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Commission Working Paper

**“TOWARDS THE 5TH FRAMEWORK PROGRAMME:
SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES”**

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INTRODUCTION

This second Working Paper on the 5th Framework Programme for Research and Technological Development is intended to pave the way for a new stage in the preparation of the Framework Programme.

The Communication "*Inventing Tomorrow*" dated 10 July 1996 set out the broad guidelines proposed for the 5th Framework Programme. In this document, the Commission underlined its readiness to mark, with this new Programme, a distinct break with earlier Framework Programmes, by focusing efforts to a greater extent, by improving the consistency of the overall approach and by paying greater attention to the exploitation of results and the management aspects.

The first Working Paper dated 20 November clarified and gave more detail about the proposed structure and instruments for implementing the Programme. The two documents have already been widely discussed, and the validity of the proposed guidelines have been broadly endorsed.

The purpose of this second Working Paper is to give a more detailed idea of the possible content of the 5th Framework Programme and the scientific and technological objectives of the proposed activities within the various programmes.

These objectives have been formulated on the basis of an analysis of the socio-economic and technological situation in Europe, and the conclusions of the evaluation of the activities conducted under earlier Framework Programmes.

In support of this Communication, the Commission Services have prepared separate documents setting out the main socio-economic and technological indicators and a summary of the conclusions of the five-year evaluation reports on European Union activities.

This Working Paper also explains the criteria used to select the objectives and provides further clarifications about the implementation and legal and financial aspects.

These aspects and the financial aspects will be explained in full in the formal proposal concerning the 5th Framework Programme that the Commission plans to submit at the end of March 1997, and which will contain the Commission's definitive proposals in the light of reactions to this Working Paper.

THE CRITERIA FOR SELECTING THE OBJECTIVES AND AREAS

The basic task of the European Union's research and technological development policy is to ensure that advances in knowledge and technologies serve the purposes of the Union and its policies. From this perspective, the two inseparably linked objectives of this policy are:

- to maintain and enhance, in the context of a genuine “*European research area*”, the **research potential** of European laboratories, universities and companies and their ability to produce knowledge of the highest level and high-quality technologies;
- to help ensure that European research serves the Union's economic and social objectives, in other words **European research at the service of the citizen and European competitiveness** in a global framework.

Basically, therefore, as provided for in Article 130f of the Treaty on European Union, the EU's research and technological development policy is based on the twin principles of scientific and technological excellence and relevance to the objectives of Union policies.

On account of these specific features, and in pursuit of a cost-benefit approach dictated by concern for optimum allocation of European public funding, the choice of objectives and activities under the Framework Programme must be made on the basis of a set of clear criteria.

This requirement is particularly important in the case of the 5th Framework Programme where it is expected that its definition should be marked by a particular effort of selectivity and concentration on a limited number of areas and objectives. The 5th Framework Programme will therefore use for the definition of its content, three categories of criteria¹:

¹ For clarity, these criteria are presented separately; however, several of them are highly interrelated (eg: *growth, competitiveness, employment*).

Criteria related to social objectives

The scientific and technological objectives selected must help to further major European Union social objectives reflecting the expectations and concerns of EU citizens:

- *improving employment*
- *promoting the quality of life and health;*
- *preserving the environment*

Criteria related to economic development and scientific and technological prospects

The scientific and technological objectives selected must correspond to areas:

- *which are expanding and which create good growth prospects;*
- *in which European firms can and must become more competitive;*
- *in which prospects of significant technological progress are opening up.*

Criteria related to the European "value added" and the subsidiarity principle

The scientific and technological objectives selected cannot be achieved through private research alone and are more effectively pursued at the European level and can be achieved more easily with projects at that level:

- *because a "critical mass" in human and financial terms needs to be established, and a mixture of complementary expertise found in the various countries is needed;*
- *because a significant contribution can be made in this way to the implementation of one or more European Union policies;*
- *because these objectives concern European problems, aspects of standardisation and the development of the European area.*

Table n° 1: The selection criteria

These criteria have been used for the identification of:

- the six major priority areas set out in the Communication "*Inventing Tomorrow*";
- scientific and technological objectives for the activities which could be conducted under the programmes corresponding to those priorities.

They will also be used during the subsequent stages of preparing the Framework Programme and they will continue to guide the concentration and selectivity effort at the stages of the definition of the detailed content of specific programmes and of their work programmes, as well as at the proposal selection stage, where they will help to identify the relevance of proposals to the objectives. They should also subsequently facilitate programme evaluation.

THE PROGRAMMES: CONTENT AND OBJECTIVES

The Treaty on European Union provides for four types of activities to implement research and technological development policy.² The structure of the 5th Framework Programme takes this into account. This section describes how the proposed programmes would be organised on the basis of these four activities and sets out the scientific and technological objectives identified for the activities under the programmes.

1. ORGANISATION AND CONTENT

In its first Working Paper dated 20 November 1996 the Commission proposed organising the 5th Framework Programme on the basis of six programmes corresponding to the six priorities identified in the Communication *"Inventing Tomorrow"*. The first three programmes ("thematic" programmes) are the research and technological development programmes corresponding to the first activity referred to in the Treaty. The last three ("horizontal" programmes) are programmes corresponding to activities II, III and IV respectively.

Three "thematic" programmes:

"Unlocking the resources of the living world and the ecosystem"

"Creating a user-friendly information society"

"Promoting competitive and sustainable growth":

Three "horizontal" programmes:

"Confirming the international role of European research"

"Innovation and participation of SMEs"

"Improving human potential".

Table n° 2: The six programmes proposed for the Framework Programme

The "thematic" and "horizontal" programmes would be both complementary and interrelated. With a view to maximum efficiency, and in line with the recommendations of the Framework Programme evaluation panel, it is proposed that the greatest possible account should be taken of the objectives of activities II, III and IV in the "thematic" programmes. One of the main

² **Activity I:** Implementation of research, technological development and demonstration programmes by promoting cooperation with and between enterprises, research centres and universities; **Activity II:** Promotion of cooperation in the field of research, technological development and demonstration [...] with third countries and international organisations; **Activity III:** Dissemination and optimisation of the results of research, technological development and demonstration activities [...]; **Activity IV:** Stimulation of the training and mobility of researchers [...].

functions of the “horizontal” programmes would therefore be to ensure coordinated implementation of all the activities related to these objectives at the level of the Framework Programme as a whole. While having their own objectives, the “horizontal” programmes would therefore help in the coherent implementation of the “thematic” programmes.³

1.1 The content of the “thematic” programmes

These programmes would be organised in such a way as to reconcile the desire to focus efforts on a limited number of objectives and the need to maintain and strengthen the science and technology base. To this end, these three programmes would comprise, firstly, a series of “key actions”, secondly, general activities for the development of generic technologies and basic research, and, thirdly, activities in support of research infrastructures.

(i) Key actions

The aim of these actions would be to stimulate the implementation, on topics connected with priority social and economic objectives for the European Union, of comprehensive approaches based on the mobilisation of a wide spectrum of disciplines, technologies and knowhow, concentrating on the bottlenecks of all types (scientific, technological and socio-economic) which are hindering the resolution of the problems involved. The experience built up during the first phase of implementation of the 4th Framework Programme shows that organising the 5th Framework Programme in a limited number of bigger programmes, while creating the conditions for more consistent and more effective management, would make it much easier to carry out such actions.

For the implementation of “key actions”, lessons would be drawn from the pilot experience of “Task Forces” set up in the 4th Framework Programme. In particular, their detailed content would be defined and their implementation monitored in close conjunction with research players and users. In this process, the detailed arrangements of which are being examined, efforts will be made to maintain an appropriate balance between suppliers and users of knowledge and technology.

One of the aims pursued would be to stimulate the emergence of a genuinely integrated science and technology area in the fields concerned, by mobilising public and private European and national resources in a convergent manner.

³ Some of the programme activities would be implemented by the Joint Research Centre (JRC). As the Commission’s scientific and technical arm, the JRC provides, through its impartial and independent position, the expertise and support needed for the implementation of Union policies.

As and when implemented, the key actions would give rise to the definition and launching of large targeted projects.

