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**FIFTH FRAMEWORK PROGRAMME for  
Research and Technological Development  
(1998-2002)**

**Commission Working Paper  
on the SPECIFIC PROGRAMMES:  
Starting Points for Discussion**

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## **INTRODUCTION**

The European Union's research policy is on the move.

A number of milestones have been reached this year. First of all, the proposal for the Fifth Framework Programme (1998-2002) was published. This has been earmarked an overall allocation of ECU 16.3 billion, i.e. a 3% increase in the percentage of the EU's GDP represented by the new Framework Programme compared with the previous one.

The Treaty of Amsterdam was signed. It provides, in particular, for replacing unanimous voting by qualified majority voting in certain areas. The decision on the Framework Programme is among the beneficiaries of this step forward.

Last but not least, the Commission adopted *Agenda 2000*, the general framework for enlargement and policy reform, setting out, in particular, the financial framework for the EU's activities in the period 2000-2006. Taking into account the importance of research for the future of the EU, Agenda 2000 confirmed the need for a faster increase in the resources allocated to research than the forecast increase for GDP in the EU in the period in question.

This paper indicates that the basic principle which has guided the Commission in its choices concerning the structure and content of the Fifth Framework Programme is the need to address the European Union's major policy challenges. A new approach has been pursued in order to increase the impact of the Community effort, encouraging multidisciplinary research and the focusing of resources. Strict criteria have been laid down in this connection in the Fifth Framework Programme proposal. They also form the basis for the selection of the research priorities for the specific programmes, the objectives and scientific and technological content of which are set out in the Annex to this paper.

The primary objective of this paper is to facilitate conclusion of the debate on the Fifth Framework Programme proposal now in progress in the Institutions. At the same time it will help to prepare the ground for the discussions on the specific programmes, with a view to ensuring rapid adoption thereof in the course of 1998.

### **I. THE URGENT NEED FOR ACTION**

Several converging reasons point to the conclusion that a decision must be taken on the future of Community research without delay.

First of all, a series of problems going far beyond the purely national framework must be dealt with. Increased research can help to identify ways of responding to them. By way of example, the Nobel prize awarded recently for the groundwork on prions echoes the "mad cow" crisis and the growing challenges posed by climate change, urban life, progress with the information society, and the ageing population of the Western world all call for research to seek solutions.

Secondly, as recently confirmed by the Amsterdam European Council, research has a vital role to play in order to improve competitiveness, promote innovation and create jobs, especially in SMEs; research is also an acknowledged means of consolidating economic and social cohesion in the European Union.

Technological, organisational and social innovation is one of the principal driving forces for growth and job creation, but for many years Europe has been building up handicaps. This is borne out by the figures: Europe accounts for 46% of the world consumer market for information technologies but for no more than 15% of the relevant production. Development of new products accounts for less than half of research spending in France and Germany but over 60% in the USA and Japan. Finally, the European Union's balance of trade and payments in high-tech goods and services has deteriorated markedly vis-à-vis the rest of the world, with a tenfold increase in the deficit in the space of ten years.

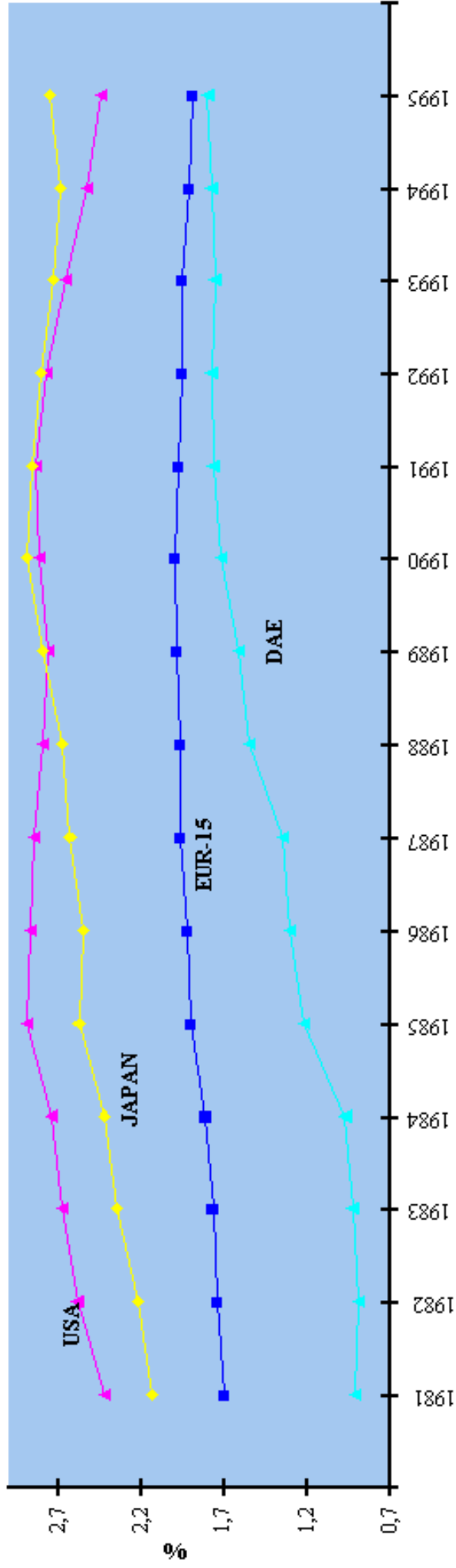
For lack of research and innovation, particularly between 1970 and 1980, Europe lost 20% of its industrial jobs at a time when the USA gained 1.5% and Japan 4%.

This state of affairs is unacceptable. The fact that the EU has been persistently lagging behind its leading rivals in the research field over the last ten years (see graphs) calls for a greater effort. In a general climate of tighter budgets, research is, moreover, one of the few items which our leading competitors are still increasing.

The Commission has pronounced on this matter recently in its communication proposing guidelines for Member States' employment policies, 1998. This communication invites Member States to boost significantly RTD expenditure as a percentage of GDP, thereby raising the European average from 1.9% to 2.5%, so as to match its global competitors, while at the same time encouraging more effective sharing of innovation and new technologies through reinforced coordination between large, medium and small enterprises.

The European Union must show the way by continuing to provide strong support for research and technological development. This is the task set for the Fifth Framework Programme. Adoption of the Programme cannot be delayed. The existing models are no longer appropriate and must be renewed rapidly, while the continuity of the efforts made in a number of key fields for the future must be secured.

## Intensity of R&D spending 1981-1995 (% of GDP)

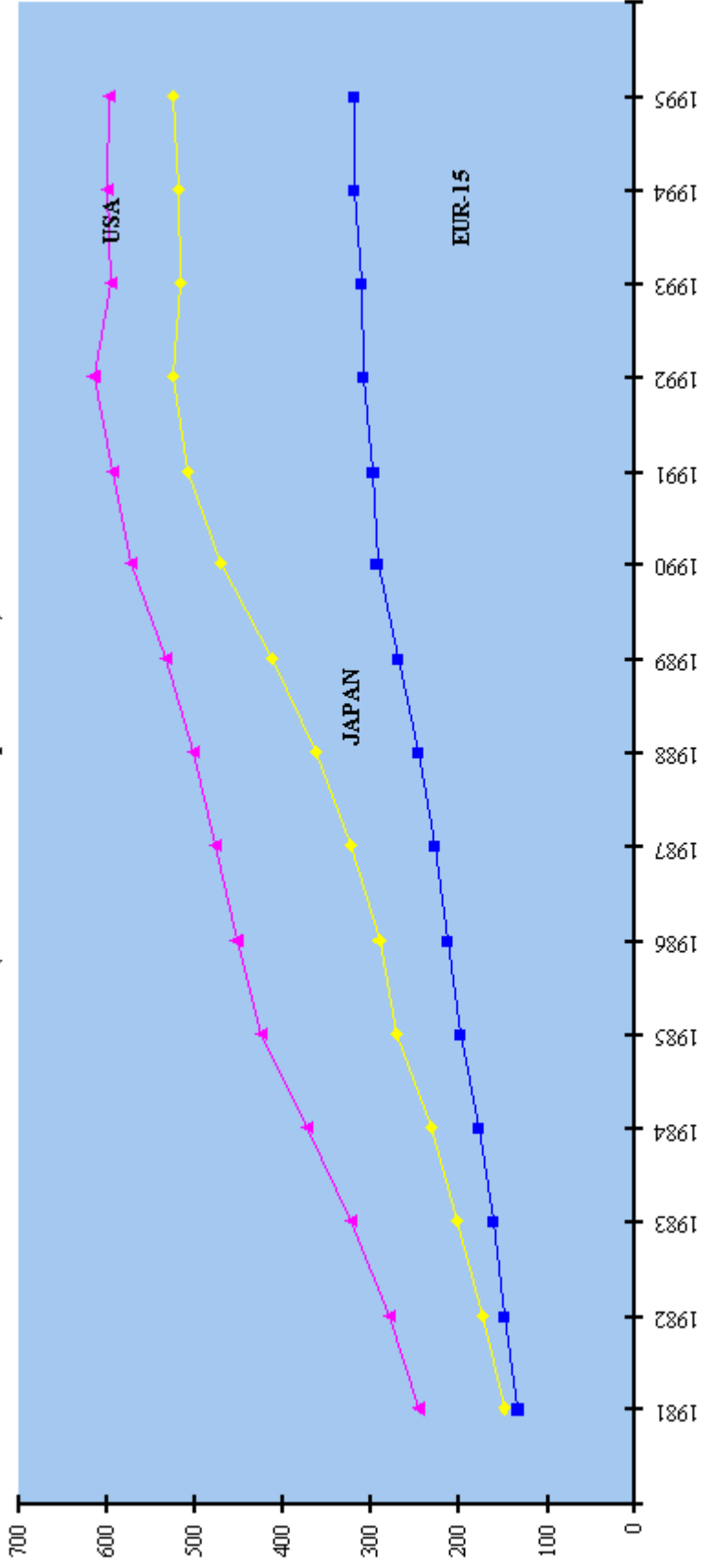


**Footnotes :**

- (1) EUR-15 : Based on estimates by DG XII-AS4 where data are unavailable.
- (2) The data concerning Japan have been adjusted by the OECD.
- (3) The data concerning Germany relate to WEST Germany for the period 1982-90.
- (4) DAE=Dynamic Asian Economy.

Source : *Second European report on S&T indicators, 1996: Estimates by DG XII-AS4 on the basis of data from Eurostat, the OECD and the Ministries in the various countries.*

## Total per capita spending on R&D 1981-1995 (GERD in European PPS)



**Footnotes :**

- (1) EUR-15 : Based on estimates by DG XII-AS4 where data are unavailable
- (2) The data concerning Japan have been adjusted by the OECD.
- (3) The data concerning Germany relate to West Germany for the period 1982-1990.
- (4) GERD: Gross Domestic Expenditure on Research and Development
- (5) PPS: Purchasing Power Standard

Sources : European Commission, DG XII-AS4 on the basis of data from Eurostat, the OECD and the Member States.

Missing data and data for 1995 estimated by DG XII-AS4

## **II. REASONS FOR THE STRUCTURE PROPOSED FOR THE FRAMEWORK PROGRAMME**

The Fifth Framework Programme is designed to ensure that European research efforts are translated much more effectively than hitherto into practical and visible results, including via demonstration activities. The aim is, in particular, to help transform the European Union into a priority area for investment in research and innovation and to maintain its position of excellence at world level. The programmes of which the new Framework Programme is composed are characterised by:

- the targeting of activities on major EU policy objectives (e.g. improving the employment situation, the quality of life of citizens, and the competitiveness of firms);
- the concentration of efforts on a small number of themes and activities so as to maximise the impact of the measures initiated and resources deployed.

These characteristics are reflected in the structure and organisation of the programmes, the small number of which is inherent in the approach adopted. The Commission has proposed a Fifth Framework Programme divided into just six programmes<sup>1</sup>, including three major thematic programmes. Limiting the number of programmes makes it possible, in particular:

- to concentrate a critical mass of human and financial resources on each subject addressed;
- to incorporate greater flexibility for taking account of the priorities to be covered and adjusting the budget where necessary. Since the programmes provide the basic framework, far greater flexibility is possible within a given programme than between different programmes;
- to adopt an integrated approach covering the full complexity and many and varied aspects of the economic and social issues targeted.

Each of the three thematic programmes, on which the main thrust of the efforts will focus, is based on this approach. The “integration” aspect is strengthened by the key actions, a major innovation of the structure of the Fifth Framework Programme.

Programme I “*Unlocking the resources of the living world and the ecosystem*” covers mainly the health, agriculture and environment dimensions. For example:

The key action “*Health and food*” covers the twin dimensions of health and agriculture. Environmental aspects are also included, with work on pesticide, fertiliser, and heavy metal residues in foods.

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<sup>1</sup> In accordance with the proposal COM(97) 142 final, the Fifth Framework Programme will be implemented by means of nine Decisions adopting specific programmes.

The key action “*Management and quality of water*” combines the environment, agriculture (looking at both the water requirements in this sector and the effluent problem) and health (impact of water quality on health) dimensions.

Programme II “***Creating a user-friendly information society***” reflects the convergence of information, communication and audiovisual technologies in a host of applications:

The key actions “*Systems and services for the citizen*”, “*New methods of work and electronic commerce*” and “*Multimedia content*” integrate the contributions made by digital and multimedia technologies in the development of services in a variety of fields: health, administrations, and transport; trading in goods and services; publishing, education, and language industries.

Programme III “***Promoting competitive and sustainable growth***” is designed to take account of the close integration, in many fields of activity, of industrial production, transport, energy and sustainability. For example:

The key actions “*The city of tomorrow*” and “*Products, processes and organisation*” cover various aspects of industrial production and sustainability (one key objective being to reduce environmental impact) as well as the reduction of energy consumption (an objective which also applies to the transport-related key actions).

Similarly the key action ‘*Sustainable mobility and intermodality*’ touches on industrial production and energy aspects (optimum use) in addition to the development of a sustainable intermodal transport system.

Structures other than the division into three thematic programmes have been proposed, notably by national administrations anxious for the Framework Programme to reflect their traditional organisational arrangements. However, abandonment of this structure would inevitably result in spreading the effort too thinly and could push the resources allocated below the critical mass required.

It would also produce a more rigid structure, detrimental to the capacity to provide a rapid response since each additional programme would add further administrative barriers and extra procedures.

Finally, it would mean abandoning the integrated approach sought and jeopardise certain key actions.

Experience with negotiating previous Framework Programmes has shown how counter-productive this tendency to inflate the number of programmes and activities - which is encouraged by the decision-making procedure - could prove to be.

### **III. IMPLEMENTATION AND MANAGEMENT**

The Fifth Framework Programme should be implemented with more efficient and flexible management methods and procedures. Apart from the technical measures involved, this will entail in particular the establishment of a new type of relationship between the Member States, the European Parliament and the Commission (which implements the specific programmes) in the context of a veritable ‘confidence pact’. The Commission, for its part, is prepared to commit itself to greater transparency and speed of execution.

The objective is not, however, to call into question the fundamental principles underlying the European Union’s research activities (e.g. equal access and treatment, rigour in the administration of public funds) or the mechanisms and methods which have proved their effectiveness and secured a broad consensus.

Implementation and management of the programmes form a whole, extending from discussions on programme strategy, in which the Member States are fully involved on the relevant committees, to the day-to-day management issues for which the Commission is responsible. The following measures are envisaged:

- *The Programme Committees*

The principle of “one committee per programme” will continue to apply. With fewer specific programmes than in the past, it should, therefore, be possible to streamline certain aspects of management. The Explanatory Memorandum to the proposal for a Fifth Framework Programme also suggests that, in accordance with the nature of their work, the Programme Committees should concentrate on the general aspects of programme implementation. In the case of the JRC, this role would be performed by the Board of Governors.

To speed up implementation of the programmes, the Commission proposes that the committees should no longer be consulted systematically on the lists of projects to be funded but should be informed very fully, after the event, of the lists adopted. In all cases, the committees would be consulted for their opinion on measures of a normative or more general nature, such as the content and review of the work programmes, the timetable and content of calls for proposals, the criteria and terms of reference for evaluation of the programmes, and changes in the breakdown of funding within them.

The committees would also be informed, regularly and very fully, of all important developments in implementation of the programmes. In view of the scale of the field covered by each programme, the permanent committee members could be assisted by specialist experts whenever necessary.

- *Day-to-day management*

To ensure efficient operation of the Framework Programme as a whole and the transparency required by outside observers, consistent management of the various activities is essential. Without calling into question the need for flexibility, the management procedures and rules should be harmonised as far as possible.



The main means of implementation will remain the mechanism of public calls for proposals and evaluation with the assistance of independent experts. This mechanism will be based, quite transparently, on the participation rules laid down pursuant to Article 130j of the Treaty.

As a result of the introduction of key actions, a number of innovations should be made. These would concern, among other things, the calls for proposals, the frequency and formulation of which should be tailored to the different categories of activities.

For example, the calls for RTD projects in the context of the key actions could, according to requirements, be formulated in a targeted fashion and accompanied by specifications indicating the expected technological results; likewise, permanently open calls could be launched. In addition, in order to facilitate SMEs' access to the programmes, a "one-stop office" would be set up for them at the level of the Framework Programme, and a single entry point could be arranged at the level of the key actions.

In order to increase the efficiency of the evaluation and selection progress, operating on the basis of established criteria, and improve its transparency for proposers, new decision-making procedures are in preparation, designed to provide proposers with rapid information about the fate of their proposal. Clear objectives will be set with regard to time limits for processing.

· "Collegial" management and coordination

To ensure optimum and coordinated implementation of programme activities, the plan is to set up, in good time for the launch of the Fifth Framework Programme, a "collegial" type of coordination structure whereby greater consultation and flexibility can be built into the administrative arrangements. The objectives, which are consistent with the guidelines set out in SEM2000 and MAP 2000, are as follows:

- greater harmonisation of approaches and consistent implementation of programmes, taking account of their specific nature and providing the necessary flexibility;
- greater coordination of activities within the Commission (including with the Directorates-General responsible for the relevant policies) and vis-à-vis the outside world;
- clear definition of the distribution of tasks and monitoring of compliance with the division of responsibilities between the various Commission Services involved in implementation of the programmes.

- The “Advisory Groups”

Numerous contacts already exist between the Commission and scientific communities, industry and users, notably in the Task Forces set up on specific topics.

The aim would be to learn from this experience and, where necessary, rationalise these contacts and make them more transparent, particularly as regards the key actions and the coordination of space activities, by setting up a number of ‘Advisory Groups’ at the appropriate level (key action or cluster of key actions). These Groups would be set up on the basis of requirements to liaise with the abovementioned players. They could draw on the experience of earlier bodies (and in particular the Task Forces), and, where appropriate, build on this experience through systematic interaction with the circles concerned. In principle, they would be composed of a small number of eminent persons, representative of and recognised by the world of research and industry and appointed by the Commission in a personal capacity.

Their role would be to advise the Commission on certain aspects of implementation of the Fifth Framework Programme, for example before the Commission drafts the work programmes to be submitted to the Programme Committees for endorsement. The names of the members of the *Advisory Groups*, as well as the conclusions of their deliberations, would be systematically made public.

The practical procedures for implementing these proposals will have to be specified and defined precisely and, in some cases, put into legal form. This will take place in the context of the proposals concerning the specific programmes, and the Commission’s forthcoming proposal concerning the rules governing participation and the dissemination of results (Article 130j of the Treaty).

## **CONCLUSIONS**

This working paper, giving a preliminary view of the content of the specific programmes and their objectives, helps to shed light on and substantiate the structure and choices proposed for the Fifth Framework Programme.

There is an urgent need to take decisions and action. The objectives which the proposed research is intended to further require Union research teams to be able to begin their work as soon as possible. To enable this work to be carried out in good time and make inroads on the lead taken by the European Union's major competitors in their research, it is essential that all the political decisions concerning the Framework Programme be taken before the end of 1998.

The Commission calls upon the other institutions to intensify and rapidly conclude their discussions on the Fifth Framework Programme on the basis of this new paper. It stresses the innovative nature and great overall consistency of its proposal, from both the technical and management points of view. It will pay careful attention to the outcome of the discussions when framing its detailed proposals for specific programmes.

**5th Framework Programme for Research and  
Technological Development  
(1998 - 2002)**

Scientific and technological content  
of the specific programmes implementing  
the 5th Framework Programme

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**TABLE OF CONTENTS**

**THEMATIC PROGRAMMES**

<b>I.</b>	<b>Unlocking the resources of the living world and the ecosystem</b>	<b>1</b>
	<i>Health and Food..</i>	3
	<i>Control of viral and other infectious Diseases.</i>	4
	<i>The “Cell Factory”.</i>	5
	<i>Management and Quality of Water...</i>	6
	<i>Environment and Health.</i>	7
	<i>Integrated Development of rural and coastal Areas.</i>	8
<b>II</b>	<b>Creating a user-friendly information society.</b>	<b>13</b>
	<i>Systems and Services for the Citizen.</i>	16
	<i>New Methods of Work and electronic Commerce.</i>	18
	<i>Multimedia Content and Tools</i>	20
	<i>Essential Technologies and Infrastructures..</i>	22
<b>III</b>	<b>Promoting competitive and sustainable growth.</b>	<b>27</b>
	Part I : EC Treaty	27
	<i>Products, Processes and Organisation..</i>	30
	<i>Sustainable Mobility and Intermodality</i>	31
	<i>New Perspectives for Aeronautics.</i>	32
	<i>Marine technologies</i>	33
	<i>Advanced Energy Systems and Services</i>	34
	<i>The City of Tomorrow..</i>	35
	Part II : Euratom Treaty.	39
	<i>Controlled thermonuclear Fusion.</i>	40

**HORIZONTAL PROGRAMMES**

<b>IV</b>	<b>Confirming the international role of Community research.</b>	<b>43</b>
<b>V</b>	<b>Innovation and participation of SMEs.</b>	<b>48</b>
<b>VI</b>	<b>Improving human potential...</b>	<b>54</b>
	<b>DIRECT RTD ACTIONS...</b>	<b>62</b>

# *Unlocking the resources of the living world and the ecosystem*

## **INTRODUCTION**

Economic and political developments in Europe have globally resulted in much prosperity, increased life expectancy and better working conditions. These improvements have been accompanied however by challenges such as higher health care costs, an ageing population, and environmental degradation. Increasingly, a gap is becoming evident between natural resources, whether from agriculture and fisheries, mining or the global environment, and human activities. Paradoxically, this has occurred at a time when there is an “*explosion*” in the knowledge base concerning the structure and working of all living things and of the ecosystem, pointing at new developments in the corresponding sectors, e.g. health-care, pharmaceuticals, agriculture, food, and the environment.

Europe has a strong tradition and an excellent record in research and application of environmental and life sciences and technologies. Furthermore, Europe provides a huge single market with a certain receptiveness for bio- and eco-based products. It has, therefore, the potential to address and solve major challenges such as a varied and safe food supply, affordable health care and the protection of ecosystems and the environment. The scientific basis on which living and natural materials are exploited for these ends is undergoing a dramatic change, in which the intimate and interactive workings of living and ecosystems are being revealed. With the progress of scientific knowledge of recent decades, one can now expect to probe more deeply the questions surrounding the production of food, curing diseases, and the sustainable management and use of natural resources. One can also anticipate clarifying their relationships with human behaviour and needs, industrial practices and consumer demands.

## **Strategic objective of the programme**

The aim would be to link the ability to discover to the ability to produce, in order to address the needs of society and to meet the requirements of the consumer, leading to future wealth and job creation and respecting the principles of sustainable development. Therefore the research strategy of this programme would be to focus on specific areas where the growing knowledge potentially contains technical answers to some of the pressing questions of the citizen facing biological and/or ecological issues which require to be tackled at a European scale.

The **novelty of the approach** is the willingness to couple the dynamics of massive knowledge production with few areas of expected desirable spin-offs, while pursuing the renewal of knowledge to reinforce European strengths in fields which are strongly associated with further growth and quality of life. The proposed scientific and technological solutions should be seen as part of an integrated “system” approach, in which man is a key interacting component of both natural and man-made ecosystems. Six priority key actions have been identified in which European research could make an urgent contribution, by way of innovative products, processes or services, to problem resolution. These key actions are targeted at immediate socio-economic needs including the needs of the Community’s policy objectives, with a view to aligning resources and expertise to a common thrust of public interest. A unique characteristic of key actions is their ability to respond to the compatible needs of cross-linked Community’s policy objectives such as in agriculture and fisheries industry, environment and in the field of health. They are supplemented with generic research and development of technologies as well as support for research infrastructures activities aiming at the longer-term, building up the knowledge base in identified areas of strategic importance for the future.

**Socio-economic needs.** On the demand side, research should be developed which promotes health, reconciles economic developments with environmental requirements; improves the response to consumer needs and facilitates consumers’ understanding of available products, diets and foods. On the supply side, there is huge potential for economic growth and job-creation in this field, both in the traditional industries including primary production

(employing some 19 million people in Europe) and in the nascent high technology industries (fast-growing sectors, with a large role for SMEs).

**European added value.** Cross-border issues would have to be selectively addressed, such as health aspects (nutrition, food safety, ageing, rare diseases), environmental problems, climate change, natural hazards or transboundary resources management (terrestrial and aquatic living resources). Other examples such as drug abuse, biosafety or bioethics, involve the reinforcement of scientific bases in support of Community policies. Significant environmental issues affecting Europe (pollution diffusion, air and water quality, land degradation), have been recognised as important European issues in the Community 5th Environmental Action Plan. Many of the activities to be addressed in the programme (e.g. genomic research, natural hazards), due to their size and complexity, are only feasible if they are addressed at the European level.

**European competitiveness.** The programme will capitalise on specific scientific strengths in new knowledge areas and on productive sectors with strong growth potential, such as the biotechnology-eco-and food industries. Thus, the heart of this programme, promoting life sciences and technologies, improving the quality of life and decoupling economic growth from environmental degradation, will contribute in the short and in the longer term to European competitiveness and employment. As a reminder, Europe holds a leading position on environmental technologies, and must close the gap with the US in the number of biotech-related start-ups which have recently shown a consistent 20 % growth rate.

