required for progressing towards the exploitation of fusion as an energy source; the results of such studies will be of benefit both for the operation of ITER and, in the longer perspective, for the conceptual definition of DEMO.

Therefore, for the period 1994-1998, the proposed strategy necessitates the simultaneous development of three themes of activities, as represented on the figure, on which efforts will be concentrated, mainly by means of shared-cost actions.

- Next Step Activities: Design proper and R&D supporting the design, construction and operation of the Next Step;
- Concept Improvements : DEMO-oriented R&D on plasma physics and engineering;
- Long Term Technology : DEMO- and reactor-oriented R&D on technology.



It is also important that, regarding alternative approaches to fusion, such as inertial confinement fusion, a concertation of the efforts in the Member States is undertaken, possibly in the frame of an extra-Community cooperation.

Environmental and safety criteria will be essential elements governing the evolution of the whole Fusion Programme.

During this evolution, attention will be given to :
- strengthen further the cooperation between Associations, as well as the mobility of research workers;
- foster the involvement of industry;
- extend the scope of international collaboration;
- strengthen the synergy between research and advanced training.

Themes of scientific and technical activities

Next Step Activities

The ITER-EDA include the design proper by the Joint Central Team and by the Home Teams of the four parties and the supporting R&D in physics and technology by the Home Teams. For the EURATOM Party, the activities, other than the participation to the Joint Central Team, will be coordinated by the NET Team and executed by JET, the Associations, the Joint Research Centre (JCR) and industry.

Plasma physics and plasma engineering R&D in support of the ITER-EDA will be pursued on JET and on specialized devices in the Associations, in particular regarding particle and energy exhaust; plasma heating, confinement and disruption; long plasma pulses. JET's main task is to establish reliable methods of plasma purity control under conditions relevant for the Next Step and then to complete its programme with high performance operation in D-T plasmas. After the termination of the JET Joint Undertaking[1], and where appropriate, JET's equipment and expertise will continue to be used to perform specific developments in support of the Next Step.

The share of the ITER-EDA technology and design tasks allocated to the Community will be performed primarily in the Associations, in the JRC, and in industry. In order both to increase the Community competitiveness for the construction of ITER and to preserve the option of proceeding towards a European Next Step in the event that the ITER co-operation would prove too difficult to continue, the necessary competence will be developed in all key technologies for the Next Step, in particular in the fields of superconducting magnets, plasma facing components, operational and environmental safety, fuel cycle,

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[1] Council Decision 91/677 EURATOM of 19 December 1991 stipulates : "*The Joint Undertaking shall be established for a period until 31 December 1996*".

remote handling maintenance and decommissioning of the device. The present generation of technology test facilities will be intensively exploited. Specialised laboratories in the JRC, JET, and the Associations will contribute in demonstrating the safe handling of tritium.

A European candidate site for the construction of the Next Step will be identified and qualified.

Protocol 1 of the ITER-EDA Agreement covers the period until March 1994. A proposal to conclude Protocol 2 will be submitted to the Council in time to allow the ITER-EDA to continue without interruption. The completion of the ITER-EDA is scheduled for mid-1998. A decision about where, when and in what frame to build the Next Step should therefore be taken during the period under consideration; before proposing this decision, the Commission will arrange for an external evaluation of the Fusion Programme.

Concept Improvements

Research on concept improvements for the tokamak and the configurations akin to it are essential, in the longer perspective, for the definition of DEMO ; this research should also contribute to finalize the design of the Next Step and prepare its operation.

The current techniques for tackling certain plasma physics and plasma engineering issues, most of them common to all toroidal magnetic confinement devices, demand improvements which could require, apart from the extension of running programmes, the upgrading of existing devices and the construction of new ones. Specifically, studies on improved confinement regimes, magneto-hydrodynamic stability, plasma-wall interaction, fuelling and exhaust, heating and current drive, will be carried out on the specialized devices existing in the Associations : TORE-SUPRA, ASDEX-U, TEXTOR, FTU, COMPASS, START, TCV, RTP, ISTTOK, TJ-I-U, TJ-II, WVII- AS, RFX and EXTRAP T-2. New plasma diagnostic methods will be developed and theoretical activities, in particular on plasma modelling, will be carried out to support these studies.

Preparatory activities are in progress; the most advanced relate to, in particular :

- the engineering design and prototype development for a possible large stellarator (WVII-X) aiming at demonstrating the advanced performance of that configuration; conceptual studies on the reactor relevance of stellarators;

- a possible compact tokamak, aiming at ignition. A revised proposal may be submitted to the Consultative Committee for the Fusion Programme (CCFP) for in-depth examination;
- the possible upgrading of some tokamaks, notably TORE-SUPRA.

The main axis of research will continue to be fusion by magnetic confinement. However alternative approaches, such as inertial confinement fusion by use of high power lasers or particle beams, will receive attention, possibly in the frame of an international collaboration. The possibility of using advanced fuels, such as deuterium-helium3, for future commercial reactors will also be studied.

Long-Term Technology

The long-term technology effort will be expanded with a view to provide technically and environmentally acceptable solutions to the technical problems relevant to the exploitation of fusion power as an energy source. Environmental and safety acceptability as well as economic viability will eventually be essential for the widespread introduction of fusion power. This long-term technology effort will be undertaken in the Associations, in the JRC and in industry, and will include in particular:

- development of tritium breeding blankets, with the aim of building DEMO-relevant blanket modules to be tested in ITER;
- development of radiation resistant and low activation materials; testing these materials will require the availability of a high energy neutron source. The engineering design of such a facility should be started during the period 1994-1998, preferably in an international frame;
- further safety and social acceptability analysis of fusion power.

Implementation

- The period 1994-1998 will be marked by the ending of the JET Joint Undertaking, presently the major focus of fusion research in Europe. After the end of the Joint Undertaking, the acquired scientific data will be fully exploited. The effective transfer of expertise from JET to elsewhere in the Fusion Programme, and in particular to ITER, will be ensured; where appropriate, JET's facilities will continue to be operated, within organizational frames to be defined; in particular, research on JET decommissioning could be made part of the Programme's activities.

- The ending of the JET Joint Undertaking will be balanced by extending further the cooperation between the Associations. New forms of cooperation between the Associations will be established to take into account the European nature and the limited duration of research projects. Joint projects carried out by formal groupings of Associations as consortia for integrated actions will be encouraged by the Commission

through an adaptation of the existing modalities. During the design, construction and operation of the Next Step, the Associations and JRC will have to provide, as was the case for JET, a substantial contribution to its physics and technology programmes.

- The involvement of industry will be fostered qualitatively and quantitatively, with the view of both injecting industrial expertise into the realization of the Next Step and ensuring that European industry will master all key technologies required for the construction of future fusion reactors. The measures, initiated during the 1990-1994 programme and aimed at involving European industry in the Community contribution to the ITER-EDA, in the design proper as well as in the accompanying R&D, will be reviewed and adapted as necessary. In particular, dissemination to industry of the scientific and technical results obtained in the frame of the Fusion Programme will be developed.

- The possibility of extending international cooperation beyond ITER, in particular by joint planning with the major fusion programmes in the world, will be explored. Possible examples of cooperation are on a material test facility and its powerful high energy neutron source, and on specialized devices for concept improvements.

- Considering the long-term effort required for the exploitation of fusion power, great importance will be attached to maintaining the excellence and cohesion of the research teams within the Community, to developing the mobility of scientists and engineers, and to fostering the synergy between research and advanced training, by strengthening the links with the wider European scientific community.

The decentralised structure of management of the Fusion Programme, inherent to its network structure, has proven to be efficient and will be maintained.

ANNEX II

Indicative breakdown of effort between areas[1]

	(%)	
Area 1 : Next Step	40-50[2]	
Area 2 : JET Joint Undertaking	19-23[3]	
Area 3 : Concept Improvements	24-30	
Area 4 : Long-term Technology	5-9	
	100	(930 million ECU)

[1] This breakdown does not exclude that a project could relate to several areas.

[2] Including design proper and the necessary R & D support in physics and technology.

[3] The activities of the JET Joint Undertaking, which has its own legal personality, are principally oriented towards support of the Next Step.

FRAMEWORK PROGRAMME, 1ST ACTION, THEME 6, TRANSPORT "RESEARCH FOR A EUROPEAN TRANSPORT POLICY"

Introduction

The development and implementation of the Common Transport Policy demands research to achieve the efficient and cost-effective transport network for goods and persons under the best possible environmental and social conditions and with an acceptable energy consumption (sustainable mobility).
This specific research programme has been developed to improve the efficiency of the individual transport modes and their integration into a European Transport Network and to support future transport policy decisions at both national and European levels.
The importance of transport to the European economy can be illustrated by the following figures:

- transport industry is Europe's second largest, employing about 6.5 million people;

- transport services represent 7 to 8% of its GNP;

The demand for transport has been risen dramatically (70% since 1970) and will continue. The growth has resulted in increased congestion, inefficiency and lower safety performance. The consequent costs to the European economy is estimated to be at least 50 billion ECU per year for road and 4 billion ECU for aviation growing to 10 billion ECU by 2000. Transport is the second largest consumer of non-renewable energy and, as opposed to industrial and domestic users, will continue to grow.
The results of transport research will have, for the above reasons, a direct effect on the economy and quality of life in the Community. In addition, the direct effect on the transport industries will contribute to the development of the whole european industrial fabric.

The exploitation of technological opportunity and the improvement of economic and environmental efficiency require the breaking down of barriers separating different modes of transport (and those between transport, information and communication systems) in favour of an integrated approach.
This research programme therefore sets two priorities: provide the elements of the strategy for a transeuropean multimodal network and the optimisation of networks.
The first will provide industry and authorities with the appropriate associated decision-making instruments based on a full knowledge and understanding of European transport flows, through establishing appropriate models of European transport developments, their interactions and interdependancies for improving the assessment of transport demand, developing effective transport network scenarios, determining the impact of changes in transport demand, modal split, economic and institutional influences based on statistical information to define the needs and constraints to orientate future actions.
These tools are essential before committing large amounts of public and private money for long term investments in infrastructure projects, including telecommunication/management technologies.

The second priority will ensure, on the one hand, the development of compatible management systems for the individual transport modes as these are crucial for interoperability, interconnectivity and accessibility as well as, on the other hand, improving

capacity, safety, reliability and quality of the transport services.

The research activities will be conducted within a coherent and coordinated framework taking account of the activities under other themes : industrial technologies, telematics, environment and energy, where they relate to the objectives of the Common Transport Policy focussing on generic technologies, in effect, carried out under the relevent themes within the first activity.

Tangible results should become available in the short and medium term, in particular enabling a modular approach and a phased implementation of transport systems in co-ordination with EUREKA.

For SMEs, a specific procedure will be implemented aiming at increasing their participation in the programme (technology stimulation), based on the experience of CRAFT activities and feasibility awards.

Outline proposals may be submitted at any time (a continuously open call for proposals) and those proposals selected will receive a feasibility award to search for partners and to prepare a detailed proposal. That proposal will then be evaluated in order to decide on the funding of the research project itself.

A. Strategic research for a transeuropean multimodal network

This part of the programme will maximise the synergies and compatibilities for developing the inter-operability and inter-connectivity of individual transport modes for their effective integration in support of the Trans-European Transport Network through provision of a full knowledge and understanding of the total transport system in Europe, its individual elements, their inter-relationships and inter-dependancies. Within these objectives national initiatives 'Concerted actions' will undoubtably play a role, however action at Community level is also essential to:

- coordinate and reinforce research to maintain technological development, and to face up to competition from America and Asia.
- control the development of international traffic, which requires Community initiatives and strategy.
- enable the common transport policy to be supported through community research.

This work will enable a full understanding of the european transport system, able to provide the necessary elements for the development of a multi-modal transeuropean network, through socio-economic and technological research to guide the development of the common transport policy, taking account of social benefit (welfare economics) and external costs. This knowledge (expertise) includes the application of new technological means for the creation of a performant statistical system on European transport, the comprehension of the techniques and development of scenarios of mobility needs at urban regional and international level; methodologies for assessing technological innovation or new transport concepts in relation to economic efficiency, safety performance and environmental impact; capacity and benefits of each transport mode to contribute effectively to the total transeuropean transport network and, lastly, validation parameters and implementation strategies.

This work will establish the necessary knowledge on nature and volume of transport flows, develop suitable European-wide methodologies for assessing technological innovation and the growing constraints of environmental impact, safety perfomance and energy efficiency. It is necessary at the same time to define the development of implementation strategies, demonstration programmes including pilot projects making use of existing infrastructure and a selective combination of appropriate technological tools.

This information system will be usefully developed through new technologies (eg EDI) to enable and accelerate the data collection process, improve the quality and reliability of collected information and improve user access. The statistics will also benefit from progress in spatial representation systems and modeling (SIG - systèmes d'informations géographiques) which will permit a better interpretation of data as a function of topographical elements.

During the development of this work it will be necessary to ensure the coherence of the activities within theme 6 as well as all other transport related activities of the 4th Framework Programme to guide the initiatives of the Common Transport Policy.

B. Optimisation of networks

Railways

The work will identify the differences between the existing national rail systems and provide economic and technical solutions to the problem of interoperability. In particular, it will analyze the railway networks, with respect to the system and links with an intermodal system, to accelerate the decision concerning the future community transport structure.

Firstly, one of the priority issues is the harmonisation of train traffic control, of which the research was started in the framework of the EURET programme. This research has the objective of developing a European rail traffic management system and its principal functionalities through the integration of the results of research on generic technology developed in other programmes. It was developed with the collaboration of the railways and the industry. This work needs to be continued to be able to develop an architecture for the European rail traffic management system, before passing to the stage of pilot projects to validate the technology through specific applications.

In this context it is necessary to develop the system specifications, study the ergonomic aspects and human factors, communications and design of equipment. The interfaces between the connected systems, i.e. communications, management, and information for public and other services must also be taken into account. Finally, considering the importance of this common architecture for the development of the european rail network, and notably the high-speed train, the research results will be validated in the framework of safety criteria established at a Community level.

Secondly, rail safety is based on the principle of the intrinsic safety of equipment and systems. No system is ever totally safe and there is always a risk, however small, of failure. The minimum risk will be quantified to allow harmonised criteria to be applied throughout the Community and that investment decisions for safety equipment can be taken as a function of their 'added value'. This work is even more necessary today due to the general use of

micro-electronics in new equipment, the nature of the modes of failure, and the predisposition to digital analysis. The research work will build on techniques developed for other industries, and adapt then to the specific rail application.