On the basis notably of an analysis of the needs capable of being most effectively addressed at European Union level, 16 subjects for key actions to be undertaken are proposed.⁴

(ii) General activities for the development of generic technologies and basic research

These activities represent the “traditional” component of EU research programmes and would comprise a significant volume of activities, but on very selectively defined topics. These activities would complement the key actions, covering work either on topics linked to the objectives of the programme but distinct from those of the key actions, or on the topics of the key actions but addressing other aspects of those topics than those considered in those actions, particularly the more fundamental aspects.

Complementing the key actions, the activities for the development of generic technologies and basic research would therefore also provide support for such actions. Carrying them out would help to both achieve the objectives of the programme and implement the research and technological development policy of the Union as a whole: one of their prime functions would be to help the Union maintain and develop the flow of ideas and knowledge, as well as its technological capability.

(iii) Support for research infrastructures

In most of the areas covered by the three programmes it is necessary to use different types of infrastructure in order to conduct research activities: large facilities, networks, centres of excellence. With a view to making the most cost-effective use of them and in order to improve the consistency of the European research fabric, greater support would be provided than hitherto towards optimizing the utilization of such infrastructure on a European scale.

⁴ Justification based on the identified criteria is provided to support the outlines of key actions in the next chapter. The synopsis table in Annex I suggests the extent to which each of these actions satisfies the different criteria.

1.2 The content of the “horizontal” programmes

The “horizontal” programmes are at the crossroads of European Union research policy and its external policy, innovation policy, and policy on education and training and the promotion of personal mobility. Each of them would comprise:

- activities directly linked to those conducted in liaison with their respective objectives in the context of the “thematic” programmes. They would essentially take the form of coordination, support and accompanying activities;
- activities linked to the general objectives of European Union policy in the field of external relations, innovation and human resources which cannot be carried out under the “thematic” programmes.

The two categories of activities would be carried out in close coordination between each other and with the corresponding activities under the “thematic” programmes.

1.3 Coordination

By reducing the number of programmes, some contributors to administrative compartmentalisation are eliminated, and they should not be reintroduced. The activities under each of the programmes would therefore be conducted, much more clearly than before, in close consultation with those of other programmes. In some cases they would be implemented in the context of actual inter-programme integration.

This formula is essential for the implementation of multi-disciplinary activities of very general interest, based on work carried out in several programmes. This would be the case notably in the fields of space technologies, the key action on ‘The City of Tomorrow’ and of course, the key action on ‘Products, Processes, Organization’ which is equally relevant to the two programmes ‘Creating a User-Friendly Information Society’ and ‘Promoting Competitive and Sustainable Growth’.

Giving a much larger role to the demonstration dimension, as well as to pre-normative research aspects, the research activities under the various programmes would take more account, from the start, of user and consumer requirements in terms of safety and quality.

The 5th RTD Framework Programme

Organization and Content

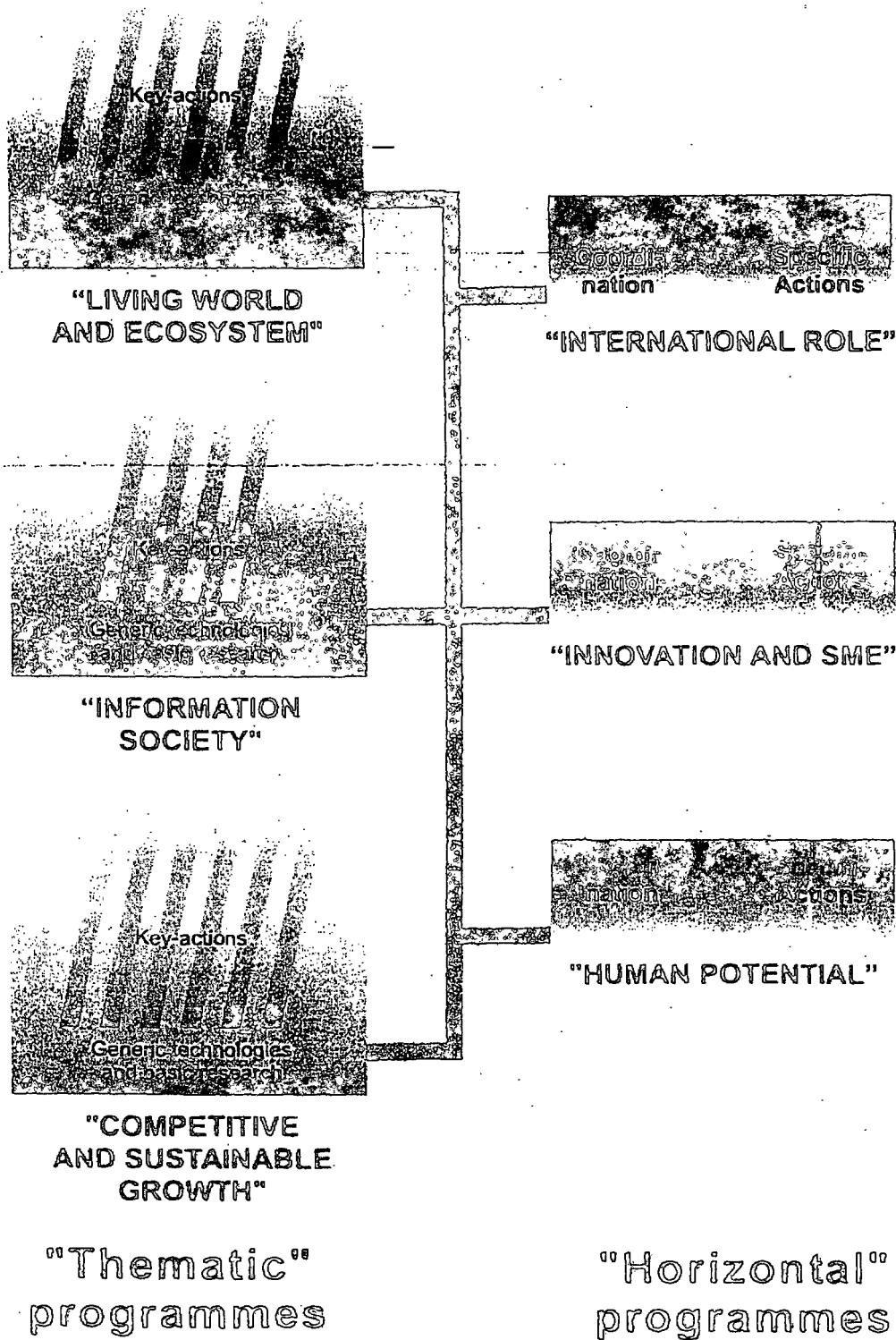


Table 3: Proposed organization of the 5th Framework Programme ("thematic" and "horizontal" programmes; key actions and general activities for the development of generic technologies and basic research).

2. THE SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES

2.1 Unlocking the resources of the living world and the ecosystem

The progress of knowledge and technology in the fields of the living world and the environment is essential for the implementation of the policies of the Union, in particular in the fields of health, agriculture, and the environment, as well as its industrial policy.

In this context, a broad range of new markets, bringing growth and employment, should soon emerge.

To ensure the exploitation of these markets and to optimise their impact on the quality of life of its citizens, the Union can build on its strong tradition in molecular biology and biochemistry, medical and pharmaceutical research, and agronomic and environmental sciences, and on its great potential in the corresponding areas of industry.

(i) General objectives of the programme

To acquire knowledge and develop the necessary technologies to:

- maintain and improve the quality of life of the citizens of Europe and the quality of the environment in Europe;
- increase the competitiveness of European industry, particularly in the fields of biotechnology, health, agro-industry and the environment;
- understand and master the problems and trends affecting the environment on the European and worldwide scale.

(ii) Scientific and technological objectives

- **Key actions**

**The living world and ecosystem (I):
health and food**

The quality of food is a subject of major concern for the people of Europe, and they expect the Union to provide a permanent framework for its guarantee. With this in mind, this action would aim at the development of knowledge, technologies and methods based, for example, on biotechnology for the production in Europe of a safe, healthy, balanced and varied food supply. This requires as a priority the development of tests to detect, and methods to eliminate, infectious and toxic agents, as well as work in the areas of epidemiology, science and technology of nutrition, and public health.

