COUNCIL DECISION

of 27 July 1994

adopting a specific programme for research and technological development, including demonstration, in the field of industrial and materials technologies (1994—1998)

(94/571/EC)

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 130i (4) thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Parliament [1],

Having regard to the opinion of the Economic and Social Committee [2],

Whereas, by Decision 1110/94/EC [3], the Council and the European Parliament adopted a Fourth Framework programme for Community activities in the field of research, technological development and demonstration (RTD) for the period 1994—98 specifying *inter alia* the activities to be carried out in the field of industrial and materials technologies; whereas this Decision takes account of the grounds set out in the preamble to that Decision;

Whereas Article 130i (3) of the Treaty stipulates that the Framework programme is to be implemented through specific programmes developed within each activity under the Framework programme and that each specific programme is to define the detailed rules for its implementation, fix its duration and provide for the means deemed necessary;

Whereas the amount deemed necessary for carrying out this programme is ECU 1 617 million; whereas the appropriations for each financial year shall be laid down by the budgetary authority, subject to the availability of resources within the financial perspectives and to the conditions set out in Articles 1 (3) of Decision 1110/94/EC;

Whereas a strengthening of cooperation in RTD concerning industrial and materials technologies is needed in order to develop technologies for the sustainable development of European industry;

Whereas this programme may make a significant contribution to the stimulation of growth, to the strengthening of competitiveness and to the development of employment in the Community, as indicated in the White Paper on 'Growth, competitiveness and employment';

Whereas the content of the Fourth Framework programme for Community RTD activities was established in accordance with the subsidiarity principle; whereas this specific programme specifies the content of the activities to be carried out in accordance with this principle in the field of industrial and materials technologies;

Whereas Decision 1110/94/EC lays down that a Community action is justified if, *inter-alia,* research contributes to the strengthening of the economic and social cohesion of the Community and the promotion of its overall harmonious development, while being consistent with the pursuit of scientific and technical quality; whereas this programme is intended to help meet these objectives;

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

Whereas precompetitive and multisectoral research activities relating to steel product and process innovation may gradually be taken into account in the context of this specific programme, given the importance attached to these activities and in view of the forthcoming expiry of the ECSC Treaty;

Whereas the rules for the participation of undertakings, research centres (including the Joint Research Centre (JRC)) and universities and the rules governing the dissemination of research results specified in the measures provided for in Article 130j of the Treaty apply to this specific programme;

Whereas provision should be made for measures to encourage the involvement of small and medium-sized enterprises (SMEs) in this programme, in particular through technology stimulation measures;

Whereas the Commission's efforts to simplify and accelerate the application and selection procedures and make them more transparent must be continued in order to support the implementation of the programme and to facilitate the action which firms, and particularly SMEs, research centres and universities have to undertake in order to participate in a Community RTD activity;

[1] OJ No C 205, 25. 7. 1994.
[2] Opinion delivered on 2 June 1994 (not yet published in the Official Journal).
[3] OJ No L 126, 18. 5. 1994, p. 1.

Whereas this programme will help to strengthen synergy between the RTD activities carried out in the field of industrial and materials technologies by research centres, universities and enterprises, in particular SMEs, in the Member States and between these and the corresponding Community RTD activities; whereas coordination between research projects with a common theme should be improved; whereas the establishment of thematic networks will permit greater synergy between fundamental research and industrial research and coordination with other European initiatives and frameworks, in particular Eureka and COST;

Whereas the nature of the activities to be undertaken in this programme requires close coordination with activities undertaken under other specific programmes;

Whereas an action designed to place the development of Europe's industry on new technological foundations must be based on an adequate knowledge of technological demand; whereas such knowledge is particularly necessary in order to give priority to general technologies for widespread dissemination among the sectors involved;

Whereas it may be appropriate to engage in international cooperation activities with international organizations and third countries for the purpose of implementing this programme;