The capacity of a rail section is limited by the need to maintain sufficient distance between trains to enable each one to stop in complete safety in the remaining portion of available track. To be able to achieve this, the current safety system often leaves a gap which is much greater than necessary, in the absence of knowledge of train breaking performance, the system of communication and use of specific approved spacing. In high density areas improved train flow is necessary, this requires innovations developed in other programmes and new techniques and safety systems. This research work is also needed to improve performance and reliability of safety systems.
Thirdly, for interoperability, linked to traffic management, the work will concentrate on the elimination of obstacles to rail traffic due to national equipment and requirements, and will require the use of new common solutions to overcome them.

This research using the results of other Community research activities, will result in the development of interoperability specifications, and mandatory requirements forseen in Community drafts in the framework of the trans-european high speed and conventional rail networks, and their associated sub-systems (infrastructure, electrical power systems etc).

Integrated Transport Chains

With the opening of the single market, the future extension of the European Community and the progression of the Central European Countries towards market economies, the international transfer of goods will inevitably grow strongly. It is generally expected that traffic will double in 20 years. Faced with such a growth in demand, the public authorities need to try to modify the supply structure, if not the major part of this growth will fall to the existing dominant mode : road transport.

It is generally recognised that road transport causes significant external costs. In effect, considerable nuisance such as atmospheric pollution, low safety, network congestion and noise arises from road transport and is currently borne collectively. Multimodal Transport also appears to be a promising solution. Through its development, it could contribute to a reduction in road transport and improving the quantity of the environment.

The work will be based on existing research in technology, economics, social and environmental fields and analyze the cost/benefit of transfer between modes through an evaluation of effective transfer options (e.g. short sea shipping). It has primarily 4 activities:

- the interfaces between transport modes and transfer points to ensure a rapid and reliable transfer of goods or transport equipment (loading units) taking account of technical, logistic and economic aspects as well as the access of small and medium sized organisations to multimodal transport
- for multimodal loading units, including those more specifically intermodal, the work will also consider unit loads adapted not only to industry needs but also infrastructure constraints
- for existing and foreseen infrastructure, the modal interoperability will be addressed, notably to assure links with peripheral or isolated regions of the Community

- for logistics, applied to the whole multimodal chain, the work will address the management of supporting telematics (informatics and communications).

Air Transport

Firstly the work will address **Air Traffic Management** (ATM) as part of an overall European ATM strategy which has been developed in close cooperation with Eurocontrol and the Member States. Building upon existing work defining a consolidated ATM concept, it will evaluate and demonstrate the integrated elements, both operational and technological, to achieve a future ATM system for 2006 - having at least double the existing capacity, with enhanced safety and at a minimum cost. This work will contribute notably to the definition of the european application of the ICAO CNS/ATM concept.

In particular, strategic action will develop an overall ATM concept including integration of airport systems through appropriate modelling and simulation to enable the definition of the system requirements and high level functional architecture.

This work will also integrate the results of generic technology research developed under other action lines, identify the application related technologies necessary to develop an effective system from the technological, operational and organisational viewpoint.
Operational consolidation will also address the specific aspects, such as role of the human, automation of the planning and executive control function, the use of an experimental Aeronautical Telecommunications Network (ATN), using, and adapting as necessary, the innovations developed under other action lines. The integration of these elements will be validated initially on an experimental testbed to enable the improvement in capacity and safety of the overall ATM system to be quantified. To facilitate the integration and validation process a validation plan will be developed together with the methodology to be used in the process. Suitable certification methods will be developed and validated for such failure-critical ATM systems.

Secondly, the work on **Air Transport Safety**, developed to complement the work of the Joint Aviation Authorities and National Aviation Administration RTD Programmes.
In particular it will model and assess the airworthiness and operational factors that affect safety of air transport, determine possible solutions to the safety shortcomings and support future normalisation (regulatory) actions in the field of certification and continued airworthiness.
Through strategic research including modelling the influence of critical factors, the work will address: passenger survivability criteria; external hazards (icing, collision with the ground, electro magnetic integrity, engine ingestion, etc..); as well as aircraft reliability and safety standards (airworthiness requirements) linked with noise, emissions etc.
More precisely, for survivability, continued airworthiness and flight operations, work will concentrate on the assessment of technologies to improve : crash and fire protection, passenger evacuation, integrity and reliability of crack detection techniques, improved certification methods, human factors issues for long range and high workload operations, take-off and landing criteria for contaminated runways.

Urban transport

Urban transport poses three types of problems namely : energy efficiency, transport system efficiency and environmental protection.
The technical responses to these problems are not necessarily the same but together they must contribute to resolving these three problems. To this end the actions undertaken in the telematics, energy and transport domains must be developed in a coherent fashion.

The work will address the solutions able to improve the "attractiveness", efficiency and capacity of urban transport systems, to rationalise traffic management and transport demand by improving the condition of urban life and contributing to the creation of a real citizens network. In particular the work will address :

- ecological traffic management
- safety management, including unprotected users
- optimisation of road use
- measures and conditions to stimulate public transport in face of private transport
- design of transfer points between local and long distance traffic to improve town accessibility.

In addition, it will also analyze on one hand the finance systems for urban transport and in particular public transport as foreseen in the "White Paper", and on the other hand the external costs entailed by the different modes of transport in built up areas (public/private, level of responsibility). In particular, the effects of different systems of financing public transport will be looked at.

With the coming of the internal market, all Member States are today looking for new forms of organisation and new finance modes for urban transport systems. This involves the application of new technologies, namely use of telematic tools, new energy sources, use of new means of transport, traffic regulation, urban tolls, planning of transfers and management of parking. It will be necessary here to integrate these elements taking account of the individual conditions in urban zones, and to proceed to a large scale evaluation of this integration through pilot projects.

Most built-up areas will have to introduce a range of these actions (road pricing, modal split, ...), but little is known about the complex interactions which will arise in these different combinations and their interface with interurban systems. A progressive introduction of selected measures could be carried out in towns, chosen at the end of the research, to validate them and their gradual implementation.

A validation of procedures by simulation and test on the ground is, in effect, necessary to evaluate their environmental and socio-economic effects as well as the contributions of new technologies and types of organisation (industrial or telematic innovation, regulatory measures or new transport organisations) necessary for the achievement of sustainable mobility.

Maritime Transport

The research has the objective of increasing efficiency, improving safety and protection of the environment of maritime transport through the development of common solutions to the major problems, not only strategic but also technological, for the development of operational systems which integrate new generic technologies, organisational factors and human resources.

Firstly, the work will address, amongst others, the evaluation and modelling of supply and demand of maritime transport and flow of goods, at both world and intra-European levels. In particular, the role of short sea shipping in maritime transport will be analyzed within the framework of the logistics chain and the needs for harmonisation of procedures. This will include the development and evaluation of sea/inland waterway systems and analysis of competitivity between operators (both Community and non-Community) for the whole operation (land and maritime), management structure, the chain of human resources and quality of service (total quality control, ...).

Secondly, the work will evaluate (particularly through simulations) the contribution of new technologies, notably communication and information, to the improvement of maritime traffic management. In particular, information exchange between ports and port communities will help the flow of goods, improve safety and the interface role of ports. It is also necessary to analyze and develop new techniques for the whole operation (ships and ports) notably through the problem of standardisation of cargo unitisation.

It is also necessary to analyze the options for improving the provision of maritime transport through the application of new technologies, notably new rapid transfer systems for goods and passenger and by the analysis of their reliance on professional qualifications and infrastructure capacity. This will address the definition of a new generation of operation systems and higher performance ships, able to ensure more efficient, safer and environmentally friendly operations (e.g. higher speed, reduced emissions and fuel consumption); in particular the conceptual and design requirements resulting from safety measures linked with the transport of dangerous goods must be analyzed. The use of alternative, more environmentally friendly energy sources will also be examined, as well as the treatment of refuse of ships and in the ports.

Thirdly, the work will also evaluate the factors having an influence on maritime safety. Simulation methods for traffic scenarios will be developed. The application of integrated telematic tools will be evaluated. The impact of the whole chain of human factors will be assessed (e.g. ship operation, traffic management and control, shore-based operations). Common criteria for establishing the level of training of crews, as well as procedures for the whole operation (ship and shore-based), communications and traffic management will be developed.

Finally, the work will address specific research such as :

- a common methodology to investigate and determine accident causes, and the means and tools to remedy them
- the provision of an operational solution for a working European "electronic chart display and information" system

- the harmonisation of common procedures at a European level to facilitate the flow of goods
- a common approach to evaluate the problems of pollution and sedimentation in ports and remedy them.

Inland Waterways

The work will address the integration of new generic technologies together with organisational factors and human resources for inland waterways. It will analyze in particular the role of this transport mode in the whole chain and will define evaluation criteria for scenarios which are able, as a whole, to reflect the importance and potential of inland waterways and in particular, which could hamper the development and transfer of goods transport demand to inland waterways.

In particular, the work will enable the transfer of the results of generic technology research to inland waterways with respect to cost-benefit, safety and environmental impact criteria notably to improve the whole operation of ships and ports. It will also be necessary to examine the evolution of construction and barge characteristics as a function of increased speed, reduced emissions and energy consumption. Similarly, human factors with regard to safety on barges and ground infrastructure needs to be analyzed, particularly the requirements for certification, training and the operational use of information and communication means. Finally, the work will address restrictions to navigation, low depth hydrodynamics, infrastructure, ports, traffic management and organisation, goods information flows.

Road Transport

Research in this domain should contribute to greater efficiency of tranport, enlarged capacity of road infrastructure and reduction of unnecessary movements.
Many technologies have been developed independently and now have to be subjected to comprehensive assessment in relation to the criteria of sustainable mobility.
Assessment will be done through modelling, simulation and demonstration including pilot projects.
This work will serve as an instrument for identifying appropriate applications, their interaction and their socio-economic effects. This involves pre-normative and legislative actions to support the realisation of a common policy for road safety.
In particular it will address, amongst others the integration of infrastructure, vehicles, man and telematic tools with the objective of improving traffic circulation and safety.

ANNEX II

Indicative breakdown of the effort between the different areas

A.	**Strategic research for a multimodal transport system** (strategy,demonstration,validation)	**18-22%**
B.	**Network optimisation**	**78-82%**
-	Rail transport (management,safety,interoperability)	**16-18%**
-	Integrated transport chains (transhipment,logistics)	**5-7%**
-	Air transport (management/ATM,safety)	**16-18%**
-	Urban transport (management, optimisation)	**10-12%**
-	Road transport (management,safety,logistics)	**8-10%**
-	Maritime transport & Inland waterways (management/VTS,safety,human factors)	**19-21%**
TOTAL		**100% (280 MECUS)**

"TARGETED SOCIO-ECONOMIC RESEARCH"

ANNEX I

SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES AND CONTENT

CONTEXT

Europe faces a threefold challenge:

- *the scale and pace of scientific and technological change in relation to growth, employment and the quality of life in Europe, which call for constant monitoring, and the capacity for systematic forward-planning and assessment;*

- *the gulf between the qualifications required by the constant changes in production activities and public and private education and training systems at a time when education and training tailored to these changes are essential preconditions for economic and social development;*

- *the renewed poverty and the upswing in new forms of intolerance and social exclusion symptomatic of the deep-seated unease felt by European society about the means and ends of economic and social development.*

Article 130f of the Treaty on European Union sets the Community's research and technological development (RTD) activities the objectives of making European industry more competitive and of supporting all the Community's policies and activities. Article 130h calls on the Community and the Member States to coordinate their research and technological development activities so as to ensure that national policies and Community policies are mutually consistent. Beyond that, the Treaty provides for strengthening economic and social cohesion (Article 130a), for a social policy and for the Community to contribute to the development of quality education and training (Title VIII, particularly Articles 126 and 127).

In this context, this programme supports research and studies in the field of economic and social sciences, the primary objective being to update and enlarge the common knowledge base necessary for decision-making on science and technology policy and in the fields where science and technology have a role to play (at both Community and Member State level). It will be necessary to encourage the emergence of a European community of researchers (sensitive to the needs and aspirations of different sectors of society) willing to share the fruits of their work, to work together and to place their results at the disposition of decision makers and the general public. To this end, this research will build on the work and skills available at national level and aim at closer cooperation and coordination and at generation of added value at Community level in the form of:

- *fuller knowledge and analysis of the interrelationships between scientific, technological and socio-economic changes at world, European and national level, public- and private-sector strategies and policies and the anticipated short- and medium-term needs of society;*

- *wider dissemination of the innovations in education and training systems and methods which emerge from the far-reaching changes in know-how and production methods and from further European integration, taking due account of diversity;*

- *a greater contribution by research and technological development activities to understanding, preventing and solving the phenomena of social exclusion in Europe, particularly in urban areas, and to strengthening social integration measures.*

As well as these horizontal targeted research activities, socio-economic research will be carried out within each RTD topic in the first activity (evaluation of socio-economic impact and risks) and also under the second activity (socio-economic conditions for international scientific and technical cooperation and links with the Community's external policy), the third activity (more efficient uptake of RTD results) and the fourth activity (training and mobility of researchers in the social and economic sciences).

THE RTD ACTIVITIES

A. SCIENTIFIC OBJECTIVES AND CONTENT

The programme is divided into three sections:

- evaluation of science and technology policy options;
- research on education and training;
- research into integration in Europe and the phenomena of social exclusion.

1. EVALUATION OF SCIENCE AND TECHNOLOGY POLICY OPTIONS (TECHNOLOGY ASSESSMENT)

The objective of this action is to enable scientific and technological priorities in Europe (at regional, national or Community level) to be derived from the evaluation of challenges facing European industry and society in the medium to long term in order to ensure that science and technology are used to reply to their needs. To this effect a structured approach will be implemented which effectively integrates all categories of decision makers (industry, social partners, consumers, public authorities) in the process. The resulting common, recognized information and analysis base must provide a fuller picture of:

- the research situation in Europe, in the world context;
- the probable socio-economic consequences of emerging developments in science and technology;
- the impact of the social and cultural changes (demography, social structures, behaviour and value systems) on the needs for and directions taken by research in the next five to ten years.

The approach will ensure a dialogue between decision makers and those involved with the activities with a view to identifying areas for which scientific and technological developments can assist the resolution of difficulties concerned with sustainable growth, competitiveness and employment in Europe.

These activities on the evaluation of science and technology policy options will also help with the constant analysis of the role and position of science and technology in the definition and implementation of the other Community policies to which they must contribute.