Aspects of justification:⁵ The problem of "mad cows" and the controversies surrounding genetically modified soya and maize have indicated clearly that the quality of food is a matter of public concern which must be addressed as a serious social issue on a European scale. The European Union is the world's largest producer of food and drink, which represent 16.5% of its industrial production. The impact of food on health can easily and accurately be illustrated by comparing clinical and epidemiological data from different European countries.

**The living world and ecosystem (II):
control of viral and infectious diseases**

Despite the progress achieved by medicine during the 20th century, microbial, viral, parasitic, 'prion', and infectious diseases are still far from being under control. With responsibility for ensuring a high level of public health in Europe, the Union has to help fight them. Such would be the aim of this action, which would focus particularly on the fight against AIDS, the control of the "new plagues" (haemorrhagic fevers, illnesses connected with new or mutant microbial or viral strains), and the development of vaccines, especially against viral illnesses. Close attention would be paid to prevention strategies and to aspects connected with public health and care provision systems.

Aspects of justification: Infectious diseases kill 17 million people every year throughout the world and 30 new epidemics have been observed during the last two decades. The world market for vaccines (3 billion ECU per annum) is set to grow by 9.7% per annum in the coming years; the world market for vaccines for the treatment and prevention of cancer could reach 10 billion ECU in the year 2000. Multi-centre clinical trials at European level will allow a considerable increase in the speed of development, authorisation and marketing of new medicines and facilitate their use throughout Europe.

**The living world and ecosystem (III):
the "cell factory"**

Progress in the science and technology of the living world opens up considerable opportunities for industry. To assist enterprises to exploit these opportunities in the single market in the context of the Union's policies on, for example, health and the environment, the aim of this action would be the development of multidisciplinary technologies based on the exploitation of the properties of living organisms (micro-organisms, plants and animals) at the cellular and sub-cellular levels, in order to develop, in particular, new antibiotics and anticancer agents, bio-treatment methods for waste, and new biological processes for the agri-food industry.

Aspects of justification: 280 new therapeutic molecules were developed in 1995 through biotechnology. The European market for biotechnology-derived products has grown by 30% since 1995 and should reach 100 billion ECU by the year 2000. Biotechnology is an activity at the intersection between many disciplines and technologies. Progress relies on combining a range of skills and knowhow, and this is much easier to achieve at European level. This sector also plays a very important role with respect to the Union's industrial policy, and must be considered in the framework of an overall approach which covers the industrial, research, environment and ethical aspects together.

⁵ This justification gives examples, for illustrative purposes, based on the three categories of criteria - societal demand, economic and technological prospects and European added value.

**The living world and ecosystem (IV):
management and quality of water**

Now a rare resource whose quality is under threat, water must be managed in the most rational way possible. Situated at the intersection of agricultural policy, environmental policy and regional policy, this action would aim to produce the knowledge and the technologies necessary to achieve this, to satisfy both domestic needs and those of industry and agriculture. Among the priority fields concerned are: technologies for treatment and purification; for monitoring the quality of the water table and of surface waters; systems for surveillance, warning and communication; technologies for the regulation of stocks and technologies for arid and semi-arid regions.

Aspects of justification: 20% of surface water in the Union is threatened by pollution and more than 60% of farmland contains levels of fertilisers and pesticides considered alarming in terms of local water quality. Investments in equipment and services for water in the European Union are likely to be more than 30 billion ECU in the year 2000. Water is in many cases a shared resource across the Union: several member states depend for more than 50% of their water on suppliers from other countries. The problem of water quality also plays a central role in the Union's environmental policy.

**The living world and ecosystem (V):
environment and health**

The deterioration of the environment can have a serious adverse effect on health. The aim of this action would be to help reduce this effect, starting with a better understanding of the mechanisms involved. It would consist in particular of work on epidemiology and the development of new methods of diagnosis and prevention, as well as methods to reduce harmful impacts, and be carried out in close coordination with the aims of the Union's environmental policy objectives and would concern subjects such as the effects on health of air pollution, heavy metals and toxic substances, electromagnetic radiation, the effects of pollution at the workplace, and the impact of climatic changes on public health.

Aspects of justification: 13% of cases of asthma and 15% of respiratory infections affecting the European urban population could be related to exposure to urban pollution. Much of the progress made in improving our understanding of the effects of heavy metals (such as lead) on health is due to comparative epidemiology at the European level. Regulations adopted at European level on nuclear and industrial safety and the safety of domestic products depend on the availability of an objective scientific information base.

**The living world and ecosystem (VI)
new rural and coastal areas**

Agriculture and fisheries, essential areas of activity in rural and coastal areas, are facing profound changes. From this perspective, the aim of this action would be to mobilise knowledge and the technologies needed to put in place innovative approaches to production and exploitation, adapted to recent adjustments in the common agricultural and fisheries policies, whilst also providing the scientific basis for Community regulations. Among the priority areas are: new systems of production and utilisation in agriculture, forestry and fishing taking into account profitability, the sustainable management of resources, product quality and employment; non-food uses; control methods; new models of sustainable development of rural and coastal areas based on optimisation of the specific potential of each area and the diversification of activities and the use of land, and involving the people concerned.

Aspects of justification: 80% of the Union's territory can be categorised as rural, and the agricultural sector is made up of nearly 7 million holdings which give work to some 14 million people. In the fisheries sector, 70,000 enterprises (essentially SMEs) generate a turnover of nearly 20 billion ECU. Agriculture and fisheries are fully integrated policies at European level and account for half of the Community budget. The European Parliament and the Committee of the Regions recently confirmed their desire to give rural areas the means to play their full part in the territory and economy of the Union.

- **General activities for the development of generic technologies and basic research**

Work would concentrate on the following priorities:

- research in support of the fight against age-related diseases and health problems (e.g. Alzheimer's disease), degenerative illnesses (e.g. cancer and diabetes), illnesses of genetic origin and rare diseases; genome research and the neurosciences;
- research in support of the improvement of health systems, the improvement of safety at work, and the fight against drug-related public health problems; bioethics;
- research to support the fight against major natural and technological risks (in particular "global change"): forecasting, prevention, evaluation of impacts and mitigation of consequences, research on the impact of environmental changes on the economy, society and employment within a perspective of sustainable development;
- work to support the development of generic earth observation technologies, notably satellite technologies, for environmental monitoring and resources management.

- **Support for research infrastructure**

- support for optimum use at European level of infrastructure such as databases and collections of biological material; clinical testing centres; marine research facilities and computer centres for climate studies.

(iii) Consideration of the recommendations of the evaluation exercise

Recommendations of the programmes' evaluation panels in the areas concerned include:

- a stronger involvement of user sectors and the industrial sphere should be sought (Biotechnology);
- greater account should be taken of "sustainability" aspects and the concerns of consumers (Agriculture and Fisheries);
- actions should be directed more strongly towards the needs of users and should be designed with more attention to short- and medium-term policy objectives (Environment).

2.2 Creating a user-friendly information society

The creation of the information society can make a significant contribution to renewed growth and the development of new forms of jobs in the Union: the development of information and communications technologies and their application will lead to the creation of several million jobs in Europe.

The Union is faced with intense international competition yet concerned to preserve the cultural diversity which constitutes its wealth. It must therefore develop those technologies which will make it possible to create an original and user-friendly kind of information society.

The information society means fundamental industrial and social change: its establishment is opening up multiple possibilities for new activities, both for individuals and for companies, in the fields of trade, work, transport, education, health, and culture. The technologies associated with the information society at the same time penetrate every kind of industrial activity and all areas of society. Their economic and social impact by far exceeds that of the industries which directly produce information and communications equipment and services. In sum, these technologies provide a vital contribution to the key actions of the other two thematic programmes.

(i) General objectives of the programme

It will not be possible to achieve fully the potential of the information society on the basis of the systems and technologies of today. Continual progress is being made in the essential technologies such as micro-electronics and this determines all the new applications. A continuous effort of research, technological development, and technology adoption is therefore necessary, which requires a single, integrated programme to be put into effect in conjunction with the policies of the Union. The aim of this programme should be to help the goods, services and methods made possible by the technologies of the information society to contribute to the achievement of the political goals of the Union in:

- creating new jobs and strengthening the competitiveness of companies;
- stimulating the development of new markets and services of general interest and strengthening the role of the general public in society;
- improving the attractiveness of Europe as a place for investment, research, and innovation, and strengthening the scientific and technological base of the Union, with the goal of reinforcing global competitiveness.