Whereas this programme should also comprise support activities and activities for the dissemination and exploitation of RTD results, in particular towards SMEs, notably those in the Member states or regions which participate least in the programme, and activities to stimulate the mobility and training of researchers within this programme to the extent necessary for proper implementation of the programme;

Whereas an analysis should be made of possible socio-economic consequences and technological risks associated with the programme;

Whereas progress with this programme should be continuously and systematically monitored with a view to adapting it, where appropriate, to scientific and technological developments in this area; whereas in due course there should be an independent evaluation of progress with the said programme so as to provide all the background information needed in order to determine the objectives of the Fifth RTD framework programme; whereas at the end of this programme there should be a final evaluation of the results obtained compared with the objectives set out in this Decision;

Whereas the JRC may participate in indirect actions covered by this programme;

Whereas the JRC will also contribute, through its own programme, to the attainment of the Community RTD objectives in the areas covered by this programme;

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

HAS ADOPTED THIS DECISION:

Article 1

A specific programme for research and technological development, including demonstration, in the field of industrial and materials technologies, as set out in Annex I, is hereby adopted for the period from 27 July 1994 to 31 December 1998.

Article 2

1. The amount deemed necessary for carrying out the programme is ECU 1 617 million, including a maximum of 5,08 % for staff and administrative expenditure.

2. An indicative breakdown of this amount is given in Annex II.

3. The budgetary authority shall lay down the appropriations for each financial year, subject to the availability of resources within the financial perspectives and in accordance with the conditions set out in Article 1 (3) of Decision 1110/94/EC, taking into account the principles of sound management referred to in Article 2 of the Financial Regulation applicable to the general budget of the European Communities.

Article 3

1. The general rules for the Community's financial contribution are laid down in Annex IV to Decision 1110/94/EC.

2. The rules for the participation of undertakings, research centres and universities, and for the dissemination of results are specified in the measures envisaged in Article 130j of the Treaty.

3. Annex III sets out the specific rules for implementing this programme, supplementary to those referred to in paragraphs 1 and 2.

Article 4

1. In order to help ensure, *inter alia*, the cost-effective implementation of this programme, the Commission shall continually and systematically monitor, with appropriate assistance from independent, external experts, the progress within the programme in relation to the objectives set out in Annex I, as amplified in the work programme. It shall in particular examine whether the objectives, priorities and financial resources are still appropriate to the changing situation. It shall, if

necessary, in the light of the results of this monitoring process, submit proposals to adapt or supplement this programme.

2. In order to contribute towards the evaluation of Community activities, as required by Article 4 (2) of Decision 1110/94/EC and in compliance with the timetable laid down in that paragraph, the Commission shall have an external assessment conducted by independent qualified experts of the activities carried out within the areas covered by this programme and their management during the five years preceding this assessment.

3. At the end of this programme the Commission shall have an independent final evaluation carried out of the results achieved compared with the objectives set out in Annex III to Decision 1110/94/EC and Annex I to this Decision. The final evaluation report shall be forwarded to the European Parliament, the Council and the Economic and Social Committee.

Article 5

1. A work programme shall be drawn up by the Commission in accordance with the objectives set out in Annex I and the indicative financial breakdown set out in Annex II, and shall be updated where appropriate. It shall set out in detail:

— the scientific and technological objectives and research tasks,

— the implementation schedule, including dates for calls for proposals,

— the proposals financial and managerial arrangements, including specific modalities for implementing technology stimulation measures for SMEs and the general lines of other measures, including preparatory, accompanying and support measures,

— arrangements for coordination with other RTD activities carried out in this area, in particular under other specific programmes, and, where appropriate, for ensuring improved interaction with activities carried out in other frameworks, such as Eureka and COST,

— arrangements for the dissemination, protection and exploitation of the results of RTD activities carried out under the programme.