These activities will be carried out in close collaboration with the other specific research programmes covered by the Fourth (1994-98) Framework Programme, with the work of the JRC's Institute for Prospective Technological Studies and with the activities conducted in this field in the Member States, by the relevant Parliamentary bodies (particularly the European Parliament's STOA), by public and private research institutes and by universities. They will also draw on the similar work conducted by international organizations and non-Community countries.

The Community's research on this topic will therefore concentrate on three subjects.

a) Analysis of the RTD situation in Europe

The first objective is to strengthen the information system for generating and providing access to **RTD statistics and indicators**, based on cooperation between Eurostat and the other Commission departments involved in collecting and using such data. The system must contain information on RTD resources (inputs) and results (outputs), and on Europe's competitive position, must cover both the public and private sectors and must contain data allowing comparisons at world level. It will be built around the indicators already available at national, Community (EUROSTAT) and OECD level, from international organizations (UNESCO, UNIDO, FAO, etc.) and from original studies. This open information system must allow **publication of an annual situation report on RTD in Europe** and of papers on individual topics plus dissemination of the information collected or generated, on request, at any time.

In addition, this information system and these publications will be supplemented, supplied and utilized by carefully selected, systematic collaborative studies carried out on the European scale:

- following a geographical approach: RTD in each Member State, in each region or interregional association, in non-Community countries and by international organizations, including the policies pursued (objectives and implementing procedures);

- by sector, discipline or technology: industrial RTD (by sector, type of firm, scale, strategies, etc.); the Community's strengths and weaknesses in comparison with its leading rivals in the various fields of RTD (monitoring of science and technology);

- at company level: technology management methods, organizational approaches, workers' role and involvement in social and technical change, etc.;

- by subject or horizontally: for example, studies on forms of cooperation in the RTD field in Europe, on the inter-relationship between research and competitiveness or research and cohesion, on the researcher population in Europe and on the obstacles to researcher mobility, or on the legislative aspects of research.

This open information system will therefore be built up and expanded by working closely with the national and international bodies specializing in the production of science and technology indicators and in analysing public and private sector RTD policies and strategies.

b) Evaluation of the socio-economic impact of new scientific and technological developments

The objective of these activities will be to evaluate in advance:

- **the potential benefits** of RTD and the advantages which it can offer from various points of view - scientific (e.g. new insights into natural phenomena, new methods), economic (e.g. improving the competitiveness of companies in various sectors, introduction of new products or services, greater penetration of existing markets, opening up of new markets, etc.) or social (e.g. job creation, new forms of work, improvements in safety, the quality of life or the environment, consumer protection, etc.);

- **the potential costs and risks:** from the economic point of view (e.g. widening of the gaps between regions due to greater concentration of competitive advantages, destruction of skills due to over-rapid obsolescence of knowledge and know-how, etc.) and from the social point of view (e.g. loss of jobs, marginalization of technically illiterate sections of society, destabilization of private life due to insufficient security for the data circulated, psycho-sociological effects, etc.).

These activities will focus on emerging fields of science and technology or fields developing at the interface between different areas of research. In particular, the work to identify **technologies of major importance for industry and other sectors of activity** (including public services) in Europe will be continued and expanded.

The evaluations of the socio-economic impact of new scientific and technological developments will harness the various approaches followed at national, Community (particularly in the specific programmes under the Third Framework Programme) and international levels in this field in order to compare the experience gained and **create a framework for comparison of methods** with a view to gradual establishment of a set of

comparable approaches. Opinion polls on public perception of science and technology in Europe will be carried out, in conjunction with the surveys conducted in non-Community countries.

c) Prospective impact of socio-economic and cultural change on research

The objective is to conduct medium-term (five to ten year) forward analyses of the major economic, social and cultural challenges to be met by RTD with a view to providing guidance for research efforts in Europe.

From **the economic and financial** point of view, the work should produce an in-depth analysis of the changes under way or in prospect in the world economy and of their consequences for research. The emphasis will be placed on studying the consequences of the emergence of new regional free trade zones (the North American Free Trade Association, ...), of fast-growing regions (South-East Asia) or of regions in transition (Eastern Europe and the CIS), the progress with the major worldwide problems (environment, health and ageing, mobility, energy, food, etc.) and the contribution which research can make towards solving them (notably by assessing future trends in the structure of supply and demand for new technologies on the regional, national, Community and world scale).

As regards the **socio-cultural** dimension, the emergence of new leisure pursuits or new cultural activities, Europeans' growing awareness of the environment, ethical problems and safety in all its forms, the social implications of the emergence of an "information society" and the impact of these factors on their consumption patterns will be evaluated, as will the development of new social practices and the emergence of new needs and alternative approaches with a decisive effect on the design, production and dissemination of new knowledge, products and processes. Moreover, the activities will cover the study of social problems related to changes in production processes and forms of economic organisation such as new working practices, changes in the degree of vertical integration and internationalisation of the local, national and European economies. Finally, an in-depth analysis of potential changes in socio-cultural behaviour vis-à-vis science and technology or applications thereof will carried out.

The analysis of the **medium-term changes in the European research system** will be targeted on forecasting changes which could affect organization of the research itself (relations between disciplines and technologies, researchers' careers, likely channels of communication in the scientific community, scientists' perceptions of the questions raised by society, etc.).

The studies of prospective nature must produce practical results which can be used by decision-makers in the public and private sectors. Consequently, the experts will be urged to give priority to the construction of scenarios providing a clear picture of the various trends and changes in progress or expected, without disregarding the points of view of eminent researchers in the Community who have produced major works on socio-economic and cultural change in European society.

This work will be carried out in close collaboration with the forecasting bodies in the Member States and, where appropriate, in non-Community countries.

2. RESEARCH ON EDUCATION AND TRAINING

The Community's research activities on education and training have three objectives: first, **to develop and disseminate innovations in education and training systems**; second, to identify the new generic processes linking education and training to the changes affecting science, technology and the skills required to build the necessary interfaces; third, to evaluate the implications of European integration and globalization in order to identify the Community's contribution to improving education and training systems in Europe. Generally, the work planned will bring to light and place at the disposal of all concerned new methods and approaches and new models and techniques for high-quality education and training.

The work will be conducted in close synergy with and draw on Community initiatives on European education and training (COMETT and ERASMUS and future initiatives in this area), on research (research training under the programme on human capital and mobility, research on telematics applications for education and training) and will provide inputs for subsequent measures.

The Community research on education and training will focus on two lines of action:

a) Problems of mutual concern to Member States: the Single Market, new skills requirements, and demands of endogenous development

On the one hand, this research will compare the national approaches adopted to meet the twin challenges of the accelerating pace of industrial change generating new needs for skills and of the internal market and of the resultant increased mobility. The primary aim of the research will be to predict the new skills required in companies in order to master the complex social and technical changes in a context of increasing globalization of the economy and technology. In particular, the reforms of syllabus and curriculum dictated by these changes will be analysed, together with skill-building organisation in enterprises the needs and approaches for in-service training and the addition of a European dimension to education and training systems, the development of common curricula, multi-cultural practices and approaches reflecting the process of European integration and the development of European citizenship, and the approaches taken to language teaching. The impact of the various European networks for education, training and research in terms of forging new partnerships between businesses, schools and training institutes at local, sectoral and national level will also have to be identified.

On the other hand, the analysis of the regional differences and mechanisms for adaptation to the requirements of endogenous development will be considered.

The diversity of the education and training systems in Europe, stemming from historical, cultural, socio-economic and political factors, can be harnessed at Community level with the aid of comparative research. Particular importance will be attached to:

- education and training opportunities available at regional level (development of statistics and indicators, studies and research, networks, etc.) in order to understand the processes dictating the differences in education and training opportunities (gradual strengthening or weakening, organizational models, role of the socio-economic circles concerned and of the public authorities, etc.);

- needs for education and training at regional level (in relation to the strategies for socio-economic and cultural development and to the rapidly changing specialization of production).

b) Innovations in education and training methods: tools, psycho-pedagogical and organizational aspects, quality management

This research will focus in the first instance, on the use of new technologies, particularly of information and communications technologies (home study methods, multimedia systems, artificial intelligence, etc.), in education and training activities and on pedagogical and organizational innovations. Research will also be carried out on the didactic and pedagogical aspects of new technologies (such as biosciences and biotechnologies, materials science and technologies, environmental science and technologies, etc.) and on potential applications of cognitive sciences and artificial intelligence.

In particular, the processes for the dissemination of innovations in education and training systems will be analysed (the interfaces between pedagogical research and school reforms, the compatibility of the teaching tools available with the training required by businesses and innovation transfers between initial and continous training), together with experiments on the reorganization of education to supplement and enrich schooling and vocational training (for example, science and technology teaching with the aid of museums, associations, media campaigns, etc.). The question of new methods of transferring technological innovations developed in the course of research programmes, with the aid of training programmes and networks, will be covered.

Account will also be taken of the impact of the research and pedagogical innovations on training for instructors and on teachers' new role.

On the second instance, this research will evaluate various methods of quality control, based on the experiments carried out in different Member States whether of a single course, of an entire educational programme, of teaching processes, of teacher performance or of management of an education and training institute. In particular, giving due consideration to cost-effectiveness, this research will evaluate which methods give the fullest picture of:

- the relevance of a training programme to the needs identified (of students, industry, public services, etc.);

- the quality of the design of the programme, compared with the declared objectives;

- the potential impact of the programme on students' attitudes and career prospects.

Finally, the various national systems for monitoring and evaluating curricula, their methodologies and impact on changes in education and training systems, will be analysed.

3. RESEARCH INTO INTEGRATION IN EUROPE AND THE PHENOMENA OF SOCIAL EXCLUSION

Research under this heading is closely linked to Community initiatives (notably the new medium term action programme against social exclusion) and national initiatives which are aimed at combatting social exclusion in Europe. The research will provide decision makers in this domain with a common knowledge base on certain specific aspects.

Indeed, there are two objectives in this field: to study how far the actual process of European integration (single market, economic and monetary union, world context, etc.) gives rise to particular causes of social exclusion and integration, as opposed to those specific to the changes at national and local level, and to allow all Member States to benefit from successful social integration schemes, particularly those in which technology has played a significant part, by conducting comparative research and by joint application of the results of evaluations of the most innovatory projects.

Urban areas are the focal point for the appearance of new forms of social exclusion. Cities, towns and interregional networks thereof are therefore the level for observing the phenomena with the greatest consequences (and opportunities) for the future.

The research will centre around two principal objectives:

a) The social and cultural aspects of European integration and the associated phenomena of globalization

The objective will be to analyse **past or ongoing changes in the morphology of society in the Community Member States** which, coupled with the changes in production plant and technical systems, have had a major impact on social integration and exclusion. The changes in social morphology which will be analysed in depth include the ageing of the population and the position of young people in society, the reduction in the working population coupled with the growing number of working women and the changes in family life, organization of time and the relationship between work and training.

Another objective will be to study the major issues relating to **the quality of life, security and Europeans' values, opinions and behaviour**, particularly in situations marked by a multi-ethnic population. The aim is to analyse the methods used in successful schemes on European integration, population change and local fragmentation and to evaluate the prospects of general application of effective solutions.

b) Contribution by technological developments to social integration

The objective is to analyse integrated applications of different technologies, notably information, communication and transport technologies, to facilitate social integration.

This work will focus on:

- the demand for existing or undeveloped technologies to encourage social integration;

- new demand for technological developments in the services sector and changes in the social exclusion processes.

Here too the research will give priority to a comparative multidisciplinary approach backed up by the scientific networks and concentrating on analysis of specific innovatory schemes. As a general rule, this research will be carried out in close collaboration with the local, national and European bodies with solid experience in this field (notably networks of cities) and with the groups directly concerned with exclusion.

B. RESOURCES

As a general rule, the research activities will take the form of concerted action, shared-cost projects and accompanying activities (principally studies but also, possibly, grants for science and technology conferences organized by third parties, conferences, seminars or other scientific gatherings organized by the Commission and publications).

However, in order to coordinate the Community's research closely with the national work and, in the process, develop a joint information and analysis infrastructure accessible to all, the activities concerning the evaluation of science and technology policy options will be carried out within the framework of the **European Technology Assessment Network** (ETAN). The network will hinge around the Commission, which will provide the secretarial services. It will bring together the leading national organizations working on the evaluation of science and technology policy options, the JRC's Institute for Prospective Technological Studies and the Forward Studies Unit. A steering committee consisting of representatives of the bodies involved and the heads of the European Parliament's STOA, of the European Parliamentary Technology Assessment Network and of the two sides of industry will advise the Commission on the work programme for this first part of the programme and on

application and utilization of the results or of the national, transnational or European work which the members of the network wish to share at Community level. The activities will also be coordinated with the work of the other Commission departments most directly concerned with RTD activities in Europe and special attention will be devoted to make the best use of the expertise available around the various socio-economic actors in Europe.

In addition, the members of the ETAN network will carry out a number of coordinated activities which will receive support as shared-cost projects or concerted action projects, notably with a view to setting up harmonized databases on the situation of research in Europe or on major joint studies or projects.

Generally, in order to promote more effective socio-economic research in Europe, support will have to be given to the development or consolidation of joint research infrastructure (data availability and access, exchanges and networking) far more streamlined than the infrastructure used in the development of "hard" science. This infrastructure must encourage the emergence of European networks of research laboratories working in the social sciences field.

IMPLEMENTATION

The aim will be to concentrate the Community's activities on a reasonable number of studies and research projects of moderate size to simplify administrative and financial management. As far as possible this will be decentralized with a view to concentrating the tasks of the teams working on the programme on **network management and on definition, selection, utilization and application of the work done.**

ANNEX II

Indicative breakdown of effort between the different domains

Evaluation of science and technology policy options (technology assessment)	**45 - 55%**
Research on education and training	**20 - 30%**
Research on integration in Europe and social exclusion phenomena	**20 - 30%**
TOTAL	**100% (ECU 90 million)**

COOPERATION WITH THIRD COUNTRIES AND INTERNATIONAL ORGANIZATIONS

PROMOTION OF COOPERATION ON RESEARCH, TECHNOLOGICAL DEVELOPMENT AND DEMONSTRATION WITH THIRD COUNTRIES AND INTERNATIONAL ORGANIZATIONS

ANNEX I

AIMS AND SCIENTIFIC AND TECHNOLOGICAL CONTENT

BACKGROUND

This activity is the vehicle for international cooperation on RTD with third countries and international organizations. The essential aim of this activity is to amplify, through targeted RTD cooperation and in synergy with other Community activities, the added value of Community RTD, enhance its scientific and technical base and to support the implementation of other Community policies. It will also aim at enhancing the coordination of the S&T cooperation between Member States and third countries in order to avoid duplication and better to define the Community's areas of activity on the basis of the subsidiarity principle.