#### **LINKS WITH OTHER PROGRAMMES**

Coordination with the thematic programme on “creating a user-friendly information society” is based on the following principle : activities concerned with the development of information society technologies as such (which include applications, demonstration and take up actions) will be concentrated in the “information society” programme; activities concerned with the integration and adaptation of information society technologies in applications relating to the living world and the ecosystem would be conducted in this programme.

This principle would apply in particular to (i) work in the area of *Management and quality of water*, which would be closely coordinated with related work in programme 2 on *Systems and services for the citizen (environment)*, and (ii) work in the area of *Environment and health* which would be closely coordinated with related work in programme 2 on *Systems and services for the citizen (health and environment)*.

- Most key actions are likely to involve **third country participations** to give a reasonable coverage to wide transboundary issues. Generic activities and infrastructures are essentially based on critical pools of knowledge and capabilities, suggesting participation in world-wide networks.
- Concerning **innovation and the participation of SMEs** the objective is to promote partnerships between SMEs and other research actors, so as to foster profitable interactions at all points in the innovation process and take full advantage of the dynamism that SMEs have demonstrated in developing and exploiting knowledge in the lifesciences and eco-industries.
- **Training** with a view to providing qualified human resources in the entrepreneurial and professional sectors, as well as socio-economic analysis of technology impacts will be carried out right in the frame of this programme, to accommodate the rapid turn-over of new expertise in many traditional fields.

#### **(i) KEY ACTIONS**

# Health and Food

## Rationale

European consumers are increasingly aware that balanced dietary patterns contribute to the prevention of chronic diseases such as cardiovascular disease and cancer, or other disorders. An improved understanding of the role of food in health and well being leading to the production and the consumption of foods of high quality will have a significant impact upon the lifestyles of the European population in the near future. The recent BSE crisis, and other safety issues, have highlighted the need for European food policy to be centred on the requirement that only foodstuffs which are safe, wholesome and fit for consumption be placed on the market.

Furthermore, the link between food production, diet, and health is characterised by a pan European dimension and also involves the combined competencies of various sectors such as agriculture, fisheries, the food and pharmaceutical industries and health undertakings. The EU is the world's leading producer in the food and drink sector; this industry accounts for 16.5% of the Community's total industrial value, making it the EU's leading industrial sector with a total agro-industrial value of 650 billion ECU. Europe possesses world class companies in food production, both large and small, although the ratio of research expenditure to gross production in the food and drink industry still remains very low in comparison with other sectors.

## Objectives and RTD priorities

The overall goal of this key action would be to provide safe, healthy, balanced and varied food products. It intends to address the whole food chain from farm to plate, examining major issues of food safety, new and improved raw materials, food processing, and a more profound understanding of the links between food consumption, well being and health. To achieve this, a new approach viewing the food production chain as an integrated entity would be used, based on the following scientific and technological objectives :

- **Development of new processing methods to improve food quality.** Research would focus on optimised and novel raw materials and processes, thereby promoting consumer confidence in the food supply.

*RTD priorities: improved production systems; design of food crops and functional foods; quality and traceability of raw materials and food products in the food chain; minimal processing and process control; advanced food technologies and packaging systems.*

- **Development of tests to detect and processes to eliminate infectious and toxic agents.** To prevent hazards caused by food contaminants, their exact origins and the strategies that would allow for safer food production would be investigated.

*RTD priorities: improved understanding and control of the contamination conditions; rapid detection tests for pathogens, xenobiotics, hormones; new and safer methods of food production; new methodologies for assessing microbial, chemical and allergenic risks.*

- **Study of the role of food in preserving health, in particular from the point of view of nutrition, epidemiology and public health.** To reduce diet-related risk factors contributing to chronic diseases, knowledge and new approaches for improved nutrition and more balanced diets would be developed.

*RTD priorities: the role and impact of food and diet on physiological functions, physical and mental performance; the particular nutritional needs of defined population groups; links between diet and chronic diseases and disorders; consumer attitudes and responses to products, food processing methods and labelling.*



# Control of Viral and other Infectious Diseases

## Rationale

Infectious diseases are responsible for 17 millions deaths globally each year. Thirty new epidemics have been observed during the last two decades. HIV infection, which causes AIDS, will exceed 40 million people world-wide, including over 5 million children, by the end of the century. Diseases like hepatitis C, affecting more than 5 million patients in Western Europe, are a growing issue of social concern. As regards animal pathogens, in addition to the increasing concern about zoonotic diseases, outbreaks of highly infectious diseases in livestock cost millions of ECU to the Community, in terms of eradication measures, restriction of trade, losses of market.

The scientific means available to the individual Member States are insufficient to approach this kind of problems. Europe has a strong research tradition in infectious diseases. European vaccines manufacturers and the pharmaceutical and veterinary industry would benefit from an action, together with SMEs, diagnostics industries and the biotechnology sector, for which it has already carried out extensive preparatory work.

## Objectives and RTD priorities

The overall goal of this key action would be to fight against major emerging or re-emerging infectious diseases, such as AIDS, linked to old, new or mutant agents. This would be achieved primarily by mixing complementary expertise in transdisciplinary projects, by linking these activities to national and international organisations, and by encouraging the interface between academic research, policy makers, healthcare providers and pharmaceutical and veterinary industries, pursuing the following scientific and technological objectives :

- **Development of vaccines, especially against viral diseases.** Research would contribute to the development and the production of new vaccines against AIDS and other major infectious diseases caused by human and animal pathogens.

*RTD priorities: vaccines against emerging and re-emerging infectious diseases and other diseases related to infectious agents (e.g. some cancers); vaccines against animal pathogens; development of European networks for clinical and field trials of vaccines and drugs including, where necessary, support for high level containment facilities.*

- **Treatment and prevention strategies.** The objective would be to establish new strategies for the diagnosis, treatment and control of infectious diseases, to improve the control of drug-resistant infectious agents, to establish new or improved detection methods ensuring the safety of medicinal and veterinary products.

*RTD priorities: improved understanding of mechanisms of protection against infectious agents and of drug resistance; technologies for safer and more efficient vaccines and immunotherapy; specific risk factors influencing the spread of infectious diseases and development of new strains; development of an early warning system and response network for communicable diseases; improved methodologies for early and accurate detection of adverse reactions to drugs and vaccines.*

- **Aspects connected with public health and care-delivery systems.** The aim would be to ameliorate the organisation within services supporting public health as related to management and prevention of infectious diseases, including perception of the value of prevention and surveillance of such diseases.

*RTD priorities: organisational and economic public health aspects; surveillance, monitoring and assessment methodologies in prevention and cure; methodologies for product safety surveillance in the market place.*

## The “Cell Factory”

### Rationale

The emerging biotechnology industry represents a vast potential, both in economic and social terms, and must be strongly promoted. The actual and forecasted growth rate of this industry is as high as 20 per cent annually. Estimates show that the value of products using modern biotechnology could reach 250 billion ECU in Europe by the year 2005. The associated employment would amount to 3.1-3.3 million. This illustrates the huge potential of this technology in contributing to economic growth and job creation. To date, some 300 novel biotechnology derived drugs/vaccines have been approved for medical use world-wide and 1600 patents have been issued based on molecular biological applications.

The “cell factory” benefits stem from employing living organisms or parts of organisms to generate, modify and optimise products or processes, improve plants or animals. New bio-molecules can be discovered or designed and used to battle diseases, metabolic pathways can be engineered to degrade highly toxic compounds and novel processes designed to minimise environmental pollution.

### Objectives and RTD priorities

The overall goal of this key action would be to help Community industry exploit progress of biotechnology particularly for applications in the fields of health, agro-food and the environment. For this purpose, it would promote development and use of key technologies for generating new bio-products and bio-processes with high added-value, that can be adopted and implemented by industry. The assessment of the fate and impact of recombinant organisms (e.g. transgenic plants, recombinant vaccines), where relevant, would be part of this key action. Emphasis would be put on the following scientific and technological objectives :

- **New health products.** Research would focus on bio-products relevant for diagnosing, preventing or curing human and animal diseases and improving the quality of life.  
*RTD priorities: improved understanding of the cell, gene functions and gene delivery methods applicable to the development of new therapeutic substances: anticancer drugs, antibiotics, antibodies; new “in vitro” diagnostic testing assays.*
- **Waste biotreatment processes.** The objective would be to prevent, detect, monitor, treat and remove pollution as well as to maximise the economic value of waste.  
*RTD priorities: new bio-processes for preventing industrial pollution, treating and/or recycling bioaccumulation of wastes and industrial by-products; simple bioassays and biosensors; biodegradation of recalcitrant chemicals by microbial catalysts alone or in combination with plant systems and chemical catalysts.*
- **New biological processes for the agro-food industry.** Focus would be on high value bio-molecules and bio-processes leading to an enhanced exploitation of renewable resources and to desirable characteristics for plants and farm animals.  
*RTD priorities: applications for improved plants and farm animals combining economic, agronomic, ecological and/or consumer advantages; new enzymes; use of terrestrial and marine organisms as a source of new valuable products; identification and sustainable use of metabolic and genetic diversity.*

# Management and Quality of Water

## Rationale

The European water industry is growing rapidly and is expected to reach a turnover of about 32 billion ECU by the year 2000. Further development of advanced management strategies, coupled with improved environmental technologies and industrial techniques would strengthen its pre-eminent role acquired worldwide and would contribute to the creation of jobs.

The sustainable management of water resources also requires a sound regulatory basis. A combination of fundamental socio-economic and applied research is needed to create the basis for the development of water related policies at Community, regional and local scales and to fulfil the international Treaty obligations.

## Objectives and RTD priorities

The overall goal of this key action would be to meet one of the major requirements of European citizens, namely the protection and provision of affordable high quality water, in particular drinking water in sufficient quantity, while maintaining the integrity of the ecosystem. The aim is to develop the knowledge and the technologies needed for the rational management of water resources, through the following scientific and technological objectives:

- **Treatment and purification technologies.** They would be developed together with advanced and integrated pollution prevention and the re-use of treated waste water, for application in industry, agriculture, forestry and aquaculture.

*Research priorities: optimisation of technologies to minimise use and pollution and treat waste water at source and through process integration; new hybrid technologies coupling the most advanced physico-chemical and biological techniques and integrating control techniques.*

- **Technologies for monitoring the quality and the level of groundwater and surface waters.** They would provide a better understanding, in both qualitative and quantitative terms, of the state and evolution of water resources, as well as the functioning of aquatic and wet land ecosystems, to enable better management and sustainable use of water resources.

*RTD priorities: improved measurement methods; predictive models and advanced pollution impact assessment methodologies; updated water quality criteria and indicators for water policy.*

- **Surveillance, early warning and communication systems.** The objective would be to develop systems able to react on different time and space scales, including early warning systems with direct feedback to pollution sources.

*RTD priorities: surveillance systems for point and diffuse pollution sources and for the various environmental recipient systems; control and data management systems, including leakage detection and stormwater management and systems for floods and drought assessment.*

- **Technologies for the regulation of stocks and technologies for arid and semi-arid regions.** The aim would be to improve and protect water resources and ecosystems, to optimise water management systems in water deficient regions, and to manage better water crises.

*RTD priorities: integrated approaches at catchment level incorporating the various political, social, economic and environmental interactions; improved management systems; improved information systems about water resources and their uses at EU, national, regional and local level to assist decision making.*

## Environment and Health

### Rationale

Steps need to be taken in order to protect and improve the health of human populations by limiting their exposure to biological, chemical and physical hazards in their environments, including occupational factors. Diseases such as cancer, respiratory and cardiovascular diseases have yet to be conquered and there is an alarming increase in the incidence of diseases such as allergies, asthma, skin cancer. The gap in life expectancy between Eastern and Western Europe is actually widening and it has been predicted that increasing mobility of populations, coupled to global climatic change will alter the distribution and frequency of diseases on the continent.

Tackling these issues requires a broad-scale research effort to understand and quantify the interactions between the environmental, the public health, the social and the economic sectors. Because to a large extent the environment-health link knows no boundaries, research would be necessary at Community level to support EU policies in this area, complementing the solutions that are still needed at national, regional and local levels. European environmental regulation and policy making would be facilitated by the provision of sound basic information; research at European level would improve its acceptability and applicability. This is a transfrontier issue where important gains can be made by utilising the heterogeneity of exposures, populations, conditions and expertise existing in Europe.

### Objectives and RTD priorities

The overall goal of this key action is to improve the knowledge-base, the coordination and the links between environment and health fields, this would contribute to reduce the negative impact on health of factors such as air pollution, heavy metals, toxic substances, noise, climatic changes and electromagnetic radiations (e.g. those generated by mobile communication systems) as well as the effect of pollution at the workplace. To address these issues, the following scientific and technological objectives would be pursued :

- **Epidemiological studies.** They would focus on the application of uniform transnational protocols using large populations in standard-setting to effect public health protection.

*RTD priorities: analysis and quantification of the impact of environmental factors on human health; assessment of the relative importance of and the interactions between factors impinging on health; improved understanding of the interrelations between environmental and public health indicators; assessment of the impacts of climate and other global changes on human health.*

- **The development of new methods of diagnosis, risk assessment and prevention.** The objective would be to improve the identification of vulnerable groups to environmental exposures.

*RTD priorities: biomarkers of exposure, effect and/or susceptibility to environmental agents including mixed exposures and cumulative effects; improvement of predictive toxicity testing and mechanism-based risk assessment aiming at an eventual reduction, refinement and replacement of animal testing; improved methods and technologies for both long and short-term exposure and effects assessment.*

- **The development of processes to reduce causes and harmful health effects.** Focus would be placed on quality of indoor and outdoor air, on quality of water and soil, on wastes as well as regional manifestations of climate change and other global changes.

*RTD priorities: improved understanding of the mechanisms of action for the identification and control of environmental risk factors; methods for the incorporation of health effects into environmental policy and for measuring environmental health benefits and costs; improved techniques to address the issues of environment, health, risk perception and communication.*

## *Integrated development of rural and coastal areas*

### **Rationale**

Need exists to establish a coherent multidisciplinary approach in support of the objectives and implementation needs of the evolving Common Agricultural and Fisheries Policies and of the realisation of the sustainable integrated development of rural and coastal areas.

Agriculture, forestry, fisheries and related industrial sectors are facing pressing economic difficulties due to international commitments, liberalisation of trade, technological developments as well as changing societal needs in terms of environment and quality of products and services. These difficulties are causing serious socio-economic problems such as unemployment, the departure of the young, the ageing of populations, the lack of services, competitive use of space, over-exploitation of natural resources and environmental degradation.

In view of the diverging interests of the producers, end-users and consumers, sustainable rural and coastal development will depend on the integration of production, transformation of renewable biological resources with environmentally sound practices. It will also depend on the successful exploitation of the possibilities offered by the life sciences and technologies. Since rural and coastal development activities are interlinked with food and non-food production, this key action is closely linked to those on “Health and Food” and “Cell Factory”.

Given the transboundary nature of the issues and the implied European dimension, national efforts must be complemented with co-ordination and concentration at the European level.

### **Objectives and RTD priorities**

The overall goal of this key action would be to **promote competitiveness and employment in rural and coastal areas**, in light of the need to adapt to the evolution of the Common Agricultural and Fisheries Policies, to world trade situation and globalisation of markets; to **reduce the vulnerability of the relevant sectors** through the diversification of productions; to **respond to societal demands** for sustainable management and use of renewable resources and for products and processes complying with health and environmental requirements.

- **New systems of production and exploitation in agriculture, forestry, fishing and aquaculture.**

They would combine competitiveness, sustainable management of resources, quality and employment.

*RTD priorities* : For **agriculture**, sustainable farm production systems and methods and corresponding ex-ante and ex-post control and analysis. Diversification of productions and activities. Support to Community policies on: plant health with prevention, prediction and protection; animal health with prevention, control and eradication of major diseases and zoonoses; animal welfare. Identification and characterisation of quality of agro-food products and agricultural farm-processed products and technologies; definition of parameters, specifications, methods, forms of organisation and technologies for total quality. For **forestry**: Support to forest policy issues. Diversification (non-wood uses, agro-sylvo-pastoral systems). Multifunctional and sustainable management combining quality production with conservation and protection. For **fisheries**, support to integrated fisheries management, linking resources conservation, means of capture, interactions with ecosystems, market requirements and socio-economic considerations. For **aquaculture**, sustainable production systems with the reduction of impacts on ecosystems and diversification of cultivated species. Improvement of production techniques. Promotion of disease resistance and control.

- **Non-food uses: sustainable utilisation of biological resources.** This would cover integrated production and processing chains from genetic improvement to end use and market requirements.

*RTD priorities* : forestry wood chain, green chemicals and bio-polymers chain, bioenergy chain.

- **Methods of control.** They would support the sound implementation of the Common Agricultural and Fisheries Policies and related activities.

*RTD priorities* : Reliable, transparent and cost-effective methods to monitor, assess and control.

- **Sustainable development of rural and coastal areas.** This would promote integrated development, based upon competitiveness, local potential development, diversification of activities, involvement of local populations and sustainability.

*RDT priorities* : Analysis of the **situation and changes under-way** with the relationships between all sectors involved and the factors influencing technological and socio-economic changes. Diversification and job opportunities. Easy access to innovation and new technologies. Development of the **integrated rural and coastal development concept**, with the investigation of potentials and constraints, the elaboration of new models and tools including for spatial planning and the improvement of organisational capacity of local actors. Support to **follow-up and evaluation of rural and coastal development programmes and policies** with tools to monitor, assess and forecast socio-economic and environmental impacts.

## **(ii) ACTIVITIES FOR GENERIC RESEARCH AND DEVELOPMENT OF TECHNOLOGIES**

These activities have a longer term impact that may even preclude the possibility of satisfying some of the citizens' needs expressed before, for as long as fragmentary knowledge is not pooled together to a sufficient degree of completeness. There is in the related disciplines a time-dependent need for integration of the science base which is why industry, services and policy-making in Europe require to maintain or reinforce their responsive capacity in a rapidly changing world.

### **• Life Sciences for Health**

#### **Rationale**

In the next decade, for the first time, there will be more people in Europe over 60 than under 20, creating increased social demand for research on age-related illnesses and health problems. A still increasing morbidity in chronic and degenerative diseases, cancer, diabetes mellitus, cardiovascular disease require a focused effort for a better understanding of the underlying causes, and to optimise multidisciplinary research and the implementation of results in clinical practice. Research into neurosciences and genomes will benefit from an increased flow of ideas and techniques which will increase Europe's attractiveness as a research base for the global biotechnology industry and eventually create qualified employment. Medical research at the European level must be targeted towards coordinated approaches to treatment and diagnosis of diseases, prevention and identification of risk factors.

#### **Objectives and RTD activities**

**Fight against age-related illnesses and health problems (e.g. Alzheimer's disease), degenerative diseases, cancer, diabetes and cardio-vascular diseases; diseases of genetic origin and rare diseases; research into genomes and the neurosciences.** The objective would be to promote healthy ageing and independent living, to reduce the need for long-term care and limit its costs, and to apply modern technology to treatment and control of major diseases. Research would also aim at exploiting genome data for the better understanding of molecular mechanisms underlying human, animal and plant genetic and rare diseases (e.g. Creutzfeldt-Jacob disease). Promoting new insights in neurosciences would enable the mechanisms governing the inter-relationship of biological and psychological processes to be understood for the benefit of new therapeutic approaches to neurological and psychiatric disorders.

*RTD priorities: basic mechanisms underlying age-related changes, and integrated physiology of ageing and quality of life; management of disability; pathophysiology and basic mechanisms of disease development; epidemiological and clinical research including therapeutic, diagnostic and preventive strategies; improved knowledge and understanding of genetic and rare diseases and gene sequence and function information; cellular communication and human behaviour; mechanisms of brain development, disorder and repair, and their clinical, epidemiological and social implications.*

### **• Public Health Research**

#### **Rationale**

In view of the growing limitations of health care budgets in the Member States and the parallel increasing demands, it is essential to increase knowledge on socio-economic and cost aspects of health care so that the health needs of society are met and that high quality care is maintained. Given the increasing importance of drug abuse, health and socio-economic aspects of drug problems have to be addressed. The diversity of health services and prevention approaches in the Member States constitutes the natural ground for European collaborative research which can better assess the efficiency of health initiatives, focusing on the needs of users, health undertakings, health policy providers or industry and also taking into account the needs of the patients. Assessment methodologies of current and new practices or technologies with emphasis on cost-effectiveness is equally relevant.

## Objectives and RTD activities

**Improvement of health systems, enhancement of health and safety at work, and fight against drug-related public health problems.** The objective would be to develop standardised tools and improved methodology for assessment of health systems, including implementation of best practices. Research would contribute to alleviate health consequences of the use of new technologies at the work place and of new forms of work organisation. It would also aim at developing innovative biomedical and social approaches for drug demand reduction.

*RTD priorities: improved methodologies in epidemiology; identification of new health determinants and etiologic factors of disease; socio-economic and organisational determinants of prevention, care and health services; work-related exposure to biological, chemical and physical agents and to physical and mental stress; physical detection side, drug profiling and biological monitoring of drugs.*

- **Major Natural and Technological Hazards**

### Rationale

Activities to forecast, reduce and manage both natural risks and technological hazards that Europe has to cope with should concentrate on a multiscale, multidisciplinary and multinational approach. This would maximise the benefits that citizens could draw from this research. A better safety in Europe would also contribute to strengthening economic competitiveness in some aspects. Various target groups, institutions and organisations have to be considered as well as international programmes and conventions, and policies undertaken by EU, Governments and other regulatory bodies and industries.

## Objectives and RTD activities

**Fight against major natural and technological hazards** The objective would be, through a better understanding of processes, mechanisms and events generating natural and technological hazards, to develop forecasting technologies and low risk and environmental impact assessment and mitigation technologies. Support to improved decision making systems, including evaluation and validation tools for assessing hazards and for emergency management would be provided.

*RTD priorities: identification of factors, which increase the level of natural risks; methods for hazard prediction, and for vulnerability and risk assessment including quantification of the present and future levels of risk; effective tools and methods for information management; innovative methods to combat natural and technological disasters and alleviate their consequences; improvement of the operational safety of hazardous installations*

- **Global Environmental Change**

### Rationale

Rising population and per-capita use of resources, coupled with the globalisation of world economic markets, are causing or exacerbating a number of major environmental problems which are global in scope, but with consequences experienced at the regional or local level.

Global change will inevitably have implications for industrial strategies, and the necessary measures required for mitigation or adaptation against adverse change will have major economic impact on many sectors. In addition, EU policies relevant to international agreements also have global implications for the environment. However, addressing these impacts and mitigation options also provides economic prospects and market advantage for new and cleaner technologies, a fact recognised in other major industrial countries such as the USA and Japan.

Europe has established a leading international role in global change research, but maintaining and improving this leadership requires continued commitment. Strong European research efforts would also strengthen European environmental policies and EU input to international agreements. (e.g. EU participation in the 1992 Rio Conference follow up).

## Objectives and RTD activities

**Understanding the processes and interactions involved in the “Global Change”.** The objective would be to attain the necessary understanding of global change processes, interactions and feedbacks (at global and European scale) in the Earth system, in its components (ocean, land, ice, atmosphere) and in ecosystems, and their interactions with social and economic activities. This would encompass the development of prediction, prevention, mitigation and adaptation strategies as well as the formulation and evaluation of technology and policy options.

*RTD priorities: coupled models for improved assessments of both climate variability and change; atmospheric ozone changes and their interaction with climate; behaviour and role of oceans; assessment of the impacts on sensitive terrestrial and aquatic ecosystems, areas and seas (including biodiversity) ; economic and technical feasibility and social acceptability of technology and policy options; establishment of long term consolidated data sets of environmental and climate state variables.*

- **Satellite Earth Observation Technologies<sup>2</sup>**

#### **Rationale**

Earth observation from space already plays an important, and often critical, role in the implementation of EU policies, particularly in agriculture and the environment. It can help mitigate major hazards, monitor the sustainable use of biological resources, and help in development and humanitarian aid. It can be used to monitor compliance with international environmental conventions, and authorities concerned with the implementation of public policy could reduce costs and increase effectiveness through the use of information derived from Earth observation. Efforts in this area would help to develop a robust supply sector which has a high proportion of SMEs.

#### **Objectives and RTD activities**

**Development of generic Earth observation technologies (notably satellite technologies)** The objective would be to provide applications, products and services based on Earth observation, for environmental monitoring, resources and ecosystem management. Research would create favourable conditions for the development of a strong European operational capacity to monitor Earth from space, providing information for a wide range of users. The following research priorities would be implemented, notably in the context of the “Centre for Earth Observation” project.

*RTD priorities : innovative applications and focused methodological research to improve the effectiveness of activities in priority areas for EU policies; test models of technical, legal and economic aspects to prepare sustainable operations; promotion, education and training to make better use of existing and planned Earth observation data and information source.*

- **Biomedical Ethics and bioethics**

#### **Rationale**

European citizens expect research to be conducted in a responsible way, fully respecting the fundamental human rights and values which constitute the cornerstone of all European policies. “Ethics” is a dimension of the development of science and technology. The ethical implications of its impacts on human beings have to be addressed to foster informed public debate in a pluralistic society.

#### **Objectives and RTD activities**

**Study of problems relating to biomedical ethics and bioethics.** The objective would be to identify the ethical, legal and social questions raised by scientific and technological development; to understand and address issues of public concern, and to analyse the ethical dimension of legal and regulatory measures.

*RTD priorities: universal ethical principles, religious and cultural diversity; ethical aspects of medical research, medical practice and health policies; ethical aspects of life sciences research and its application to animals, plants, and the environment.*

- **Socio-Economic Aspects of Life Sciences and of Environmental Change in the Perspective of Sustainable Development**

#### **Rationale**

Competitiveness and sustainable development will together be the source for the Union’s future wealth and employment opportunities, ensuring enhanced quality of life for Europe’s citizens, and the protection of the environment and natural resources. Simultaneous pursuit of these objectives is only possible through an adequate recognition and understanding of the key interrelations between technologies, environment and society and integration of the knowledge into sustainable development policies.