To fully achieve its potential, such a programme must take into account, on a cost/benefit basis, the need for accessibility and interoperability, at all levels, from technologies and tools to systems and applications.

In determining the structure of the programme, account must be taken of:

- the links between applications and technologies, so as to reflect the complex dynamics of innovation, pulled by demand and driven by technology, as well as the role played by applications to guide and validate research and to stimulate the adoption of technologies, through encouraging the user-producer link which is at the heart of innovation.
- the need for transdisciplinarity.

In this context, the best structure will be obtained by grouping together those applications and technologies which are most alike or most interdependent and integrating research with technology take-up in order to maximise effectiveness and minimise the need for coordination. These considerations lead to a programme of 4 closely coordinated key actions, supported by a group of basic research activities.

(ii) Scientific and technological objectives

• Key actions

Information society (I): services for the citizen
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Information society technologies must meet users' and consumers' expectations and requirements and the need to provide them with access, at the lowest cost, to quality general-purpose services. This key action would emphasise interoperability of applications and focus on the following five priority fields: education and training, health and the elderly, public authorities, the environment and transport. Particular attention would be given to the integration of these applications and their validation in digital sites, towns or regions. In education and training, the emphasis would be on multimedia applications and new teaching methods using simulation and virtual reality and, lastly, the development of applications using broadband communications. On the subject of health and the elderly, priority would be on developing computerised medical systems, secure high capacity health networks, and advanced interfaces and tele-systems for the integration of the elderly and the disabled into social life. The tasks of the public authorities could be made easier by giving the public and businesses better access to public services through applications giving access to "on-line government". As regards environmental protection, priority would go to the development of telematic systems for environmental managers and for the public for the purposes of surveillance, analysis and issuing warnings. Finally, transport would benefit from the development of the advanced telematic systems needed for management and teleservices.

Aspects of justification: the countries of the European Union are all faced with the challenge of improving the quality of their public services while containing costs. Furthermore, the emergence of the information society in these sectors provides major opportunities for industry and employment. Indeed, the number of households connected to electronic information networks is set to triple worldwide between 1996 and the year 2000 to a total of 100 million, including 30 million in Europe. Within 10 years, the market for applications connected with the Information Society could be worth several billion ECU annually; for example, ECU 15 billion for health applications, ECU 10 billion for education and training, ECU 8 billion for transport-related telematics alone, and ECU 5 billion for the environment. The applications involved in the information society (health, transport, education, and the environment) are transnational by nature and constitute several of the European Union's

policy areas. Performing activities in this area at a European level will help with the required modernisation of the sectors concerned, ensure the interoperability of services and compatibility of equipment, and help to preserve Europe's linguistic and cultural diversity

Information society (II): electronic trade and new methods of work

The completion of the single market and Economic and Monetary Union are two major priorities of the European Union. This action would aim to help European enterprises operate efficiently and enable them to become more fully part of the global economy, amongst other things by means of modern statistical systems. It would focus in particular on improving the efficiency of trade in goods and services. Among the topics concerned are: management systems for suppliers and consumers; the security of information and networks; the technical means for authentication and protection of ownership and the integrity of contents, as well as interoperable payment systems; flexible, mobile and remote working methods both for individuals, and for cooperative- and group-working.

Aspects of justification: by the year 2005, one third of all banking transactions worldwide could be completed electronically; by the year 2000, it is expected that there will be more than 10 million teleworkers in the European Union and nearly 40% of businesses will be trading electronically. By 2004, the European market for commercial telematic services should amount to some ECU 11 billion. The changes in working methods and trade resulting from information and communication technologies mostly go far beyond the level of the individual firm, the industrial or service sector, or even the national economies. They affect the whole world and necessitate action at a European level, if we wish the Union to fulfil its potential as the primary world market.

Information society (III): multimedia contents

Developing creativity in, and increased use of, multimedia contents are two major elements in fully establishing the information society, and helping to promote linguistic and cultural diversity. The objective of this key action would be the development of innovative forms of multimedia contents as well as tools for structuring and processing them. The action would be focused on three main lines: interactive electronic publishing, with new methods for creating and structuring publications, and for personalised dissemination of information and accessing cultural items, for example through electronic libraries and virtual museums; new language technologies which help to make information and communications systems more user-friendly; advanced technologies for accessing, filtering and analysing information which help to manage the explosion of information and facilitate the use of multimedia contents, notably will respect to geographical and statistical information systems.

Aspects of justification: the turnover of industries in the European Union connected with the content of information and communication systems and networks amounts to ECU 150 billion per annum. They employ 2.1 million people full time, and within the next 10 years are expected to create one million additional jobs. Even if almost all the information on the Internet is in English, 50% of current Internet users do not have English as their mother tongue. Highlighting Europe's cultural and linguistic diversity forms an important part of the European Union's education, audiovisual and culture policies.

Information society (IV): essential technologies and infrastructures

To foster the spread of the information society throughout Europe, excellence in the technologies constituting its key elements should be promoted, their introduction speeded up, and their field of application broadened. These technologies include: computing, communication

and network technologies, the latter comprising architectures, protocols and methodologies, as well as their introduction and use; software and systems technologies and engineering; mobile and personal communications, in particular satellite-based services; interfaces making use of multiple human senses; peripherals, e.g. flat screens, microsystems; micro-electronics (technologies, skills, equipment and hardware necessary for the design of circuits and the development of applications).

Aspects of justification: from 1994 to 1995, the worldwide market in information society technologies grew by 11% - more than any other economic sector. In 1995, this market was worth ECU 304 billion. Approximately 40-50% of the cost of a modern aircraft is for avionics hardware and software. More than 15% of the cost of a car lies in its electronics.

- **General activities for the development of generic technologies and basic research**

Work undertaken from a "visionary" perspective, connected with all the key actions and intended to ensure a continuous flow of ideas from laboratories to industry.

This would be focused on the following priorities:

- technologies for the representation, creation and handling of knowledge;
- simulation and visualisation technologies in real time and on a large scale, and virtual presence technologies;
- quantum, photonic, bio-electronic technologies for very large scale integration; ultra-high performance computers and super-intelligent networks.

- **Support for research infrastructure**

- support for advanced high-flow electronic networks for research. These networks would be particularly useful for all programmes.

(iii) Consideration of recommendations from evaluation exercises

Recommendations of the programmes' evaluation panels in the areas concerned include:

- the three programmes dealing with telematic applications, advanced communications technologies and information technologies should be grouped together in a single programme (common conclusion of the evaluation panels of the three programmes);
- work on telematics should be concentrated on emerging sectors and those sectors with a particular economic and social relevance, such as those linked to the information society (Telematics Applications);
- support for the development of interactive multimedia services should be increased (Advanced communications technologies).

2.3 Promoting competitive and sustainable growth

Strengthening the competitiveness of firms and moving towards sustainable development are two complementary and inseparable objectives for the Union: the products and processes which will be competitive on tomorrow's markets will also be "clean", intelligent products and processes.

The development, distribution and application of knowledge and technologies necessary to reach these goals are crucial for the implementation of the Union's industrial policy, and its policies in numerous other fields, especially transport and energy.

The objective of competitive and sustainable growth should also be extended to urban areas, in which most European citizens live and work.

(i) General objectives of the programme

To produce the knowledge and technologies which may help to increase growth and create new jobs in Europe, by helping to develop:

- "clean" and "intelligent" industrial products and processes to boost European industrial competitiveness, which will give businesses the opportunity to make the necessary adjustments to their activities;
- economic, safe and environmentally-friendly transport systems;
- energy systems and services guaranteeing security of supply and sustainable exploitation.