Cooperation will be based on the principle of mutual benefit, which means not only direct or short-term benefits, as perceived by those involved in a project, but also long-term or indirect benefits to the Community, in so far as it concerns both its industrial competitivity and its external relations.

The activities involved in cooperation will be accompanied by systematic monitoring and analysis of developments in policies and the machinery for implementing R&D in third countries in order to adapt Community cooperation policy and to derive maximum benefit for the Community and its partners.

All of the actions involved in cooperation, as developed in the earlier framework programmes, in APAS and in energy demonstration, will be incorporated into this programme. The geographical scope covers all of Europe, including the independent States of the former Soviet Union, the non-European industrialized countries and the developing countries. Moreover, greater opening-up of the other specific programmes to third countries will provide new opportunities for cooperation.

THE PROPOSED RTD ACTIVITIES

A. SCIENTIFIC AND TECHNOLOGICAL COOPERATION IN EUROPE

The Agreement setting up the European Economic Area (EEA) will enable six of the seven EFTA countries to become involved in all the specific non-nuclear programmes under the Third Framework Programme. Suitable adaptation of the EEA Agreement is planned in order to permit their full involvement in the Fourth Framework Programme. Other Western European countries outside the EEA may become associated via bilateral agreements.

1. Collaboration with other forums for European scientific and technological cooperation

The aim is to boost the coherence, efficiency and overall cost-effectiveness of European research, while taking full account of national programmes and activities within the European Economic Area as a whole, via COST, EUREKA and links with European international organizations and with relevant bodies at global level.

COST

The COST Actions, which are complementary to Community programmes projects, are expanding vigorously and will continue to pave the way towards identifying new areas for scientific cooperation in Europe, a recent example of which is socio-economic research. The essential role of COST in integrating scientists from Central and Eastern Europe into a broader European context will assume increasing importance. The assessment of the current COST projects and the practical application of their results have been pinpointed as priorities for the years ahead.

The Commission intends to continue the controlled development of COST activities and to provide the support needed for the proper functioning of the secretariats of the relevant committees and for international coordination. The support of the COST countries is illustrated by their readiness to second national experts in order to run certain secretariats.

EUREKA

The dovetailing of EUREKA with the Community's RTD framework programme is based on respecting the specific aspects of the two frameworks. The Edinburgh European Council in December 1992 stressed the need to intensify synergy between them.

Recent developments within the Community and EUREKA open up new avenues and give practical expression to a common intention to extend concertation, which must be pragmatic and follow a case-by-case approach. On the one hand, the pre-competitive parts of the EUREKA projects could be dealt with under the framework programme, and on the other, the results from Community projects can be taken into account within the (closer to the market) EUREKA projects.

The practical implementation of this joint policy will be designed to meet the following aims :

- the movement of information and flexible concertation among the two forums will be guaranteed by the network of Community programme managers and EUREKA-project coordinators set up earlier.
- more efficient use of the existing counselling and information-distribution networks, at Community level (VALUE, STRIDE, etc.) and at the level of EUREKA and the Member States, in order to improve transparency for industry and researchers, and in particular SMEs.

Improved machinery for taking account of precompetitive work within the EUREKA projects could include the option of reserving part of the financial resources in the workprogrammes of the Community's specific programmes. The EUREKA projects could be selected at the same time as the projects coming from a call for proposals, under the conditions that the objectives of the specific programmes were respected and the procedures for submission to the corresponding programme committers were followed.

International organizations

The aim is to strengthen the coherence of research in Europe via closer coordination with the European and international scientific organizations and with the networks of research workers they have frequently set up. Links with the ESF, CERN, ESA, EMBL, ESO, etc. will be forged more strongly, and the European presence within the international political organizations (UN, FAO, WHO, OECD, etc.) will be stepped up in order to promote a common European position.

The intention is to negotiate cooperation agreements with relevant European scientific organizations with a view to mutual involvement in projects of common interest. This will not concern the main fields of activity of those organizations, but rather the common application of ancillary, and often unique, expertise derived from their main activities.

2. Cooperation with the countries of Central and Eastern Europe and with the new independent States of the former Soviet Union

The principal aim is to help safeguard the scientific and technological potential of these countries, to redirect research towards social needs, and thus help restore their production systems, as well as helping to improve the quality of life in the societies in question. The Community will be able to benefit from cooperation with the East European countries by obtaining access to the sometimes highly advanced results of research in those countries.

There are three principal aims here :

- To stabilize R&D potential : this is first of all a question of safeguarding human potential and existing equipment. The current earnings of research workers in these countries are low and the lack of hard currencies suggests a difficult future leading to isolation of East European researchers whose access to equipment is difficult and who have little contact with their foreign counterparts. One of the main consequences is that, if the opportunity arises, researchers leave this sector to go abroad or take up other professional activities. There is therefore an urgent need to promote scientific and technical cooperation on a long-term basis : East European scientists should be associated with high-tech research, for example, in areas of advanced technologies essential to the creation of the future infrastructure of these countries. Links should be forged between researchers and industry, especially via the use of computerized communications networks, in order to promote the integration of these countries into European and world markets.

- To help solve problems specific to the East European countries by means of targeted R&D actions.
- To widen and deepen cooperation via involvement in the specific Community programmes : identification of R&D areas where these countries are in the forefront at world level, and introduction of balanced cooperation. Several of these countries occupy a very high position in scientific terms, but the potential has not always been used in order to stimulate economic development. Thus a reform of science and technology structures in favour of a more decentralized, flexible and open approach is urgent in order that research and development may play an effective part in the transition of these countries towards a market economy and their integration into the Community environment. In order to better merge the East European countries into the fabric of the world market, support will also be given to involvement in pre-normative activities in industrial areas such as information technologies and telecommunications, advanced materials, and energy (by making use, for example, of the "energy centres" set up in these countries under the THERMIE programme) and the dissemination and valorisation activities carried out in Activity 3.
  For what concerns the associated countries, the Commission proposes to open up all of the specific programmes to these countries, as requested by the Copenhagen European Council.

The activities involving the countries of Central and Eastern Europe will be conducted via :
- involvement of these countries in the specific programmes under the Fourth Framework Programme, with Community funding;
- specific actions to meet specific needs. For example, resource utilization and production cycles in the East have caused environmental deterioration which extends beyond national frontiers and continents. There is an urgent need to find a common solution in areas such as the rational utilization of energy resources, and climatic change;
- the International Association for Scientific Cooperation.

This activity will supplement that of the Member States and synergy with the PHARE and TACIS programmes will be guaranteed. At the same time, it will help to coordinate Member States' activities in this area.

B. COOPERATION WITH NON-EUROPEAN INDUSTRIALIZED THIRD COUNTRIES

The aim is to further the Community's interest, notably by favorising a balance between the Community's industrial research orientation and the potential international market for their application so as to enhance the competitivity of European industry. Furthermore it should optimize its efforts by seeking or easing access to scientific and technological sources in the countries in question, since these highly industrialized countries conduct RTD similar or complementary to that conducted by the EC. To some extent, the reasoning behind cooperation between the Community and those countries on RTD is the same as that underlying intra-Community cooperation.

In other instances cooperation with these countries is a basic prerequisite for the implementation of "megascience" research projects such as fusion, the human genome and global change. This is the background to such multilateral cooperation and consultation as, for example, within the OECD or multilateral projects such as the "Human-Frontier Programme" and "Intelligent Production Systems". To this should be added involvement in research in preparation for international standards.

The dialogue on scientific policy with the abovementioned countries will be deepened. This could lead to cooperation on the basis of a sectoral agreement or a wider agreement on scientific and technical cooperation. Nevertheless, since the countries concerned are both Community partners and competitors it is important to be selective as regards the areas of cooperation and to concentrate on a few carefully selected sectors in the light of Community priorities.

This cooperation requires a degree of flexibility as regards the details of cooperation, ranging from consultation to an exchange of information and experts, to programmes of post-doctorate fellowships in foreign laboratories, to joint projects or studies, and possibly to reciprocal involvement in projects or complete research programmes.

A closer link is planned between scientific and technical cooperation and education and training.

These activities also underpin the Community's external policy activities and offer all of the Member States the advantage of equal access to foreign sources of science and technology.

Actions which facilitate the access to such information and their dissemination will be encouraged.

C. SCIENTIFIC AND TECHNOLOGICAL COOPERATION WITH THE DEVELOPING COUNTRIES

The main aim of this activity is to enable the DCs to be associated with developing the know-how needed in order to solve the problems arising from their own development. This aim has two results : one is to harness training and the relationships that will be established between research workers in order to maintain and even boost DC research capacity - in particular at human-resource level. The other will be to enable the European scientific community to maintain and improve excellence in the scientific areas that are relevant to DC problems. To help attain this general objective, dissemination and valorisation actions will be put in place in liaison with Activity 3.

In order to achieve this aim, research will target three areas of major importance in most of the DCs :

- **production** resulting from a lasting improvement of land and labour productivity in **agriculture** and in associated sectors such as agri-industry. This involves plant improvements and protection in order better to adapt plants to environmental conditions, thus permitting better utilization of the land available; improved stock-raising and thus protection of animals; environmentally-acceptable improvements to breeds and animal feeds; fisheries and aquaculture, promising areas which have hitherto been the subject of little research; improvements to product storage and conversion, areas in which losses within DCs are considerable; analysis of production systems and the scope for intensifying rural systems.
- **health and population,** focusing on control of the predominant diseases in the DCs, improving health-care systems and the impact on the environment and on health of demographic change and urbanization. This concerns research into vaccines, the biology of pathogens and their vectors, the development of new methods of diagnosis and the production of new medicines; research into population, health-care systems and methods of intervention, account being taken of the specific constraints on and the socio-economic context of the DCs.
- **natural resources,** (particularly with a view to their sustainable utilization), forests, oceans and other aquatic environments, water, soil and the diversity of the living world, with particular attention focusing on conservation and utilization (for example, water and competition for its uses), and on complex interactions with natural resources (for example forests and biodiversity; forest and atmosphere, land and water, ...).

Priorities will be focused within each of these areas during the preparation of the work programme, since this will be drawn up for the individual regions - taking into account their ecological, demographical, public health and economical situations.

The other aim of this activity is to make it easier for DCs to participate in the major international or Community research programmes on topics of general interest. Problems affecting the future of the planet (desertification, the greenhouse effect, communicable diseases, pandemics, population growth, uncontrolled urban growth, economic and social imbalances, ...) are being experienced most acutely in those countries today. However, it is also there that important factors in their solution (human resources, biodiversity reserves, natural resources, regulation of atmospheric exchange via tropical forests ...) are to be found.

The research activities undertaken in order to achieve the second aim are, by their very nature, global and must be dealt with in a global rather than regional manner. They are often defined in international fora in which the EC is active, and they sometimes form part of the specific programmes under activity 1. Among the more urgent topics are global change, communicable diseases and social health-care provision, Earth observation in cooperation with other organizations, and in particular the JRC, and the assessment and conservation of natural resources.

Any bolstering of DC research capacity requires the use of communication and information technologies enabling cooperation on R&D to be optimized and the harmonious, gradual integration of these countries into the world economy to be promoted, while helping to bring them out of their isolation. For this purpose, particular attention will be given to improving the scientific and technological conditions enabling advanced communications networks and systems to be set up and access to be provided to the European networks relevant to the development of these countries, while making the best use of the results of the specific Community programmes within activity 1.

Finally, research topics of mutual interest for the countries in question and the EC, coming under the specific programmes within activity 1 open to them, may be identified for the DCs which are most advanced in scientific terms.

In view of the cooperative nature of the research and the essential characteristics of the partnership it will primarily be implemented via joint shared-cost projects. In the specific cases of topics of mutual interest, concerted action may also be considered. The part played by joint research networks is also important, as are scientific presentations, meetings, workshops and conferences. The training and education provided under the activity will in essence be provided via these joint research contracts and accompanying measures, the networks being, as it were, a means of continuous training and the contracts a basis for guaranteeing that the training will be put to good use.

IMPLEMENTATION

Apart from the secretariat and coordination costs no Community funding is planned for projects concerning other areas of European cooperation (topic A1). Nor is any Community project funding planned for cooperation with the non-European industrialized third countries (topic B), but activity 2 funds may be used for Community involvement in the exploratory stage of a joint project or programme, it being understood that the funding of the operational stage of the project or programme must be covered by activity 1.

A distinction must be made between two categories of activity where cooperation with the CEEC, NIS and DCs[1] (topics A2 and C) is concerned.

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[1] Central and Eastern European Countries (CEEC), New Independent States (NIS), Developing Countries (DCs)

First of all, the specific cooperation activities in the areas not covered by activities 1, 3 and 4 will be managed within activity 2. The expertise already present within the Commission will be deployed for scientific management purposes.

Secondly, where activities 1, 2 and 4 within the Framework Programme are open to participation by S&T organizations in these countries, the rules under the specific programmes concerned would apply (call for proposals, selection procedure, committee procedures, etc.), management being the responsibility of those specific programmes. Activity 2 would only be invoked if the non-Community partners need to call upon Community funding. The money reserved for that purpose within the budget for activity 2 will permit financial support of this type in accordance with the details to be laid down within the work programme for activity 2.

Cooperation with the countries of Central and Eastern Europe, the new independent States and DCs will take place in close liaison with other Community projects such as PHARE and TACIS, or within other vehicles for cooperation such as the Lomé Convention, in order to mutually enrich the inputs to and results of these activities and the cooperation in the context of Community policy on RTD.

Where intellectual property is concerned, the guidelines adopted jointly by the Council and the Commission in June 1992 will apply.