Socio-economic research is also needed to enhance the quality of the public debate, as illustrated by the applications of modern biotechnologies. The regulatory process both in life sciences and environment and the impact on citizens confidence influences public concern which in turn has a strong impact on decision makers.

#### **Objectives and RTD activities**

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<sup>2</sup> Space-related activities are subject to an overall coordination across the various programmes.



**Study of the socio-economic aspects of development of the life sciences and technologies and of environmental change in the perspective of sustainable development.** The objectives are to assist in the construction of strategies and models for sustainable development and to provide a sound scientific basis for the conception and implementation of relevant policies, exploiting knowledge and technologies from the life and environmental sciences (including the creation of employment opportunities in environmental protection and the bioindustries); and to develop a better understanding of the links between science and policy including the ways in which opinions on the benefits and risks of technological progress are formed and are reflected in the regulatory process.

*RTD Priorities: technology evaluation and assessment, public perception, education and opinion forming in the field of life sciences; analysis of social and economic driving forces and of new opportunities in the bio and eco-industries; development of indicators and knowledge bases, relevant to decision making and regulation; analysis of the social and economic aspects of the links between science and policy in the field of environment and sustainable development.*

### **(iii) SUPPORT FOR RESEARCH INFRASTRUCTURES**

#### **Rationale**

Most meaningful and promising research in the life and environment sciences relies on the accessibility and availability of complex data and models, rare instrumentation and pooling of expertise and high quality resources. Europe is rich on resources that underpin the Member States' research activities. The success of the European research and its capacity to respond to the scientific and societal demands, require a level of integration and critical mass that should be equal, if not surpass, that of our most direct competitors.

#### **Objectives and activities**

The objective would be to help manage the biological information and the diversity of life, to provide biological data and resources for the development of new drugs including high level containment facilities, to support infrastructures for observing and understanding the Earth system, predicting global changes and natural hazards.

**Biological data and resources.** Databases, information services and networks of biological expertise; major instrumentation for the study of biological structures; collections of genetic materials, living and non-living specimens; breeding of animals to provide models of human diseases; pre-clinical and clinical research facilities.

**Earth system observation.** Marine databases, fisheries and aquaculture infrastructures and test basins; research vessels; platforms and centres for forecasting of climate and ocean state; simulation chambers, ground-based stations and aircraft for the observation of the atmosphere; robotic and automatic observing systems, untethered vehicles and drone systems, devices and networks for observation of palaeo-environmental information and satellite remote-sensed data.

**Global change and natural hazards.** Super-computer facilities; archiving facilities; centres for integrated assessment; key operational European networks for atmospheric and earthquake data, for floods and waves and for storms, landslides, volcanoes and wildfires.

# *Creating a user-friendly information society*

## **INTRODUCTION**

We are undergoing a fundamental transformation: from an industrial society to the information society. Information society technologies increasingly pervade all industrial and societal activities and are accelerating the globalisation of both economies, in particular by providing SMEs with affordable access to the global marketplace, and societies.

Europe's industrial competitiveness, its jobs, its quality of life and the sustainability of growth depend on it being at the leading edge of the development and take-up of information society technologies. Also, by enabling communities in remote and rural areas to overcome isolation and to compete in the global economy, information society technologies contribute to cohesion in the European Union.

At the same time, the technologies underpinning the development of the information society are in rapid evolution. Advances in information processing and communications are opening up exciting new possibilities. There is a shift from stand-alone systems to networked information and processes. Digitisation is resulting in the convergence of information processing, communications and media. Content is of increasing significance. However, the increasing diversity and complexity of systems is also presenting new challenges for their development and use.

It will not be possible to realise the full potential of the information society in Europe with only today's technologies, systems and applications. Key requirements such as usability, dependability, interoperability and, above all, affordability are far from being sufficiently met for the broad deployment of information society technologies in all areas. Continuous efforts are required, in research, technological development, demonstration and technology take-up.

### **Strategic Objectives of the Programme**

The strategic objective of this programme would be to realise the benefits of the information society for Europe both by accelerating its emergence and by ensuring that the needs of individuals and enterprises are met.

The programme would have four inter-related specific objectives, which would both focus the technology developments and enable the close articulation between research and policy needed for a coherent and inclusive information society. For the private individual the objective would be to meet the needs and expectations of European citizens for high-quality, affordable general-interest services. Addressing the requirements and concerns of Europe's enterprises, workers and consumers the objective would be to enable both individuals and organisations to innovate and be more effective and efficient in their work and business. Multimedia content is central to the information society; the objective here would be to confirm Europe as a leading force in this field and enable it to realise the potential of its creativity and culture. For the essential technologies and infrastructures that form the building blocks of the information society the objective would be to drive their development, enhance their applicability and accelerate their take up in Europe.

**Novelty of the approach** Community-funded research in information and communication technologies is integral to the overall strategy of the European Union for the information society, which was defined by the Action Plan 'Europe's way towards the information society' and revised in the Action Plan adopted in November 1996. In response to the needs of the next millennium, the Fifth Framework Programme introduces the Information Society Technologies Programme.

The context, rationale and objectives of this programme necessitate a new approach, one that introduces a single and integrated programme which reflects the convergence of technologies and media and of industries and markets, together with the increasing significance of content, and responds to the need to integrate research and development and take-up actions. To this effect, this programme consists of a set of four key actions centred on the four specific objectives and a specific activity on longer-term or higher-risk research on future and emerging technologies. These activities complement each other and are derived by grouping together the technologies, systems, applications and services and the research and development and take-up actions with the greatest affinity or interdependence. Each activity has its own specific focus and priorities, however, the key issues of usability of technologies, systems, applications and services, interoperability at all levels, dependability and affordability would be addressed ubiquitously throughout the programme.

The coordination and integration of the activities through a single work programme would allow a “theme” that cuts across the programme (e.g. interfaces, mobility or satellite-related activities) to be addressed in a coherent manner in more than one activity, each concentrating on and contributing from its particular perspective. Clustering and concertation would be used to focus, coordinate and integrate activities. The technological scope of the activities would provide the flexibility to re-focus over time, through the single rolling work programme (defined in consultation with the key actors), to respond to changes in industrial and societal needs and the technological context.

**Socio-economic needs** A vast range of goods, services and processes are being transformed through the integration and use of information society technologies. Work would target the quantitative and qualitative benefits that information society technologies offer in all industrial and societal activities, from more competitive methods of working and doing business to higher-quality, lower-cost general interest services or new forms of leisure and entertainment. Socio-economic research would be integrated throughout the programme, to support the take-up of information society technologies, and into its management. As too would be work on statistics, which are central to the information society and for which information society technologies offer new ways to attain the highest standards of quality and the widest and most rapid and accessible dissemination.

**European added value** Realising the full potential of the information society requires technologies, infrastructures, applications and services, accessible and usable by anyone, anywhere, anytime, whether it be for business or individual use. Collaborative research and technological development is needed to create both the critical efforts and the interoperability necessary to ensure this in Europe. Pan-European research is also needed to ensure that content, together with its creation and use, properly reflects the EU’s cultural diversity and many languages.

**European competitiveness** Information society technologies are integrated in or support products and processes in all sectors of the economy. To be competitive in the global marketplace Europe needs to master both the supply and use of information society technologies. To this end, to accelerate the realisation of knowledge as innovation, this programme would integrate actions to stimulate the take-up of information society technologies with the research and technological development to ensure that the conditions and requirements for their use can be met. In addition to demonstrations and trials, these include actions to stimulate the development and diffusion of the skills necessary to take-up research and development results (such as validations, assessments, awareness building, first-user actions and best-practice initiatives) and consensus building and standardisation activities.

### **Links with Other Programmes**

Articulation with the other thematic programmes is based on concentrating the activities concerned with the development, demonstration and take-up of information society technologies in this programme and concentrating their deployment (application-specific integration research as well as use) in specific domains in the other thematic programmes. In particular: (i) work addressing health or the environment, particularly that under the key action on ‘*Systems and services for the citizen*’, would be closely coordinated with the related work in both Programmes 1 and 3, in particular that in the key actions on ‘Health and the environment’ and ‘Quality and management of water’; (ii) work related to transport and transport means, in particular that under the key action on ‘*Systems and services for the citizen*’, would be closely coordinated with the relevant work

carried out under Programme 3, in particular that under the key actions on 'Sustainable mobility and intermodality' and 'New perspectives in aeronautics'; and (iii) work addressing new methods of work and electronic commerce would be closely coordinated with the corresponding work on competitive and sustainable development in Programme 3. In addition, the satellite-related activities in this programme would be coordinated with related activities in Programmes 1 and 3 in the context of the Commission's Space Coordination Group.

Reflecting the global nature of the information society, international cooperation would play a major role in the development and take-up of information society technologies. This needs to be reflected in the participation in and operation of this programme and in its linkages with the horizontal programme on 'Confirming the international role of European research' addressing support for organisations from third countries. Specific activities to facilitate the participation of organisations from third countries and to maintain links with European-trained specialists in third countries would also be used in addressing the international dimension of the programme. Links with the horizontal programme on 'Innovation and participation of SMEs' and with EUREKA, Trans-European Network actions and the Structural Funds would be used to establish routes and mechanisms for the further take-up and the deployment of results. The work on skills development and socio-economic research integrated in this programme would be enhanced through the appropriate links with the horizontal programme on 'Improving human potential' and European Social Fund initiatives. This programme's work on '*Research networking*' would interface with the 'Improving human potential' programme's support for access to large computing facilities and with the 'support for research infrastructure' activities of the other thematic programmes. Where appropriate, work will complement and be coordinated with that in the COST Programme.

**(i) KEY ACTIONS**

## Systems and Services for the Citizen

### Rationale

Given the significant weight of general-interest services in its GDP, a key challenge for the European Union is to improve their quality while containing their costs. Both the overall competitiveness of the EU economy and the visibility and social impact of the information society would be durably improved if the modernisation of these services were achieved in terms of flexible access to them by everyone and of improved quality and efficiency of service delivery.

RTD is needed to support the transition towards new paradigms that affects the evolution of sectors of general interest. In the field of health the new paradigm includes the informed citizen caring for his/her own health and the stakeholders responsible for the continuity of health services in a regional setting. In the field of persons with special needs, including the elderly and the disabled the new paradigm aims at ensuring full access, participation and equality for all citizens. In the field of administrations, citizens have come to expect the provision of a transparent and efficient one-stop-shop for individually tailored services oriented towards their everyday life. In the field of environment, what is at stake is to support sustainable development through the harmonious co-existence, including health, between further competitive economic development, the optimal use and re-use of what essentially are limited natural resources, and the environment. In the field of transport, the vision is one of building the mobile society within the information society through the introduction and use of information society technologies to improve effectiveness and safety of all transport

### Objectives and RTD priorities

This work would foster the creation of the next generation of user-friendly, dependable, cost-effective and interoperable general-interest services, meeting user demands for flexible access for everybody, from anywhere, at any time. Work would cover RTD addressing the whole of the key action, as well as specific RTD in the following fields: health; special needs, including ageing and disability; administrations; environment; and transport. Certain of the ubiquitous issues addressed throughout the whole of this programme would need to be addressed further in order to pay due consideration to the needs and expectations of the typical users in this key action, in particular the user-friendliness and acceptability of new services, including the socio-economic and ethical aspects. Integrated application platforms are needed to provide seamless interaction between citizens, businesses and administrations - these would be demonstrated and assessed in “digital sites”, in particular cities or regions, paving the way to “digital communities”.

• **Health and ageing, disability and other special needs** In the area of health, work would cover both new generation computerised clinical systems, advanced telemedicine services and health network applications to support health professionals, continuity of care and health service management, and intelligent systems allowing citizens to assume greater participation and responsibility for their own health. For the aged, the disabled and other persons with special needs, the work would address person/system interfaces and adaptive and assistive systems to overcome problems caused by environmental barriers and by physical or intellectual impairments, as well as intelligent systems and services to support autonomous living, social integration and participation in the information society.

***RTD priorities professional health care:** systems enhancing the ability of health care professionals for prevention, diagnosis, care and rehabilitation, such as intelligent systems for non-invasive diagnosis and therapy, intelligent medical assistants, and advanced medical imaging; advanced telemedicine applications; “virtual hospitals” offering single-point-of-entry services; high-speed secure networks and applications for linking hospitals, laboratories, pharmacies, primary care and social centres for continuity of care; health service workflow management and re-engineering; new generation electronic healthcards for sophisticated health data objects; **personal health systems:** systems for personal health monitoring and fixed or portable prevention systems, including advanced sensors, transducers and micro-systems; personal medical advisors for supervision of prevention and treatment; tele-systems and applications for supporting care in all contexts; user-friendly and certified information systems for supporting health education and health awareness for citizens; “design-for-all” products, systems and service, including improved participatory design methods, multi-modal terminals and universal interfaces; **adaptive systems:** communication tools for persons with special requirements, mobility support devices, both at home or in the wider environment, robotics control systems; multimedia applications for **supporting daily living and social integration** at home, work, education, transport, leisure, etc., social support and intervention networks, new methods of service delivery; **long-term research** to create the knowledge and understanding to underpin the development of future services.*

• **Administrations** Work would focus on multimedia systems and services addressing the specific needs of Community and national administrations, in particular to support the widening and deepening of the EU, and offering interactive services to citizens and/or making them available at natural meeting-points for people, especially in remote and rural areas. Attention will be paid to improving effectiveness and internal efficiency.

***RTD priorities technologies and systems for on-line democracy** and for improved, distance- and language-independent, **access to information and services**, in order to support one-stop service access and transaction handling for citizens and businesses; multilingual personalised services and intelligent multi-functional systems facilitating interaction between citizens and Community and national administrations, including the development of virtual fora (public hearings, opinion polling, etc.); systems and tools for enabling statistics to play their role in **enhancing the transparency and accessibility of administrations** and for promoting multimedia data*

modes and provide new mobility options in a sustainable way.

If a European approach to research, technological development, take-up and standardisation is maintained, the total potential general-interest services market (equipment, systems, services) in Europe will be substantially in excess of 1,000 BECUs.

*interchange between administrations; the innovative applications to support the **adaptation of Community and national administrations** to the information and processing systems needs of Community policies.*

- **Environment** Work would focus on new generation monitoring, forecasting and decision-support systems and services for administrations, industries and the public, together with advanced systems and services for the identification, assessment, monitoring and prevention of risks, and for the management and mitigation of emergencies, both natural and man-made (including anti-personnel landmines).

***RTD priorities monitoring, forecasting and decision support:** intelligent information systems on air/water/soil quality and for monitoring and management of natural resources; advanced systems for water/air/sea/soil/waste pollution monitoring, prevention and warning; high-performance systems and advanced tools for environmental data fusion, data mining and modelling, including geo-referenced data; integrated information tools and support systems for sustainable development and to improve ecological and resource efficiency; **risks and emergencies:** advanced management systems exploiting satellite imagery, remote sensing, sensor systems, real-time systems, and communication networks.*

- **Transport** Work would focus on intelligent infrastructure and vehicle systems for the management of all modes of transport, including for intermodal operations and “mobility chains” for freight and passengers, for safety and operational efficiency in all modes, supporting inter alia actions in Programme 3, as well as for information, mobility and tourism related systems and services.

***RTD priorities surveillance, positioning and guidance systems** and the necessary enhancement of space and ground-based communication and positioning infrastructures, fixed, on-board and portable interactive multimedia devices, and tele-payment systems - in particular for traffic and demand management, collective transport, fleet and freight operations supporting the whole logistics chain, telepayments and user information; **new traffic control systems** with advanced interfaces, environment, simulation and prediction tools; **on-board human-centred systems** for safety and efficiency, including vision enhancement, obstacle detection and advanced warning, crash-avoidance, driver impairment watch; **telematic systems** for intelligent vehicle and autonomous aircraft operations; **personalised travel information systems** including tele-reservation and payment; multimedia systems and services on weather, **tourism**, and leisure; on-board “info-mobility” services, including infotainment; virtual mobility services.*

## *New Methods of Work and Electronic Commerce*

### **Rationale**

More than 70% of office workers use a PC. Over 2 million people in Europe already “telework” for part of the week. According to one industry estimate, goods and services worth approximately 4 billion ECU were traded electronically in 1996 and this figure is expected to rise to 200 billion ECU by the year 2000. Information society technologies are radically transforming the way people work, the way organisations operate and the way that consumers undertake purchases.

Despite these dramatic changes, we are only at the beginning, continued technological development and take-up is needed to enable new ways of working and conducting business that enable Europe to be competitive in the global marketplace, and which improve the quality of working life and provide increased confidence for consumers.

With the Internet growing at over 60% per year, new business opportunities are continuously emerging for electronic commerce, with lower costs, wider markets and more choice for consumers. Particularly for SMEs and individual

### **Objectives and RTD priorities**

The aim of this key action would be to enable European workers and enterprises, in particular SMEs, to increase their competitiveness in the global marketplace, whilst at the same time improving the quality of the individual’s working life, through the use of information society technologies to provide the flexibility to be free both from many existing constraints on working methods and organisation, including those imposed by distance and time. It would cover both the development and the trading of goods and services, in particular in the electronic marketplace, and take into account the different requirements of the individual worker, consumer and of businesses and organisations. Considerations of the global context and socio-economic factors would guide the work in this action, and the objective would be to develop and demonstrate world-best work and business practices, exploiting European strengths such as electronic payments, smart cards, mobile systems, software for business process modelling and enterprise management and consumer protection.

• **Flexible, mobile and remote working methods and tools** Work would focus on enabling, validating and demonstrating competitive, flexible and human-centred work methods and business organisation, by means of an integrated approach to the combination of business process and work organisation, human resource management, and information society technologies, informed by socio-economic and legal requirements analysis and considerations of the global context and actual business practice. It would address the needs of workers, enterprises and consumers alike. Best-practice pilots and scaleable demonstrations, together with dissemination actions to stimulate broad experimentation and adoption would be major features of the work.

*RTD priorities work methods: telework and networked cooperative working; simulation- and virtual-reality-based methods, for both individual and collaborative working; entrepreneurship and portfolio working; organisation: integrating new or re-engineered work methods, structures and electronic commerce in all sectors, including administrations, taking into account existing practices; agile, extended, virtual enterprises and networks of individuals; integration of the value chain, including workflow management; socio-economic issues: (including the necessary statistical methods and tools); analysis of change; organisational methodologies, including benchmarking, scenario planning, transformation methods and change and risk management; human resources and training; human factors, usability and ergonomics for workers and consumers; the legal and regulatory framework, including consumer protection.*

• **Management systems for suppliers and consumers** Work would focus on seamless end-to-end support, covering both tangible and intangible products, for electronic trading and distributed virtual enterprises and marketplaces. It would cover

entrepreneurs, for whom electronic commerce provides the possibility for affordable channels to the global marketplace. It is vital for all Europe's businesses that the new marketplaces are open, accommodate European business practices, internationally interoperable and reliable. However, the enabling technologies continue to evolve very rapidly. European research and technology development is essential to the coherence of and confidence in these new marketplaces in Europe.

Consumers and businesses must both have confidence in the integrity of information and services; confidence to publish material without suffering from IPR piracy; confidence that their right to privacy be respected and personal data will not be abused, and confidence in the security of electronic payment systems. New models of "best practice" need to be established. Research and technology development is essential to the preservation of consumer protection and for trust and in new methods of work and electronic commerce.

applications or systems for interactions within and between consumers, individual entrepreneurs, businesses and administrations. It would address both business and work processes covering the full value chain and the information society technologies needed to support them.

*RTD priorities information society technologies systems to address **processes in development**, including: life-cycle support, design, engineering and maintenance, logistics and distribution management, quality control, productivity measurement; systems to address **processes in marketing and sales**, including: customer interaction, negotiation and contracting, mass customisation, packaging and trading; systems to address **processes in financial services**, integrating where appropriate support for the EURO, including: ordering, billing and payment, accounting and taxation; public and private procurement; systems to address **processes in management**, including: decision support and planning; virtual and real marketplace management systems; personnel management; systems for on-line business information search and management, including directories and catalogues and multimedia digital assistants.*

• **Information security** Work would focus on technologies to boost trust and confidence in the information infrastructure, and in its services and information resources, as being reliable, efficient and user-friendly for new methods of work and doing business. This includes protecting information integrity, managing intellectual property rights and enhancing privacy.

*RTD priorities digital signature and certification techniques; electronic authentication techniques; representation of product data; prevention of fraud and misrepresentation of goods; electronic IPR management technologies; privacy enhancing technologies, including those avoiding the improper collection, recording and disclosure of personal and business data; secure electronic transactions and payments, including anonymous ones; integrating next-generation smart-cards; critical systems management and reliable next generation electronic commerce infrastructures; support the development of and conformance to the legal and regulatory framework; technologies to generate confidence in meaningfully managing vast amounts of data by businesses and consumers, including user customisation; **take-up: concertation for ensuring interoperability and contributing to internationally recognised standards.***



## Multimedia Content and Tools

### Rationale

Content is a key asset in the global information society. Technological advances have provided ever-improving information processing and communications infrastructures. Increased research is now needed to address digital content, so that it can be produced effectively, given attractive functionalities, exchanged or traded securely, retrieved confidently and used or re-used in a variety of digital ways. European research and development is needed to ensure that future technologies and tools enable content, together with its creation and use, properly reflect the EU's cultural diversity and many languages, in order that the full potential of the EU's creativity can be realised in both social and industrial contexts.

The current turnover of Europe's content industries is estimated by the OECD at around 178 billion ECU. Digital information products (both on-line and off-line) are growing at an exponential pace, for example the number of registered World-Wide Web sites increased from 50 in 1992 to seventy thousand at the end of 1995 and 650,000 in Autumn 1997. As we make the transition to the information society, work is needed to promote European excellence in advanced multimedia content systems, services and technologies. In particular it is critical to improve the functionality and usability of digital content for international business and social applications, promote new education and training systems, and enable cultural and language diversity.

### Objectives and RTD priorities

Work would cover new models, methods, technologies and systems for creating, processing, managing, networking, accessing and exploiting digital content, including audiovisual content. An important research dimension would be new socio-economic and technological models for representing information, knowledge and know-how. The work would address both applications-oriented research, focusing on publishing, audiovisual, culture and education and training and generic research in language and content technologies for all applications areas, and would include validation, take-up, concertation and standards.

• **Interactive electronic publishing and digital heritage and cultural content** For interactive electronic publishing, work would focus on new publishing and media paradigms for both commercial and private use (including the evolution of the World-Wide-Web). It would address future publishing systems able to handle new combinations of content and to provide users with new levels of interaction and control, and cover new forms of content such as virtual objects, in multi-user environments, or immersive, animated content. Three fast-evolving application areas would be addressed: knowledge publishing, in particular for scientific and business content; lifestyle publishing, in particular for news, entertainment and information for the citizen; and geographic and statistical information, including related socio-economic information, particularly where complex information needs new presentation forms for the non-specialist user. The work on digital heritage and cultural content would aim to expand the key contribution of libraries, museums and archives to the emerging "culture economy", including economic, scientific and technological development. Actions would particularly address new digital processes and cover business and economic models, especially those which stimulate new partnerships through networking and new services for the citizen.

*RTD priorities for interactive electronic publishing: generating creative content through advanced tele-collaborative real-time authoring and design systems and skills development (for example for 3-D or virtual reality design and conceptual modelling); systems for the generation and re-use of content from different media; collaborative creative expression and publishing; managing digital content by supporting distributed and networked content; processing large sets of data in innovative ways (e.g. visualisation, scenario development or spatial analysis); devising new metrics for valuing information assets; personalising content delivery (via push or pull technologies), by cost-effective content packaging, advertising and transactions, customer profiling and individualised design and presentation (in a manner that respects the user's right to privacy); exploring the limits between domain-specific and domain-independent content; for digital heritage and cultural content: integrated access to heterogeneous distributed collections and repositories in digital and traditional form (e.g. library holdings, museum exhibition material, public archive contents, multimedia art or sound archives, digital film collections); improving the functionalities of large-scale repositories of content by providing rich and powerful interactive features and advanced management and copyright techniques; preservation of and access to valuable multimedia content from multiple sources, covering electronic materials and electronic surrogates of fragile physical objects.*

• **Education and training** This work would aim at providing the EU with a blueprint for a seamless and cost-effective implementation of advanced technologies for enhancing education and training systems. This work would focus on the common needs of different teaching and learning processes, on new approaches to lifelong learning, and on innovative ways of integrating multimedia pedagogic material.

*RTD priorities improving the learning process through more autonomous and more individualised learning - work would include local learner support, peer learning, remote tutoring, curriculum/course design systems, and accreditation systems; developing higher quality learning material by improving: the quality of the content itself, the embedded pedagogical or didactic approaches, and the adaptability*

*to learner needs - work would address new instructional design tools, learner modelling techniques, modelling methods for knowledge transfer, as well as learning ergonomics, and would cover content ranging from simple hypermedia to advanced simulations; **broadening access to learning resources and services** for all - work would address common platforms allowing full access to services across heterogeneous networks, including harmonised identification and retrieval of knowledge resources.*

• **Human Language technologies** This work would focus on advanced human language technologies enabling cost-effective interchanges across language and culture, natural interfaces to digital services and more intuitive assimilation and use of multimedia content. Work would address written and spoken language technologies and their use in key sectors such as corporate and commercial publishing, education and training, cultural heritage, global business and electronic commerce, public services and utilities, and special-needs groups. Work would also develop electronic language resources (e.g. dictionaries or terminologies) in standard and re-usable formats.

*RTD priorities adding **multilinguality** to systems at all stages of the information cycle, including content generation and maintenance in multiple languages, localisation of software and content, automated translation and interpretation, and computer-assisted language training; enhancing the **natural interactivity** and usability of systems where multimodal dialogues, understanding of messages and communicative acts, unconstrained language input-output and keyboard-less operation can greatly improve applications; enabling **active assimilation and use of digital content**, where work would apply language-processing models, tools and techniques for deep information analysis and metadata generation, knowledge extraction, classification and summarisation of the meaning embodied in the content, including intelligent language-based assistants.*

• **Information access, filtering, analysis and handling** This work would focus on advanced technologies for the management of information content to empower the user to select, receive and manipulate (in a manner that respects the user's right to privacy) only that information required when faced with an ever increasing range of heterogeneous sources. Improvements in the key functionalities of large-scale multimedia asset management systems (including the evolution of the World-Wide Web) would support the cost effective delivery of information services and their usage.