(ii) Scientific and technological objectives

- Key actions

**Competitive and sustainable growth (I):
products, processes, organisation**

To improve their position in the face of increasingly harsh world competition, European industry and enterprises must be able to put innovative products and services on the market and develop new production and fabrication methods. The research would cover the elaboration, development and integration of new technologies for design, manufacturing, control and production: micro-engineering and micro-systems; information society technologies for "intelligent" manufacturing, including systems of flexible workshops and flexible management of supply chains, embedded systems and remote services for operation

and maintenance and simulation and shared-work technologies; technologies to reduce resource utilisation and effluents, for waste recycling and for the development of clean products, based on the concept of "life cycle analysis"; new methods of organisation of work and production, and for using skills .

Aspects of justification: *The European Union market for industrial goods and associated services amounts to an estimated 4500 billion ECU per annum. 2 million enterprises (99 % with fewer than 500 employees) are involved, employing some 40 million people. The market for environmental protection products is forecast to grow by 50-100 % between now and the year 2000. Use of flexible systems of production and clean production processes should bring about, in time, a reduction of 50 % in both industrial energy consumption and time to market of products. In addition to cost-sharing, cooperative research will facilitate the elaboration and adoption of standards which will be essential in the operation of the internal market.*

Competitive and sustainable growth (II): sustainable mobility and intermodality

In an integrated Europe, the mobility of people and goods will considerably increase. This must be able to take place effectively and without damage to the environment, while reducing the costs in particular of traffic congestion and accidents. This action is intended to assist in this process, at the point at which transport, environment and regional policies intersect, by helping to set up a safe, intelligent and interoperable land, air and maritime transport system for passengers and freight on a broadly intermodal basis at the European level. This requires, among other things, the development of systems for the rational management of transport, including second-generation satellite navigation and positioning systems; research on infrastructures, accessibility and the integration of regional planning and transport policies; and the development of socio-economic scenarios.

Aspects of justification: *Demand for internal transport of goods within the Union doubled between 1975 and 1995 and will probably double again between now and 2025. The costs of road congestion in the Union amount to 120 billion ECU per annum and the total cost of transport "externalities" is estimated at 250 billion ECU per annum. As it is closely related to the Trans-European Networks policy being implemented by the Union, following on to the White Paper on Growth, Competitiveness, Employment, and will involve the very large number of SMEs operating in this sector, the development of an intermodal transport system can by definition only be conceived from a European perspective.*

Competitive and sustainable growth (III):new perspectives in aeronautics

Aeronautics is one of the most successful sectors of European industry and is one of the Union's main export industries. This action would aim at helping the Union to maintain and consolidate its position in this field by improving its mastery of advanced technologies. It would cover, more especially, new integrated design and manufacturing technologies, as well as the reduction of energy consumption, emissions and noise for various designs of aircraft, and include demonstration activities on these topics; technological and economic feasibility of new generation aircraft concepts.

Aspects of justification: *Air traffic is forecast to double in volume between now and 2000 and 15000 new aircraft need to be produced before then. The European aeronautics industry exports 2/3 of its production and its performance depends directly on the quality and competitiveness of its products. European companies started gaining new markets when they got together to create the Airbus 25 years ago. The growing links now visible among US aeronautics companies, to which the US Government pays large amount of state aid, could mean the Union might be facing a de facto monopoly controlling 70 % of the world market and should encourage Europeans to invest further in the field.*

**Competitive and sustainable growth (IV):
marine technologies**

The sea, which surrounds Europe on every side and has played such an important part in European history, is a major economic, social and technological challenge for the Union. The objective of this action would be to boost the development and integration of specific knowledge and technologies which would enable the Union to fully utilize the sea's potential, in support of a true European policy of the sea. The emphasis would be on technologies needed to boost the competitiveness of Europe in the range of areas concerned: technologies for the design of advanced ships which would be safe, efficient and environmentally-friendly; for the use of the sea as an economical means of transporting goods and people (advanced port infrastructure; regional maritime transport systems); and for the rational and sustainable exploitation of the sea as a source of energy and mineral resources (offshore and subsea technologies).

Aspects of justification: The Union has 90.000 km of coastline and 47 % of its inhabitants live less than 50 km from the sea. 90 % of the Union's foreign trade is transported by sea. Between 3 and 5 % of the Union's GDP relates directly to marine industries and services and marine industries employ more than 2.5 million people throughout the Union. The sea is central to the Union's industrial, environment, fisheries, research and energy policies and is the subject of several international agreements to which the Union is a party.

**Competitive and sustainable growth (V):
advanced energy systems and services**

The expected growth in the demand for energy and the need to meet this demand without endangering the environment are a major challenge for the Union. This action, based on market needs, would aim to help meet this demand, through the development and improvement of advanced energy systems that are efficient as regards both production and consumption, so as to achieve a substantial reduction of CO₂ emissions and other greenhouse gases. The work would cover new and renewable sources of energy and their integration into decentralised systems: technologies for energy storage and transmission; technologies for clean use of fossil energies and the rational use of energy; technologies for exploiting controlled thermonuclear fusion (in the context, notably, of the ITER experimental international reactor project); study of economy/environment/energy interactions.

Aspects of justification: Total energy consumption in Europe is forecast to grow by 20 % between now and 2020, and the related production of CO₂ should rise by 14 % unless specific measures are adopted. The world market for energy technologies should grow over the next few years to more than 800 billion ECU per annum. In its Green Book on Renewable Energies, the Commission proposed as an objective the doubling of the share of these technologies in the Union's total energy supply, to rise to 12 % by 2005. The Union's energy policy is based on the diversification of sources of supply and the maintenance of a diversified technological capability which is easier to achieve through European co-operation.

**Competitive and sustainable growth (VI):
the city of tomorrow**

Most Europeans live and work in towns and cities. The urban environment is the focus of most new developments in the economy and society but it also exacerbates the resulting problems. Their harmonious development must be approached from a global, innovative viewpoint based on advanced models of urban organisation blending together the heritage of the past, e.g. the cultural heritage, the restoration of social equilibrium, e.g. making city life safer, and the development towards a "value-added" economy. The action would focus as a priority on technologies for the integrated management of transport (see the key action on

sustainable mobility and intermodality), energy (notably in buildings) (see the key action on advanced energy systems and services) and technologies for economic and sustainable construction; and technologies necessary for the development and demonstration in urban contexts of economic, clean, safe and intelligent motor vehicles, e.g. zero-emission vehicles.

***Aspects of justification:** 80 % of Europeans live today in towns and cities, which are the focus of most economic activity in Member States. The costs of the decay of the European cultural heritage are estimated at more than 14 billion ECU per annum. Towns and cities have played a key role in European history and today contribute substantially to European integration through the creation of networks of co-operation and trade between big regional metropolises (Euro-metropolises: Euro-cities etc.).*

o **General activities for the development of generic technologies and basic research**

The effort would concentrate in particular on the following priorities :

- research to support the development of new materials for industry and the processes for their manufacture; materials resistant to high temperatures (for example for energy generation and engines); light materials (for transport and construction); functional materials (opto-electronics, biomaterials, sensors) designed and developed with ease of recycling in mind; new materials and technologies for the production of coal and steel⁶;
- precompetitive research in support of standardisation and the fight against fraud as well as on product and service quality (including the development of high-precision measuring instruments);
- research in support of nuclear safety and security: work on the nuclear fuel cycle, storage and waste processing; control of fissile material; the effects of radiation; and to support the development of new designs of inherently safe systems;

• **Support for research infrastructures**

- support for optimum use, at European level, of computing centres for industrial research; high power wind tunnels; specialized databases; test laboratories.

⁶ Under the framework programme, it is proposed increasingly to expand the activities currently being carried out on the basis of the ECSC Treaty, which expires in 2002.

(iii) Consideration of recommendations from evaluation exercises

Recommendations of the programmes' evaluation panels in the areas concerned include:

- implement an approach combining a "vertical" concentration on a limited number of application topics and "horizontal" support for generic technologies (Industrial Technologies);
- guide activities in a more definite way towards users' needs and applications (Non-nuclear energy);
- keep an appropriate balance between technological research and policy research in transport (Transport).

2.4 Confirming the international role of European research

In a world characterized by increasing globalization of economies, problems and issues, international cooperation has become an important dimension of the research policy of the European Union.

It should contribute significantly to the implementation of the Union's external policy, especially the policy towards Central and Eastern European accession candidate countries, and promote its role on the international stage.