ANNEX II

Indicative breakdown of the effort required between the different sectors

		%	
A.	*Scientific and technological cooperation in Europe*		47-54
	1. Other forums for European cooperation - COST - Other (CERN, ESF, EUREKA Secr. etc.)	6-6.7	
	2. CEEC and former USSR - involvement in activities 1, 3 and 4 - specific activities - International Association	41-47	
B.	*Cooperation with industrialized non-European third countries*		4.8-5.3
	USA, Japan, etc.		
C.	*Cooperation with developing countries*		41-47
	- involvement in activities 1, 3 and 4 - specific activities		
	Total		100 % (790 million ECU)

DISSEMINATION AND EXPLOITATION OF RTD RESULTS

ANNEX I - AIMS AND CONTENT

of Community action for the dissemination and exploitation of the results of Community research, technological development and demonstration activities

I AIMS AND GENERAL PRINCIPLES OF IMPLEMENTATION

Dissemination and exploitation activities are pursued under specific programmes and in the context of a horizontal Community activity which is the subject of the present Decision and is referred to in the framework programme as "Dissemination and Optimization".

The specific programmes ensure the implementation of the dissemination and exploitation activities relating to their specific domains and , in particular, that due account is taken of the dissemination and exploitation criteria for the evaluation and selection of RTD projects, that the provisions of the contracts which relate to protection, exploitation and dissemination are complied with and that networks and partnerships established in connection with research projects are also enabled to contribute to the process of dissemination and exploitation of the results obtained.

The action to be taken by the Community supplements the actions undertaken by the Member States by giving them a dimension and an added value at a Community level. It has three objectives:

- to ensure the widest possible dissemination of the results of RTD activities under Community and national programmes;

- to optimize their exploitation, i.e. to ensure with the assistance of the various sectors concerned that the results obtained under Community and national programmes are transformed into innovations, possibly in synergy with other results, and to promote transfers of technology, particularly to the SMEs;

- to support the various initiatives launched at national level so as to give them a trans-European dimension.

Responsibility for the exploitation of RTD results must be largely borne by enterprises, but Community assistance is needed in this context, especially for SMEs. Part A, concerning the "dissemination and optimisation of the results of Community research", is particularly addressed to the SMEs participating in the specific programmes or those which are capable of exploiting the results of Community or national research programmes. Part B, concerning the "dissemination of technologies to enterprises", is aimed at the large number of SMEs which have to integrate in their activities the know-how and new technologies on which the preservation or enhancement of their competitiveness depends and which they have to procure from external sources because they do not possess the necessary internal RTD capacity. Part C, concerning the "financial environment for the dissemination of technology", provides for measures and instruments to assist both these categories of SMEs.

By virtue of its aims and content, this action will help the least_favoured regions of the Community and contribute to economic and social cohesion. Hence its close links with the various initiatives in these domains.
The synergies with the EUREKA programme will be developed and the Community's contribution to the corresponding activities will come under this action.

The action will also involve a contribution to cooperation activities with non_member countries in the fields of dissemination and exploitation.

II CONTENTS OF HORIZONTAL ACTION

A) Dissemination of the results of research

The aim of action in this domain, is to promote the dissemination and trans-sectoral and transnational exploitation of the results of research, regardless of their source, and in particular to publicize Community RDT activities and their results in order to increase utilization.

What is offered here is a cohesive set of activities comprising services of a general nature, such as the Community network of relay centres, the public information and dissemination service, the services specializing in assistance with regard to the protection and exploitation of research results, together with action to improve not only the economic but also the social impact of the exploitation and transfer of the results of research.

1) The Community network of relay centres

The action taken under the Third Framework Programme to establish a network of relay centres in the Member States ("VALUE") in order to promote Community RTD activities and their results will be continued and intensified with the aim of attracting closer attention from enterprises and research laboratories in the individual countries, improving the exploitation of research results and fostering scientific and technical collaboration in Europe.

This action will consist in:

- providing support for enterprises and research laboratories, via the relay centres, to facilitate their access to information on Community RTD and demonstration activities;

- systematic examination of the technical and economic potential of RTD results, in collaboration with the specific programmes and contractors concerned with a view to their dissemination to the relay centres;

- evaluation of the potential scientific and technological needs of industry so that the supply of results from Community or national research can be better matched to them;

- organization of targeted actions designed to promote the results of research, with the emphasis on themes selected for their relevance to the needs of local industry;

- developing the synergies with the relevant national and regional networks and operators with the aim of boosting the transnational dissemination and exploitation of research results from any source;

- supplying telematic services to the relay centres, to facilitate the organization of joint activities.

The OPET network of organizations for the promotion of energy technologies will be integrated in this approach.

2) **The public information and dissemination service**

The three pillars of this structure are the data collection and production service, the services which specialize in the dissemination of information via networks serving the general public or the various target groups and those which concentrate on publicizing and heightening public awareness of research.

The following activities are planned:

- extension of the CORDIS information service to incorporate new sources of information (EUREKA, COST, national contact points, etc.) and multimedia documents;

- organization of dissemination projects aimed at specific target groups (scientific journalists, documentalists, relay centres and other intermediary networks etc.);

- design and production of new products adapted to the wide ranges of potential requirements for dissemination on a variety of media including CD-ROM, public networks, extracts from databases, bulletins, etc;

- sustained publication activity aimed primarily at information "multipliers" and the public at large;

- use of various means of communication with the public and methods of increasing awareness other than publications, such as audiovisual and multimedia techniques;

- improvement of coordination with similar activities at national level.

3) **Protection of results**

The aim of this line of action is to inform researchers and sensitize them to questions relating to the protection of industrial and intellectual property rights in respect of research results and to help organizations which do not themselves possess the necessary resources to protect the results of Community RTD which they have acquired.

Conferences and awareness-enhancement and training activities will be organized with the aim of giving researchers a closer insight into the various aspects of intellectual and industrial property rights. Steps will also be taken to develop collaboration with the European Patent Office and its national counterparts with a view to the organization of joint activities.

Provision will be made for continuing protection of the property rights of the Community in respect of research results and for management of its patent portfolio. On request also, subject to certain conditions, assistance and financial support will be made available to universities, research centres and SMEs with the aim of protecting the results of Community research.

4) **Help with the exploitation of research results**

The aim of this line of action will be to offer particularly to SMEs specialized services and assistance in addition to the activities of the relay centres, to facilitate transfer from research to industry and the trans-sectoral and transnational exploitation of results.

- the services offered under this heading can include, in particular, the identification of future markets, technical and economic feasibility studies, promotion activities, training schemes, advice on exploitation strategies and examination of industrial exploitation potential within the framework of inter-governmental projects (Eureka) or other Community initiatives;

- the aim of assistance is to provide partial financial support for activities in the fields of transfer, adaptation and exploitation of research results. It may include projects which are specifically designed to meet the needs of SMEs, support for know-how transfer schemes (training, technology clubs, researcher mobility) and the shared-cost financing of transnational and trans-sectoral exploitation projects.

This work will be done with the help of selected experts, or consultants or competent organizations in the Member States. Steps will be taken to develop closer coordination with national and regional exploitation activities.

5) **The exploitation of research and the needs of society**

The aim of this line of action is to carry out measures and studies which will help to improve the effectiveness of the exploitation and transfer of research results in the light of both economic and social needs and to organize joint action projects involving the scientific and educational community, public and private decision-makers, the social operators and the media in order to streamline communications between the general public and the world of science.

The competent structures in the Member States will be associated with the implementation of this line of action with the aim of stimulating synergies and ensuring mutual enrichment via the adoption of a coordinated approach and exchanges of information.

The following themes and activities, from the standpoint of the transfer and exploitation of know-how, will include:

- evaluation of the economic and social impact of RTD activities;

- the economy and the management of research;

- organization of communication projects designed to enhance awareness of the implications and impact of science and technology.

B - Dissemination of technology to enterprises

Priority attention will be given to SMEs in the industrial and service sector which depend on access to new technology for the preservation of their competitiveness but do not have sufficient resources to participate in Community research activities or the direct exploitation of Community research results. Many of these enterprises are in the lower or middle ranges of technological intensity and measures must be taken to improve their absorption capacity for new technology.

Hence the need to heighten their awareness of the new technologies which are available, whatever their origin, and or the opportunities they provide from the standpoint of their individual needs and strategies. They are so numerous that direct action is not a feasible proposition.
To stimulate these enterprises and get them moving in the right direction, the Community must play the role of a catalyst, and this will involve the radical decentralization of the organization of its activities and reliance on the competent organizations in the Member States, the TT intermediaries, the multipliers of information etc, in order to optimize the impact of its action.

The action taken under this heading is intended to raise the level of European awareness of these organizations and improve their quality and professionalism by fostering the establishment of cooperation networks, exchange of good practice, the provision of training and the organization of joint activities.

Community action must also contribute to the establishment of an environment favouring the absorption of technologies, via the organization of awareness-enhancement projects in the business sector, the demonstration of effective methods and the promotion of modern innovation management techniques. Finally, it must raise the general level of knowledge of the relevant mechanisms, instruments and policies and facilitate the dissemination of good practice to the local and regional operators, particularly by organizing the exchange and evaluation of experience.

Hence the simultaneous involvement of five major categories of operators:

- **technological resource centres (TRCs)**, capable of providing SMEs with access to the sources of technological expertise they need for an innovation project (universities and public research centres, sectoral joint research centres, companies specializing in research under contract, etc.);
- **suppliers of interface services**, capable of rapid diagnosis of the needs of client SMEs and able to put them in touch with the competent TRC ("conseillers technologiques" in France, "one-stop shops" in the United Kingdom, innovation centres in the Netherlands, etc.);
- **suppliers of specialized advisory services**, (quality, design, management, search for partners, creation of networks, etc.);
- **suppliers of financial services**, able to mobilize the capital resources required for innovation projects;
- **the national, regional or local public organizations** which lay down policies, determine the conditions under which enterprises have to operate and manage a range of support procedures.

Three lines of action are to be followed in this domain:

1. **Transnational networks providing support for the transfer and dissemination of technology**

In the follow-up to the SPRINT programme, the emphasis will be firmly fixed on European orientation and the quality and effectiveness of the services providing support for innovation and technology transfer. A coordinated bottom-up approach, geared to the needs of enterprises from the outset and encompassing every aspect of the transfer and utilization of technologies, will be promoted in this context.

Provision will be made for the following activities:

- consolidation of the transnational cooperation networks of national or regional operators in the fields of technology transfer or dissemination, so as to strengthen their European orientation: RTD organizations, sectoral technology centres, science and technology parks, local and regional technology dissemination organizations and networks, etc.;
- promotion of transnational cooperation between universities, research centres, industry and sources of financing in order to facilitate the expansion and transnational development of high-tech firms;
- support for national or regional schemes to make technology transfer services more effective, in the form of training sessions (e.g. in the form of a "summer university"), exchanges of experience and good practice, publication of manuals, etc., in order to give a trans-European dimension to these initiatives;
- measures to facilitate the trans-European dissemination of technological opportunities, whatever their origin, and to promote contact between suppliers, potential clients and intermediaries (TT conferences, technology exchanges etc.);

2. **An environment favouring the absorption of technologies by industry**

The aim is to foster the absorption of new technologies not only by industry in general and especially by SMEs but also by public sector organizations, particularly at a local level. A special effort will be made to help the users to express their requirements and hence to choose the technologies which match their individual strategies and absorption capacities (demand-led approach).

The following activities are proposed:

- support for pilot projects for the transregional or inter-sectoral transfer of technologies which can serve to demonstrate the methods and conditions of adoption of technologies by new users. These projects will be supported by intermediary organizations selected for their capability of playing a positive role as multipliers in the dissemination of technology in the SME sector;

- promotion, among businesses and especially among SMEs, of good practice in the various domains of innovation management and absorption of new technology by new users, including strategic planning, technology watch, value analysis, design, quality management and the marketing of innovations. These activities may include the organization of competitions (for prizes such as the EC Design Prize) and support for decentralized projects for the promotion of an integrated approach to the application of these management techniques (MINT initiative);

- promotion of inter-business cooperation in the field of technology in all its phases (search for partners, establishment of contacts, mobilization of financial resources, negotiation of contracts) with the help of appropriate instruments and networks;

- promotion of decentralized awareness-enhancement projects in the fields of technology transfer and innovation (e.g. "Innovation Road Show").

3. Exchanges of information and experience with regard to policies for the dissemination of technologies

Action under this heading is intended to improve the interlinkage of national, regional and Community TT policies and the instruments used for their implementation.

This means not only raising the levels of awareness of innovation systems (and their performance) and of regional, national and Community rules and regulations but also the organization of regular exchanges of experience and good practice between the various operators concerned.

The following actions are proposed:

- further study and observation of the various European systems, policies and instruments (European Innovation Monitoring System) with particular emphasis on comparative analysis of the rules and regulations with regard to licensing, financial incentives or legal instruments;

- action to help the regional actors to analyse their TT infrastructures and fine-tune their policies and instruments with the assistance of external experts;

- creation of a forum for the exchange of experience and good practice in the formulation, implementation and evaluation of national and regional TT policies (Innovation Policy Forum).

C - The financial environment for the dissemination of technology

The aim in this area of activity is to improve the European environment for financing the exploitation, adaptation and dissemination of technology by means of an appropriate Community scheme to be implemented in accordance with the principle of subsidiarity.

This domain encompasses:

1) Indirect support measures

These include:

-the organization of schemes for improving transnational communications between financial circles and promoters of technology projects (such as investment forums);

- continuation of the pilot project for Technology Performance Financing started under the SPRINT programme, with the aim of encouraging the traditional industries to absorb new technologies;

- support for the analysis and possibly the experimental application of systems for mobilizing private funds (including investment exit mechanisms) for the benefit of RTD projects (e.g. comparison of local networks of private investors or "business angels").

2) **A pilot scheme to promote the transfer and exploitation of technologies by SMEs**, e.g. via a system of premiums for SME participation in activities designed to promote the dissemination and exploitation of Community RTD results. The management of this activity will be largely decentralized and entrusted to organizations with a well-developed national or regional network or experience in the provision of support for SMEs (public innovation agencies, relay centres, etc.).

3) **Experimental application of a financial instrument for the mobilization of finance for exploitation of research results and technology by SMEs.** This new instrument will be compatible with those employed in the Member States and finely tuned to national conditions. The instrument will be managed, under contract, by selected financial intermediaries in the different Member States, in close collaboration with the national authorities, on the basis of criteria including, in particular, their experience and capability of mobilizing funds for co-investment or the constitution of quasi own funds. The selected intermediaries will be provided with specific assistance to facilitate the technical evaluation and management of dossiers requiring modest financial support.

This should make it easier for the beneficiary SMEs to obtain guarantees in respect of the funds they borrow or to qualify for interest rebates.

The activities under this heading will be closely coordinated with the various related and supplementary activities at a Community level (Eurotech Capital, European Investment Fund, business policy, etc...), their indicative funding being relatively limited in view of the fact that it is proposed to proceed through actions of a pilot type."