*RTD priorities **mastering information**: rich descriptive models of digital information content, covering all media types and supporting all human senses, in addition to spatial and temporal aspects; associated tools to enable users to develop information profiles, possibly based on vague concepts and enabled via personalised agents; radically new cognitive relations between the system and users via individualised metaphors or visualisation techniques; **information management systems**: new organisation and management methods for multimedia information sources - work would explore advanced techniques for data warehousing integrating access control mechanisms, quality assurance, integrity control and technical protection of multimedia "fragments", and payment systems; **information categorisation, labelling and filtering** enabling selective information retrieval and filtering (including for the control of illegal and harmful content).*

## Essential Technologies and Infrastructures

### Rationale

A television now contains more than one million lines of software. In 1996 more than 34 billion microprocessors were sold for embedding into products. Today around 50 million European citizens have mobile phones. These examples illustrate the scale of the pervasiveness of information society technologies.

With such a ubiquitous role in products and processes competitiveness is critically dependent on the information society's essential technologies and infrastructures. At the same time, the usability, dependability and, above all, the affordability is far from that required for their broad take-up. Continued research is needed, to enable Europe to master their supply and use.

The convergence of communications, computer networking and broadcasting poses a major policy and technological challenge to Europe over the next decade. Interoperability and interworking of diverse infrastructures and services must be assured at European level, and industrial-led consensus on a European or global charter for service and network management will need a strong foundation of collaborative technology development.

The rapid and coherent deployment of next generation infrastructures and services needs joint efforts to create the necessary critical mass.

### Objectives and RTD priorities

The work would address the convergence of information processing, communications and networking technologies and infrastructures. The priorities would be to enhance their applicability and accelerate their take-up. The focus would be on technologies and infrastructures common to several applications, while those specific to one application only would be addressed in the context of that application in other parts of the Framework Programme.

• **Information processing, communication and network technologies** Application requirements often call for heterogeneous multi-processor architectures and increasingly exploit broadband networks, including wireless communications. The work would focus on the development and convergence of information processing, telecommunications and broadcast network and system technologies.

*RTD priorities concurrent systems technologies and tools for the sharing and interactive use of remote resources and concurrent activities in geographically dispersed locations, in the context of heterogeneous hardware and software architectures and systems; real-time systems handling large volumes of data; basic technologies and tools supporting real-time embedded systems applications - related work should actively contribute to, or adhere to, standards; interoperability and interworking particularly at the network management and service levels, to increase capacity, flexibility and functionality and to promote the introduction of competition and new services (including the evolution of the Internet); generic service management models capable of handling the increased network complexity, new architectures and the requirements for network dependability and security are required; technologies for network integration (fixed and mobile, including satellite links) and new service independent architectures and systems, to ensure all users have affordable access to broadband multimedia nomadic services; reliable high capacity terabit optical transmission; a major effort in photonic technologies for end-to-end optical transparency in core and access networks, including communication management in the optical domain; take-up: measures to promote and transfer best practice, for concertation to contribute to standards, and to validate technologies and services in field trials.*

• **Engineering and technologies for software, systems and services** The work would centre around the development, deployment, operation and evolution of software-intensive systems in goods and services as well as in production and enterprise processes.

*RTD priorities software and systems engineering work would focus on dependable, survivable and scaleable systems and address the reduction of the development cycle and costs; the use and further development, as required, of reliable methods and tools will be a central issue; the integration of custom and off-the-shelf components into systems would be a key aspect; service engineering would address the integration of heterogeneous platforms and networks and the increasing complexity and sophistication of the new services and their creation and provision - the objective would be to develop technologies and tools for rapid, customised and cost-effective service creation, deployment, provision and management that provide for an open information and communications service infrastructure, with the necessary reliability, security and quality of service; software technologies work would foster knowledge-based methods and tools, which increase the usability as well as the capability of systems and the intelligence in the network, this includes the timely collection, production, dissemination and communication of high-quality information (including statistical and management information); take-up: best practice and other take-up measures will be a priority; work will be complemented by the validation and assessment of technologies*

and services in field trials, and by concertation measures to contribute to standards.

• **Mobile and personal communications and systems** The target of the work would be the move to an integrated seamless network that ensures global personal connectivity and enables access to wireless multimedia communications and services by anyone, from anywhere, at any time, with capabilities, quality and performance comparable to those of fixed network services.

*RTD priorities* work would focus on the development and evolution of new generations of affordable terrestrial and satellite **broadband wireless** architectures, systems and technologies, for both private and public environments, supporting advanced services and maximising spectral efficiency and network performance; full coverage will be addressed through a multiplicity of radio systems deployed in a multi-layer, multi-dimension cell architecture; **service mobility and terminal roaming** across wireless and wired networks would be a priority; software reconfigurable networks, systems and terminals, to facilitate improved network planning, interoperability and interworking; miniaturised, low-cost, low-power mobile and portable communication terminals (both hardware and software aspects); **technologies, services and applications** supporting interactive mobile and personal multimedia services, with regional or global coverage and integrated where appropriate with navigation services; **take-up**: a key aspect will be validations and demonstrations of broadband interactive mobile multimedia technologies and services; a major effort will be dedicated to technology assessment and concertation measures to contribute to standards.

• **Multisensory interfaces and visualisation and simulation technologies** Work would address the provision of intuitive ways to capture, deliver and interact with systems. Work would include the development and integration of advanced sensor, actuator and display technologies, as well as simulation and visualisation environments.

*RTD priorities* multimodal multisensory **interfaces** and novel tools and devices - validation and assessment would be central to this work; technologies including image and auditory scene processing, understanding and synthesis will be developed and integrated for new solutions for the work and leisure/entertainment environments; the work would progressively facilitate the introduction of technologies such as augmented vision and virtual reality; the development and integration of a range of advanced display technologies for professional and consumer applications would be addressed; emphasis would be given to the development of low-cost and low-power interfaces well as the use of new flexible materials for portable and mobile subsystems; included are issues such as user adaptability, user interaction modelling and profiling; **simulation**: work on simulation environments would include pre-processing, advanced post-processing (including visualisation and virtual reality) and tools for the validation of simulation with experimental and archival data; tools to support the integration of simulation in industrial and business processes would be a priority; work would also address tools to support the interoperability of heterogeneous software and hardware systems; the work will be complemented by validations and assessments, together with first-user actions and other best-practice initiatives and concertation networks.

• **Peripherals, sub-systems and microsystems** Work would address the need for advanced intelligent (computing and communications) network peripherals which can have multiple functionality yet remain user-friendly. Work on sub-systems would cover the building blocks of information processing and communications systems and networks. Work on intelligent microsystems would, in this context, cover miniaturised systems comprising sensing and/or actuating with processing functions, and normally combining two or more of electrical, mechanical, optical, chemical, organic, biological, magnetic or other properties, integrated onto a single chip or a multichip hybrid.

*RTD priorities* integration, low-power consumption and miniaturisation would be the drivers for technology development for **peripherals**

*and terminals, as well as software and hardware modules for content capture, storage and manipulation; the development of advanced mass storage methodologies is a key requisite; **sub-systems**: in addition to basic building blocks a major focus will be home systems; **microsystems** work will be concentrated on facilitating the broader application of intelligent microsystems, primarily for the medical, biochemical, environmental, automotive and aerospace applications, as well as their use in measurement and control systems or sub-systems; the primary aim is to transfer competence from research to industrial use and to facilitate access to existing technologies for prototyping and small volume production; the integration of optical interconnects into microelectronic subsystems and microsystems for high-performance applications (e.g. electro-optical circuit boards); the work will be supported through measures complementing those in Programme 3 addressing the manufacturability of intelligent microsystems and the associated assembly, interconnect, packaging, materials and equipment technologies, together with support for the appropriate design and simulation activities; **take-up**: the work will be complemented by concertation for coordination and to contribute to standards, and in particular for microsystems by first-user actions.*

• **Microelectronics** Work would address materials, equipment, processes, design and test methodologies and tools which enable the development of electronic components, their packaging, interconnection and application. The approach would be system-oriented and application-driven, and would aim at reinforcing strengths and exploiting technological opportunities drawing on appropriate microelectronic technology solutions best filling generic application requirements.

*RTD priorities application and **hardware/software co-design** methods and tools; the key **technology requirements** would be addressed through support for semiconductor materials and equipment development and assessment, packaging and interconnect technology, notably for the most advanced generations; the focus would be on broadening applicability through the development of cost-effective active and passive silicon, silicon-based, or compound **semiconductor components** and subsystems for applications with generic characteristics, in particular mobility (low power, high frequency wireless communications), high complexity/high performance systems, systems resistant to hostile environments in terms of reliability and endurance, measurement and control; the development, integration or customisation of advanced signal and data processing functions into sub-systems together with their associated memory and input/output functions, will be a priority, together with **macrocells and support tools** for classes of applications; **optical technologies**: new optical sources, optoelectronic integrated circuits, active and passive optical components and devices at new wavelengths, including optoelectronic devices based on organic compounds; **take-up**: promotion of application and design competencies will be addressed in thematic clusters; a major effort will be devoted to technology assessment, first-user and other best practice measures.*

## **(ii) ACTIVITIES FOR GENERIC RESEARCH AND DEVELOPMENT OF TECHNOLOGIES**

### **• “FUTURE AND EMERGING TECHNOLOGIES”**

It has been shown that major technology-based industrial and societal advances can arise from unexpected scientific and technological ideas, ideas that were originally treated as *curiosities*. Few foresaw the importance of the World-Wide Web when it was first developed or, going further back, the industrial impact of lasers when they were “just interesting scientific phenomena”.

This specific activity on future and emerging technologies would cover research that is of a longer-term nature or involves particularly high risks - compensated by the promise of major advances and the potential for industrial and societal impact. Such research would typically be either transdisciplinary or in an emerging discipline. It would reinforce the link and flow of ideas, initiatives and people between academia and industry in the EU. This activity complements the domain-specific work integrated in each of the key actions.

To ensure a seamless coverage of the information society technologies the door needs to be kept open to any new idea with a potential industrial or societal impact, in a bottom-up fashion. This openness would need to be reinforced in specific areas with highly focused well-coordinated pro-active initiatives of a strategic nature. Flexibility is essential just as is an appropriate balance between proactive initiatives which need careful, but rapid, planning on the one hand and, on the other hand, openness to new highly promising ideas as they arise.

#### **The Open Domain**

By definition the topics addressed cannot be prescribed. Project proposals could include, in a non-prescriptive way, knowledge technologies (covering technologies for the representation, creation and handling of knowledge), technologies for computation- or bandwidth-intensive applications, future devices and circuits (including those based on quantum, photonic or bio-electronic effects and technologies for very large scale integration), and ultra-complex systems (such as ultra-high performance computers and super-intelligent networks).

#### **Proactive Initiatives**

Complementing the open domain, a number of proactive initiatives having a strategic perspective and addressing areas of substantial future growth, where close coordination across different projects is necessary, would be defined in the course of the execution of the programme. The definition of topics would be based on their potential for long-term industrial and societal impact (including employment through “start-ups”), on the opportunity offered by scientific advances or a combination of both. The planning of the proactive initiatives would need to make allowance for the necessity to be able to react rapidly if windows of opportunity present themselves unexpectedly through scientific advances.

Initiatives would each consist of a set of autonomous but closely coordinated and appropriately networked projects. The networked nature of the initiative could be reinforced with some central research facilities when these provide economies of scale to the participants of multiple projects. For example, experimental shared nano-fabrication facilities, model spaces or communities for experiments in the areas of interfaces or virtual reality, and so forth.

The actual choices would be made at appropriate times through consultations with the research community, following the setting of an agenda that draws on a very broad body of scientific and technological opinion. In this context, advance knowledge would be sought through a combination of a series of strategic workshops aimed towards setting trends and research targets, and a technology-watch activity, to be carried out in close cooperation with the JRC’s ‘Institute for Prospective Studies’ and the ‘Scientific and Technological Options Assessment’ Unit of the European Parliament where appropriate.

### **(iii) SUPPORT FOR RESEARCH INFRASTRUCTURE**

- **“RESEARCH NETWORKING”**

#### **Broadband Interconnection of National Research and Education Networks**

The objective would be to facilitate the supply of trans-European broadband interconnections between national research, education and training networks (which are currently fragmented into local islands of connectivity) at capacities and of a quality matching the aggregated need of Europe’s academic and industrial researchers and to keep the resulting network at the forefront of the state of the art. This would imply an upgrading of the existing capacity of 34 Mbits/s via 622 Mbits/s to gigabits/s, including support for different levels of ‘Quality of Service’ and the necessary connectivity to third countries. This would allow effective European collaborative research and education activities (including the creation of “virtual laboratories” and “virtual institutes”), enabled by the deployment of state of the art Internet-based applications within the academic and industrial research communities. This work would support research in all fields and therefore the whole Framework Programme.

#### **Advanced European Experimental Testbeds**

The objective would be the integration of leading-edge collaborative research and development, demonstration and take-up activities, from all key actions in this programme, addressing future generations of communication technologies, protocols, services and distributed applications. This experimental interconnection of the testbeds of individual operators, industries, universities and research facilities in Europe (together with necessary connections to third countries) would provide a practical basis for collaborative research efforts (e.g. in photonic networks, service configuration protocols or mobile broadband services). It would also lead to the early availability of the most advanced infrastructure, which would in turn allow for early experiments with advanced applications (e.g. remote high-volume data visualisation, meta-computing or networked immersive virtual reality) requiring very high bandwidth or new services. It would also enable Europe to play a leading role in defining, standardising and validating the next generations of network protocols (including those for the Internet) and other emerging broadband services. It would contribute to the long-term interoperability and seamlessness of advanced network infrastructures, services and applications.

# *Promoting competitive and sustainable growth*

(Part I : EC Treaty)

## **INTRODUCTION**

Competitiveness and sustainability are the keys to the long term future of the Union's economy: creation of wealth and employment opportunities, enhancement of the quality of life of Europe's citizens, and preservation of the environment and the natural resource base. Competitiveness depends on the capacity of enterprises, regions and nations to produce and use the science and technology of tomorrow, in high quality, innovative goods and services, and in new and more efficient organisations. Research is clearly crucial in generating a more competitive technological base for European industry and in fostering the transition to a sustainable world, which will involve both a transformation of working practices and an optimised use of resources.

Competitiveness and sustainability can no longer be considered a matter for individual organisations or sectors alone. In the context of an increasingly interlinked and globalising economy a "systems approach" is necessary, in which research activities support the development of coherent, interconnected and eco-efficient industrial and social systems, responding not only to market but also to societal needs. At the heart of these systems will be *efficient and quality-based production systems*, embedded in agile organisations and producing high-quality eco-friendly products and services. These wealth creating activities should be, in turn, supported by key services and products, including *efficient transport systems, clean and safe vehicles and energy supplies*. Material and immaterial *infrastructures*, i.e. the *built environment and the research and training communities*, complement the critical factors for long term competitiveness. Such a holistic approach will be most effective in improving the long-term efficiency and sustainability of Europe's economic system in the face of worldwide evolving market constraints and socio-environmental responsibility.

### **Strategic objective of the Programme**

The goal would be to link economic growth, citizen needs and the environment through a systemic, multidisciplinary and integrated RTD approach. The Programme would support activities contributing to competitiveness and sustainability, particularly where these two objectives interact, by addressing key technological bottlenecks. Support to the development of new concepts such as eco-industry, intermodality, new generation aircraft and sustainable management and use of marine resources, integration of renewable energy sources, and to new approaches to urban living would help to prepare industrial sectors for the challenges of the new millennium, and to generate a strategic approach to research throughout European industry. In this context, industry's role will not only be in identifying areas for collaboration but also in bringing together and integrating projects, especially cross-sectoral projects along the value chain so that technology uptake and innovation are more efficiently ensured across Europe.

The need to master complex interdisciplinary problems within complex systems demands **innovative approach**, comprising three elements: (i) a set of six key actions, each of which is targeted on tangible and measurable socio-economic objectives, and brings together complementary resources from a variety of disciplines. They have been selected and designed to address the major problems and challenges related to the achievement of long term balanced growth, reconciling competitiveness and sustainability; (ii) research on generic technologies to develop the scientific and technological base to support innovation across a range of application areas related to competitive and sustainable growth. By definition generic research would mainly be of a medium and long term nature and would be characterised by multiple possible applications. However, the research would focus on identifiable areas of need which arise from the objectives of this thematic



programme and the Framework Programme as a whole; (iii) support for the more efficient development and utilisation of research infrastructures at European level, in order to provide an attractive, networked environment for leading edge research activities, related in particular to the development of international standards and codes of good practice.

**Socio-economic needs.** By strengthening the innovative capacity of the existing European industrial system and by fostering the creation of businesses and services built on emerging technologies and opportunities the programme would help face the major challenge of employment. In parallel, research into new and environmentally-friendly processes, products and services, would contribute to improving quality of life. Both objectives are jointly pursued by the activities of the programme. The key action *‘city of tomorrow’* exemplifies how combined efforts in various research areas (e.g. building, energy, transport, environment) would converge to achieve such socio-economic goals.

**European added value.** The critical mass to attain concrete and visible results in cost-intensive technologies, such as those involved in the key actions *‘new perspectives for aeronautics’*, *‘marine technologies’*, *‘advanced energy systems and services’*, would necessitate mobilising national and Community resources (public and private). Activities to develop norms and standards in support of Community policies have a clear European dimension, as do the cross-border problems, relating to transport issues, addressed in the key action *‘sustainable mobility and intermodality’*.

**European competitiveness.** Europe has a strong science base but suffers from a recognised “gap” compared with its major competitors inasmuch as Europe is less able to translate this scientific knowledge into innovation. Research into new types of industrial applications (e.g. eco-industries), new production systems, new organisational concepts should be fostered to boost competitiveness. This objective in particular is central to the key action *‘products, processes and organisation’*.

#### LINKS WITH OTHER PROGRAMMES

Coordination with the thematic programme on “creating a user-friendly information society” is based on the following principle : activities concerned with the development of information society technologies as such (which include application, demonstration and take up actions) will be concentrated in the “information society” programme; activities concerned with the integration and adaptation of information society technologies in applications relating to competitive and sustainable growth would be conducted in this programme.

This principle would apply in particular to work in the areas of (i) *Products, processes and organisation*, (ii) *Sustainable mobility and intermodality*, (iii) *New perspectives in aeronautics*, (iv) *Marine technologies*, and (v) *City of tomorrow*. These activities would be closely coordinated with related work in programme 2, in particular on *New methods of work and electronic commerce*, *Systems and services for the citizen (transport)*, *Multimedia content and tools (digital heritage and cultural content)* and *Essential technologies and infrastructures*.

- Many of the problems addressed by this programme would only be tackled effectively in a broader **international context** : this is clearly the case for energy, transport and standardisation related issues, where world-wide competition is strong, and where major geo-economic challenges and significant export opportunities are at stake; it is also the case for “intelligent manufacturing systems” and other production oriented activities, where collaboration with international initiatives would bring added value to European research work.
- In view of the increasing need to bridge the gap between research results and their potential applications, and of the large number of companies which could be interested by the potential results, particular attention would be given to activities related to **innovation and participation of SMEs**.
- The improvement of European know-how, competences and skills in the fields covered by the programme would considerably enhance its capability to produce tangible and lasting impacts; for this reason **training** measures would represent an integral part of the programme.

Appropriate links would be ensured for these activities with the relevant horizontal programmes. Activities should be integrated and coordinated as necessary, within and between the different key actions and Programmes, as well as with the JRC. This should provide mechanisms by which industry, public authorities and the research community can work jointly, in response to common problems, particularly in fields such as business organisation, microsystems, traffic management, rational use of energy and “digital cities”.

**(i) KEY ACTIONS**

## Products, processes and organisation

### Rationale

Production must be a central target of strategies to enhance the competitiveness and sustainability of the European economy. The increasing economic role of services and mounting competition from low cost competitors abroad mean that, far from abandoning its production industries, Europe must both modernise and adapt them to the new circumstances, whilst reinforcing its distinctive strengths through high quality technology and skills.

The opportunities opened by technology for increasing functionality, flexibility and “intelligence” in products and processes gives huge scope for strategies which boost competitiveness and job creation at the same time as dramatically reducing lifecycle environmental impacts. With the right approach, higher productivity, improved time-to-market and greater “service value” to consumers can be achieved with lower resource inputs and high levels of recovery and reuse of valuable materials. Making progress towards this objective, and at the same time enhancing the development of “eco-industries”, however requires comprehensive and systematic treatment of the different dimensions of production. The critical factors include design and production for complex, high quality products, intelligent production, lifecycle resource optimisation and the organisation of production, not just within individual plants or industries but throughout the extended value chains which represent Europe’s system of production, including, in particular, SMEs.

### Objectives and RTD priorities

The overall goal of this key action would be to develop new methods of design, production and manufacture that improve the quality and cost of processes and products (aiming for a substantial improvement in the medium term); reduce overall lifecycle impacts (aiming at a 50% reduction); improve understanding of the “soft” aspects (organisation, management, logistics, etc.), needed to integrate them fully into relevant business processes; and ultimately contribute to employment growth (aiming at creating and maintaining in Europe a number of jobs comparable, in percentage terms, to those of our major competitors).

- **New technologies for efficient design and production.** The aim would be to improve competitiveness through quality and industrial added value and responsiveness to market, reduced material intensity in product/service combinations and reduced time-to-market, rather than through cost competition.

*RTD priorities:* integrated product design, multi-technology integrated products and related manufacturing processes; advanced production techniques for higher process accuracy and reliability; advanced manufacturing technologies for optimal use of materials and miniaturisation of products; methods to overcome the barriers between designers and consumers and achieve full integration of “product/service combinations” within the whole industrial system.

- **“Intelligent” production and manufacturing through integration of Information Society Technologies.** The aim would be to optimise the level of performance of all elements of the industrial environment through the application of Information Society Technologies in production systems, in coordination with relevant activities in programme 2.

*RTD priorities:* intelligent production systems; extended life and optimal use of production facilities; maintenance systems; flexible and interoperable “extended” supply/production/distribution systems.

- **Technologies to minimise resource consumption, to promote waste recovery and to develop clean processes and products** The goal would be to minimise “full life-cycle” impacts on the environment, taking account of all essential elements of the industrial system ranging from extraction through production to waste management, with emphasis on resource intensive processes.

*RTD priorities:* clean and eco-efficient processing technologies; research aimed at mastering basic phenomena such as synthesis, catalysis, separation and reaction mechanisms, on-line process control; impact monitoring and assessment of risks; in-situ and on-line recovery of waste; novel processes for treatment, re-utilisation and safe disposal of waste and for upgrading, re-use or dismantling products and production systems.

- **New methods of organising production, work and management of human resources** The goal would be to move towards high performance work places, agile customer driven networked industrial enterprises, including SMEs, and multi-skilled highly motivated workforces, through research that would be coordinated with relevant activities in programme 2.

*RTD priorities:* human, organisational and socio-economic determinants of a smooth transition of enterprises towards efficient and sustainable production and consumption; company level methods for measuring performance; integrative architectures for human oriented production; “learning” production systems to facilitate the management of change and the development of know-how and skills; new concepts for more sustainable product/service combinations at the level of industrial networks; impact and acceptance of new industrial production patterns, including those arising from the use of electronic commerce, compatible with sustainable consumption and production.

## *Sustainable mobility and intermodality*

### **Rationale**

Mobility is at the heart of modern society with major repercussions on spatial planning, urban development, organisation of economic and industrial activity, environment and use of energy. The European transport sector (7.5% of GDP) however faces a multitude of critical challenges. Traffic volumes are expected to double in the next 25 years, but already around 2% of Europe's GDP is annually lost because of traffic congestion, a figure which rises to 4% if all external costs - including those due to accidents and pollution - are taken into consideration. It is urgent to address these challenges and in doing so make a substantial input to the further development and implementation of the Common Transport Policy and other Community policies. The promotion of transport *sustainability* from an economic, social and environmental point of view goes hand in hand with enhanced *efficiency* and quality of transport systems and services, improved comfort, *safety* and

### **Objectives and RTD priorities**

The overall aim of this key action would be a better long-term balance between the growing demand for mobility and the need to respect environmental, social and economic constraints. It would contribute to decoupling the direct link between economic growth and traffic volumes; reducing the negative impact of transport modes; and encouraging their more sustainable use. Particular attention would be paid to intermodality and how best to integrate the respective strengths of the modes of transport in order to provide user-oriented door-to-door services for both passengers and freight.

- **Modal and intermodal transport management systems.** The aim would be to develop, validate and demonstrate and facilitate the deployment of advanced transport management and information systems for air, waterborne, rail, road and urban transport, both on a modal basis and for integrated intermodal transport, using inter alia the development of Programme 2.

*RTD priorities: development, validation and demonstration of modal and intermodal traffic and transport management systems, including operational, regulatory, administrative and organisational solutions for their deployment and the analysis of pricing regimes, integration of information and data exchange systems across modes including real time user information, electronic documentation and services with transport management; second generation satellite navigation<sup>3</sup> and positioning systems; satellite supported operations; integration of services such as traffic management, vehicle identification, location and guidance, pricing, freight planning, travel information and passenger services. within the transport system.*

- **Infrastructures and their interfaces with transport means and systems.** The goal would be to enhance interconnectivity and interoperability and to promote intermodality in the transport system, through integration of all its components across the modes at the levels of infrastructure, transfer points, transport means, equipment, operations, services and the regulatory framework.

*RTD priorities: more efficient use and reduced operating, development and maintenance costs of existing infrastructure; effective interchanges; interconnection between trans-European, regional and local networks; innovative infrastructure concepts and operations; relationship between transport, land use, environment and health; reduced congestion, energy consumption, pollution nuisances and infrastructure degradation; use of new generation vehicles, collective transport and innovative concepts for sustainable mobility in urban and rural areas; safety of transport, including for transport of dangerous goods; accessibility, security and comfort of transport, including for people with special needs; human factors such as human/machine interface, user and operator acceptance of new intelligent systems, optimal training methods and use of simulators.*

- **Socio-economic scenarios for the mobility of people and goods.** The aim would be to develop strategies and tools for managing the impact of social and economic developments, including deregulation and liberalisation of transport services and globalisation of economic and commercial activities, on mobility demand and transport policies.