Scientific and technological cooperation should also help the Union establish industrial cooperation and conquer new markets.

(i) General objectives of the programme

Operating in the context of the implementation of the Union's foreign policy, and with the accession of new Member States in mind, the general objectives of the programme would be:

- to promote scientific and technological cooperation between entities and researchers from third countries and from the Union, likely to produce significant and balanced benefits for both sides (cooperation for "mutual benefit");
- to facilitate access for European laboratories and firms to scientific skills and know-how available outside the Union, useful to the interests of the Union;
- to strengthen the competitiveness of European industry and its presence in new markets and help those involved in European research obtain information on research capabilities, activities and priorities outside the Union.

(ii) Specific objectives

The Union pursues its international scientific and technological cooperation policy with both cooperation and competition in mind. Rooted in the principle of mutual benefit, cooperation with different groups of countries would also be geared towards specific objectives:

- Associated countries of Central and Eastern Europe: to prepare their accession to the Union by helping them to preserve and develop their research capabilities and apply them to their economic and social needs;
- Mediterranean third countries: to assist the development of scientific and technological cooperation in support of the Euro-Mediterranean Partnership; to help economic take-off, social development and the development of new markets in these countries;
- Non-associated countries of Central and Eastern Europe: to help these countries stabilize their human resources in research and mobilize their scientific and technological capacity in support of economic and social development;
- Newly Independent States of the former Soviet Union: to stabilize their human resources in research and to help them apply their research capabilities to the modernization of their economies and to the resolution of the environmental, health, transport, communications and nuclear safety problems they must confront;
- Industrialized countries: to obtain access for European researchers to the knowledge and know-how existing in these countries, in order to increase the level of their activities;
- “Emerging economies”: to develop scientific and technological cooperation so as to facilitate access for European companies to these fast-growing markets;
- Developing countries: to associate researchers in these countries with the production of specific scientific knowledge and appropriate technologies which can help solve their development problems.

International scientific and technological cooperation activities would be implemented in two ways, in line with cooperation agreements where these exist: on the one hand, participation of third country entities in the other programmes; on the other, activities specific to the international cooperation programme. Within each of these big categories, various cooperation formulas would be used according to the countries involved, the nature of the activities and the sources of financing.

- **Participation of third country entities in programmes:**

Four instances are envisaged:

- Full association with the Framework Programme (certain accession candidate countries choosing this formula,⁷ notably Central and Eastern European; third countries of the European Economic Area; Israel⁸): participation under similar conditions as for Member States, detailed arrangements for Central and Eastern European countries still to be determined. The technical assistance fund for Central and Eastern European countries, Phare, could be used to support this participation, in accordance with its own operating rules;

⁷ An alternative formula being participation on a programme-by-programme basis.

⁸ If the association agreement to the 4th Framework Programme is extended to the 5th, as envisaged.

- Participation in programmes open to third countries on the basis of bilateral or multilateral cooperation agreements (certain industrialized third countries and “emerging economy” countries). “Project-by-project” participation (with no financing from the Framework Programme for the third country partner). Measures would be taken to enhance access to the Framework Programme for “emerging economy” countries;
- Participation in programmes open to third countries without specific cooperation agreements (principally Central and Eastern European countries not associated with the Framework Programme; European NIS; Mediterranean third countries). Justified by the intensity of the political dialogue, participation on a “project-by-project” basis would in principle be financed by the third countries themselves. The use of the technical assistance funds Phare, Tacis (for NIS) and MEDA (for Mediterranean third countries) could also be studied here.
- Participation in projects in which it is in the Union’s interest to have third country participants involved (all third countries). This would be financed by the third country or, in certain duly justified cases, by the thematic programme concerned.

• **Activities specific to the international cooperation programme:**

Three categories of activities would be implemented:

- Specific cooperation activities with certain categories of countries (Central and Eastern European countries not associated with the Framework Programme; NIS; Mediterranean third countries; developing countries; “emerging economy” countries). These activities, related to very specific problems faced by these countries (e.g. in health and environment) and therefore outside the scope of the other programmes, would be financed by the international cooperation programme;
- Training of researchers: a system of grants would be established whereby young researchers from third countries could be given a chance to spend time in European laboratories and participate in Framework Programme projects. This would be financed by the international cooperation programme, just like the grant system for young European researchers in Japan and South Korea.
- Coordination with COST and with the EUREKA initiative, and with other European science and technology cooperation organizations (e.g. CERN, ESA, EMBL, ESF).

(iii) Consideration of recommendations from the evaluation exercises

The evaluation panel’s recommendations in this field (international cooperation) included the following:

- by the combined use of the international cooperation programme and the PHARE and TACIS assistance funds, to reinforce measures taken to help the Central and Eastern European countries and the Newly Independent States restructure their research systems and apply them to their economic and social needs;
- to attach greater priority to technological cooperation with the “emerging economies”.

2.5 Innovation and participation of SMEs

Innovation is the key factor in industrial competitiveness. To enable European research to impact fully on growth and employment, and to help it achieve concrete outcomes and economically beneficial and socially desirable results, mechanisms need to be set up to promote innovation, exploit the results of scientific work and stimulate the creation of innovative companies.

Important vectors and actors in innovation, SMEs, which provide 66% of employment in the European Union, should be able to benefit from easy access to the advanced technologies which they need, and to the possibilities offered by the Union's research programmes.

(i) General objectives of the programme

The general objectives of the programme would be:

- to improve the economic and social impact of the Union's research projects by reinforcing the mechanisms designed to ensure the best possible exploitation of their results, as well as the dissemination and transfer of the technologies produced;
- to facilitate the access of participants, particularly SMEs, to the instruments which finance innovation and support the creation of innovative enterprises (financial engineering; venture capital);
- to stimulate the participation of SMEs in the Union's research programmes, both SMEs active in research and high technologies and those with little or no research capabilities but with substantial technological needs; to help SMEs, notably in the least favoured regions, to develop their technological capabilities.

The fact is that the real bottle-neck in the European research-development-innovation system is in the transfer of research results to market exploitation. Venture capital exists in Europe, but, in contrast to what happens in the United States, for example, there is not enough of it, and, above all, it is seldom used to finance technological innovation. The problem far exceeds the scope of the Framework Programme. In the context of its activities to promote innovation, the Commission will be working to promote the creation of instruments to remedy this weakness.

(ii) Specific objectives

Union action to promote innovation and support the participation of SMEs in the programmes should be undertaken in the double framework of the thematic programmes and the “Innovation and Participation of SMEs” programme. The objectives and methods of this action would be principally as follows:

• *for innovation*

in the various programmes:

- integration of mechanisms (e.g. value analyses, market research, training) into the “life-cycle” of projects, so as to facilitate the exploitation, private financing, and transfer of technologies and results produced, while guaranteeing protection of the knowledge acquired; creation, to this end, of “innovation units” in the programmes;
- management of structured interfaces with the entities which finance innovation and help create innovative start-ups, principally via European organisations and funds (European Investment Fund, European Investment Bank, Eurotech Capital);
- management of innovation support networks specific to the research programmes concerned and the setting-up of networks of cooperation and exchange between innovating companies in the fields of the research programmes.

in the programme “*Innovation and Participation of SMEs*”:

- rationalisation and coordination of networks providing information and assistance on the research and innovation activities of the Union, particularly in relation to the identification and dissemination of best practices in the area of technology transfer (joint action: innovation/SMEs); coordination of studies and analyses, particularly in the area of innovation policy;
- coordination of the operation of the “innovation units” in the programmes, of the structured interfaces with the entities which finance innovation and help create innovative start-ups; conception and definition of new methodologies for technology transfer projects, integrating the technological, economic and social aspects of innovation;
- creation and development of a service giving assistance in the area of Intellectual Property Rights and access to private finance, notably the Venture Capital Funds (joint action innovation/SMEs).

• *for SMEs*

in the various programmes:

- “cooperative research” activities enabling groups of SMEs without suitable research capabilities to entrust the resolution of their common technological problem to third parties;
- activities to support and encourage the participation of SMEs in collaborative and cooperative research projects (e.g. “exploratory awards”) as well as the

implementation and coordination of national and European information and assistance networks.

in the programme "*Innovation and Participation of SMEs*":

- management of a "one-stop shop" - for all the research programmes - within the Commission services (for project proposals to be implemented specifically by SMEs).