ANNEX II

Indicative breakdown of the effort between the different areas

A.	Dissemination and exploitation of results This bracket includes 55 MECUs for the OPET network	48-55 %
B.	Dissemination of technologies to industry	40-45 %
C.	Financial environment for technology dissemination	7-10 %
Total		100 % (530 MECUs)

TRAINING AND MOBILITY OF RESEARCHERS

ANNEX I

OBJECTIVES AND SCIENTIFIC AND TECHNOLOGICAL CONTENT

1. THE CONTEXT

1.1. STAKES AND PROBLEMS

The optimal use of human resources is an essential parameter of socio-economic activities. Although Europe possesses a great deal of human capital in the area of research, its utilisation is often heavy and slowed down by barriers which isolate Member States, separate disciplines or prevent technology transfers. The development of human resources by means of training through research and their improved exploitation through mobility and transnational cooperation are essential instruments for strengthening the foundations of European industry and its international competitiveness.

Important problems originate from such stakes which are amplified by the fragmentation of the Community, the isolation of fundamental research and the diversity and complexity of topics to be studied. One has, on the one hand, and as foreseen by the specific programmes of Action I of the 4th Framework Programme, to undertake a targeted approach of objectives defined by the European Communities on the basis of the priority needs of the Member States (top-down approach). It is necessary, on the other hand, and this is the role of the present programme, to stimulate, for all areas of research, generic or fundamental, not covered by this targeted approach, transnational activities of training and cooperation which are spontaneously proposed by the scientists themselves (bottom-up approach) without any outside imposition of targets or of pre-established objectives. The distinction between the two strategies is not always easy and it will be necessary, in addition, to establish between them the complementarity links which are needed for bringing the training and mobility actions of Community programmes to contribute fully to the bridging of fundamental research and applied research.

A large effort will have to be made, in order to stimulate fully the mobility of researchers, to adapt the conditions and implementation modalities of Community training grants to national regimes and, in the longer term, for harmonising in all Member States the social, fiscal and salarial conditions of these grants.

1.2. CONTINUITY AND EVOLUTION OF THE PROPOSED ACTION

The proposed action follows, with the necessary modifications, the "Human Capital and Mobility" programme (1992-1994) and the yet earlier programmes "Stimulation" (1983-1988), "Science" (1988-1992) and "Access to large installations" (1989-1992).

Continuity elements, essential to any long term activity, deal with objectives (increase, through training, mobility and cooperation of the efficiency of research and of research infrastructures) and with cohesion criteria (taking into consideration of the needs for qualified scientific staff in less-favoured regions) and subsidiarity criteria (exploitation of the catalytic effects originating from the pooling of competences and resources disseminated throughout the Community). These elements cover certain essential features of the SCIENCE programme.

The adaptations rendered necessary by the evolution of activities are to be made at two different levels, that of strategies and that of implementation :

- continuation of activities, such as laboratory twinning and access to large installations, based upon the modalities of the Science programme.

- simplification and increase in the flexibility of comitology, of consultation mechanisms and of the procedures foreseen for the execution and management of the programme;

- reduced dispersion of financial efforts, reduction in the number of calls for proposals, standardisation of the amount of Community financial contributions;

- strengthening of coordination with closely related Community activities (education and training; specific programmes of Action I of the Framework Programme);

- adaptation of the conditions and implementation modalities of Community training grants to the national regimes and gradual harmonisation of these regimes;

- taking into consideration of synergism with the Action II of the Framework Programme (cooperation with Third Countries and with international organisations).

2. PROPOSED RDT ACTIVITIES

2.1. GENERAL OBJECTIVES

The aim of the programme is to promote, through the stimulation of training and of the mobility of researchers, a quantitative and qualitative increase of human resources within the Community.

The nature of the proposed activities and the measurable objectives of the programme are outlined in section 3; the general objectives are the following :

- to stimulate training through research and, by means of cooperation, to foster better utilisation of high-level researchers in the Community;

- to improve the mobility of European researchers geographically, and also between different disciplines;

- to encourage partnership between industry and university;

- to promote transnational cooperation for "free" research, i.e. research activity proposed by the scientists themselves;

- to improve large-scale facilities which are indispensable for high-quality research, and to place them at the disposal of all European researchers;

- to improve the scientific and technological cohesion of the Community, by offering research opportunities to scientific institutions and to researchers, in particular from the less-favoured regions of the Community, which may help them to reach a level of excellence.

The activities will cover the exact, natural, economic and management sciences, as well as social and human sciences of relevance to Europe.

2.2. SPECIFIC ACTIVITIES

The programme is divided into three interdependent domains (training through research, organisation of networks of laboratories, and assistance to large installations) to which is attached an activity of execution of accompanying measures aimed at improving communication of researchers between themselves and with industry, encouragement to young researchers and publicising the results and achievements of the programme.

2.2.1 Training through research

- Coordination of the training activities defined in the specific programmes in activities I, II and III of the 4th Framework Programme. This is in order to offer a harmonised and coherent framework (correspondence of fellowship stipends and categories of fellows, single entry-points for receiving proposals and for financial engagements ...) for the different Community-level programmes of training through research, while at the same time not imposing a centralised system unsuitable for the special requirements of each programme.
- Study of the conditions of Community Fellows. Large differences exist between Member States as regards the juridical and fiscal (salaries, taxes, national insurance costs and benefits) status of Community Fellows. The analysis of these differences will be pursued and efforts made to compensate them or to adapt the regime of Community Fellowships to the various national situations.
- Implementation of an activity of training through research and of stimulation of mobility of researchers in all the domains covered by the programme. The training periods supported would have a duration of between three months and three years and allow European researchers to undergo training or specialisation outside their country of origin.

These training periods will be open to scientists holding or preparing a doctoral degree. The monies will be allocated to the host-laboratories and shall cover costs of mobility and of subsistence of the researchers as well as a contribution to research and management expenses. Particular attention shall be given to training activities devoted to the management of changes, within enterprises, which are associated to new technologies. An important priority will be attributed to the training of researchers belonging to SMEs.

With regard to cohesion, measures will be taken to :

- constitute industry-university training networks for researchers of the less favoured regions;

- encourage the return of scientists of the less favoured regions to their countries of origin; for this purpose, research trainees from the less favoured regions will be able to benefit from an additional year of support for facilitating their return and their installation;

- allow high-level scientists from the industrialised regions to undertake long stays in the research centres in less favoured regions.

2.2.2. Networking of laboratories of different countries

This will be based on the concept of "European Laboratories Without Walls" (ELWW). The ELWW concept has been implemented in various Community programmes over the past few years. Associations of laboratories situated in different Member States will be mobilised to collaborate on a common research problem. They will be financed, with an amount to each participating laboratory, by a grant which will on the average correspond to the cost of taking on one postdoctoral researcher. The grant will cover mobility expenses and certain research and equipment expenses.

It will be the task of each ELWW to distribute the research responsibilities between laboratories, and to coordinate the research operations so that cooperation and communication shall be as open and efficient as possible. Each ELWW must ensure the diffusion of their principal research results by publication of brochures and overview articles. After the work of an ELWW has started, arrangements will be made for establishing regular dialogue with industrial laboratories, particularly from SMEs, that could exploit the research findings, or finance an extension of the research towards new objectives. In as much as possible, SMEs of the less favoured regions will be associated in this dialogue and encouraged to integrate transnational research teams.

The lifetime of an ELWW should not be less than three years and a large fraction of the funds should be engaged at the start of its programme.

2.2.3. Access to and support of Large Research Installations

This area is entirely devoted to the coordination and exploitation of large research installations whose uniqueness or rarity in the Community, high investment or upkeep costs, and importance for research justifies substantial effort at Community level.

The Community action will include :

- support for university and industrial researchers to enable them to use and be trained in the use of the large installations. A priority will be attributed to researchers from the less favoured regions;

- help to improve certain infrastructures and coordination of their activities.

2.2.4. Accompanying measures

Accompanying measures will consist of publicising scientific information and research results in all the domains covered by the programme, as well as appropriate publication of the results of the training, network and large installation activities. They will in particular include :

- a system of Euroconferences whose purpose is to enable young researchers to learn from leading researchers about the present state-of-art in themes of advanced fundamental or applied research.

- organisation of practical courses to give laboratory or field training in novel or underexploited techniques and methods. These courses will be organised, in priority and whenever possible, in the less favoured regions of the Community.

- awards of prizes for young scientists and a young scientists' talent competition.

- publication of brochures, review articles and evaluation reports on the activities of the programme.

- encouragement, through the organisation of information seminars, of the participation of the less favoured regions to the programme.

- consultation of distinguished European scientists and industrial representatives on the progress of the programme and on any needs for modifying its organisation or objectives; regular assessment, in direct consultation with the Member States, of the progresses resulting from the different initiatives taken, in the framework of the programme, in favour of cohesion.

3. PRIORITY AREAS AND CONCENTRATION OF EFFORTS

It is not possible in a programme of this nature, open to all disciplines and with a "bottom-up" character to predefine thematic priorities. The uniformity of approach is based rather on the emphasis given to the scientific quality of proposals which should allow a distribution between different disciplines covered by the programme. The targets of training and network activities appear in the next section.

For the "Large Installation" activity it is, however, intended to restrict the assistance to infrastructure and coordination and, in the beginning, to themes concerning development of detectors, high vacuum and ultra-clean technologies, optical systems and methods of data visualisation. Community support for access of researchers to large installations can be given in all scientific domains where the triple criterion of quality, usefulness and unicity is satisfied.

3.1. NATURE OF ACTIVITIES AND MEASURABLE OBJECTIVES

ACTIVITY	NATURE	MEASURABLE OBJECTIVES
Training		
. Community fellowships Analysis of national situations	concertation	Adaptation of host conditions
. Fellowships	training contracts	5000 fellowships/yr
Networks of Laboratories	research contracts	1000 - 1500 laboratories networked in 200-250 ELWWs
Large installations		
. access of young researchers		50 large installations for 800-1000 user groups
and	shared cost contracts	
improvement of infrastructures		10 transnational projects (concentrated on detector development, high vacuum and ultra clean technologies, optical systems, methods of data visualisation)
. coordination	concertation	Studies, workshops, seminars and forums for information and strategy and the proper organisation of national efforts for utilisation, research and management.

4. MEANS

ACTIVITY	MEANS
Training	
Coordination	Unique entry-point; meetings.
Adaptation fellowship conditions	Enquiries, studies, meetings.
Fellowships	Contracts with host-laboratories after establishing for each Member State stipend tables, with coverage of certain research, management and social insurance costs. Trials for certain research themes of mechanisms of decentralised management.
Networks of laboratories	Community contribution of ca. 80.000 ECU/yr/laboratory
Large installations	
Coordination and improvements in infrastructures	Meetings and shared-cost contracts.
Access to large installations	Contracts with institutions.
Accompanying measures	Euroconferences, summer schools, meetings, studies, publications.

ANNEX II

Indicative distribution of efforts between the different domains

Training	30-40 %
Networks of laboratories	40-50 %
Large installations	13-17 %
Accompanying measures	4-6 %
Total	100 % (785 Mio ECU)

SCIENTIFIC AND TECHNICAL OBJECTIVES AND CONTENTS OF PROGRAMMES

to be implemented by the Joint Research Centre for the European Economic Community (1995-1998)

The Joint Research Centre (JRC) will conduct strategic and applied research. It will be carried out as an integral part of the European science and technology system and should also contribute to the scientific foundation of the various Community policies. It will follow the basic criteria set out in the Council Decision concerning the Fourth Framework Programme of Community activities in the field of research, and technological development and demonstration (Fourth framework programme), including the "customer/contractor" relationship and the principle of subsidiarity, and be based on the following characteristics:

- scientific and technical excellence,
- neutrality and independence,
- unique research facilities,
- openness to all Member States.

The scientific and technical research carried out by the JRC should meet the needs of the Community as a whole, its Institutions and Member States with the objectives of:

- helping to strengthen the scientific and technological basis of European industry and to encourage the development of its international competitiveness;
- providing the independent scientific expertise necessary for the implementation of Community policies and the tasks which the Treaty assigns to the Community;
- providing scientific and technical services to Community Institutions and making JRC capabilities and scientific and technical installations available to public and private bodies;
- contributing to the improvement of public safety aspects of new technologies;
- contributing to the improvement of environmental impact assessment and protection;
- contributing to the reduction of scientific and technological disparities between Member States.

The European dimension of its work must remain one of the fundamental strengths of the JRC. Its activity should be characterised by a multidisciplinary approach based on the broad span of its capabilities. This multidisciplinarity shall be reflected in the subjects developped by its institutes, thus ensuring its aptitude to face up to new challenges as they arise.

Thanks to its capabilities and its involvement in the formulation and implementation of Community policies, the JRC will contribute to the integration of national, Community and European activities. Thus it will participate in networks of public and private laboratories in the Member States or European research consortia, and may be the focal point of such networks in its areas of expertise. It will furthermore participate in relevant EUREKA projects.

This large exposure should not, however, lead to an excessive dispersion of the activities undertaken. Without ignoring the expectations of its customers, the Centre and its management must have clear views on the proper scientific and technical policy for the JRC and be able to maintain a balance in order to ensure that the activities and contracts which are accepted can be executed at all times with the requisite level of competence, both qualitatively and quantitatively.

The following summary of the objectives of the programmes, which is based on and takes account of the above, sets out the research activities as such, as well as the scientific and technical support services provided by the JRC at the request of the Directorates-General responsible for formulating and monitoring Community policies and legislation. Where they coexist, these programmes will be executed in close coordination with other specific programmes implementing shared cost actions, and in particular with the programme committees concerned.

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The following points describe the objectives assigned to the JRC under the First Activity of the Fourth Framework Programme.

- **Information and communications technologies**

  The JRC will make its contribution to safety and systems reliability. The following areas are addressed : safety-critical computer systems, robots and safety-relevant computer systems. The main prenormative area covered is the drawing-up of design guidelines to ensure that safety and reliability are taken into account. Tools for analysis and validation of the safety and reliability of systems will be developed.

  Furthermore the JRC will make a contribution in the area of high-performance computing and its applications, in association with a network of national centres, in defining methods for comparing such systems. The Centre could also become a conformance testing site for specialised software and make other contributions, as required, in the information technology area, such as the development of testing methodologies, and contribute with the organising of workshops and the setting up of training activities.