*RTD priorities: scenarios on travel supply and demand and policy options for mobility demand, market organisation and accessibility; legal, institutional, organisational and financing aspects of transport systems and infrastructures; logistics; benchmarking tools; methods for enforcement of regulations; methodologies to measure costs and benefit, safety, performance and impacts of different transport systems, networks and their operations; assessment of new*

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<sup>3</sup> Space-related activities are subject to an overall coordination across the various programmes.

security, and greater attention to  
*human factors* in transport

*technologies and concepts, including their impact on employment, environment, work organisation, social conditions as well as on safety and security.*

## *New perspectives for aeronautics*

### **Rationale**

Growth in air transport is expected to continue at a substantial rate, opening considerable opportunities for industry across the Union. However, competition is fierce. The US dominates global markets and annually spends some \$15 billion directly on industrial R & D in aeronautics, much of which is directly funded by NASA for civil applications through its aeronautics programmes. There are also numerous examples of spillovers for US civil aeronautics producers from R & D defence programmes. If Europe is to continue its successes of the past - 30% of the world market in civil aeronautical products and ECU 13 billion in exports - the capabilities of its industry including the supply chain must be enhanced and the system of technology acquisition significantly improved, so as to complement and contribute to the restructuring taking place throughout the industry in favour of greater competitiveness. Furthermore, from the perspective of growth in aviation, it will be crucial to satisfy the public demand for economic, environment-friendly and safe air transport. Essential technology areas in both traditional aeronautical disciplines and new innovative concepts call for attention to technology integration for sub-sonic aircraft as well as the enabling technologies for a second generation supersonic aircraft. The scale of the required response is beyond the capacity of a single member state and can only be realised through a pan-European effort. Coordination of RTD would be essential, based on strategic planning in cooperation with the member states, research establishments and industry. The challenge is to build on the current strengths of Europe's industry and its research community and create a new integrated and competitive scientific and technological framework for the future, in conformity with international agreements.

### **Objectives and RTD priorities**

The overall goal of this key action would be to facilitate the development of aircraft and their subsystems and components for the next century in order to foster the competitiveness of the European industry while assuring the sustainable growth of air transportation. The medium-term targets of the RTD effort, including large scale validation activities, are to contribute towards substantially reducing development time and costs of new aircraft ; improving efficiency (fuel consumption and maintenance costs) and reducing environmental impacts (pollutant emissions and perceived external noise) and accident rates (by at least the same factor as the growth of traffic volume).

- **Technology integration and validation.** The aim would be to facilitate the introduction and combination of the newest technologies and to prove their economic and operational feasibility both for new products and for upgrading the existing ones over their long life time. It will represent a multi-disciplinary approach, including technology integrator platforms at the required scale, focusing on lower design, production and operational costs, aircraft performance, and environmental aspects.

***RTD priorities:** advanced design tools and concurrent engineering for reconfigurable, flexible, distributed and multi-site production systems; advanced developments in propulsion, structural and aerodynamic efficiency and systems performance; airframe and engine technologies and operational procedures to reduce significantly engine emissions and noise, and improve cabin environment.*

- **Acquisition of critical technologies.** The aim would be to contribute to the long term competitiveness of the European aeronautics industry from a strategic perspective by advancing enabling technologies and the development of new generation aircraft concepts, including aircraft more respectful of the environment.

***RTD priorities:** innovative approaches and evolutionary advances in aerodynamics, structures, propulsion, noise, equipment and systems and avionics; development of multi-disciplinary technologies, such as aeroelasticity, flight mechanics and airframe-propulsion integration; methods and processes for aeronautical design and manufacture.*

- **Operational capacity and safety.** The aim would be to help alleviate congestion in airports, increase air traffic management system capacity, and improve the safety performance of aviation to accommodate the threefold increase in air traffic which is expected over the next 15 years. The focus would be both on the development of technologies and their operational implementation in the air vehicle.

***RTD priorities:** on-board systems for improving the operational capabilities of aircraft and supporting their integration within the future ATM system; maintenance techniques and condition monitoring in support of improved aircraft reliability and dispatch availability; technologies and methodologies including human-factor aspects, for more effective accident prevention and improved aircraft design for passenger survivability.*

## Marine technologies

### Rationale

The European Union has a coastline of over 90,000 km and a seabed area larger than its terrestrial landmass; 90% of the Union's foreign trade is transported by sea and the marine based industries and services generate 3-5% of European GDP. A conservative estimate indicates that more than two million direct jobs relate to the marine industry in the Union, most of them in coastal and peripheral regions. The challenges facing the EU cannot be met by a single Member state, since the marine industries (shipbuilding, maritime transport and services, exploration and exploitation of marine resources) are international by nature. Shipbuilding and the other maritime industries have an urgent need for targeted RTD. The common EU challenges are concentrated in the complex exploration and production process; in the improvement of design for the optimisation of the overall ship efficiency and promotion of a safe and environment-friendly operating culture; and in delivering advanced vehicles, marine systems, transport and services as a response to the persistent growth in world trade and competitive pressure. In the framework of the Task Force, priorities were defined. Coordination efforts must be continued, in particular to refine these priorities. The response must be coherent and systematic to prepare for the emergence of advanced services and integrate the marine industries into the fabric of European industrial and production systems.

### Objectives and RTD priorities

The overall goal of this key action would be to help develop and integrate knowledge and technologies specific to sea-based applications, to enable the Community to fully exploit the sea's potential while minimising the environmental impact of such activities, reverse the present negative trends by improving the competitiveness of the marine industries and related sectors and provide the basis for a European maritime policy. Particular attention would be given to activities under the MARIS initiative. Indicative targets in the medium term would include: reduction of production costs and time to market by 25-30%; improvement of efficiency and reduction of operating costs by 20%; substantial enhancement of safety and environmental sustainability.

- **Technologies for the development of advanced ships which are safe, environment-friendly and efficient.** The aim is to systematically improve the design process, reduce production costs and enhance the operating efficiency and economy of ships, exploration and exploitation vessels and off-shore structures. The adoption of a "life cycle approach" for products, systems and components would reduce operational costs and environmental impact.

*RTD priorities: integration of technologies and concurrent engineering, in particular with advanced information technologies tools; standardisation/modularity of components and mock-up of product and processes for automated and flexible production; multidisciplinary cooperation on RTD for advanced structural materials, structures, and propulsion trains; support for safety and environment sustainability, based on comprehensive costs/benefit assessment of risks and mitigation measures.*

- **The use of the sea as an economic and environment-friendly means of transporting goods and passengers.**

The aim would be to improve the operability, reliability, economic performance and environmental compatibility of ports, marine and inland waterway infrastructures and equipment, in coordination with the Key Action on Sustainable Mobility and Intermobility, and with relevant activities in programme 2.

*RTD priorities: improved safety and environmental performance of ports and related marine operations, including data collection, analysis and forecasting tools; improved efficiency of ship operations in ports and related ship-to-shore interfaces, including safety, risk and waste management, improved methods and tools for training..*

- **Rational and sustainable management of the sea.** The aim would be to promote a coherent approach to the exploitation of the sea as source of energy and mineral resources, through the development of off-shore and subsea technologies, improved coastal zone management and sea space utilisation, and minimising the environmental impact of sea-based activities.

*RTD priorities: Innovative technologies to survey and exploit the sea floor and the deep sea, including remotely operated vehicles to improve accessibility to marine resources; tools to monitor and forecast the state of the sea and marine environment; marine biotechnologies including remediation techniques to fight pollution; environmental management, including coastal engineering, sampling strategies and techniques; new sensing and pilot systems for data management.*

## Advanced energy systems and services <sup>4</sup>

### Rationale

Economic expansion has led to a continual increase in energy consumption since the dawn of the industrial age. But long established assumptions about the provision and use of energy can no longer be sustained.

Cleaner, more secure and improved life-cycle energy systems and services are vital for an enhanced quality of life and industrial competitiveness. The European energy markets are becoming more integrated and liberalised thus giving greater emphasis to customer needs, price competition and technological change. Moreover, the global perspective is one of rapidly increasing energy demand especially in emerging economies which depend largely on fossil fuels. There are both serious challenges and enormous opportunities for European industry in this sphere, in the development and application of clean, economic and effective technologies for energy

### Objectives and RTD priorities

The overall goal of this key action would be to contribute to industrial competitiveness and sustainable growth by promoting clean, efficient, and competitive energy systems and services. For the short/medium term, the focus would be on technological bottlenecks in both large scale and decentralised energy systems and services; on improved efficiency (aiming at 10 % overall cost reduction), diversification and safe supply; on reduced emissions at local and global levels (-15 % of CO<sub>2</sub> emissions in 2010 from 1990 levels); and on increasing the share of new and renewable energies (renewables beyond 10 % of energy supply in 2010, coupled with 20% reduction of energy intensity by 2010). For the long term, the focus would be on advancing the technological base and exploring radical technological approaches.

- **New and renewable sources of energy and their integration into, in particular, decentralised energy systems.** The aim would be to improve efficiency and reduce costs and environmental impacts by developing and integrating new and renewable technologies to enhance production, storage and conversion efficiencies and optimise energy flows in all systems, in the short and long term.

*RTD priorities:* Renewable and associated conversion technologies for increased utilisation of renewable energy sources, such as fuel cells; reduced manufacturing costs, improved efficiency and reliability of photovoltaics and wind energy systems; clean conversion and cost effective use of biomass both for transport fuels and high efficiency applications in the context of an integrated energy chain of production, conversion and end-use; development of potentially competitive new and renewable energy sources, including geothermal and mini-hydroelectricity demonstration; integration of new and renewable energies into decentralised and established energy systems and networks.

- **Energy storage transmission and distribution; rational use of energy.** The aim would be to improve flexibility, reliability and safety while decreasing costs, losses and environmental impact for new and renewable energy technologies and for transport, stationary and micro-machine applications; and to secure substantial energy economies in buildings, transport and industry by promoting the early adoption of new demand-side technologies.

*RTD priorities:* advanced batteries, superconductivity, and promising energy vectors such as hydrogen; intelligent energy transmission and distribution systems, network management and control systems for centralised and decentralised production; optimal system efficiency for electricity, gas, and district heating and cooling energy grids.

**For rational use of energy:** Improved space heating and cooling, combined heat and power, and energy-efficient industrial process technologies, with a focus on demonstration; integration of renewable energies and advanced and competitive energy technologies for efficient production and high quality user services.

- **Competitive and clean production and use of fossil fuels.** The aim would be to help transform present large scale energy systems into cleaner, more secure, flexible, efficient and competitive operations.

*RTD priorities:* High efficiency, safe and clean coal technologies for retrofitting existing plant and for advanced coal fired stations, and for mining and transport; economic and clean oil and gas exploration and production in difficult areas, such as North Sea or the deep off-shore, and tools for the better characterisation, development and management of hydrocarbon reservoirs; improved natural gas transport, transport fuel quality and gas conversion; assessment of the potential for CO<sub>2</sub> capture and storage.

- **Economy/energy/environment interactions.** The aim would be to develop strategies for the production and use of energy from fossil or new and renewable

<sup>4</sup> The part relating to “Fusion” in this key action is addressed separately under part II (Euratom) of this programme.



production and use.

sources, for the introduction of new technologies and for policy development.

*RTD priorities: long and short term scenario analysis of supply and demand in the context of social, economic and market developments and environmental needs; modelling and policy impact analysis; assessment of energy, market and technology impacts on climate change, competitiveness and employment .*

# The City of Tomorrow

## Rationale

Cities and urban agglomerations are the centre of social, cultural and economic life for 80% of Europe's citizens. But many urban areas today are facing critical challenges to their economic, social and environmental sustainability. Congestion, air pollution and noise for example are in some cases reaching unacceptable levels. The challenge is to improve quality of life, make better use of resources, and make cities more dynamic and innovative, while respecting their cultural identity. They will thus be able to attract new and established businesses, create and consolidate employment, and more effectively serve citizens' needs and aspirations. A framework for better city management is needed which integrates land use planning, efficient use of resources and provision of essential services, as well as technologies for improving the built environment, for preserving cultural heritage and for alleviating problems of congestion, air pollution, noise, waste, safety, and security. Energy, water, waste, transport and information infrastructures may be instruments for achieving sustainable development. Moreover, construction related activities, which represent more than 10% of EU GDP, bear the potential for considerable gains in macro-economic terms.

## Objectives and RTD priorities

The overall goal of this key action would be to support economic development and competitiveness, improved urban management and integrated planning policy, and help safeguard and improve the working and living environment and cultural identity of citizens. It would focus on the provision of an integrated socio-economic knowledge-base, and products, services, tools and technologies for better city management.

- **Integrated Approaches to “Human Centred” Urbanisation and Optimal Use, Safety and Security of Supply of Essential Resources.** The aim would be to develop and demonstrate alternative approaches to urbanisation through integrated comparative assessments, in the light of indicators covering the range of economic, social, and environmental requirements, as well as demographic and structural changes, including the trend towards “digital cities”.

*RTD priorities: urban development scenarios and integrated planning tools; impact of technologies, noise and air pollution from all sources on social development, resource utilisation, health and the environment; demand management, safety and security of the supply of essential resources (e.g. energy, land and water); integrated approaches to better use and conservation of resources and reduced pollution and waste.*

- **Sustainable Construction, Renovation and Recovery; Preservation and Enhancement of Europe's Cultural Heritage.** The aim would be to renew, enhance and protect the built environment in a manner which responds to citizens and cultural needs, in a framework of long term sustainability and improved quality of life, using improved design, energy efficient and safe construction techniques.

*RTD priorities: techniques for economic, safe and environment-friendly design, maintenance, repair, upgrading, conversion and recovery of buildings and infrastructure; technologies for diagnosis, protection, conservation, restoration and sustainable exploitation of historic buildings, museums, libraries and artefacts (in coordination with relevant activities in programme 2); integration of cultural heritage into the urban setting and facilitation of accessibility and preservation; protection of the built environment, essential services and cultural heritage against hazards; integration of “smart” technologies for more efficient management of resources, indoor environmental management, maintenance, safety and security.*

- **Vehicle Technologies Compatible with Achieving Sustainable Mobility in the City.** The aim would be to promote affordable and sustainable transport through the development, demonstration and comparative assessment of infrastructure and technologies for affordable, clean, energy efficient, safe and intelligent vehicles (e.g. zero emission vehicles).

*RTD priorities: propulsion technologies, embracing existing and alternative fuels and their infrastructure (in coordination with the key action on Advanced Energy Systems and Services); noise and vibration suppression; new concepts for energy-efficient, lower-emission vehicles including micro-cars, and for individual, collective and goods transport vehicles in cities; cost-effective implementation strategies for new and existing vehicle concepts and systems; validation and demonstration at prototype and fleet scale to ensure efficient and intelligent operation, within a framework of sustainable mobility.*

## **(ii) ACTIVITIES FOR GENERIC RESEARCH AND DEVELOPMENT OF TECHNOLOGIES**

### **• New materials and their production and transformation**

#### **Rationale**

Products and industrial processes in areas such as construction, transport, environment, energy, health and other services, are becoming increasingly complex, putting ever greater demands on the quality, durability, functionality and structural properties of materials. New and improved materials and related processes are essential in maintaining European competitiveness, not just in the 400 BECU materials markets, but throughout the entire fabric of European industry. Growth in the segment of new materials alone is estimated to be around 5% per year. Long term research is, however, increasingly under threat as the result of the current trend towards decentralisation in industry, and the high levels of cost competition, which are leading industry to focus on shorter term objectives. Moreover, environmental sustainability will require substantial reductions in resource utilisation, on a “lifecycle” basis, leading to the need to progressively introduce renewable raw materials, reutilise materials, and generate and integrate an increasing stream of “secondary” raw materials.

#### **Objectives and RTD activities**

**Improved and new materials with wide applications.** The aim would be to promote research on the most promising avenues for improving the functionality and performance of existing materials and the development of new materials with distinctly new or radically improved characteristics.

*RTD priorities: innovative approaches such as nanostructured materials, supramolecular chemistry, colloidal systems and biomimetic chemistry; expanding the limits of materials properties and performance for extreme conditions; improving the understanding of deterioration mechanisms; new structural and functional materials with reproducible properties and reliable operation; improved and new biomaterials such as implants, tissue and body fluids, biosensors, drug delivery systems.*

**Materials production and transformation processes** Research would focus on technologies which can ensure quality, reliability and cost effectiveness of materials to allow optimum exploitation, especially in the context of the trend towards shorter production cycles.

*RTD priorities: materials production technologies for high added value, SME-intensive industries, including fine chemistry, advanced polymers, metals and alloys, composites, ceramics; processing technologies for micro and nanopowders; surface, interfacial and coating technologies for advanced materials (e.g. composites, functional glasses, ceramics and polymers), and for functional applications (e.g. corrosion, environmental protection and reduction of wear).*

**Sustainable use of materials.** Research would focus on the environmental impact of new materials and on materials reutilisation with the aim of increasing the flow of secondary raw materials with reliable material properties and reducing lifecycle impacts.

*RTD priorities: research supporting the development of materials which are easy to recycle; recycling processes enabling guaranteed materials properties, fitness for purpose and cost-effectiveness; material waste minimisation and re-valorisation; renewable raw materials, in particular for production of organic chemicals.*

### **• New materials and production technologies in the coal and steel fields**

#### **Rationale**

Over many years, the European Coal and Steel Community (ECSC) has created a framework for collaborative research and an effective network of researchers, promoting not only high quality scientific and technical results, but also effective technology transfer and rapid implementation of research results. However in view of the expiry of the ECSC treaty in 2002 and taking into account the conclusions of the Amsterdam European Council (June 1997), it is

urgent to speed up the “phasing in” of coal and steel research into the Framework programme. This will benefit both the steel industry and suppliers, end-users and other research actors, by cost reduction, improved user satisfaction and higher added value.

## **Objectives and RTD activities**

**Coal research** would be focused on production of metallurgical coke.

*RTD priorities: research to reduce cost and improve quality of coke; improved production of reducing gases; reduced emissions and improvement of health and safety in industrial plants.*

**Steel research** would be focused on the development of flexible and compact production lines, cleaner processes, innovative steel products, and development of recycling.

*RTD priorities: iron and steel making technologies and processes for flexible, cost-effective production; technologies to reduce energy consumption and CO<sub>2</sub> emission, improve steel cleanliness, increase recycling rates; casting, rolling and downstream treatment, including quality enhancement, tolerance, energy saving, coating and surface techniques, integrated process management and control; development of improved steel grades and high strength steels for higher performance and extreme conditions; "de-materialisation", recycling and upgrading of by-products.*

- **Measurements and testing**

### **Rationale**

The assurance of quality and sustainability of industrial and agricultural products, associated services and commodities is critical in strengthening the functioning of the EU internal market and responding to society's needs. New and improved technologies and methodologies are needed for measurement and testing, to support the development of clean and efficient products, processes and services taking into account the changes in technology and legislation. Harmonised and validated methods across the EU and the establishment of international traceability of measurements would help to remove barriers to trade, promote environmentally-friendly products and facilitate the conclusion of mutual recognition agreements with third countries. New methods are also needed in order to combat fraud, which is very costly for national and Community budgets. **Development of efficient instrumentation to meet industrial and societal needs would also stimulate market opportunities for instrument manufacturers, particularly SME's.** Novel approaches need to be implemented in this area to increase SME access and include SME related objectives in research activities.

## **Objectives and RTD activities**

**Prenormative research and technical support to standardisation.** Research would focus on development of measurement and testing methods and the production of scientific and metrological data.

*RTD priorities: development of new standards over the range of industrial requirements; improvement of existing standards; support to the development of performance standards and directives to facilitate trade, to protect consumers and the environment and to favour mutual recognition agreements.*

**The fight against fraud.** Research would focus on the development and improvement of measurement and testing techniques aiming at fighting dishonesty in society in order to detect misrepresentation of materials, components, goods, services or persons.

*RTD priorities: techniques to combat deceit of consumers through counterfeit or falsely labelled industrial and agricultural products; avoidance of circumvention of trade regulations or E.U. legislation, including customs tariffs, quotas, waste disposal; avoidance of deceit of legal authorities including detection of drugs, doping, and identification of the provenance of cultural artifacts.*

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<sup>5</sup> Communication of the Commission to the Council on *Expiry of the ECSC Treaty - financial activities* COM(97)506, 8.10.97

**Improvement of quality.** Research would support the development of techniques and tools to enable industry, associated services and agriculture to identify, quantify and measure the attributes that consumers perceive to be present in a quality product.

***Research priorities:** improved quality measurements and test methods; new methods and principles, including measuring the effectiveness of the ISO 9000 & 14000 series of standards; support for the development of instrumentation for reference and field measurement and testing, including novel sensors and sensing techniques, with emphasis on robust portable and in-situ instruments; development of certified reference materials to ensure reliability and traceability of measurements.*

### **(iii) SUPPORT FOR RESEARCH INFRASTRUCTURES**

#### **Rationale**

Industrial research in Europe is widely recognised for its excellence, with well established strongholds at national level. To bring competitive advantages, scientific and technological results must however be converted into successful applications. This requires testing new materials processes or prototypes for which highly specialised and costly infrastructures are needed. However, new findings generate new data, in increasing quantities. Collecting, storing, organising them, at European level, would benefit industry and the whole user community. Not only would efficiency be improved by reducing duplication but more importantly focusing the whole fabric of research infrastructure in Europe towards common goals would enable a strategic approach to be put in place. Action is needed **to encourage the optimum utilisation of the existing research infrastructures and large installations, with attention to the situation in the less favoured regions; to identify common needs and coordinated strategies for their enhancement and to integrate the existing facilities as far as possible to avoid duplication of work and ensure interoperability of data exchanges.** As the stages of development of the national institutions vary in the Community, there is also a need to reinforce collaboration, in areas such as conformity assessments, training activities, transfer of know-how.

#### **Objective and activities**

Following the objectives of this Programme, activities would aim at the optimum utilisation of distributed research capabilities, and medium and large scale research facilities, and rapid transfer of existing and complementary RTD results to industrial applications. **Amongst the areas of interest would be** computing centres for industrial research, industrial high power lasers, transport test facilities, high quality wind tunnels, oceanographic vessels, materials and structures test facilities.

**Virtual institutes.** Using the development of Information Society Technologies and by the creation of a new kind of networked institute “without walls”, **research centres, especially smaller ones, would be encouraged to come together to make use of their individual potential to achieve synergy and reap wider benefits to support industry and society, in particular around objectives** related to the key actions and generic technologies.

The **European metrological infrastructure** for quality products, processes and services (including reference materials) would continue to be supported to build upon the extensive network that is responsible for ensuring the equivalence of standards in the field of measurement and testing across Europe and beyond.

**Reference data bases** have been identified as a mean to support the development of the European research fabric in particular in the field of materials engineering. Activities would help to catalogue and compare research actions at national and international level and the output of different research facilities. They would focus on ensuring that the data generated is of acceptable quality and comparability and on bringing together sectorial and local activities in support of research at EU level. Such activities would preserve the property rights of individual organisations.

# *Promoting competitive and sustainable growth*

(Part II : Euratom Treaty)

## **INTRODUCTION**

The availability of secure, sustainable and competitive sources of energy (especially electricity) is key to economic growth, prosperity and quality of life in the industrialised world. The aspirations of, and economic progress in, the developing world will lead to major increases in global energy demand with implications for fuel prices, health and environmental impact and, eventually, security of supply. In the medium term much of the increased world demand will be met by fossil fuels which will exacerbate the problems of acidification of the environment regionally and of carbon dioxide emissions globally. These problems can only be mitigated through international concertation. Energy savings and increased use of renewables will help but their impact will be limited in the short and medium term; in the long term, such measures alone would be insufficient.

Given the expected growth in demand for energy, continuing use will need to be made of all potential sources. Strategic considerations will, however, favour the use of energy sources that offer greater sustainability and have lower health and environmental impacts. Nuclear energy has the potential to provide Europe with a secure and fully sustainable electricity supply at a competitive price and with health and environmental impacts that are lower compared with those from fossil fuels.

### **Strategic objective of the programme**

The aim of this programme would be to contribute to realising the full potential of nuclear energy, both by making current technologies even safer and more economical, and by exploring new promising concepts. It would have three distinct components, with differing time horizons, that would be included within two separate programmes.

Firstly, an indirect action comprising:

- research work on controlled thermonuclear fusion, that would represent an integral component of the key action “*Advanced energy systems and services*”. These activities would further the development of this energy source for use in the long term;
- generic technologies concerned with enhancing the safety (including health, environmental and technological aspects), competitiveness and social acceptability of nuclear fission and of other industrial and medical uses of ionising radiation in the short and medium term.

Secondly, a direct action, to be carried out by the Joint Research Centre, addressing:

- the safety and security of the nuclear fuel cycle, aspects of reactor safety that would have short, medium and longer term objectives and a limited, specific contribution to the work on fusion.

While nuclear fusion research is already fully integrated at a European level, greater and more effective integration of research (including both national and Community supported activities) in the area of nuclear fission would be needed in future. The benefits of greater integration would include economies of scale, better use of available resources, more effective support for and use of essential infrastructures and maintaining the necessary level of expertise within the nuclear industry and among the safety authorities.

### **(i) KEY ACTION (contribution to)**

# Controlled Thermonuclear Fusion

## Rationale

Fusion is one of the very few energy sources which, from the mid of the next century on, might contribute substantially to satisfying the needs for safe and clean base-load electricity generation, without threatening global equilibria. The size of the research effort needed is beyond the capabilities of individual Member States. The Community Fusion activities, which include all fusion research carried out in the EU (and Switzerland) are a response to the need expressed by Member States to develop their cooperation in this area, with the long-term objective of jointly creating prototype reactors for power stations to meet the needs of society: operational safety, environmental compatibility, economic viability.