2. The Commission shall issue calls for proposals for projects on the basis of the work programme.

Article 6

1. The Commission shall be responsible for the implementation of the programme.

2. In the cases provided for in Article 7 (1), the Commission shall be assisted by a committee composed of representatives of the Member States and chaired by the representative of the Commission.

3. The representative of the Commission shall submit to the Committee a draft of the measures to be taken. The Committee shall deliver its opinion within a time limit that the chairman may lay down according to the urgency of the matter. The opinion shall be delivered by the majority provided for in Article 148 (2) of the Treaty in the case of decisions which the Council is required to adopt on a proposal from the Commission. The votes of the representatives of the Member States within the committee shall be weighted in the manner set out in that Article. The chairman shall not vote.

4. The Commission shall adopt the measures envisaged when they are in accordance with the opinion of the Committee.

5. If the measures envisaged are not in accordance with the opinion of the Committee or if no opinion is delivered, the Commission shall, without delay, submit to the Council a proposal relating to the measures to be taken. The Council shall act by a qualified majority.

6. If, on the expiry of a period of three months from referral of the matter to the Council, the Council has not acted, the proposed measures shall be adopted by the Commission.

Article 7

1. The procedure laid down in Article 6 (2) to (6) shall apply to:

— the preparation and updating of the work programme referred to in Article 5 (1),

— the content of the calls for proposals,

— the assessment of the RTD activities proposed for Community funding and the estimated amount of the Community contribution for each activity where this is equal to or more than ECU 0,9 million,

— any adjustment to the indicative breakdown of the amount as set out in Annex II,

— specific modalities for the financial participation of the Community in the different activities envisaged,

— the measures and terms of reference for programme evaluation,

— any departure from the rules set out in Annex III,

— participation in any project by legal entities from third countries and international organizations.

2. Where, pursuant to the third indent of paragraph 1, the amount of the Community contribution is less than ECU 0,9 million, the Commission shall inform the Committee of the projects and of the outcome of their assessment.

3. The Commission shall regularly inform the Committee of progress with the implementation of the programme as a whole.

Article 8

This Decision is addressed to the Member States.

Done at Brussels, 27 July 1994.

For the Council
The President
TH. WAIGEL

ANNEX I

SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES AND CONTENT

This specific programme fully reflects the guidelines of the Fourth Framework programme in applying the selection criteria and in specifying its scientific and technological objectives.

Paragraphs 2.A, 2.B and 2.C of Annex III, (First Activity) of that Fourth Framework programme are integral parts of this programme.

OBJECTIVES

The globalization of markets, the greater international competition with newly industrialized countries, the increased cost of developing new technologies and the reduction of product lifetimes are forcing European industries to revise their cooperation strategies in order to master a broad spectrum of technologies and to ensure the cost-effectiveness of RTD efforts. In addition, in our changing society we are moving towards a different development model in which more importance is attached to the quality of life and more rational use of human and natural resources. In this context substantial R&D is needed to develop the technology for human-centred production systems taking account of human factors and based on clean technologies. This being the case, Community programmes may act as a catalyst in spurring medium to long term R&D and in supporting national activities and industrial efforts.

As indicated in the White Paper on growth, competitiveness and employment, boosting industrial competitiveness is one of the most effective means of maintaining and even increasing employment, this being one of the most urgent problems to be overcome if jobs are to be guaranteed for the coming generation.

Technological research may be a major factor in stimulating innovation in respect of products, processes and business organization, and underpinning and prompting new industrial activities which ease the incorporation of new technologies and processes to traditional sectors and the emergence of new sectors, for which Europe's export capacity is currently still limited. The Community's industrial research activity is particularly well placed to provide assistance where the best means of conducting R&D is to do so on the basis of multidisciplinary, cross-frontier cooperation, focusing on generic technologies which can rapidly be applied in different Member States and different industrial sectors.