- **Industrial technologies**

  The JRC will make its contribution in this area with the aim of promoting the competitiveness of European industry by participating in the following two themes, in close liaison with the shared cost actions:

  - Materials and material-related technologies
  - Research linked with standards, measurement and testing

  Prenormative research will, with exceptions, be undertaken in the context of networks of European institutes with interests and capabilities in prenormative research, and in association with the CEN, so as to ensure from the outset an approach reflecting the generic needs of industry.

  Research into materials, will be directed mainly at the following sectors, which have a prenormative dimension and good potential as enabling technologies, with an emphasis on clean technologies :

- ceramics and composite materials, characterisation, defect evaluation and prediction of useful life,
- surface modification and characterisation technology, using ion implantation and laser beam,
- prenormative research leading to standards on material recyclability, including the development of data base on recyclable materials,
- development of non-destructive testing techniques for analysing the reliability of mechanical structures, including estimating their useful life.

This research is aimed at acquiring, in close cooperation with the national laboratories concerned, the scientific knowledge necessary for these materials to be used industrially, and to provide the standards bodies with knowledge which is essential for standardization in this field.

A main area of research directly linked to standardization is aimed at supporting the development of standards (EUROCODES) to improve the reliability of earthquake-proof buildings and mechanical structures under impact loading. To that end, experimental research is carried out under the auspices of the European Association of Structural Mechanics Laboratories. This research will be mainly conducted using the ELSA reaction wall and the associated facility LTDF; it will be aimed at improving the mathematical models used to evaluate the behaviour of such structures when subjected to earthquakes or to wave stresses in general.

This research will be of particular interest for industrial policy and internal market policy, related essentially to safety aspects.

Research into reference measurements and reference materials covers the following areas with nuclear and non-nuclear applications :

- preparation, characterization and certification of high quality reference materials,
- establishment of a common basis for chemical reference measurements,
- measurements and evaluation of basic data with improved accuracy.

The results achieved by the Institute for Reference Materials and Measurements (IRMM) in establishing extremely accurate measurements have won it recognition as a reference centre. Intercalibration campaigns conducted by the IRMM among the network of all interested laboratories in the Community will provide each laboratory with an impartial and reliable evaluation of the quality of its own measurements. This activity will be extended on request to any third-country laboratory, on payment of a fair fee.

- Environment

The JRC will provide assistance in this area with the aim of promoting environmental protection by participating in the following two themes, in close liaison with shared cost actions:

- natural environment, environmental quality and global change
- new technologies for environmental protection

The European Community should make a major contribution to international research into global change, in particular by participating in major initiatives taken by the scientific community, such as the International Geosphere Biosphere Programme (IGBP), - the activities of the European IGAC (International Global Atmospheric Chemistry) Project Office (EIPO) will be continued at Ispra for IGBP - the World Climate Research Programme (WCRP) and the Human Dimension Programme (HDP).

In this context, the Joint Research Centre will concentrate its research on:

- the surveillance and study - particularly using remote sensing technology - of biosphere-atmosphere interactions and interactions between the processes taking place on land and in the ocean and the related parameters affecting climate change;

- physical and chemical analyses of atmospheric processes (in particular the study of sulphur in the atmosphere), including the behaviour of biogenic and anthropogenic emissions. This should include both measurements and modelling;

- the surveillance of Global Change by remote sensing, by developing advanced Earth observation techniques. This should include research into and development of techniques for using space data obtained from satellite observation for the surveillance of the marine environment and of changes in the terrestrial ecosystem. A number of advanced techniques (including those of a statistical nature) for using the new Earth observation system should also be developed.

In this research area, a significant contribution will be made by the implementation of two major initiatives: the European Network for Research in Global Change (ENRICH) and the Centre for Earth Observation (CEO).

The objective of ENRICH is to reach the critical mass of resources and capabilities in industrialized and developing countries, while providing a logistical basis for the management of cooperation between the countries concerned and the international research institutes. This network should also contribute to the development of endogenous research capabilities in developing countries, mainly, but not exclusively, in Africa and the Mediterranean; it should also provide support for research in the countries of Central and Eastern Europe. ENRICH should be implemented by the JRC's own contributions and by shared-cost projects, and by recourse to other Community instruments.

The scientific community and decision-makers need accurate and consistent Earth observation data spanning a long period. To meet this urgent need, the European Community should set up the Centre for Earth Observation in close cooperation with the Member States and in association with the European Space Agency. This project is designed to guarantee users continuous and long-term availability of consistent data relating to Earth observation; it will set up a decentralized network of interested European bodies and thus bring users, the bodies responsible for thematic analysis and the data processing centres together in a single forum. The role of focal point of such a network should be performed by the JRC, while the programmes of shared-cost actions will provide support for the national components of the network.

Research into global change will enable the JRC - and the scientific community in general - progressively to acquire the scientific knowledge needed for the purposes of environmental and external relations policy.

The JRC will continue to contribute to improving environmental quality, mainly by means of its work on air and water quality and the evaluation of the risks arising from products and from chemical waste.

Research into air quality inside buildings will also be continued, as will research into the working environment. The study of pollution caused by metals in trace quantities will be continued.

Research into air quality will complement the work of the Central Laboratory for Air Pollution conducted by the JRC, which has been active for many years in providing scientific and technical support to EC air quality directives by the harmonization of air quality measuring methods, intercalibration of instruments and techniques, development of new measurement methods and exchange of information in the Member States. This activity will also include the set up of predictive models for the evaluation of radioactivity air pollution.

Research into the risks arising from chemical products will complement the work of the European Chemicals Bureau (ECB), which the Commission has decided to set up at the JRC and which was the subject of a Communication to the Council, Parliament and Economic and Social Committee in December 1992; the ECB is intended to provide essential support functions with regard to EC notification procedures.

Likewise, the work of the European Centre for the Validation of Alternative Methods (ECVAM), set up by the Commission at the JRC and the subject of a Communication to the Council and Parliament in October 1991, will be continued. The aims of ECVAM are to coordinate, at Community level, the validation of alternative testing methods and to act as an exchange of information and meeting point for industry, regulatory bodies and animal protection associations.

Research aimed at improving environmental quality for environmental protection will continue to be conducted directly in support of Community environmental policy (including, in future, the European Environment Agency), either for the monitoring of directives already in force or for the formulation of new policies. This research will be integrated harmoniously into the Fifth action programme on the environment.

Research into innovative technologies for environmental protection will be continued; it is aimed at developing new methodologies for the improved assessment of the reliability of industrial systems (chemical industry) and the man-machine interface in order to evaluate the environmental risks, including those in the Working Environment. This research will continue to be conducted in support of the Community Environmental policy.

The research and support activities, notably for global change, but also for those aimed at improving environmental quality will be conducted within research networks to which the JRC will contribute substantially.

- Life sciences and technologies

The JRC will provide assistance to the application of life science and technologies in agriculture, forestry, rural development, agro-industry and fisheries by making its capabilities available to Community policies (agriculture, environment, consumer protection, Statistical Office), in particular by:

- using its laboratory (European Office for Wine, Alcohol and Spirit drinks - which was the subject of a Communication by the Commission to the Council and the Parliament in September 1993) for the analysis of wines and other alcoholic beverages, the objective of which is to provide scientific and technological support within the framework of the relevant Community legislation,
- setting up a technical support project for the management and control, using satellite data, of the application of the Common Agricultural Policy,
- continuing to implement the project on remote sensing applied to agricultural statistics following the Council Decision of 26 September 1988 on pilot projects of Remote Sensing applied to Agricultural Statistics.

These last two actions will require the use of new technologies for earth observation and research into high performance methodologies in order to increase the efficiency of European information systems in the area of agriculture, fishery and forestry.

- Energy

The JRC will provide assistance to technologies for cleaner and more efficient production and use of energy use by conducting research in the following sectors:

- prenormative research into renewable energy, mainly into photovoltaic energy, by operating the European solar testing installation (ESTI),
- materials for clean technologies :
  . development of materials for clean technologies such as long lived catalyst supports for emission control, nanoporous ceramic membranes for advanced ceramic filters,
  . characterization of ceramic alloys and composite materials for high-temperature applications such as heat exchanger and heat engines (including high-temperature testing in a corrosive atmosphere),
- prenormative research into energy conservation, with an emphasis on energy conservation in buildings,
- modelling the relationship between energy production, consumption and environmental protection.

- Targetted Socio-economic Research

The JRC will provide assistance in the Evaluation of science and technology policy options :

- by setting up a technological observatory with the task of collecting and analysing information relating to scientific breakthroughs and technological innovations,
- by carrying out medium- and long-term prospective technological studies

and technological evaluations, including the impact of technological innovations on the environment and on society.

The work of the technological observatory will be carried out on a permanent basis, whereas prospective and evaluation studies will be carried out mainly at the request of Directorates General of the Commission and of other Community Institutions, so that technological developments and global scientific issues are properly taken into account when Community policies are drawn up.

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The JRC will also contribute to the objectives relating to the Third Activity of the Fourth Framework Programme, which are described below.

- Scientific services for Community policies

  - The JRC will be responsible for the dissemination and exploitation of the results of its own research activities, including the transfer of know-how to industry, and in particular to small businesses. This work will be conducted in concert with that of the Directorate-General responsible for the field in question. The exploitation of results by means of the transfer of know-how to - and possibly by association with - EUREKA projects will also be promoted.

- The JRC will also provide scientific assistance for Community policies at the request of the Directorates General responsible for those policies, wherever the need and the request are made apparent.

  These, generally short-term, activities are difficult to describe, as the need for them will only become apparent during the course of implementation of the Framework Programme when it is found that scientific know-how acquired by the JRC can be applied to the formulation of one Community policy or another; thus by their very nature they hardly lend themselves to long-term planning, as they provide an immediate response to the requests of the Directorates General.

However, the following general outline can be sketched:

- remote sensing for the specific surveillance of certain forms of pollution or the cultivation of certain hallucinogenic plants (drug control),
- systems analysis, enabling the contributions of various partners to be evaluated; analysis of certain statistical data,
- work in support to the transport policy, mainly oriented towards safety, environmental and societal impact studies,
- remote sensing for fisheries policy,
- reference measurements for trace pollution (common agriculture and consumer protection policy).

ANNEX I

Indicative breakdown of the effort between the different areas

	(ECU million)
FIRST ACTIVITY	
• INFORMATION AND COMMUNICATION TECHNOLOGIES	12
• INDUSTRIAL TECHNOLOGIES	227
- Materials and material-related technologies	
- Research linked to standards, measurements and testing	
• ENVIRONMENT	345
- The natural environment, its quality and global change	
- Innovative technologies for environmental protection	
• LIFE SCIENCES AND TECHNOLOGIES	60
- Application of life sciences and technologies to agriculture, forestry, rural development, agro-industry and fisheries	
• ENERGY	45
- Technologies for cleaner and more efficient production and use of energy	
• TARGETED SOCIO-ECONOMIC RESEARCH	35
- Evaluation of science and technology policy options	
THIRD ACTIVITY	
• DISSEMINATION AND EXPLOITATION OF THE RESULTS OF COMMUNITY RESEARCH, TECHNOLOGICAL DEVELOPMENT AND DEMONSTRATION ACTIVITIES	70
Scientific services for Community policies	
Total	794

ANNEX 2

DETAILED RULES FOR IMPLEMENTING THE PROGRAMMES AND ACTIVITIES FOR DISSEMINATION AND EXPLOITATION OF THE RESULTS

1. The Commission, assisted by the Board of Governors of the JRC, shall implement the programmes on the basis of the scientific and technical objectives and contents.

2. The rules for implementing the programmes, comprise research and technological development projects, scientific and technological support directly linked to Community policies and accompanying measures.

   The projects shall be the subject of research and technological development performed in the relevant institutes of the JRC.

3. The institutes of the JRC shall endeavour, whenever feasible, to execute the projects in proper collaboration and in concert with national research bodies in the Member States. Particular attention will be paid to associations with industry, notably with small and medium-sized enterprises, in collaborative schemes around the projects. In the same way, research bodies established in third countries may also collaborate on projects in accordance with relevant provisions.

   Research projects can be the subject of an international cooperation, under circumstances mentioned in the previous paragraph, including cooperation with research laboratories and exchange of scientists. Supplementary measures should allow for cooperation with research laboratories and institutes situated in the countries of central and eastern Europe.

4. The accompanying measures shall include :

   - the organisation of long-term visits to JRC institutes of grantholders, visiting scientists and detached experts,

   - the organisation of long-term visits of JRC scientific agents to national laboratories, industrial laboratories or universities,

   - the activities of internal coordination, including the organisation of particular internal centres, which ensure homogeneity of the approach and a unique common interface to the users of, and partners in, the projects,

   - the activities of specialized training with accent on multidisciplinarity,

   - a system for information exchange,

   - the promotion of the exploitation of the research results,

   - the scientific and strategic independent evaluation of the performance of the projects and the programmes.

5. The dissemination of the knowledge gained through the realisation of the projects will be done on the one hand by the programmes themselves, and on the other hand by the centralized action described in the Third Activity of the Framework Programme.

SCIENTIFIC AND TECHNICAL OBJECTIVES AND CONTENTS OF PROGRAMMES

to be implemented by the Joint Research Centre for the European Atomic Energy Community (1995-1998)

The Joint Research Centre (JRC) will conduct strategic and applied research. It will be carried out as an integral part of the European science and technology system and should also contribute to the scientific foundation of the various Community policies. It will follow the basic criteria set out in the Council Decision concerning the Framework Programme for Community Research anfd Training Activities for the European Atomic Energy Community (Framework Programme), including the "customer/contractor" relationship and the principle of subsidiarity, and be based on the following characteristics:

- scientific and technical excellence,
- neutrality and independence,
- unique research facilities,
- openness to all Member States.

The scientific and technical research carried out by the JRC should meet the needs of the Community as a whole, its Institutions and Member States with the objectives of:

- helping to strengthen the scientific and technological basis of European industry and to encourage the development of its international competitiveness;
- providing the independent scientific expertise necessary for the implementation of Community policies and the tasks which the Treaty assigns to the Community;
- providing scientific and technical services to Community Institutions and making JRC capabilities and scientific and technical installations available to public and private bodies;
- contributing to the improvement of public safety aspects of new technologies;
- contributing to the improvement of environmental impact assessment and protection;
- contributing to the reduction of scientific and technological disparities between Member States.