The proposed strategy to achieve this long-term objective would include the development of an experimental reactor (the “Next Step”), with the objective of demonstrating the scientific and technological feasibility of fusion power production as well as its safety and environmental potential, and then of a demonstration reactor (DEMO) capable of producing significant quantities of electricity.

The widely acknowledged progress achieved in fusion research worldwide in recent years shows that the construction of the “Next Step” during the next decade is scientifically and technically feasible. Instrumental in this progress has been the ITER (International Thermonuclear Experimental Reactor) quadripartite cooperation, allowing the EU to share the effort; for this reason the construction of an experimental reactor should preferably take place within the ITER framework. However, the EU participation in the engineering design activities for ITER should not prejudice a decision on the construction of the “Next Step”.

## Objectives and RTD priorities

The main objectives would be to prepare the European fusion community, including industry, to effectively participate in the construction and plan the operation of a “Next Step” such as ITER; to demonstrate the availability of technologies essential for a fusion reactor; to improve the basic concepts of fusion devices through activities in the field of physics; to make progress in the longer term technological issues for realising the potential of fusion as an energy source including those relating to environmental acceptability, safety and economic viability; and to continue, in the context of a “keep-in-touch” activity, the coordination of civil research on inertial confinement.

- **Next Step Activities.** The aim would be to advance the engineering design activities, procurement specifications and licensing arrangements for ITER with a view to its possible construction during the next decade.

*RTD priorities: adaptation of the ITER design to at least one possible specific site within the EU and initiation of the dialogue with the potential licensing authorities; completion of the design and supporting research, finalisation of the procurement specifications and consolidation of the scientific basis for ITER operation; completion of the full scale operation of JET, focusing it on the needs of the “Next Step” (after the end of JET Joint Undertaking, its facilities could be used to supplement knowledge for the operation of the “Next Step”).*

- **Concept Improvements.** The aim would be to improve the basic concepts of fusion devices from the perspective of preparing the “Next Step” operation and the conceptual definition of DEMO.

*RTD priorities: new plasma diagnostic methods; construction, full exploitation or upgrading of devices decided upon during the previous framework programme and upgrading of other existing devices; studies to assess the viability of operating a remotely located fusion experiment; training and mobility of scientists and technologists.*

- **Long-term Technology.** The aim would be to prepare for longer term developments in particular the construction and operation of DEMO and then the prototype reactor.

*RTD priorities: development of tritium breeding blankets and a reference structural material for the construction of DEMO-relevant modules; low activation and radiation resistant materials for DEMO; safety and environmental assessment; analysis of socio-economic aspects of fusion; conceptual study of a DEMO reference design.*

## **(ii) ACTIVITIES FOR GENERIC RESEARCH AND DEVELOPMENT OF TECHNOLOGIES**

### **Nuclear Fission Energy System**

#### **Rationale**

Nuclear fission has several important strategic benefits: independence from fossil fuels, long term security of primary energy supply and zero emissions of carbon dioxide. Nuclear fission energy contributes about 33% of the Community's electricity supply. Its continued safe and efficient use is essential for achieving a proper return on investment, and maintaining its competitiveness and social acceptability. By maintaining a competitive industry and high quality technologies and operation, Europe can also take advantage of important market opportunities for new installations elsewhere, especially in Asia and help to ensure the highest safety standards throughout the world by exporting its expertise. Considerable challenges also need to be faced in the context of the future enlargement of the Community, which will increase the Union's nuclear capacity with the introduction of Soviet designed reactors, and bring the need for dedicated research and training to ensure conformity with Community safety standards.

Nuclear technology moreover contributes greatly to advances in a wide range of industries, including medicine and health care, and has important economic and health benefits which could be enhanced through further research work carried out at Community level.

#### **Objectives and RTD activities**

Work should focus on the safety and competitiveness of nuclear fission energy in Europe, enhancing the prospects of European industry in world markets and exploring more innovative concepts that have potential longer term economic, safety, health and environmental benefits. It should also focus on improving the safety and efficacy of other industrial and medical uses of radiation and on enhancing protection from natural sources of radiation. While mainly scientific or technological in nature, the research would have a significant socio-economic dimension.

The programme should be fully open to participation from countries in Central and Eastern Europe and the Former Soviet Union with financial support from the Community. This would help maintain and enhance essential competence in nuclear safety in these countries, many of which are candidates for enlargement, and facilitate collaboration in important areas of mutual interest.

- **Safety and competitiveness of nuclear installations.** Work would focus on the critical issues for determining and extending the residual operating lives of installations, and on the safe long term management and disposal of radioactive wastes.

*RTD priorities: effects of ageing on the integrity of structures and systems; improved methods of inspection and monitoring; modernisation of control systems; deep geological disposal; actinide separation and transmutation; improved conditioning of waste forms.*

- **Assessment and management of safety.** Research would focus on the development of improved and more complete methods for assessing and managing the safety of the whole nuclear fuel cycle, to inform policy choices and the allocation of resources for safety, promote the adoption of best safety practice and enhance public confidence.

*RTD priorities: integrated risk management and treatment of uncertainties; Probabilistic Safety Assessment; organisation of safety and involvement of stakeholders; development of consensus on the management and disposal of radioactive wastes, including waste minimisation.*

- **Health and environmental protection.** Research would focus on management of safety with respect to existing installations and sources of radiation.

*RTD priorities: estimating risks of low and protracted doses of ionising radiation; management of nuclear emergencies; techniques and strategies for the restoration of contaminated environments; risk assessment, perception and communication; enhancing the safety and efficacy of other uses of ionising radiation and management of natural sources of radiation.*

- **Incremental or evolutionary improvements.** Research would aim at improving the reliability, availability and safety of new installations at reduced cost.



*RTD priorities: enhanced passive safety features; advanced control systems; longer service life for materials and equipment with less need for inspection and maintenance; new fuels including the better utilisation of fissile material; smaller and simpler reactors and optimisation of the fuel cycle as a whole.*

- **More innovative concepts.** Research would focus on innovative concepts for energy generation, the better management of wastes and the better utilisation of fissile materials.

*RTD priorities: development of concepts which provide long term benefits for safety, waste management and disposal; reduced the risk of diversion of fissile material; greater sustainability and lower costs.*

### **(iii) SUPPORT FOR RESEARCH INFRASTRUCTURES**

Collaboration within Europe among nuclear research institutes and with other nuclear organisations is relatively well developed. This should be intensified in future in response to the ongoing rationalisation and down-sizing of many national nuclear research programmes. More effective integration and better exploitation of research would be needed to ensure the continuing safe use of nuclear energy and maintain the competitiveness of European industry in external markets.

#### **Objectives and activities**

The objective would be to further integrate nuclear research within the Union so that available resources could be more effectively utilised for the competitive advantage of European industry and to ensure the continuing safe and socially acceptable exploitation of nuclear technologies.

**Large scale facilities.** Continued access to large scale facilities is essential and can be facilitated by shared usage and collaborative programmes. Priority areas for support would include facilities for investigating core degradation, containment performance and materials testing and underground laboratories for testing and demonstrating concepts for the deep geological disposal of wastes.

**Networking.** Existing networks should be reinforced and others established where they could demonstrably enhance the achievement of the programme objectives or broader Union goals: support for extensive and diverse networks, focusing on the key issues for nuclear safety, waste management and disposal, decommissioning, emergency preparedness and response, radiation protection, emerging safety or other technological issues.

**Data bases and tissue banks.** Existing data bases should be reinforced and others established where the need arises. Priority areas would include the extension or establishment of data bases in support of decommissioning and dismantling techniques, performance and safety of waste disposal, safety assessments of major components, mitigation of severe accidents and epidemiological studies. A data bank of tissues and biological samples from people affected by nuclear accidents should be established.

**Centres of excellence.** Greater use should be made of centres of excellence in carrying out research: support should be provided to facilitate the transfer of technology or expertise.

## *Confirming the international role of Community research*

### **INTRODUCTION**

Research and technological development are increasingly becoming decisive keys to the economic performances of world partners and competitors. A number of objectives addressed in the 5th Framework Programme can only be tackled fully if the research effort within the Union is complemented by selective and focused cooperation beyond its frontiers. Research cooperation also represents more than ever an important facet of the external relations of the Union.

#### **Strategic objective of the programme**

The aim of this programme would be to facilitate the access of the European entities participating in the Framework Programme both to the scientific and technological potential existing outside the Union, as well as to develop opportunities which exist in various regions of the world. The programme would strengthen the Community research policy by providing it with an external dimension; equally, it would add to the scope of the Community's external policies by providing a research dimension. Scientific cooperation with partners outside the Union should therefore be an integral component of all the specific programmes. Particular attention should be paid to partners from countries which are candidates for accession and from other neighbouring regions. Research cooperation should furthermore contribute to the Union's development policy, enable the Union to develop further industrial cooperation, facilitate international standardisation and gain a foothold in new markets.

Overall guiding orientations for this programme should be :

- First, participation by partners from outside the Union would be possible **in projects of all programmes** (including the activities covered by Euratom) if this is in the Community interest and in particular to the advantage of the programmes' key actions and generic activities. This access to the scientific and technological potential which exists outside the Union will be governed by the rules of participation relative to Article 130j of the Treaty. It would be based either:
  - on the opening of programmes envisaged for the neighbouring regions of the Union;
  - on specific scientific and technological Cooperation Agreements or on specific scientific and technological Protocols applying to existing Cooperation Agreements;
  - in cases not covered by the above, on an evaluation of the Community interests, to determine whether it is appropriate to involve a non-Union partner, in order to achieve the objectives of the specific programme or project concerned.
- Second, **specific actions** initiated by the international cooperation programme to support scientific cooperation addressing problems not covered by the other programmes, but which are of relevance to certain world regions and where the Community has a special interest, as well as the capacity to contribute to the solutions. These strategically defined activities should target : the accession candidate countries, other Central and Eastern European countries (CEECs), the New Independent States of the former Soviet Union (NIS), the Mediterranean partner countries and developing countries. In order to exploit fully the opportunities for cooperation and optimise the added value at European level, this programme would facilitate cooperation with certain industrialised and emerging economy countries. It should also ensure coordination of the Framework Programme activities with other Community initiatives and policies, in particular external policies, as well as with those of Member States, International Organisations and cooperation schemes such as COST and EUREKA.

(i) **COORDINATION OF ACTIVITIES WITHIN THE FRAMEWORK PROGRAMME AND WITH OTHER COMMUNITY PROGRAMMES**

In order to define and implement international research cooperation policy, this programme should take into account the policies, instruments, initiatives, interests and capabilities of other actors in this field. A key concern would therefore be to ensure coordination with the other specific programmes and with other Community policies and instruments.

Coordination with the other specific programmes would focus on ensuring consistency of approach to partners from outside the Union, across the specific programmes, on monitoring and analysing (in terms of mutual benefit and utility) the participation of non-Union entities or international organisations in the other programmes, and on examining participation trends by country and by programme.

In addition, where there are opportunities for international research cooperation of mutual interest, this programme would facilitate the other programmes in establishing effective cooperation, including the organisation of events aimed at providing information on the rules and policies applicable to Community RTD in general, and to participation of non-Union country entities and international organisations in particular.

Coordination with the Community's external technical assistance programmes such as PHARE, TACIS, MEDA, EDF and the programmes for Asia and Latin America, would increase the synergy between their actions and the work carried out under the research policy. They may then provide effective support for the scientific and technological sector in the countries concerned in the form of promoting research as a national priority, institution-building measures and investment in infrastructure.

(ii) **SPECIFIC ACTIONS OF THIS PROGRAMME**

Research priorities should be identified through a strengthened dialogue with the regions concerned, taking into account the diversity of their economic and socio-cultural situations. In the implementation of this programme, the concerns of industry and in particular of small and medium sized enterprises should be taken into account. Support should focus on research and technological development cooperation rather than on technical assistance or technology transfer which can be better achieved through Community external relations programmes.

- **COOPERATION WITH CERTAIN CATEGORIES OF COUNTRIES**

***RESEARCH STRATEGY FOR ACCESSION (ASSOCIATED CEECs)***

**Rationale and objectives**

The period covered by the 5th Framework Programme will coincide with the preparation for membership of the European Union by the accession candidate countries. In the context of *Agenda 2000*, the objective of this programme would thus be to help accelerate the reform in their science structures, while safeguarding the highly qualified human resources and building up the fundamental scientific infrastructure. This should be achieved by encouraging these countries to become fully associated to the specific programmes and to participate in projects under similar conditions to Member States. In view of the reinforced pre-accession strategy proposed under *Agenda 2000*, this association to the Framework Programme could be facilitated by PHARE in the framework of the Accession Partnerships..

**Activities**

- Specific activities would be undertaken to promote existing *Centres of Excellence* in CEECs in order to put their research capabilities at the service of the economic and social needs of their region and of the Union as a whole. The Centres to be supported should be multidisciplinary, and should bring together theoretical and applied research, including research in the natural, social and economic sciences. They should link local expertise and international excellence and should also serve young researchers as training centres. The support to be provided could include fellowships, support for networking and conference and workshop organisation. This would enable cooperation with western scientists in situ, and the establishment of programmes and events to highlight the "super-regional" relevance of the Centres, thus strengthening their attraction for neighbouring countries.
- In addition, specific *support measures* would be developed to strengthen the participation of these countries in

other programmes of the Framework Programme (e.g. disseminating information on opportunities offered by the Framework Programme)

## ***DEVELOPING RESEARCH LINKS WITH OUR NEIGHBOURS***

### ***• Non-associated CEECs, NIS***

#### **Rationale and objectives**

Closer relationships between these countries and the Union in science and technology would help maintain and stimulate their economic development. A number of these countries have made substantial efforts to consolidate the existing scientific potential and to provide new administrative structures more suitable to research needs. The Union's objectives in scientific cooperation with these countries would be to support efforts to develop a pluralistic scientific and technological system and to preserve and develop their research excellence by building on existing expertise in order to help them solve some of their major economic and societal problems.

#### **Activities**

This programme would undertake joint research projects and concerted actions in areas not covered by the other specific programmes :

- *Structural problems of transition at regional level* would be identified. These would include in particular problems linked to environment and health: e.g., desertification, rehabilitation of land-locked sea areas and large lakes, consequences of past approaches to energy production and use, management of the environment in Arctic regions, in particular as regards the coastal zone and boreal forests, and prevention and control of re-emerging diseases as well as specific industrial problems of an economy in transition.
- The *research potential in the NIS* would be preserved and its interactions with the European scientific community promoted, in fields where they have a recognised excellence and valuable cooperation potential: e.g. physics, mathematics, biology, chemistry, and socio-economic sciences, transport, laser and information society technologies, and space applications. This could be achieved by building on the experience already gained through the INTAS and other cooperation schemes.

### ***• Mediterranean partner countries***

#### **Rationale and objectives**

In addition to their participation in the other specific programmes and in the specific action for Research for Development of this programme, certain specific actions would be undertaken with the Mediterranean partner countries in order to strengthen the research and technology dimension of the Euro-Mediterranean Partnership.

#### **Activities**

Subject to dialogue with these countries, actions would be taken in some of the following areas: regional aspects of management of the Mediterranean sea, and water management including water/energy interactions; natural resource management in the context of sustainable development of tourism, cultural heritage preservation and restoration; development in the context of economic modernisation, including industrial innovation, transport and support for the establishment of a Euro-Mediterranean information society.

## ***RESEARCH FOR DEVELOPMENT***

#### **Rationale and objectives**

Scientific and technological cooperation is one of the key elements in addressing the global challenge of sustainable economic growth. It would help to maintain and reinforce the research capacity in developing countries through investment in human capital and through the provision of complementary equipment. It would also promote the development of a Community research policy based on mutual interest with developing countries. The objective of this part of the programme would be to tackle research problems linked directly to development challenges, targeting the most relevant themes applicable to developing countries (Mediterranean partner countries and emerging economies included), taking into consideration their specific socio-economic requirements.

#### **Activities**

Specific activities would be undertaken in some of the following areas :

- *Sustainable Development*: strategies for sustainable development including the socio-economic and policy conditions allowing the uptake of existing knowledge-based innovation; development of organisational and management mechanisms, initiatives and human and institutional resources to improve this uptake. In addition to the fields mentioned below, the areas to be covered could include sectoral and cross-sectoral areas such as the global information society, energy, transport, population and urbanisation.

- *Enhancement of the value of agricultural production*: development of new technologies to improve the efficiency of agricultural production chains including quality, storage, processing, and distribution of agro industrial products and by-products for local consumption and export; prospective research on the evolution in demand resulting from demographic growth and urbanisation; definition of consumer quality assurance systems, including safeguarding plant and animal health.

- *Economic use of renewable natural resources*: research work on factors simultaneously affecting socio-economic and technological progress as well as sustainable management of natural resources could include: developing strategies, including biotechnological approaches, for new products and services of potential use in agriculture, forestry and fisheries; promoting a sustainable relationship between population pressure, the use and management of ecosystems and economic growth; managing the efficient use and productivity of renewable natural resources and preventing their degradation through water and soil pollution and losses in soil fertility.

- *Health improvement*: the health status of people in developing countries would be enhanced through research contributing to: the development of equitable efficient health systems with special emphasis on the impact of service delivery and the influence of structure and policy formulation on equity, coverage of vulnerable groups, quality of care, acceptability, affordability and human resource development; improved understanding of major health problems and the development of instruments (diagnostics, drugs and vaccines) for prevention and control of the predominant diseases in these countries (depending on the region concerned).

These activities would include, where relevant, attention to information society technologies.

## ***INDUSTRIALISED COUNTRIES OUTSIDE THE UNION AND EMERGING ECONOMY COUNTRIES***

### **Rationale and objectives**

These countries represent both competitors and partners for the Union in the global market place. This programme would promote :

- bilateral as well as multilateral (e.g. G-7, OECD) policy dialogue in research in order to facilitate and monitor cooperation as well as to identify priorities of mutual interest;
- access to research know-how and opportunities available in these countries, thereby contributing to the improvement of the performance of European research and the competitiveness of the Union in the global economy;
- the sharing of the costs and benefits of global endeavours (e.g. information society, human genome, intelligent manufacturing systems);
- cooperation aimed at the solution of worldwide problems (e.g. global climate change).

### **Activities**

In order to facilitate and enhance access to the research potential which exists outside the Union, for the benefit of the programmes' key actions and generic activities, this programme would implement scientific and technological cooperation agreements in certain areas with certain non-Union industrialized countries. This instrument could also be extended to cooperation in certain domains with some of the major emerging economy countries, i.e. certain developing countries which represent important markets, and which have developed to the point that in specific scientific and technological areas they are at par with industrialised countries. Furthermore, the bursary system enabling Community researchers to work in non-Union countries (e.g. Japan and South Korea) would focus on industrial laboratories.

### **- TRAINING OF RESEARCHERS**

In the context of the activities of the 5th Framework Programme, *bursary system* could be established to allow young doctoral level researchers from the non-associated countries, the NIS and developing countries, including Mediterranean and emerging economy countries, to work in European laboratories. This would further contribute to the reinforcement of the

scientific potential in these countries, while allowing Community research to benefit from their expertise.

## - COORDINATION

### ***COST, EUREKA AND INTERNATIONAL ORGANISATIONS***

- **COST:** COST's membership, which extends far beyond the Union, is a useful instrument to foster cooperation and stimulate mutual coordination of national and international activities on a very broad scale, both thematically and geographically, as well as to stimulate the integration of researchers from CEECs into pan-European activities. Its flexibility should be used to intensify exploration of new ideas and fields of scientific and technological endeavour. Improved methods of associating COST and the Framework Programme activities would be developed, in order to exploit better the complementarity of the two instruments, particularly as concerns the implementation of the key actions and generic activities of the Framework Programme.
- **EUREKA:** Framework Programme and EUREKA projects are closely complementary but have been up to now relatively distant in terms of strategy. In future, the aim should be to maximise, around a limited number of priority themes of common interest, the exploitation of results and market access offered by EUREKA. Simple and efficient ways of associating the 5th Framework Programme and EUREKA projects would be developed and applied primarily to large-scale projects within the key actions of the thematic programmes. Proper information mechanisms between EUREKA and the thematic programmes would be put in place, so as to foster the effective transfer of Community research results towards EUREKA for further development closer to the market place.
- **INTERNATIONAL ORGANISATIONS:** Closer cooperation between the Community and International Organisations and their participation in all activities of the 5th Framework Programme would strengthen the overall coherence of research in Europe and optimise the use and exploitation of Europe's scientific infrastructures. The Commission would intensify its involvement in these organisations and encourage coordination between their Union members.

### ***COORDINATION WITH MEMBER STATES***

The international research cooperation activities of the Community and the Member States often address similar or related issues. In full respect of the principle of subsidiarity, there is both scope and need for increased coordination in certain areas which would lift the individual efforts above critical mass and enhance overall effectiveness, flexibility and visibility of Community and Member States' activities. Building on the experience of initiatives such as the "European Initiative on Agricultural Research for Development", public and industrial research areas suitable for new co-ordinated actions would be identified and coordination activities initiated through this programme.

## *Innovation and participation of SMEs*

### **INTRODUCTION**

Innovation is a key factor in growth and employment. Contemporary economies are characterised by the acceleration of scientific and technological progress and the steady increase in competitive pressure. Business competitiveness depends to a large extent on the ability to innovate: as a result of the development of new products, new markets can be won; as a result of the development of new processes, costs can be contained and competition can be handled: in the information technology sector, 78% of income is derived from products that have been on the market for two years or less. Innovation is also an important component of behavioural developments and overall social dynamics.

Europe is remarkably creative in terms of knowledge and knowhow, but this is only partially translated into beneficial spinoffs for the economy and citizens: it innovates less, and less rapidly than its competitors. To exploit this potential more effectively and increase its impact on the economy and society, a coherent innovation strategy is necessary, alongside the research effort, to help to bridge the gap between scientific breakthroughs and practical applications.

Innovation involves many players (firms, universities, research centres, and venture capital companies), but above all SMEs, which play a vital role in the European economy (66% of jobs and 65% of private sector turnover). To supplement the initiatives taken by the Member States, action at European level is needed in order to help SMEs to globalise their activities and gain access to new technologies, be they high-tech SMEs, or SMEs which, though having little or no research capacities of their own, need to make use of new technologies.

### **Strategic objective of the programme**

The aim of this programme will be to help the European Union to establish a coherent innovation strategy, in particular with a view to implementing the “First Action Plan for Innovation”.

In so doing, it will have a twofold task:

- on the one hand, coordinating and supporting actions targeted towards innovation, and the needs and participation of SMEs carried out under the thematic programmes. The bulk of the efforts in this area would be carried out within these programmes, so as to take account of the specific features of the research topics and ensure the best possible match between the exploitation of results and their application context;
- on the other, implementing specific activities of a horizontal nature or with a specific content.

### **(i) COORDINATION OF ACTIVITIES CARRIED OUT UNDER THE FRAMEWORK PROGRAMME**

#### **Rationale**

In the context of the Fifth Framework Programme, the “Innovation and SMEs” programme should promote and coordinate activities carried out in this area under the thematic programmes. On the basis of the measures, instruments, and expertise developed in the context of its specific activities, it would in particular focus on the design of mechanisms to facilitate the exploitation and transfer of results, the participation of SMEs, the evaluation of results, and the post-auditing of their exploitation in order to evaluate their economic and social impact.

## **Objectives**

The objectives would be to coordinate and guide the efforts under the thematic programmes to take account of the “innovation” and “SMEs” dimensions when setting their priorities, establishing their work programmes, and in all their activities; to ensure the overall consistency of activities relating to innovation and SMEs and their harmonisation within the thematic programmes; and to ensure the optimum use of the skills, experience and infrastructure existing at the horizontal level or in other programmes.

### **Activities in the field of innovation**

“Innovation units” would be set up within the thematic programmes in order to promote innovation in each of them. They would constitute the interface with the “Innovation and SMEs” programme and would benefit from its support activities and its information networks and services.

The tasks of the innovation units should comprise:

- planning actions related to innovation, and making a contribution to laying down and implementing the guidelines and methods established by the “Innovation and SMEs” programme;
- exploiting the thematic networks, actions, and mechanisms stimulating the exploitation and transfer of results or the creation of innovative firms;
- organising studies to evaluate projects and their results with a view, in particular, to promoting their exploitation;

### **Activities to increase the participation of SMEs**

The thematic programmes should implement stimulation measures for SMEs, comprising “exploratory awards” and “cooperative research”:

- the exploratory awards would enable SMEs to receive financial support to prepare proposals for cooperative or collaborative research, among other things through partner search, market research and feasibility studies;
- the “cooperative research” projects would enable groups of SMEs with common technological requirements that they cannot satisfy, owing to inadequate research capacities, to entrust research activities to other entities (e.g. research centres) which would carry them out on their behalf. These projects could, if necessary, include the validation or adaptation of an existing technology in the industrial environment. In order to ensure as many opportunities for SME participation as possible, the project proposals could be submitted through the thematic programmes, provided that they satisfy the general objectives of those programmes.

SMEs should also be given greater access to “conventional” collaborative research activities, in particular the key actions, through a result of practical incentives, especially notably information and assistance with the preparation of proposals. Such incentives would be designed to make it easier for them to become directly involved in project consortia or participate as subcontractors, or pilot users, in research or demonstration projects.

## **(ii) SPECIFIC ACTIVITIES UNDER THE PROGRAMME**

Supplementing the actions carried out within the thematic programmes, these specific activities would help to promote a favourable environment for innovation in Europe and to establish a framework enabling a large number of businesses to benefit from innovation.



## **INFORMATION NETWORKS AND SERVICES**

### **Rationale**

Information networks and services can help to improve the dissemination of information, knowledge and technologies. In so doing they help to increase the impact of Community research activities and the results of these activities, while promoting the transfer of technology in general, resulting in an improvement in firms' competitiveness and innovative capacities.

#### **• *European networks in support of innovation and research***

The establishment of such networks, as part of a rationalised and coordinated approach, would result in the development, in the Member States and associated countries, of an information, assistance, cooperation and innovation-support infrastructure, intended particularly for SMEs.