In order to boost the effectiveness and impact of Community action, efforts will concentrate on the following areas: objectives, scientific and technical content, programme implementation and administration of research projects:

(a) *Objectives:* The programme, which is multi-sectoral and open to various types of industrial activity, will focus on the following three objectives:

— in the short term, priority should be assigned to research for the adaptation of existing technologies, or for the development of new industrial technologies, which provide competitive leverage, particularly in sectors where the level of technology is lower; small and medium-sized enterprises (SMEs) in these sectors account for a large proportion of European industry and provide the bulk of employment,

— in the medium term, research will focus on industries which are already developing innovative technologies and strategies allowing reinforcement of its competitiveness and better use of human resources while endeavouring to reduce the adverse environmental impact of production,

— in the long term, more fundamental, strategic and high risk research will focus on new technologies for the production and design of products which allow new industries or markets to be created in a context of sustainable growth.

(b) *Content of the programme:* research will concentrate on technologies needed by European industry in relation to critical stages of production systems and the quality of products:

— Production technologies: priority will be given to improving production systems, an area which provides numerous opportunities for technological innovation and the greatest potential in terms of lasting competitive advantages. In a context of respect for human beings and the environment, and sustainable growth, the research will cover new process engineering methods, new manufacturing techniques, new inspection, diagnostic and quality maintenance and assurance systems, research into component miniaturization within industrial systems and into emerging technologies (such as nanotechnologies), and the incorporation of new and existing technologies, especially available information and communications technologies [1], into manufacturing centres taking into account the new production organization models. Special attention will be paid to business organization, the incorporation of technologies addressing social concerns, the health and safety of

[1] The industrial technologies research programme will draw upon information technologies as well as other generic technologies with a view to promoting innovation and application in manufacturing industry. In turn, it will provide inputs, knowledge, and expertise for the information and communication technologies (ICT) programme aimed at the development of new ICT solutions for advanced manufacturing and engineering processes. To ensure complementarity between the two programmes, close coordination and an active interface will be maintained.

workers (working conditions) and environmental concerns (clean technologies, rational use of resources) whilst taking into account their economic and industrial impact.

— Materials and technologies for product innovation through research into new techniques for the design and preparation of products, including structures, in the context of a rational use of resources, to reduce manufacturing costs and environmental impact, and improve quality, reliability and safety. The research will look into ways of improving the functional properties, including surface properties, of traditional and advanced materials for new and improved products via innovative design and preparation techniques, as well as new technologies for the recycling and reuse of industrial products at the end of their lifecycle. Attention will be paid to high-performance materials engineering and molecular engineering, in particular supramolecular chemistry. The principle of materials cycle optimization, avoiding the use of harmful materials, could be a common feature of the various research activities.

— Technologies for transport means: in support of the establishment of the single market and the implementation of Community policies, in particular the creation of trans-European networks, the development of new, faster, more reliable, comfortable and environment-friendly means of transport at competitive costs calls for a considerable amount of research at Community level, in coordination with that undertaken in the preceding areas, concerning the incorporation and application of new design, manufacturing, modelling, simulation and maintenance technologies, new and improved materials and environmental technologies.

Special emphasis will continue to be given to aeronautics research both to ensure continuity with the action undertaken in the Third Framework programme and to reflect further the essential advanced technology requirements of this industry and its capability for proving feasibility of advanced generic technologies which will then be spun off to other transport or industrial sectors.

(c) With regard to programme implementation, the following three types of research activities, including where appropriate basic research of an industrial relevance, will be carried out:

— industrial activities targeted on priority objectives of strategic importance to the future of European industry taking into account user needs,

— activities by and for SMEs: measures for technology stimulation, based on the Craft and feasibility awards experience, in order to encourage and facilitate the participation of SMEs, taking account of the needs of those from less advanced regions and

— know-how development and dissemination activities based on generic technologies which could be coordinated through thematic networks.