(iii) Consideration of the recommendations of the evaluation exercises

The evaluation panel's recommendations for this area (dissemination and exploitation of results) included the following:

- to reinforce the role of innovation policy in the implementation of the Union's research activities;
- to give greater prominence to innovation even in thematic programmes; the innovation programme should help optimise the work done by the individual programmes;
- to improve coordination with the other policies and services of the Commission where these concern innovation.

2.6 Improving human potential

In the field of science and technology, as in many others, Europe's prime asset is its human resources: the quality of its researchers, engineers and technicians.

In view of foreseeable needs, this human potential must be preserved, must grow in quantitative terms and must be used to the full. At the same time, the Union should help to promote European scientific and technological excellence.

To better identify current and future trends in Europe and economic and societal needs, it is also necessary to mobilize the strong European research tradition in economic and social sciences around a limited number of relevant topics.

(i) General objectives of the programme

The general objectives of the programme would be:

- to help to maintain and develop human resources of quality in Europe, particularly by supporting training and by promoting researcher mobility (including towards industry), as well as innovation (methods and technologies) in education and training with a view to creating new jobs;
- to help Europe become a location which can attract researchers and investment in research, and to promote European research in the international arena;
- to develop the knowledge needed for a better understanding of key aspects of the development of European society, and the implementation of science and technology policy and the other Union policies.

(ii) Specific objectives

The programme would be structured in 5 main lines:

- *Reinforcement of the European human research capital*

The objective would be to establish:

- research training networks, created in advanced and emerging fields of research, on topics freely chosen by the researchers. The accent would be placed on the training of young researchers at pre and post-doctoral level;

- a European grant system comprising "Marie Curie" grants for young researchers, awarded for topics chosen by the researchers themselves, in addition to the grants awarded under the research programmes; industrial grants awarded to companies to assist young or established researchers; development grants intended to help develop a high-level research capacity in the less favoured regions of the Union.

- ***Optimized utilization of major research infrastructures***

The aim is to promote the optimum use of research infrastructures (large facilities, networks, centres of excellence) in those areas (including economic, legal and social science) not covered by the thematic programmes, or for categories of installations not considered by those programmes. To this end, measures are being envisaged to help researchers with access and to set up networks, as well as to support research projects.

- ***Promoting scientific and technological excellence in Europe***

The aim here would be to stimulate European scientific and technological excellence through exchange and to make the most of the achievements of European research. This would be promoted by support for high-level scientific conferences, the networking of European researchers active outside Europe, distinctions for high-level research work, and action to raise public awareness and make information available on research activity at European level via electronic networks.

- ***Harnessing socio-economic research to the needs of European society***

This activity would complement and support the attention given in the "thematic" programmes to socio-economic aspects. It would cover a limited number of topics linked to the objectives of the Framework Programme. Work would focus primarily on study of the socio-economic impact, in Europe, of the development of services and of the "non-tangible" economy, analysis of the interplay between technological progress, training, work, the legal environment and economic competitiveness, and the production and validation of new development models fostering growth, employment and quality of life.

- ***Support for the development of scientific and technological policies in Europe***

This would be achieved by setting up an exchange forum, the ETAN network ("*European Technology Assessment Network*"), bringing together political decision-makers and researchers specialized in the study of science and technology policies, technology watch activities, forecasting, evaluation of scientific and technological choices, also the development of a system of statistics and scientific, technological and innovation indicators.

(iii) Consideration of the recommendations of the evaluation exercises

The evaluation panel's recommendations for these areas included the following:

- to introduce a special measure to support industrial training of researchers (training and mobility);
- to encourage the creation of interdisciplinary projects and industrial participation in networks (training and mobility);
- to orientate socio-economic research work towards the study of a coherent set of challenges facing Europe, considered from a political perspective (socio-economic research).

THE PROGRAMMES: IMPLEMENTATION AND LEGAL ASPECTS

Implementation and legal aspects will be set out in detail in the formal proposal for the 5th Framework Programme. However, some additional information to that contained in the first working paper can already be provided.

1. IMPLEMENTATION

1.1. Two major objectives: coordination and flexibility

An essential feature of the 5th Framework Programme should be a substantial improvement in the coordination of programmes and in the flow of information and results between their different activities, as well as in the flexibility and response capacity of Union action.

(i) Coordination

At the different levels, coordination would be achieved through mechanisms incorporated into the programmes:

Coordination between programmes. This would be achieved in particular through the key actions, as well as through coordination activities carried out in the "horizontal" programmes;

Coordination between the research programmes and other activities of the Union. As part of the implementation of the external relations policy, this coordination would be achieved, as far as international cooperation is concerned, by establishing closer links with the technical and economic assistance programmes PHARE, TACIS, MEDA, the European Development Fund and the PVD-ALA activity. As regards coordination with the Structural Funds, common regional frameworks of reflection and action would be put in place, as would mechanisms for closer linkage between the two types of activity, in line with the conclusions of the Communication on "Research and cohesion" which the Commission will be presenting shortly. Close coordination would also be ensured with the Union's various programmes and initiatives in related areas, e.g. education and training through the Socrates and Leonardo programmes.

Coordination between European and national activities. This would be achieved in particular through the key actions, which should allow the establishment of closer linkages with initiatives and programmes carried out at Member State level in the areas concerned: through projects for support to research infrastructure; and through cooperation with other European scientific and technological cooperation frameworks (e.g. EUREKA, COST) and organisations (e.g. ESA, CERN, EMBL).

(ii) Flexibility

As indicated in the first working paper, and confirmed by the evaluation work, improvements in the flexibility and response capacity of the Union's action will be brought about in particular by:

- regular adaptation of the work programmes, ideally on an annual basis;
- the creation of a "free space" of limited size within each programme. This would be to guarantee that the scope for flexibility which theoretically exists could be efficiently exploited if needed. The aim would be to be able to meet urgent needs arising within the area covered by the programme but which were not explicitly foreseen (unexpected scientific and technological breakthroughs; problems requiring a rapid response) in the shortest possible time. To this end, programme budgets would be committed in such a way as to leave open the possibility, until a point around 3/5 of the way through the life of a programme, of quickly bringing together resources on a particular theme.

1.2. Means of implementation

(i) Indirect action

"Indirect action" by the Union in the area of research would continue to be carried out through shared cost actions, concerted actions, support for collaborative networks and "accompanying measures", strictly aligned with programme objectives.

"Shared cost" actions, in which the Community contributes a part of the costs of research projects carried out by consortia of enterprises, universities and research centres, would continue to be an essential instrument of programme implementation. The possibility of varying the Commission's contribution according to the nature of the activities and thus the proximity to the market will be studied, in line with international rules and the provisions of the Community framework for state aid for research and development. In selecting proposals the Commission will take account of the partners' efforts in terms of research, investment and employment, both globally and in the specific area of their proposal.

(ii) The Joint Research Centre (JRC)

A second instrument for implementing the 5th Framework Programme would be the Joint Research Centre. Carrying out the 5th Framework Programme will require an important and active contribution from the JRC. The activities it carried out to this end would be the subject of two specific decisions covering EC and Euratom aspects respectively, and would focus essentially on the three "thematic" programmes.

A general theme for these activities would be "*Research at the service of the individual and the citizen*" (health, safety, environment, consumer protection, fraud prevention). Among the areas covered by these themes, particular emphasis would be put on pre-normative research as well as nuclear safety and security (the fuel cycle and control of fissile material).

In view of these priorities, the requirements they reflect and the features and capabilities of the Centre, the institutional and operational role of the JRC in implementing the 5th Framework Programme would be at least on a par with its role in the 4th Framework Programme.

Overall, the scientific and technological objectives of these activities would be located more particularly in areas requiring neutral and independent expertise at European level, and in areas corresponding to the objectives of the major Union policies.

In the choice and definition of activities to be carried out, there is a combination of both continuity and evolution; continuity because of the permanence of certain needs; evolution in order to take into account the new objectives for the Union's research policy set out in the 5th Framework Programme.