### **Objectives**

The objectives will be to increase firms' receptiveness to technologies capable of helping them to improve their innovative capacity; to encourage transnational transfers of technologies, whatever their origin; to facilitate participation in Community research and innovation activities, and promote the dissemination and exploitation of their results.

### **Activities**

- promotion of technology transfer, reflecting the needs of the local economic and social fabric;
  - business counselling and assistance, to guide firms' participation in the programmes and help them put together transnational proposals;
  - support for the dissemination and exploitation of the results of Community research activities, e.g. by organising "technology fairs";
  - establishment of means of cooperation and international partnerships between firms.
- ***Electronic information services and other means of dissemination***

### **Objectives**

The objectives would be to group together and encourage the dissemination, in the context of a joint information service, of all the data needed to publicise more effectively research and innovation activities, the procedures for carrying them out, and their results; to inform the public about the socio-economic impact of innovation policies, and fuel the debate about the issues at stake where these policies are concerned, given the needs of individuals.

### **Activities**

- consolidation of the CORDIS Community information service by improving ease of access (multilingual, user interface), adaptation of the content to the needs of SMEs and their support networks, and development of tailor-made tools;
- extension of the "European Research Gateway On-line" pilot scheme, by establishing a link between CORDIS and the national scientific and technical information sources.

## **INTELLECTUAL PROPERTY AND FINANCING OF INNOVATION**

### **Rationale**

The "Action Plan for Innovation" highlighted the shortcomings of innovation, protection and financing systems. In the first instance, the Member States are responsible for rectifying these shortcomings, but action at Community level can also help, as a result of the establishment of information and assistance mechanisms and pilot projects.

· *Intellectual and industrial property*

**Objectives**

The objectives would be to encourage better use of knowledge protection systems, through awareness-raising and information; to facilitate access to the various sources of information about intellectual and industrial property; to protect the knowledge in possession of the Community (JRC), and to provide assistance to participants in the Framework Programme.

**Activities**

- establishment of an information system giving access to the various sources of information about patents, other intellectual property rights, the legislation in force, and the interpretation thereof;
- creation of a “help-desk” for participants in Community programmes;
- action concerning the protection of research results belonging to the Community, and evaluation of the innovative nature of project proposals (“quick scan”); collaboration with the European Patents Office and the national offices.

· *Financing of innovation*

**Objectives**

The objectives would be to inform SMEs, and in particular, SMEs participating in Community research activities, or exploiting the results thereof, about the opportunities for access to innovation-financing instruments; and to promote cooperation between financial sources (including venture capital bodies), researchers and industry.

**Activities**

- establishment of an information and assistance service to facilitate access to sources of financing;
- implementation, in the context of thematic programmes, or with the assistance of the innovation-support networks, of *ad hoc* awareness-raising incentive and training schemes, and organisation of transnational investment forums bringing together entrepreneurs, researchers, venture capital bodies and stock exchanges;
- exchanges of experience with the players concerned in the Member States, and establishment of transnational networks involving private and public operators on specific projects (e.g. technology assessment and mobilisation of local capital).

· *Mechanisms to facilitate the creation and development of innovative firms*

**Objectives**

The objectives would be to try out new approaches to the financing of innovation and support for the creation of innovative firms, and to encourage the investment of venture capital in innovative firms, and in particular young, high-tech firms.

**Activities**

The activities carried out under this programme would supplement other initiatives by the Community, particularly on employment, and by the Member States. They could take the form of pilot projects exploring new avenues, for example in connection with the implementation by the EIB or the EIF of the Amsterdam Summit recommendations concerning high-tech projects for SMEs. They would concern the definition and validation of mechanisms to encourage financial operators to invest in transnational technology projects or in firms in the start-up phase.

## ***PROMOTING AN INNOVATION CULTURE***

### **Rationale**

The European Union's inadequate performance as far as innovation is concerned is to a large extent attributable to the uneven development in Europe of the "innovation culture" that can be observed in other parts of the world, especially in the United States. This culture can be developed by encouraging experiments concerning the transfer of technology on an international scale, and by studying and evaluating "good practices" in this area, and the successes achieved with regard to innovation.

- *New approaches to technology transfer*

### **Objective**

The aim would be, in conjunction with the activities carried out under the thematic programmes, to define methodologies and validate them in the context of pilot/demonstration technology transfer projects.

### **Activities**

The aim of these projects would be, in particular, to analyse the economic, organisational and social factors involved in the take-up of new technologies in innovation processes.

They could include an international dimension (international technology-transfer trials in collaboration with other Community initiatives) and seek to explore new forms of technology transfer.

- *Studies and promotion of good practices*

### **Objectives**

The objectives would be to analyse and benchmark innovation performances and policies, in a common reference framework, and promote consultation, exchanges, and the dissemination and application of good practices.

### **Activities**

- establishment and regular updating of a "knowledge" base on innovation policies, practices and performances (including with regard to financing, protection and transfer of technology),
- preparation and periodical publication of a trend chart on innovation,
- organisation of schemes to promote good practices with regard to innovation.

## ***INCREASING THE PARTICIPATION OF SMEs.***

### **Rationale**

• SMEs have specific strengths: great adaptability and receptiveness to the market, and considerable flexibility in response to the emergence of new needs. However, their size also entails a number of weaknesses: they tend to have inadequate resources, little or no research capacity, and their activities rarely take place internationally. To some extent, their strengths can be exploited and their weaknesses offset through participation in Framework Programme activities.

### ***• A one-stop office***

#### **Objective**

The purpose of setting up a one-stop office would be to make it easier for SMEs to take part in Community programmes, by offering them an additional means of access, common to all the programmes.

#### **Activities**

An infrastructure should be set up to enable SMEs to submit proposals at any time, in the context of a permanently open call, with a view to benefiting from measures specific to them, such as exploratory awards or “cooperative research” actions. Facilities would be made available for SMEs who wish to send in their proposals electronically.

### ***• Joint management and assistance instruments***

#### **Objective**

The objective would be to simplify and harmonise SME participation conditions, in order to supplement and strengthen the impact of the one-stop office.

#### **Activities**

- preparation of joint contractual and information management tools;
- direct assistance for SMEs, supplementing the assistance provided directly by the local networks and the thematic programmes.

Ways of assisting SMEs during projects are envisaged, possibly taking the form of “training” workshops, open to project coordinators or intermediaries, concerning the management of research contracts, project coordination and other topics of general interest to SMEs.

## *Improving human potential*

### **INTRODUCTION**

In an evolving world increasingly founded on knowledge, it is essential for the Community to reinforce and adapt its knowledge base. A key element is the human potential of its researchers which, if the Community is to enhance its competitiveness, must be encouraged to grow both in quantity and in quality. Ensuring equal opportunities for men and women is an important underlying concern in this respect.

#### **Strategic objective of the programme**

The aims of the programme, to be realised in concert with related activities elsewhere in the Framework Programme, are:

- to develop the Community's human potential, notably through the training and mobility of researchers (including towards industry and in particular SMEs) and through innovation in the methods and technologies of education and training with a view to creating new jobs;
- to help make the Community an attractive location for researchers and for investment in research and to promote European research in the international arena;
- to encourage better use of research infrastructures throughout Europe;
- to develop the socio-economic knowledge base for a better understanding of key social and economic topics linked to the objectives of the Framework Programme and for the development of science and technology policy and other Community policies.

#### **(i) COORDINATION OF ACTIVITIES WITHIN THE FRAMEWORK PROGRAMME**

A major feature of this Programme would consist of the coordination and support of relevant activities throughout the Framework Programme, concerning, in particular, researcher's training, support for research infrastructures and the overall socio-economic dimension of Community research. More specifically:

- For the *Marie Curie Fellowships*: these could also be implemented by the thematic programmes. In order to ensure consistency, common rules would be defined concerning eligibility, implementation modalities, legal and financial provisions, and a single entry point for the reception of proposals would be set up.
- For *major research infrastructures*: consistency and complementarity of approach would be ensured with the relevant actions of the other specific programmes.
- For *socio-economic research*: coordination will be achieved through participation in the elaboration of the work programmes, support in the creation of appropriate evaluation mechanisms and collection and dissemination of relevant information, in order to ensure that the socio-economic dimension is consistently taken into account in the specific programmes.

#### **(ii) SPECIFIC ACTIONS OF THIS PROGRAMME**

##### ***REINFORCING THE COMMUNITY'S HUMAN RESEARCH CAPITAL***

###### **Rationale and objectives**

The individual and collective expertise of the Community's researchers is a considerable asset. However, scientific research takes place in a strongly competitive world-wide environment. Compared with our main competitors, the Community has: a relative shortage of researchers, a rather high fragmentation and duplication of research effort; a

certain isolation of research teams, particularly in the peripheral and less-favoured regions of the Community relatively low mobility of researchers, both geographically and between academia and industry and a general tendency for ageing of workforces, which affects also the research workforce

This activity would help create a European Research Area through the following objectives : stimulating training-through-research of young researchers, especially those in the early stages of their professional career; promoting equality of opportunities between women and men in the research area; promoting transnational cooperation between research teams, particularly through networking around a common research project; promoting the mobility of researchers throughout Europe; encouraging cooperation, interaction and staff mobility between academic and industrial research; and promoting the scientific and technological cohesion of the Community, particularly with respect to its less-favoured regions.

### **Activities**

This part of the Programme would be implemented through two actions: Research Training Networks and a coherent system of Marie Curie Fellowships. These actions would be open to all fields of scientific research of the Fifth Framework Programme, for projects chosen freely by the researchers themselves. In the selection of projects, there would be no pre-established target in terms of scientific discipline or topic the selection being made on the criteria of scientific excellence and of relevance to the objectives of the actions alone (i.e. a bottom-up approach).

#### **• *Research Training Networks***

The primary objective would be to promote training-through-research, especially of young researchers, within the frame of high quality transnational collaborative research projects. Community support would be awarded both to reinforce the research teams of a network through the temporary appointment of young researchers coming from a country other than that of the team concerned and to contribute towards the costs of coordinating the collaborative research project on which the network is based.

Each network would be required to define an appropriate training programme for its young researchers. Its training programme should take advantage of the international nature of the network, the complementarity of its teams and, when relevant, the network's connections with industry. Research Training Networks would, in particular, promote the training of researchers in an industrially relevant environment as well as encourage interplay between academic and industrial research.

Additionally, as a means of stimulating proposals in newly emerging fields of science and technology or in novel transdisciplinary approaches, exploratory awards would be granted in order to bring together potential network participants for the purpose of elaborating a detailed work plan for a Research Training Network proposal.

#### **• *System of Marie Curie Fellowships***

This coherent system would embrace five activities addressing specific needs identified at Community level, of which the Marie Curie Individual Fellowships would represent the core. The system would be a focused attempt at a more efficient use of Community funding of fellowships for training through research.

The researchers participating would be of three categories: (i) postgraduates; (ii) young researchers with proven research experience, i.e. researchers with a doctoral degree or at least four years of research experience at post-graduate level other than PhD studies; and (iii) experienced researchers, i.e. researchers with at least ten years of research experience at post-graduate level and who are established staff members of a research institution.

The Marie Curie Fellowship Association established in the Fourth Framework Programme would be supported as a means of promoting the identity and prestige of Marie Curie Fellows.

#### **– *Marie Curie Individual Fellowships***

The aim would be to provide advanced training through research for the best of Europe's young researchers with a view to these fellows becoming Europe's leading researchers. Participants in this activity would be young researchers with proven research experience and the research institutions hosting them.

This individual fellowship activity would encompass two types: Marie Curie Individual Training Fellowships and Marie Curie Individual Return Fellowships. The research supported by a Marie Curie Individual Training Fellowship would be undertaken in a country other than that of the fellow's nationality or recent residence. After completion of a Marie Curie Individual Training Fellowship, fellows originating from a less-favoured region and who wished to

return to a less-favoured region in their own country would be eligible for a Marie Curie Individual Return Fellowship.

For this type of fellowships, in order to avoid the disparities of treatment resulting from the sole application of national laws, and to give the young researchers all the means to stay in the host country under appropriate conditions, a common framework would be set up. The funds attributed to the fellows would be exclusively designed to cover the beneficiaries' subsistence and social welfare expenses as well as their mobility costs.

- *PhD Stays at Community Training Sites*

The activity would provide young researchers undertaking their PhD studies with the possibility to perform part of them at a Community training site, outside the country where they are pursuing their studies, and by this means optimising the use of specialist training sites in order to create Community added value. In addition, organisers of international doctoral studies in the framework of a formal collaboration between research institutions (so called EuroPhD schemes) could apply for implementation of the mobility part for the doctoral students within that specific scheme.

- *Marie Curie Industry Host Fellowships*

The activity would provide to young researchers opportunities to carry out research in industrial or commercial environments in another Member State. Participants in this activity would be industrial and commercial enterprises carrying out research and the young researchers they host. The host would be expected to provide adequate research facilities and supervision arrangements for the fellow. The fellows would be postgraduates or young researchers with proven research experience. This activity would be jointly funded by the industry or other commercial enterprises and the Community. There would be special measures for SMEs in order to facilitate the participation of these enterprises in the activity.

- *Marie Curie Development Host Fellowships*

The activity would contribute to the development of new competence in existing research institutions in less-favoured regions. Participants in this activity would be research institutions in less-favoured regions with a need to develop new areas of competence and the young researchers with proven research experience and experienced researchers that they host. By this means the Community's scientific and technological cohesion would be enhanced.

- *Marie Curie Experienced Scientists Fellowships*

The activity would harness the expertise of Europe's experienced researchers for the transfer of knowledge and technology between industry and academia (in both directions) and for similar transfer to the less-favoured regions. Participants in this activity would be experienced researchers and the research institutions hosting them. The experienced researchers would facilitate transfer of knowledge and technology or provide initiation of new competence in the host.

This activity would encompass two components: (a) an industrial component (the experienced researcher could either come from an industry or other enterprise and go to a university or research centre; or come from a university or research centre and go to an industry or other enterprise that carry out research); (b) a less-favoured region component (the experienced researcher could either come from a less-favoured region; or go to a research institution in a less-favoured region).

## ***IMPROVING THE UTILISATION OF MAJOR RESEARCH INFRASTRUCTURES***

### **Rationale and objectives**

Access to major research infrastructures is increasingly indispensable for researchers working at the forefront of science. The ability of European research teams to remain competitive with teams elsewhere in the world depends on their being supported by such state-of-the-art infrastructures.

The term “research infrastructures” refers to facilities that provide essential services to the research community in any field of scientific research (including the economic, legal and social sciences). It covers, for example, singular large-scale research installations, collections, special habitats, libraries, data-bases, integrated arrays of distributed installations, as well as infrastructural centres of competence which operate a service for the wider research community based on an assembly of techniques and know-how.

As most of the major research infrastructures in Europe are operated by national authorities principally for the benefit of their national researchers, access to these infrastructures is often restricted largely or even entirely to national research teams. The result is that many researchers do not have the opportunity to access the infrastructures in Europe most appropriate for their work. In addition, some scarce state-of-the-art facilities owned by industrial companies tend to be closed to researchers working outside the company.

Another feature of Europe’s research infrastructures is the relatively low level of transnational cooperation that exists between infrastructure operators in many fields. A strong Community added-value would arise if the same culture of cooperation could be created among infrastructure operators as is now beginning to exist between Europe’s researchers.

To address these issues, the following general objectives would be pursued :

- to create new opportunities for transnational access to major research infrastructures in all fields of scientific research for those research teams which would not normally have access to them;
- to stimulate infrastructure operators and users to work together in order to make more effective use of research infrastructures and hence to improve the service they provide to the scientific community. Such actions (thematic networks and RTD projects) within this Programme would be confined to those research fields not covered by other specific programmes, or to categories of infrastructure not considered by those programmes;
- to arrange coordinating, supporting and accompanying actions that ensure consistency with related actions undertaken in other specific programmes.

### **Activities**

#### **• *Access to Major Research Infrastructures***

This action would sponsor new opportunities for research teams to obtain access to the major research infrastructures most appropriate for their work, irrespective of where in Europe they or the infrastructure is located.

To be considered for Community support, the infrastructure would have to provide a world-class service essential for the conduct of top quality research, be rare in Europe, have investment or operating costs that are relatively high in relation to those costs in its particular field, and provide adequate scientific, technical and logistic support to external, particularly first-time, users. Community support would be awarded to the selected infrastructure operators for them to provide access to their facilities free of charge to transnational users. Each selected infrastructure operator would be expected to publicise widely the opportunities being offered and to arrange for an independent peer-review of proposals submitted to it, where priority would be given to first-time users and to users coming from countries where no similar facility exists.

As a general rule, users conducting proprietary research would not be supported under this action. An exception would, however, be made in the case of SMEs who wished to use a particular infrastructure for the first time.



- ***Infrastructure Cooperation Networks***

This activity would catalyse the self-coordination and the pooling of resources between infrastructure operators and users in order to spread good practice, to generate critical mass for research into higher performance techniques, instrumentation and technologies as well as into next generation infrastructures, to promote complementarity and interoperability, and to stimulate the creation of distributed “virtual” large facilities.

Community support would be awarded to help coordinate those joint activities that could lead to the more effective use and exploitation of present and future infrastructures relevant to the network. Participants in these networks would be operators of major and medium-sized research infrastructures, research teams in universities, in research centres and in industry, representatives of users, and equipment manufacturers. Each network would be devoted to different aspects of Europe’s research infrastructures.

Additionally, as a means of stimulating proposals in fields of infrastructure where there is little history of transnational cooperation, exploratory awards would be granted in order to bring together potential network participants for the purpose of elaborating a detailed workplan for an Infrastructure Cooperation Network proposal.

- ***Research Infrastructure RTD Projects***

These cost-sharing RTD projects would support cooperative efforts that could have widespread impact on infrastructure provision in a particular field. Such research projects would be particularly encouraged when they are in support of the work of the Infrastructure Cooperation Networks of this Programme or of the Access to Large-Scale Facilities Concerted Actions of the earlier Training and Mobility of Researchers Programme.

## ***PROMOTING SCIENTIFIC AND TECHNOLOGICAL EXCELLENCE AND THE PUBLIC IMAGE OF RESEARCH***

### **Rationale and objectives**

Scientific and technological excellence are essential prerequisites for Europe to succeed in the competitive environment of international research and scientific development. The promotion of excellence would be expected to encourage the best individuals and teams to become involved in and be committed to European research and to increase the visibility of outstanding research findings produced by European researchers.

At the same time it would be important to improve the image of science and research in society with the objective of creating a favourable environment for research and technological development, and in particular for activities carried out under Community Framework Programmes. Scientific activities and research can only succeed and have the expected beneficial impact if citizens develop a basic understanding of science and scientific issues and come to an overall positive perception of relevant activities and their results.

### **Activities**

- ***Scientific Meetings***

Scientific meetings would contribute to the advancement of science through exchange and to create conditions for experienced researchers, working at the cutting edge of scientific and technological development, to impart their knowledge and experience to the younger generation. Scientific meetings would also create the framework for Community researchers active outside the Community to build up or preserve their network of contacts and scientific relations with colleagues in Europe.

Scientific meetings may be organised as Euro-conferences, -courses, -workshops or -summer schools. They would, as a general rule, be small scale events. Bigger events may be supported with the objective of facilitating the participation of young researchers. Non-traditional forms of scientific conferencing such as electronic conferences would be encouraged. Scientific meetings would be open to all fields of scientific research on topics freely chosen by the researchers themselves.

- ***Distinctions for High Level Research Work***

These distinctions would give public recognition and visibility to European researchers having successfully completed outstanding transnational projects in fields of research and technological development, in particular those supported under Community Framework Programmes. Distinctions for younger people who have carried out remarkable scientific work whilst being still in the secondary or tertiary educational system would motivate them to continue their efforts in the interest of Europe's scientific and technological future and also encourage other individuals of the same age to take an active interest in science and research.

Distinctions would be foreseen as follows: the "*Descartes Prize*" for outstanding scientific and technological achievements resulting from European cooperation, in particular from cooperative projects supported under Community Framework Programmes; an Award to undergraduate students of higher education institutions in Europe having developed original scientific ideas or concepts in areas which are relevant to the advancement of European science; the *EU Contest for Young Scientists*, catering for scientific talents in the age range 15 to 20 years, to be organised in conjunction with the appropriate "public awareness" activities. Where possible, European distinctions would build on existing national schemes and distinctions.

- ***Public Awareness***

The main objective would be to raise public awareness for scientific activities and technological developments, in particular those undertaken in European research programmes, and thereby bridge the gap between science in its European dimension and the public. This should help European citizens to better understand both the beneficial impact of science on their day-to-day lives as well as limitations and possible implications of research and technological developments. The activity would also aim to increase scientists' awareness of issues and subjects that are of concern to the public.

Community support would be provided: to promote European networking and the exchange of best practice between successful projects and initiatives at national or regional level; to arrange for regular encounters between scientists and science communicators; to promote the participation of women in science; to support the organisation of a *European Science Week* as a showcase for the concerted and coordinated display of European efforts in science and research; to provide via electronic networks and other appropriate means information on topical scientific and technological subjects in a language that is understandable to the scientifically interested but non-specialist citizen.

## ***HARNESSING SOCIO-ECONOMIC RESEARCH TO THE NEEDS OF THE EUROPEAN SOCIETY***

### **Rationale and objectives**

The European Union draws its strength both from the social and cultural diversities between its members as well as from the similarities of their experiences and common values. In a period of increasing challenges, such as unacceptable levels of unemployment, an increase in inequalities, and a declining relative contribution to the world economy, European society will have to undergo changes towards achieving sustainable socio-economic development, the improvement of the quality of life of all its citizens and to maintain and enhance Europe's competitive position in the world. Social sciences must therefore be in a position to respond to these challenges, overcome national boundaries, reinforce their cooperation and enhance their analytical capacity. Furthermore the process of European integration itself has given rise to a new object of study - European society - which is different from the sum of its components, although clearly dependent on them.

The objective of this part of the programme would be to improve our understanding of the structural changes taking place in the European society in order to identify ways of managing change and to involve European citizens more actively in shaping their own futures. This would involve the analysis of the main trends giving rise to these changes, the elaboration of new development strategies promoting growth and employment and the re-appraisal of participation mechanisms for collective action at all levels of governance.

Support would aim at developing a conceptual understanding of the processes described above, built upon empirical, comparative and prospective research, including constructing and integrating data and indicator systems and establishing a common research infrastructure. This activity would therefore contribute to provide the policy decision-making process with a sound knowledge of the challenges facing Europe, of their main consequences and of possible policy options to tackle them.

## Activities

- ***Societal Trends and Structural Changes***

Against a background of profound structural changes, research within this theme would aim at elucidating the complex interactions between social trends, life chances, economic changes, labour market institutions and cultural patterns, taking into account European regional diversities.

The study of these interactions would provide a better comprehension of the changing patterns of work and organisation of time, of the capacity of education and training to prepare individuals over their lifetime to a changing environment and to enhance knowledge, of the role of technical progress in social change and of the various types of organisation of productive activities according to their socio-cultural context. Research work would provide a sound knowledge base and contribute to the formulation and development of the relevant European policies.

- ***New Development Models Encouraging Growth and Employment***

This prospective work would seek to explore new development models to ensure growth, job creation, the reduction of inequalities and the improvement of the quality of life. It would investigate the dynamics of creation and distribution of wealth, in a globalised economy where “intangible” and service factors predominate. This would involve the development of indicators and methodologies for assessing the social and economic added value of the various production models, identifying competitiveness factors including human capital and characterising the different policies best adapted to the European economic area and to the evolution of Europe in the world economic relations.

Research would concentrate, inter alia, on case studies, analyses of issues such as organisational innovations, responses to the increasing demand for services, the development of non-profit mutual supporting activities, and innovations in socio-economic partners cooperation. Research would also cover the incorporation of socio-economic needs in technological development, focusing on methods of interaction between the various actors concerned as well as on the effects of the deployment of certain technologies. Special attention would be paid to how education and training can stimulate innovation, promote employment and social integration. Innovation in education and training methods and technologies is another important issue. These development models would take into account, where appropriate, the concept of life-long learning.

- ***Governance and Citizenship***

In the context of European integration, there is a need to re-assess the role of the different levels of governance in Europe. The aim would be to analyse the mutual articulation of responsibility and accountability at all levels and their real capacity as agents of change, whilst allowing for the development of mechanisms of dialogue, deliberation and decision-making (i.e. gender parity) to ensure effective cooperation between all the actors concerned.

Research would set out to explain to what extent the various types of economic and social regulation in Europe are the consequences of a specific socio-institutional and cultural construction, in order to define better European integration strategies. It would address both regulation by public authorities as well as civil initiatives. The examination of the role of public authorities would also cover the re-assessment of their missions, and of the concept of public service and the notion of public interest. In this framework, the analysis of the evolution of welfare systems would be a key element.

The analyses would be accompanied by the study of the concept of citizenship across Europe, and of types and systems of regulation to which they give rise. Research would also analyse the influence of the various components of culture (traditions, language, history, heritage, religions, migrations) and of educational models on the development of values within a global economy in which international audiovisual cultural products are increasingly present.

## ***SUPPORT FOR THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY POLICIES IN EUROPE***

### **Rationale and objectives**

To fulfil the tasks conferred on it by the Treaty in the field of research and innovation, the European Union needs to increase its ability to anticipate the stakes and issues for Europe in the field of science and technology, by exploiting the resources available to it in this area more effectively

A considerable amount of research work and studies are carried out and indicators produced ahead of the framing of science and technology policy at national and European level. The inadequate interaction between very diverse national approaches, and the complexity and often transnational dimension of the issues addressed by the work in question call for networking and the collation and coordinated exploitation of results at European level in order to shed light on certain major issues in good time

In order to nurture the framing and continuous development of Union research strategy, these activities would provide a strategic intelligence, collating and assessment service for both national and European research decision-makers and players

### **Activities**

- ***Assessment of science and technology options***

This activity would involve support for the cooperative collating work carried out by specialist organisations within the Union. It would be a question, on the one hand, of analysing the implications for research policies of the challenges of scientific and technological change, globalisation, changing societal demands, new forms of inter-firm competition and cooperation, job creation, and growth which takes into account the needs of the environment and social cohesion and, on the other, of studying to what extent the objectives, priorities and the mechanisms implementing those policies make it possible to meet them. In this context, those responsible for research policies, and researchers specialising in the study of such policies would be systematically called upon to discuss together the feasibility of various options and recommendations arising from the work on the assessment of science and technology options. These exchanges would also help to identify themes for future work.