Stress will be placed on projects displaying multidisciplinary and multi-sectoral characteristics in order to ensure the development and optimum transfer of knowhow and technologies, in particular those developed and used in the high-technology sectors, into basic industries adding more to GDP or into those which are the subject of industrial policy. This research will be organized around consortia of suppliers, manufacturers, end users, universities and research centres. Also in view of the expiry of the ECSC Treaty, research activities linked with steel product and process innovation will gradually be taken over in the context of this programme, on the condition that they comply with the eligibility criteria, in particular as regards their precompetitive and multisectorial nature. Lastly, within its technical competence, complementary activities will be implemented by the JRC in particular in domains 2.1 'materials engineering' and 2.4 'recovering products at the end of their lifecycle'. (1)

(d) *Project management:* a major concentration of effort concerning the management of selected projects could be obtained, where appropriate by means of 'vertical coordination' or the 'network' approach, which is aimed at coordinating relevant projects on a given topic. Taking into account the fact that competitive advantages are obtained right from the basic research stage through the manufacturing or production process, including the design stage, efforts will be made to coordinate research projects around common industrial objectives in order to facilitate the incorporation of technologies and the transfer of knowledge and to encourage cooperation between suppliers, manufacturers and users and between industrial sectors. This will make for improved synergy between those involved and better coordination with the various other complementary Community programmes (in particular, information technologies, telematics, measurements and testing, environment, life sciences and technologies, non-nuclear energy, transport, targeted socio-economic research) and other initiatives at European level, and in particular with Eureka, which is more market-oriented, and with which joint seminars, a reorientation of the projects proposed towards the most suitable framework and an exchange of information between projects will be organized.

SCIENTIFIC AND TECHNOLOGICAL CONTENT

Area 1: Production technologies

1. *Background*

In accordance with the White Paper on growth, competitiveness and employment, action by the European Union should focus on technological areas and applications which will have an impact on a broad range of industrial activities and which are geared towards sustainable economic growth, the rational use of natural resources and the

(1) A description of the activities envisaged for the JRC in these areas is contained in the proposal for a decision of the Council relating to the activities of the JRC (doc. COM(94) 68 final, 30 March 1994, 94/0095 (CNS)). An extract from this proposal is attached to this Decision.

optimum use of human resources. This topic covers all manufacturing and processing industries. The challenge is to develop generic industrial methods and technologies and apply them to design, engineering, organization, production and the maintenance of high quality and high value-added, thus enabling European industry to remain in the forefront of technological innovation and to clear the way for future industries. The incorporation of new, advanced technologies into production systems, including infrastructures and plant, will help to boost industrial competitiveness and create new jobs by cutting costs, improving reliability and safety and shortening market lead times. It will also help to improve the environment and health and safety at the workplace.

2. *Proposed activities*

The research will aim at developing and incorporating the most advanced design and engineering tools. These enabling technologies will be applied within production systems in such a way as to meet the requirements of inter-company networks, and the need to optimize industrial plant, cost-effectiveness, product quality and manpower management. Increasing competitiveness by improving productivity, flexibility and quality will be a major aim; the research will look for a proper balance where there is a middle way between full automation and the use of labour alone. Stress will be placed on the integration of intelligent and computer-aided techniques, the latest developments in rapid prototyping, application of cognitive engineering and microsystem technologies, the development of new organizational approaches, man-machine interfaces and the technologies required to deal with the critical aspects of production systems, and in particular those associated with clean, flexible and just-in-time manufacture. The concept of clean production puts a special emphasis on the efficient and hence more cost-effective use of energy and raw materials resources. Research efforts should therefore focus on reducing, avoiding or eliminating polluting substances at source.

Area 1.1: Incorporation of new technologies into production systems

The need for production to be rapidly and continually adapted to changes in demand calls for flexible production systems and structures which include new technologies.

Research should also be considered into the organization of production processes for 'one of a kind' or small scale manufacturing in order to achieve high manufacturing flexibility, product quality, process automation and material and labour cost reduction.