The European dimension of its work must remain one of the fundamental strengths of the JRC. Its activity should be characterized by a multidisciplinary approach based on the broad span of its capabilities. This multidisciplinarity shall be reflected in the subjects developed by its institutes, thus ensuring its aptitude to face up to new challenges as they arise.

Thanks to its capabilities and its involvement in the formulation and implementation of Community policies, the JRC will contribute to the integration of national, Community and European activities. Thus it will participate in networks of public and private laboratories in the Member States or European research consortia, and may be the focal point of such networks in its areas of expertise.

This large exposure should not, however, lead to an excessive dispersion of the activities undertaken. Without ignoring the expectations of its customers, the Centre and its management must have clear views on the proper scientific and technical policy for the JRC and be able to maintain a balance in order to ensure that the activities and contracts which are accepted can be executed at all times with the requisite level of competence, both qualitatively and quantitatively.

The following summary of the objectives of the programmes, which is based on and takes account of the above, sets out the research and technological development activities as such, as well as the scientific and technical support services provided by the JRC at the request of the directorates-general responsible for formulating and monitoring Community policies and legislation. Where they coexist, these programmes will be executed in close coordination with other specific programmes implementing shared cost or concerted actions, and in particular with the advisory management and coordination committees concerned.

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- Nuclear safety and safeguards

The objective is to increase scientific and technical knowledge and to contribute to the development of technologies aimed at improving the safety of the whole of the nuclear cycle and reducing the environmental impact of the use of nuclear energy, and to respond to the need to assume the responsibilities of the Community arising from implementation of the Treaty.

The JRC contribution will be in the following fields:

- reactor safety,
- fuel cycle safety,
- safeguards and fissile materials management.

Reactor safety

JRC research will be focused mainly on the following areas:

- contribution to accident prevention : studies of component ageing, development of non-destructive techniques of analysis;

- probabilistic safety studies: the JRC will contribute to the improvement of methodologies and to the emergence of a consensus on their implementation in safety studies;

- study of serious accidents : these studies will be conducted :

  . on the one hand, through an experimental programme done within JRC installations and the objective of which is to study phenomenas which could occur in cores subject to an accident;

  . on the other hand, through its participation to the interpretation of the results of experimentations which simulate accidental releases done in other laboratories, in particular in CEA (study of the source-term) and through its own experimental programme concerning resuspension mecanisms.

This research will make extensive use of the JRC's ability to set up cooperation networks of the European partners concerned and thus to participate in the implementation of the Community policy provided for in the Treaty.

Fuel cycle safety

The main objective of the studies conducted by the JRC is to reduce the environmental impact of using nuclear energy by means of research into the fuel cycle permitting optimized management of the end of the cycle.

This research will be aimed at improving the understanding of actinides and the plutonium cycle and drawing up the best possible waste management strategy, in particular by minimizing the production of high-level waste. It will take account of changes in reactor design.

It will also be aimed at supporting the Member States' current strategy of deep burial of radioactive waste and exploring management strategies which would make it possible to reduce the amount of waste produced by future fuel-cycle installations. This research will be conducted in close cooperation with national laboratories.

The subjects covered will include:

- studies of the safety of the behaviour of nuclear fuels (UO_2 and mixed oxide),
- fundamental and solid-state physico-chemical analyses of actinides,
- study of nuclear aerosols,
- minimization of secondary actinides and other radionucleides with long half-lives in the nuclear fuel cycle,
- plutonium fuel technology,
- characterization of waste,
- radionucleides for medical applications.

Safeguards and fissile materials management

Research conducted by networks of national laboratories will promote and be aimed at the obtention, in good time, of the results or new techniques, which implementation is necessary for compliance with obligations arising from guarantees provided for in the Treaty and in the Non-proliferation Treaty. This research will comprise techniques for the measurement, confinement and surveillance of nuclear materials and the integration of safeguards measures.

The JRC will make a substantial, direct contribution to the performance of the tasks assigned to the Commission in the field of safeguards. Its activities will cover methodologies, analysis methods and techniques, instrumentation and data management. These activities will comprise research into and development and implementation of the techniques and instruments needed for the performance of these tasks. They will be notably conducted in support to the operation of laboratories for the analysis of safeguard samples set up by the Commission at the sites of certain nuclear installations, as set out by the Commission in its Communication to the Council and Parliament of 24 March 1992. Moreover, the JRC will play a large part in the training of the Community staff concerned.

These activities will be conducted in particular using the experimental installations Perla, Lasco and Tame, on the basis of the system of nuclear reference materials.

In addition to the radiological surveillance of such staff, the JRC will constantly seek to improve their protection.

The JRC will also make use of its capabilities to participate in the establishment of a consistent and reliable international safeguards system. It will carry out research and training for the IAEA analogous to that carried out in a Community context, and cooperate with countries wishing to participate to such a system, in particular it will contribute to training of their experts.

- Controlled nuclear fusion

This activity forms part of the Community fusion research programme. It is aimed at improving the pool of knowledge and the technology of the "safety and environment" dimension of future machines intended for the European programme. The bulk of the work will be dedicated to support for the International Thermonuclear Experimental Reactor (ITER). Use of the ETHEL laboratory for the experimental study of safe ways of manipulating tritium, in cooperation with national laboratories, will be an important aspect of this programme.

Moreover, the JRC will make its capabilities available to the ITER programme by supplying scientific and technical assistance in line with its changing requirements, covering in particular studies on the behaviour of materials and on remote handling.

Moreover, the ETHEL laboratory can also be used for the initial studies of tritium safeguards.

ANNEX I

Indicative breakdown of the effort between the different areas

	(ECU million)
ENERGY	
Nuclear Safety	293
Controlled Nuclear Fusion	50
Total	343

ANNEX 2

DETAILED RULES FOR IMPLEMENTING THE PROGRAMMES AND ACTIVITIES FOR DISSEMINATION AND EXPLOITATION OF THE RESULTS

1. The Commission, assisted by the Board of Governors of the JRC, shall implement the programmes on the basis of the scientific and technical objectives and contents.

2. The rules for implementing the programmes, comprise research and technological development projects, scientific and technological support directly linked to European policies and accompanying measures.

   The projects shall be the subject of research and technological development performed in the relevant institutes of the JRC.

3. The institutes of the JRC shall endeavour, whenever feasible, to execute the projects in proper collaboration and in concert with national research bodies in the Member States. Particular attention will be paid to associations with industry, notably with small and medium-sized enterprises, in collaborative schemes around the projects. In the same way, research bodies established in third countries may also collaborate on projects in accordance with relevant provisions.

   Research projects on international cooperation, under circumstances mentioned in the previous paragraph, including cooperation with research laboratories and exchange of scientists. Supplementary measures should allow for cooperation with research laboratories and institutes situated in the countries of central and eastern Europe.

4. The accompanying measures shall include :

   - the organisation of long-term visits to JRC institutes of grantholders, visiting scientists and detached experts,

   - the organisation of long-term visits of JRC scientific agents to national laboratories, industrial laboratories or universities,

   - the activities of internal coordination, including the organisation of particular internal centres, which ensure homogeneity of the approach and a unique common interface to the users of and partners in the projects,

   - the activities of specialized training with accent on multidisciplinarity,

   - the training actions in the domain of the control of safeguards and management of fissile materials destined, in particular, for the nationals of the ex-URSS, by the allocation of short term grants,

   - a system for information exchange,

   - the promotion of the exploitation of the research results,

   - the scientific and strategic independent evaluation of the performance of the projects and the programmes.

5. The dissemination of the knowledge gained through the realisation of the projects will be done on the one hand by the programmes themselves, and on the other hand by the centralized action foreseen in the third action in the Framework Programme.

III. RECAPITULATION OF FIGURES AND REMINDER OF THE FINANCIAL STATEMENT OF THE FRAMEWORK PROGRAMMES EC AND EAEC

III The **Recapitulation of figures**, below, shows the coherence which exists between the breakdown of the effort as is indicated in the working document and the figures shown in the **financial statement** of the document COM(93)276 attached.

	4° Framework Programme EC		Framework Programme EAEC		
		Programme JRC		Programme JRC	
FIRST ACTIVITY Information and communication technologies	3888	12	-	-	3900
Industrial technologies	1573	227	-	-	1800
Environment	625	345	-	-	970
Life Sciences and Technologies	1265	60	-	-	1325
Clean and efficient energy technologies	1005	45	-	-	1050
Nuclear safety and safeguards	-	-	202	293	495
Controlled thermonuclear fusion	-	-	930	50	980
Research for a European transport policy	280	-	-	-	280
Targeted socio-economic research	90	35	-	-	125
SECOND ACTIVITY Promotion of cooperation on research, technological development and demonstration with third countries and international organizations	790				790
THIRD ACTIVITY Dissemination and exploitation of results	530	70			600
FOURTH ACTIVITY Stimulation of the training and mobility of researchers	785				785
TOTAL	10831	794	1132	343	
	11625		**1475**		

FINANCIAL STATEMENT

Part 1: Financial implications

1. TITLE OF THE OPERATION

Fourth framework programme of Community activities in the field of research and technological development and framework programme for the European Atomic Energy Community (1994-1998)

2. BUDGET HEADING CONCERNED

Sub-section B6

3. LEGAL BASIS

Article 130 Q(1) of the EEC Treaty (to be replaced by article 130i, paragraph 1 of the EC treaty after the entry into force of the Maastricht Treaty) and article 7 of the EAEC Treaty.

4. DESCRIPTION OF THE OPERATION

4.1 Specific objectives

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

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

Dissemination and application of results of Community research, technological development and demonstration activities;

Stimulation of the training and mobility of researchers in the Community.

4.2 Duration

1994-98

4.3 Target population for the operation

Industrial enterprises - including especially SMEs - research centres and universities in their research and technological development activities.

5. CLASSIFICATION OF THE EXPENDITURE AND REVENUE

5.1. Non-compulsory expenditure.

5.2 Differentiated appropriations.

5.3 Type of revenue involved

The EFTA countries as defined in Article 2 of the Protocol amending the Agreement on the European Economic Area (EEA) will contribute to proportional additional financing for this framework programme, if the EEA Joint Committee provided for in the Agreement so decides, probably limited to the non-nuclear activities.

6. TYPE OF EXPENDITURE OR REVENUE

Research, development and demonstration projects carried out by external contractors may receive a Community contribution to the cost of research, with a ceiling of 50% of the costs or the equivalent (100% of additional costs for universities and similar organisations).

Networks, training and the mobility of researchers, concerted actions, which consist of the coordination of research and development projects, and accompanying activities, may receive a contribution of up to 100% of the cost of these activities.

Research activities carried out by the Joint Research Centre will in principle be 100% funded.

7. FINANCIAL IMPACT

7.1 Method of calculating the total cost of the operation

The framework programmes have been defined so as not to exceed two-thirds of the amount allocated to category 3 of the proposed financial perspective for 1993-99.

The amounts will cover scientific, technical, demonstration and related horizontal support measures as well as personnel costs and administrative, scientific and technical expenses directly linked to the execution of the activities and measures. As far as activities carried out by the JRC are concerned, these amounts will cover the infrastructure for the institutes.

7.2 Breakdown

The four activities correspond to the four objectives listed at 4.1 above.

4th framework programme 1994-98	
	MECU (current prices)
First Activity (Research, Technological Development and Demonstration Programmes)	10925
Second Activity (Cooperation with Third Countries and International Organizations)	790
Third Activity (Dissemination and Application of Results)	600
Fourth Activity (Stimulation of the Training and Mobility of Researchers)	785
OVERALL AMOUNT	13100

	MECU (current prices)
Indicative breakdown between themes in the first activity	
- Information and Communications Technologies*	3900
- Industrial Technologies *	1800
- Environment *	970
- Life Sciences and Technologies *	1325
- Energy *	2525
- nuclear	1475
- non-nuclear	1050
- Research for a European transport policy*	
- Targeted Socio-economic Research *	125

* of which JRC 1067 MECU. N.B.: in addition to participating in the first activity, the JRC will also participate in the th[illegible] to the tune of 70 MECU.

7.3 Indicative schedule

MECU - current Prices

YEARS	Financial Perspectives	Actual Amounts 4th FP
1994	4325	pm
1995	4715	2928
1996	5078	3153
1997	5450	3384
1998	5852	3635
Total 1994-1998		13100

The deflators used are respectively for 92-93: 1.023, for 92-94 : 1.059, for 92-95 : 1.091, for 92-96 : 1.123, for 92-97 : 1.157 and for 92-98 : 1.192.

The definitive annual amounts will be fixed by the budgetary authority.

ANTI-FRAUD MEASURES PLANNED UNDER THE OPERATION

Audit programme of the Directorate-General. Supervision by the officials formally responsible for the actions.

Part 2 : Basis for cost/effectiveness analysis

OBJECTIVES

The framework programme corresponds to the objectives established by the Treaty on European Union and notably its Article 130f(1) which states: "The Community shall have the objective of strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level, while promoting all the research activities deemed necessary by virtue of other chapters of this Treaty." The four activities selected reflect Article 130g.

JUSTIFICATION OF THE OPERATION

The operation is justified by the need for the Community to help strengthen the scientific and technological bases of Community industry and to encourage it to become more competitive at international level, while contributing to the definition and implementation of Community policies and to meeting the needs of society.

MONITORING AND EVALUATION OF THE OPERATION

The form and frequency of the process of evaluation will be such as to enable the Commission to respond to the requirements under Article 4 of the draft Decisions in the proposal above, and to evaluate Community RTD programmes and policies.

The principal factors of uncertainty which can affect the results of the operation include any delay which may occur in the implementation of activities under the present proposal, the ability and readiness of private enterprises to take full advantage of the benefits which these activities will offer them, and the unavoidable difficulty in making a direct link, especially in the short term, between research expenditure on the one hand and industry's competitive success on the other, notably in the light of the fact that innovation is not a linear process from fundamental research, through applied research to commercial application.

The indicators and quantitative or qualitative criteria which make it possible to measure the results will be determined at the level of each specific programme.
During the implementation of the fourth framework programme, the Commission will examine the state of its progress in relation to criteria and objectives indicated in annexes II and III. It will assess, on a permanent and systematic basis, in particular, if the objectives, the priorities as well as the financial means are still adapted to the changing situation (see Article 4(1) of the draft Decision). It will submit if necessary proposals aiming to adapt or to complete the framework programme according to this assessment. Similarly, before submitting its proposal for the fifth framework programme, it will commission independent experts to carry out an evaluation of management and achievements of Community RTD activities during the five years preceding this evaluation (see Art.4(2) of the draft decision).