The JRC's Institute for Prospective Technological Studies would be closely involved in the preparation of the options and recommendations in which this collating work should culminate, through its technology assessment, technology watch and technology foresight work.

- ***European system of science, technology and innovation indicators***

The design, coordination and assessment of research strategies in Europe require the availability of relevant and comparable indicators, including indicators measuring progress towards sustainable development. This second type of activities, carried out in conjunction with the Statistical Office and the relevant parts of the Commission and in cooperation with the specialist institutes in Europe, should gradually establish a common European base of science, technology and innovation indicators. It would be a question of coordinating and funding the work needed in order to compile appropriate statistics and new indicators covering the Union and the main non-Union countries; it would in this way be possible to make available to the authorities concerned in the Member States, the European and national parliamentary assessment offices, and the departments of the Commission and all interested parties, a coherent set of data sent electronically and accompanied by the instructions needed for their processing and analysis

# ***DIRECT RTD ACTIONS***

## **INTRODUCTION**

Direct Actions are one of the ways the Fifth Framework Programme will be implemented. They are carried out by the Joint Research Centre - the JRC\* - as part of its mission. Accordingly, they provide scientific and technical support for the framing and implementation of the various EU policies.

The JRC is the scientific and technical body the Commission needs in order to exercise its prerogatives. In fulfilling this research function, intended to ensure the scientific base for Community regulations, it enjoys the following assets:

- neutral and impartial expertise to help frame and implement Community policies;
- units of scientific and technical excellence;
- cutting-edge facilities and sometimes unique skills, helping to make it a reference centre for many European networks.

### **Strategic objective of the programmes**

The recent past has shown that the Community and the Member States need to be able to turn to such a body when important interests are at stake, particularly when there is a potential threat to public health or in the fight against fraud. The Fifth Framework Programme should see the JRC focus its activities on areas where its European added value is fully exploited. Its activities would thus be very largely defined through its client/supplier relations with the Commission's other Directorates-General, with the flexibility inherent in such relations.

Response to needs, quality of work and the relevance of that work to the Community are the three criteria underpinning the activities the JRC pursues through the direct actions. The JRC's European dimension and its neutrality would be exploited through collaboration with European research bodies and industry. Networked working would be a leading element of JRC strategy. In this scheme of things the JRC would be an important focus of technological exchange and integration in the European Union.

## **DIRECT ACTIONS IN THE FIFTH FRAMEWORK PROGRAMME**

### **Rationale and objectives**

The JRC's Direct Actions would fit fully into the Fifth Framework Programme, tying in with the indirect actions and oriented along a number of key lines. They would contribute to the objectives of the Key Actions and the Activities for the research and development of generic technologies. Lastly, the JRC would use its position at the heart of Community research to lend its support to research infrastructures and its active assistance to collaborative networks.

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\* The first programme of JRC direct actions is based on the EC Treaty, the second on the Euratom Treaty

Direct action contribution to:

- the theme ‘Unlocking the resources of the living world and the ecosystem’  
Activities would mainly concern health policy, consumer protection policy, environment policy and the various aspects of the common agricultural policy. Priority would be given to the quality and safety of food and consumer products and to natural hazards, the management of water resources and the monitoring of water and air quality. A particular effort would be made to support Community legislation and to combat fraud and counterfeiting.
- the theme ‘Creating a user-friendly Information Society’  
Work would focus on the dependability of systems and on access for European citizens and bodies to dependable services through the use of information technologies. A particular effort would be made here to support the fight against fraud and assist the departments responsible for that fight. The JRC would also lend support to research into the detection of anti-personnel mines.
- the theme ‘Promoting competitive and sustainable growth’  
This is an area where the JRC has developed centres of excellence with a recognised European dimension. The JRC would help make industry more competitive, while protecting the citizen and the environment. The priority aim would be to draft and implement norms and standards, particularly through research activities pursued through networks.
- the activity ‘Improving human potential’  
The JRC would continue to provide broad access to its laboratories and facilities to researchers and scientists from the Member States, the associated States and the non- Member countries with which it cooperates, and thus foster cohesion in Community research.  
In the area of socio-economic research, the JRC’s contribution would deal in particular with analysis of the relation between technology and society and the development of growth/employment models. The JRC would continue to offer, through the European Science and Technology Observatory, an information and strategic analysis service on the evolution of science and technology in Europe and the world.
- implementing the Euratom Framework Programme  
Accomplishment of the tasks which would be entrusted to the JRC would help ensure constant improvement in the safety and security of the entire fuel cycle. Often the sole depository in the Union of skills or knowledge drawn upon by Europe’s major research bodies and industries, the JRC would bring its impartial expertise to debates by the public authorities or industry. It would contribute to research on controlled thermonuclear fusion in certain specific areas.

## **JRC ACTIVITIES CARRIED OUT THROUGH DIRECT ACTIONS UNDER THE EC FRAMEWORK PROGRAMME**

The JRC would pursue its research work, the exploitation of results and the transfer of technologies to users, Commission departments and industry. Priority would be accorded to SMEs in the search for industrial partners.

### • **Protection of the citizen and the environment**

#### Health protection

Greater institutional support would be needed in the areas relating to the health and consumer protection policies and their implementation, along with ‘fraud prevention’. These activities would also contribute to the objectives of the ‘Health and food’, ‘Health/environment interactions’ and ‘Multimedia content’ Key Actions and be geared towards the following concerns :

- *Quality of food and consumer products, toxicological studies*

- \* *analysis of the quality and safety of food and consumer products: through the Laboratory for Consumer Protection, a 'laboratory without walls', development of available analytical procedures, guaranteeing the highest level of consumer protection, and of tools for the implementation and legal enforcement of those methods (harmonisation of analytical techniques);*
- \* *support for the system of exchanging information on pharmaceutical regulations, using the European Technical Office for Medicinal Products;*
- \* *studies on the risks linked to various toxic products and food contaminants and on the safety of consumer products, harmonisation of inspection methods in Europe; studies on the impact and health effects of certain chemical and microbial pollution; support for the implementation of Community legislation;*
- \* *monitoring and management of chemical products: the European Centre for the Validation of Alternative Methods would coordinate at European level the validation of alternative procedures to in vivo experiments, and the European Chemicals Bureau would remain the focal point for implementing and improving Community regulations.*

**- Medical applications of generic technologies developed by the JRC**

- \* *medical imaging, certain cancer therapies, biocompatible materials (including validation of test methods), as well as qualification of certain categories of medical equipment so as to harmonise the relevant norms and standards;*
- \* *certification of reference materials in the field of biomedicine, as necessary for diagnostic tests.*

Dependability of the Information Society

Activities would be a direct response to requirements relating to the Commission's efforts to implement the Information Society and would tie in with the objectives of the 'Systems and services for the citizen' and 'New methods of work and electronic trading' Key Actions.

- \* *research into systems dependability and the guarantee of access to dependable services: further development of certain technologies touching on systems vulnerability, dependability and protection, validation of European criteria required by the Commission's departments (e.g. important safety software, qualification procedures for software and computer systems, use of research results in statistical applications).*

A humanitarian action: detection of anti-personnel mines

In conjunction with the Key Actions referred to in the preceding paragraph and in support of the Commission departments involved:

- \* *contributions to the science and technology base for helping with mine detection and destruction operations; compilation of an index of mine types and signatures and study of ways of examining mine fields and establishing detection methodologies and reference criteria for evaluating the various systems. The JRC's unique expertise and facilities (e.g. the European Microwave Signature Laboratory) would be used to support demining projects.*

Protection of citizens in their immediate environment

The JRC would here carry out a number of projects targeted on its specific skills and unique facilities and whose nature links them to the objectives of the 'City of Tomorrow' and 'Sustainable mobility and intermodality' Key Actions. Activities would cover the following :

**- Safety in buildings and public works, and protection of cultural heritage**

- \* *help in improving the resistance and safety of structures against seismic movements and rapid impacts (traffic vibrations), particularly using the Reaction Wall facility of the European Laboratory for Structural Assessment and the Large Dynamic Test Facility, and preservation of cultural heritage (laser assessment of building*

*degradation, surface cleaning and protection techniques).*

**- Mobility in cities: for safer traffic and clean, safe and efficient vehicles**

- \* *structural safety of vehicles in crash conditions (calibration of test facilities in the Member States and validation of the digital simulation methods developed as a substitute for traditional impact tests);*
- \* *use of hydrogen as a fuel: safety and certain techno-economic aspects; interactions of hydrogen with structural materials with a view to consensus on safety, norms and standards;*
- \* *development of decision-support systems for mobility, employing a combination of satellite images and simulation models.*

**Protection of the Environment**

The JRC would look both at the causes of pollution and at its effects. These activities would also tie in with the objectives of Key Actions such as 'Management and quality of water', 'Health/environment interactions' and 'Integrated development of rural and coastal areas', as well as several activities for the research and development of generic technologies. They would also meet the requirements of the Council Regulation setting up the European Environment Agency, which stipulates that the JRC must provide scientific and technical support.

**- Prevention and monitoring of pollution**

- \* *support for Community legislation on the management and quality of water, focused through the European Laboratory for Water Pollution for the analysis and treatment of water (reference methods for water quality, assessment of the toxicological risks posed by various pollutants, development and production of certified reference materials, establishment of procedures and criteria for monitoring and harmonising monitoring techniques), and water management in regions protected by European legislation and those prone to flooding and drought, including the impact of management strategies;*
- \* *contribution to the implementation of the Community Directives (harmonisation of control methods and criteria in urban and peri-urban areas, alternative fuels, emission of minute micro-particulates through the European Air Quality Reference Laboratory); support for Community regulations on radioactivity in the environment and for certain regional programmes (Alps Observatory);*
- \* *support for Commission action in fostering the use of best available technology to prevent and control pollution in various industrial sectors, using the European Integrated Pollution Prevention and Control Bureau*

**- Global change**

The Community makes a major contribution to international action on Global Change, such as the International Geosphere and Biosphere Programme. The JRC, in close cooperation with the competent national bodies, would initiate and coordinate research to provide the results needed to prosecute the relevant Community policies:

- \* *formation of tropospheric ozone, which plays an important part in the greenhouse effect and which affects human health; questions associated with vegetation and crops; atmospheric aerosols for the prediction of climate trends.*

**- Studies on the environmental impact of certain Community policies**

The EU's policies and its legal framework are always being adapted to match the socio-economic context in which they apply. The consequences of these changes for the environment therefore need to be evaluated, and above all the foreseeable impact of the various strategies being proposed. On the basis of case studies, the JRC would provide analyses for the departments responsible for these policies

- \* *activities concerning the impact of the regional development plans, the common agricultural policy, the fisheries policy and the environment policy or of decisions in fields (i.e. energy policy), including their effect on the internal market, and incorporating a number of innovative techniques.*



## **- Environmental security and civil protection**

\* *the Major Accidents and Hazards Bureau in relation with other JRC activities, would analyse the data and supply information to the Commission (implementation of Community legislation, especially the 'Seveso' and 'Seveso II' Directives), the competent national authorities and industry. The JRC would also manage the European Coordination Centre for Aircraft Incident Reporting Systems, focusing particularly on study of the human factor.*

## **• Space technology in support of Community policies and serving European industry<sup>6</sup>**

The EU has a recognised position in space technology, but needs to develop it further. This technology, and especially satellite services and applications, is rapidly being incorporated into a whole range of areas (e.g. global telecommunications, transport, environmental study, support for Community policies) and requires special attention and coordination. The EU participates in international efforts to monitor the planet so as to ensure sustainable development. The JRC would continue to contribute to the development and viability of Europe's space industry and to ensure effective use of this technology for resource and environmental management. Its activities would tie in with the objectives of certain Key Actions ('Sustainable mobility and intermodality', 'City of Tomorrow', 'Integrated development of rural and coastal areas', 'Management and quality of water') and activities for the research and development of generic technologies.

### Centre for Earth Observation

The Centre for Earth Observation would help coordinate a mixed network of all the European partners, industries and research centres.

\* *satellite imaging (optimising the use of existing systems, study of specifications for and evaluation of new systems and new types of service); use of the full spectrum of available observation satellites and planned systems, advanced navigation and telecommunications systems.*

### Space technology serving agriculture and forestry

The use of space technology in implementing the common agricultural policy and in the management of forests is now well established.

\* *harmonisation and quality control of the approaches taken, as well as other practical aspects of the CAP and forest management, such as environmental impact and fraud prevention; dealing with problems of harmonisation and analysis of situations for the purposes of Community policy, particularly with a view to EU enlargement.*

### Monitoring and management of resources and the environment

JRC activity would take place in an international context, such as the International Geosphere Biosphere Programme or international conventions.

\* *use of satellites to study the distribution, evolution and dynamics of land and marine resources.*

### Environmental security

Research combining space technology and ground studies. These techniques could be used for determining the probability of natural events and evaluating their impact if they occur.

\* *research on flood prevention and drought monitoring, and the prevention and management of other natural hazards (e.g. landslides, coastal storms, fires, etc.).*

## **• Support for the Community's legislative activities, and the fight against fraud**

Fraud costs the European tax-payer dear. It adversely affects economic development and distorts competition to the disadvantage of honest businesses. Where food and consumer products are involved it poses a health risk. The

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<sup>6</sup> There is overall, cross-programme coordination of activities relating to space applications.

development of technologies and techniques to combat fraud is an area where the intervention of a neutral and disinterested body is essential. Similarly, objective, neutral and independent scientific support is essential for the Commission's standardising activities. This collaboration would be without prejudice to the need for confidentiality and would be organised around the JRC infrastructure. These activities would be fully in line with the objectives of several Key Actions, including 'Advanced energy systems and services', 'Products, processes, organisation', 'Health and food', 'The cell factory' and 'Integrated development of rural and coastal areas', and activities for the research and development of generic technologies.

#### Standards, criteria and inspection procedures

##### **- In the field of energy**

These activities would build on the JRC's experience with high-temperature materials and through networks.

- \* *development of new testing techniques and support for the preparation of norms and standards for photovoltaic and solar-thermal systems, the new generation of electric batteries, fuel cells and the typology of insulation materials;*
- \* *improvement and evaluation of the safety and reliability of high-efficiency power generation systems and components; reduction of polluting emissions, improvement of thermal efficiency, extension of operational lifetimes for plants and preparation of norms and standards.*

##### **- In other fields**

- \* *design, prototyping, validation and harmonisation of inspection procedures for High Pressure Equipment in support of European Directives: improvement and assessment of advanced materials and new surface coating treatments to enhance the safety of high-temperature systems (aircraft, cars, etc.) and harmonisation of tests for characterising structural materials and inspection procedures;*
- \* *support for the formulation and development of standards (Eurocodes) to ensure the safety and reliability of buildings and other civil engineering structures;*
- \* *establishment of a multidisciplinary database of harmonised and coherent geographical data for Europe thanks to the Geographic Information System, a focus of technical coordination; promotion of 'criteria' software and methods making for complete systems interoperability.*

#### Reference materials and measurements

The JRC would continue its collaborative activities for the production and distribution of certified reference materials and the international evaluation of measurement quality, as well as its own research to establish reference measurements and methods:

- \* *preparation, characterisation and certification of reference materials in fields where urgent intervention is needed or where existing certified reference materials at the Community Bureau of References need to be replaced; development and validation of analytical reference methods for various elements and their chemical forms, for radionuclides and for organic constituents;*
- \* *interaction between neutrons and materials, radionuclide metrology for the preparation of primary standards, calibration of photon detectors and determination of radioactive trace elements in materials, particularly for micro-electronics;*
- \* *development and execution of primary isotopic measurements; production of isotopic reference materials for the comparability of chemical measurements (implementation of environmental Directives), for supporting accreditation bodies and for international quality assurance systems. (Isotopic reference measurements would in particular concern food, health and the fight against drugs. These activities would come under the quality system (ISO 9001) put in place by the Commission);*

- \* *establishment of a network of primary isotopic measurements with the relevant national institutes and the competent European associations; development of the traceability of chemical measurements and support to EU Member States wishing to build up their own metrology systems.*

#### Fraud prevention in the area of food

##### **- origin, authenticity and labelling of food and drinks**

- \* *support from the European Office for Wine, Alcohol and Spirit Drinks for the appropriate regulations and expansion of research to other foods (e.g. exercises in testing, certification of analytical methodologies); development of fraud control technologies (often derived from the monitoring of nuclear materials), development of techniques for determining the purity and authenticity of liquid foods (e.g. oil, milk);*
- \* *harmonisation of techniques for detecting genetically modified organisms and components thereof in food and feedstuffs; technical and scientific support for the implementation of regulations concerning the products of modern biotechnology; development and production of certified reference materials of selected organisms (thanks to the Biotechnology Information System); development of the requisite sampling to monitor the geographical spread of new genetically modified seed, using satellite observation.*

##### **- electronic identification of livestock**

The JRC would continue to give technical support for the Electronic Animal Identification project to demonstrate the full-scale feasibility of an electronic tagging and monitoring system for one million animals, from birth to slaughter:

- \* *quality control, electronic hardware certification, design and operation of a database for registering and monitoring livestock movements throughout the European Union; upon completion of the project, around the year 2000, technical support for the implementation of a system for the entire EU herd (300 million animals) allowing reliable identification and labelling up to the ultimate consumer stage.*

#### Fight against illicit drugs

Through European networks, the JRC would work along three priority lines:

- \* *use of isotopic measurements to reveal the origin of illicit drugs and create an identity card for them; characterisation of new synthetic drugs through chemical analysis; support for the agencies responsible for combating drug-trafficking, particularly to ensure the secure transmission and reliable storage of confidential information.*

#### Information and remote sensing technology in the fight against fraud

The JRC would work on protecting data and electronic transactions which are particularly vulnerable to dysfunction or deliberate fraud.

##### **- Monitoring of farmers' declarations**

The JRC's technical support to the Commission would cover:

- \* *quality control of the work performed in each Member State and means of seeing that results are consistently in line with the common agricultural policy, and reorientation of the geographic information system towards new sectors of agricultural activity.*

##### **- Analysis and control of information**

Protection of the use and exchange of sensitive EU data along the following lines:

- \* *development and operation of effective, reliable and safe communication systems between the Commission and the public authorities and between the latter; warning systems (further development of advanced technologies for filtering and analysing large quantities of data with the aim of being able to manage information better and reveal disparities indicative of possible fraud); advanced statistical methods and appropriate sampling*

*strategies in support of the CAP at the decisive stage of clearance of accounts;*

- \* *development of monitoring techniques (using satellite systems) which would allow surveillance of the regulated activities of certain businesses (e.g. in the fisheries sector) or of the movements of means of transport without having to install active systems on the object in question.*

- **Analysis of technology foresight**

Providing analysis of technology foresight for the policy-making process would be one of the JRC's tasks (in close coordination with the indirect actions). The main users of this work would be the Commission and the European Parliament, in collaboration with the Scientific and Technical Options Assessment office. The results of this work would be made public so that Europe's citizens and industry can benefit from it.

#### Technology watch

'Technology watch' activities would enable the JRC to provide the European institutions with quality expertise within short deadlines. Such a forward-looking approach should:

- \* *facilitate the identification of key areas of science and technology for the future and anticipate their potential breakthroughs on emerging markets and their social consequences, notably with help from the European Science and Technology Observatory, reinforced and expanded to create a 'virtual observatory' with a wide range of international collaborators and constituting a key source of information for decision-makers.*

#### The impact of science and technology on employment and competitiveness

To enhance its capacity to support the policy-making process, the JRC would step up its in-house capacity to analyse the technology-employment-competitiveness nexus and would make use of the results of socio-economic research programmes. New initiatives such as the 'Made in Europe' project would be used to exploit the results of this work. Two broad areas would be envisaged:

##### **- *New technologies, employment and competitiveness***

- \* *studies on the role of science, technology and innovation in fostering competitiveness, growth and employment in Europe. Particular attention would be given to the creation of knowledge, analysis of the relative development of industry and services, new forms of organisation, and the matching of skill requirements with the training offered by educational systems.*

##### **- *Exploiting Europe's S&T potential for innovation and cohesion***

- \* *studies with the aim of better understanding of Europe's S&T system with a view to stimulating innovation and cohesion; particular attention would be paid to the factors capable of enhancing the development of the least favoured regions and their capacity to create jobs, especially as regards the Mediterranean Basin.*

## **JRC ACTIVITIES CARRIED OUT THROUGH DIRECT ACTIONS UNDER THE EURATOM FRAMEWORK PROGRAMME**

### **Controlled thermonuclear fusion**

The facilities at the JRC's disposal would be operated as part of the division of tasks established with the industry and the national laboratories. An integral part of this activity, on a par with the Euratom Associations, the JRC's contribution would mainly concern:

- \* *the materials necessary for fusion (with particular emphasis on low activation materials); the way hydrogen and its isotopes interact with materials and components; lastly, participation in studies on the safety and environmental impact of future facilities.*

### **Fuel cycle safety and safeguards**

Built around skills and facilities which are unique in Europe, some of these activities would be carried out through European collaborative networks and through broader international cooperation.

#### **Fuel cycle safety**

- \* *basic research into actinides: the JRC is regarded as the centre of excellence in this field which seeks detailed knowledge of the properties of these elements. This is essential to reactor safety and indispensable for industrial operations such as reprocessing, processing, storage and disposal of waste and irradiated fuel ;*
- \* *nuclear fuel safety: work would cover detailed study of the phenomena occurring during irradiation of nuclear fuel, as well as the optimisation of those fuels to enhance both safety and efficiency (e.g. increased rate of irradiation, advanced fuels);*
- \* *study of enhanced separation and transmutation: lowering the radiotoxicity of waste by reducing, or even eliminating, the presence of actinides and other long-lived radioactive elements in the fuel cycle. The JRC would work on the development of appropriate techniques for processing these materials;*
- \* *study of irradiated fuels with a view to direct disposal: the JRC would help examine long-term behaviour in storage and final disposal conditions, and help determine the risks associated with their radiotoxicity.*

#### **Control of nuclear materials**

The scientific and technical support necessary to implement safeguards pursuant to Chapter VII of the Treaty and the obligations arising from the Non-Proliferation Treaty and the implementation of the Commission's IAEA support programme would be part of a dual process: continuity (in the pursuit of efforts to meet the technological challenges of the large fuel cycle facilities) and innovation (to meet the new challenges arising following major international decisions, as well as the incorporation of new, more efficient technologies).

#### ***- As regards continuity:***

JRC activities would aim to make control methods and techniques more efficient and cost-effective. Technological innovation would play a driving role:

- \* *analytical measurement techniques: development of new techniques or improvement in the performance of existing techniques, with emphasis on automation (on-site laboratories at large reprocessing plants, analysis of samples for safeguard controls and evaluation of the quality of these measurements; development and evaluation of volume measurement and sampling techniques; non-destructive testing techniques, particularly for the plutonium cycle);*
- \* *monitoring techniques: sealing and confinement techniques, particularly in view of the increased use of MOX fuel; use of information technology (including use of lasers for the construction of three-dimensional models of facilities)*

- ;
- \* *monitoring of performance in different operating conditions (hostile environment), and study of the conformity of industrial equipment with international standards;*
  - \* *training of inspectors and operators, in particular in new technologies.*

**- As regards innovation :**

JRC activities would reflect the very ambitious objectives set by the political authorities at international level:

- \* *development of high-performance analysis to detect minute traces of radioactive materials in the environment;*
- \* *development of techniques using remote sensing: assessment of the exact role that remote sensing can play among the methods of checking and detecting illicit activities; establishment of the requisite infrastructure (networks of laboratories) for implementation for control purposes;*
- \* *evaluation, with regard to controls on fissile materials, of certain innovative concepts in the field of reactors and the fuel cycle; preparation of an approach that is adequate in terms of control;*
- \* *development of information processing techniques for the analysis and detection of anomalies between declarations and verifications.*

The JRC's activities in this field are an integral part of a process both of European cooperation, as reflected in the European Safeguards Research and Development Association network, and of international cooperation with the United States, Russia, Japan, Brazil, Argentina and Canada.

Action to combat illicit trafficking in nuclear materials and damage to the environment

The JRC's impartiality is essential in this sensitive area. Analyses would concern the specific properties of fissile elements, such as isotopic composition, purity and granulation. Work would relate to:

- \* *perfecting of analyses to evaluate the characteristics of materials (intended use, date of fabrication, etc.) and development of a database to collate these characteristics;*
- \* *development of ultra-sensitive analyses to make it possible to identify the routing of materials up to their place of seizure. These technologies would also be used in the analysis of samples in the event of environmental damage involving radioactive materials (e.g. illicit dumping).*

• **Reactor safety**

The JRC would focus its activities on selected themes of particular importance to which it would bring high European added value.

The European networks in the fields of ageing, inspection techniques and structural integrity

The European networks, of which the JRC is the focal point, are aiming to achieve consensus and to harmonise codes in Europe. They concern:

- \* *the ageing of materials and components: determination of the residual lifespan of reactors and their main components, essential for safety and operation; constant improvement to and qualification of in-service inspection techniques through the evaluation of structural integrity and the development of methodologies and the qualification of non-destructive examination techniques. (A similar contribution would be made for the probabilistic studies and methodologies used.)*

The study of serious accidents

The understanding and management of serious accidents in reactors has assumed particular significance with the unanimous decision of the safety authorities to require this type of accident to be taken into account in reactor design.

- \* *operation, through a European network and with the support of the US Nuclear Regulatory Commission, of the FARO facility (this installation, the only one of its kind in the world, should make possible the study of in-vessel and ex-vessel phenomena following core breakdown and fusion using real materials and representative*

*configurations and the validation of analytical approaches); study of aerosols created during a serious accident, in particular where pipes burst as a result of ageing, in the 'Storm' facility; continuation of the JRC's collaboration with the international PHEBUS programme. On a reciprocal basis, the JRC would receive teams from Member State research bodies in its large facilities, in particular FARO.*