In addition, the JRC would continue to pursue vigorously the activities it carries out on a competitive basis, getting as close as possible to the end users of its research, in particular European industry.

(iii) Other means

Besides these two means of action, other mechanisms and instruments would or could be used in the implementation of the 5th Framework Programme:

- Links with EUREKA and COST

The COST and EUREKA frameworks for European cooperation in areas that are non-competitive and closer to the market, respectively, have demonstrated their usefulness, which springs from their flexibility and the principle of launching activities at the initiative of those concerned. Closer ties between these two cooperation frameworks and the Union's research programmes are both possible and widely supported.

Simple and efficient ways of associating Union projects with EUREKA projects and COST actions would thus be developed and proposed, drawing on the fact that the preparation of the 5th Framework Programme, the beginning of the implementation of the 3rd Medium Term Plan of EUREKA and the COST Ministerial Conference in 1997 coincide.

Following the general line set out in the document on "synergy between EUREKA and the programmes of the European Union" prepared by the EUREKA High Level Group for the June 1997 Ministerial Conference, and to ensure quick reaction, a permanent consultation system should in particular be set up, which would allow the identification, as soon as a project is planned, of those elements which could be covered by the Framework Programme or by Eureka, and guarantee the flow of information from the former to the latter as the work progresses, results are produced and market needs are met. This approach would be applied primarily to large-scale projects developed within the "key actions".

General coordination of the links with EUREKA and COST and the definition of common strategic plans would be undertaken within the programme on international cooperation.

- Articles 130k, l and n

The possibility has been raised on a number of occasions of exploiting these articles in addition to the other activities of the Framework Programme, notably in order to implement activities which have a particular interest only for a certain number of Member States. This possibility will not become a reality unless the Member States show a firm willingness to enter into this type of initiative.

If such willingness were to be demonstrated, one or more activities of this type could be foreseen, starting, for example, with certain activities identified in this document (e.g. the key action in the area of aeronautics and activities in the space sector).

The implementation aspects of the 5th Framework Programme will be set out in the formal proposal to be presented at the end of March, as well as in a new proposal on the rules for participation in programmes and the dissemination of research results (implementing Article 130j).

2. LEGAL ASPECTS

The legal aspects, too, will be set out in the formal proposal on the 5th Framework Programme. In defining the legal provisions of the 5th Framework Programme, the following points, in particular, will be taken into account:

- for the sake of rapid and effective implementation, and as was underlined by the Framework Programme evaluation panel, the number of decisions should be kept to a minimum; each programme should therefore give rise to only one decision, except as noted below;
- current legal provisions require separate decisions for activities carried out under the EC Treaty and those carried out under the Euratom Treaty. The programme "*Promoting competitive and sustainable growth*" and the programme of JRC activities will include activities in both of these areas, and each will therefore require two different decisions;
- in the event that activities are decided on the basis of Articles 130k, l and n (in particular 130k, "supplementary programmes"), they would each give rise to a specific decision.

All in all, and not allowing for any supplementary programmes, the adoption and implementation of the 5th Framework Programme should require 12 decisions (2 for the EC and Euratom Framework Programmes, 7 for the 6 programmes, 2 for the JRC, 1 for the implementation of Article 130j), i.e. around half the number required for the 4th Framework Programme. In setting out the timetable for their adoption, the need to launch the 5th Framework Programme at the beginning of 1999 will be kept in mind, which means launching the first calls for proposals in autumn 1998.

THE PROGRAMMES: MANAGEMENT

One of the most important recommendations coming out of the five-year evaluation of the Framework and specific programmes is the need to slim down the management procedures. Management issues will thus receive particular attention in the implementation of the 5th Framework Programme, which will continue to be carried out on the basis of the fundamental principles of the running of programmes: equal access, equitable treatment, excellence as a priority, an appropriate balance between speed and rigour, and transparency of procedures.

In some areas, the improvements made to programme management over the last few years need to be supplemented, and measures to increase the consistency and quality of this management need to be reinforced, particularly with a view to facilitating access to the Framework Programme (e.g. "one stop-shop" for SMEs), reducing processing times, and simplifying procedures.

In addition to those mentioned in the first working paper, the following measures are amongst those currently being studied:

- the implementation in appropriate cases of a scheme of permanently open calls for proposals, a formula which will allow more flexible and efficient processing of requests for participation;
- the evolution of the role of programme committees along the lines set out in the inter-institutional agreements, such as to allow faster processing of proposals.

The general organisation of the 5th Framework Programme in a limited number of large, complementary and connected "thematic" and "horizontal" programmes and the need to take account of modern research management techniques call for a new approach to the management of the Framework Programme.

To ensure genuine coordination, the Commission is currently looking into new formulas. One of these would consist in handling certain aspects of the management of the "thematic" programmes on a collegial basis, entrusting implementation and follow-up to a group drawn from the various research services involved. Working in close cooperation with the services responsible for implementing the Union policies concerned, this group would be responsible for supervising the overall implementation of the programme, ensuring the internal coordination of the various activities, as well as relations with the other "thematic" and "horizontal" programmes and with the other policies of the Union, and organising the coordination of contacts with the other European institutions, the scientific community, the world of industry and, generally, the world of users. In the same spirit, recourse would be had, as often as necessary, to the formula of invitations for multi-programme research proposals.

CONCLUSION

The scientific and technological objectives of the various types of activities envisaged in the 5th Framework Programme, as presented in this paper, have been defined with the aim of meeting the major economic and social challenges the Union is facing today and responding to the aspirations and expectations of its citizens. To achieve these objectives efficiently, a pronounced shift towards a more precise targeting of activities and a greater flexibility in implementation is proposed.

In drawing up its formal proposal, due to be adopted towards the end of March, the Commission still needs, in particular, to take into account the final conclusions and recommendations of the general 5-year assessment report on the research activities of the Union. This report, which has been drawn up by the evaluation panel chaired by Viscount Davignon, should be published in February. The Commission also intends to integrate the conclusions resulting from discussions on this second working paper. As with the two previous Communications, the ideas presented above are intended to fuel discussions in the Council and Parliament as well as with all other interested parties. A full and constructive discussion should result from the fact that these ideas are presented in this concrete and open manner.

With this debate the Commission is hoping to reconcile the pressing need for new ideas and methods of implementation with the need for continuity, not least chronologically, in the Union's research efforts. In this way, it will be able to ensure that, in the most propitious circumstances and for the benefit of all, the 5th Framework Programme contributes to *"Inventing Tomorrow"*.

KEY ACTIONS	CRITERIA								
	Social objectives			Economic development and scientific and technological prospects			European "value added"		
	Employment	Quality of life, health	Environment	Growth	Competitiveness	Technological advances	"Critical mass"	Support for Union policies	European scale of problems
The living world and ecosystem (I): health and food	✓ ✓	✓ ✓ ✓	✓	✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓
The living world and ecosystem (II): control of viral and infectious diseases	✓	✓ ✓ ✓	✓	✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓
The living world and ecosystem (III): the "cell factory"	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓
The living world and ecosystem (IV): management and quality of water	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓
The living world and ecosystem (V): environment and health	✓	✓ ✓ ✓	✓ ✓ ✓	✓	✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓
The living world and ecosystem (VI): new rural and coastal areas	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓
Information society (I): services for the citizen	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓
Information society (II): electronic trade and new methods of work	✓ ✓	✓ ✓	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓
Information society (III): multimedia content	✓ ✓	✓ ✓ ✓	✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓
Information society (IV): essential technologies and infrastructures	✓ ✓	✓ ✓	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓
Competitive and sustainable growth (I): products, processes, organization	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓	✓ ✓ ✓	✓
Competitive and sustainable growth (II): sustainable mobility and intermodality	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓
Competitive and sustainable growth (III): new perspectives in aeronautics	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓
Competitive and sustainable growth (IV): marine technologies	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓
Competitive and sustainable growth (V): advanced energy systems and services	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓	✓ ✓ ✓	✓ ✓
Competitive and sustainable growth (VI): the city of tomorrow	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓	✓ ✓	✓	✓ ✓	✓ ✓ ✓
Space technology	✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓

Special coordination of these activities under the 3 thematic programmes.

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