The main ways of making progress are to use new production technologies and information and management systems, and to take greater account of the company's environment. Moreover, the use of computer-aided design and manufacturing technologies (CAD/CAM), the trend towards microsystems and their incorporation in industrial products and processes are changing traditional industrial practices. Finally, optimization of performance, quality, environmenal impact, employment, training and health and safety aspects must also be taken into acocunt; the technical requirements in question should be addressed by research in the following areas:

— generic approaches drawing upon all the possibilities offered by new technologies, in particular computer-aided technologies (CIME), control systems, mechatronics or microsystems, with a view to optimum incorporation into production systems, for example in the machine tool or construction sectors and also in the more traditional sectors,

— research into new manufacturing technologies and improved processes which are better matched to user needs in terms of reliability and flexibility, and which may be used more efficiently for the building, maintenance and reuse of industrial systems and facilities,

— research into quality production systems based on the rapid identification, gathering and communication of manufacturing data or data concerning the use of industrial machines or facilities, defining production or service parameters or establishing references for the continual improvement of industrial processes.

Area 1.2: Development of clean production technologies

In an integrated production system the overall quality of the final product increasingly depends on advances in materials science, process control and an understanding of the phenomena governing these processes. It is therefore necessary to develop the knowhow needed in order to design and control increasingly complex processes, and in particular to develop and apply innovative and clean techniques, including those applicable to the chemical industry. The priority research topics should therefore be as follows:

— improvements in the design and control of increasingly complex industrial processes, taking account of progress in artificial intelligence, and simulation techniques for production processes and facilities, including the use of control strategies, for the increase of productivity, safety, energy efficiency, reducing waste and the need for waste management. The substitution of hazardous materials and lubricants for mechanical processing technologies should also be considered,

— research into application and adaptation to industrial processes of innovative chemical, biochemical and biotechnological engineering techniques, which boost productivity and performance through a better understanding of basic phenomena, while taking account of pollution prevention, recycling and process safety.

Area 1.3: Rational management of raw materials

The rational management of raw materials must be seen in a world context in order to safeguard the supply of resources

while respecting the environment. Given the importance of employment in this sector, emphasis will be placed on technologies aimed at maintaining or creating jobs in a context of safety, health and respect for the global system. The prevention of pollution, which improves productivity and at the same time allows more efficient allocation of resources, has become a crucial industrial parameter. Attempts will be made, in particular, to make progress on technologies for the disposal of problem wastes or the reuse of waste. This means viewing industrial systems in their totality so as to optimize the total materials cycle from raw material to end product. The research will concentrate on:

— new technologies to ensure a sustainable supply of raw materials, especially in the field of mining, quarrying and exploration;

— research into new processes and techniques used for ore treatment, and production of metals and industrial minerals in order to trim production costs and mitigate safety, environmental and energy problems;

— multidisciplinary approaches to the production, exploitation and use of raw materials, to make economic use of residues in production processes and to use them as secondary raw materials.

Area 1.4: Safety and reliability of production systems

Within the Community one of the main industrial objectives is to ensure the safety of factories, mines, building sites, offshore installations, etc., and the health and safety of the workforce or their families. That is why technological research must place emphasis on new methods of diagnosing potentially dangerous faults and the constant monitoring of the condition of plant, buildings, infrastructures and machinery. Also, efficient maintenance and the ability to intervene at the appropriate time, to ensure maximum plant availability, which has a direct impact on company viability, must be ensured. The most urgent research tasks will be:

— research into controlling the service life of production plant and systems, in connection with safety and reliability requirements, based on failure-mode analysis and optimization of inspection, monitoring, diagnostic, maintenance and repair techniques;

— research into new on-line inspection systems incorporating intelligent materials, sensors, actuators and microsystems and the use of advanced technologies, including available information and communication technologies (ICT), in order to monitor and perform diagnoses on large facilities, and to monitor production within the 'clean factory';

— research and development concerning the application of integrated and expert systems for inspecting and monitoring products and industrial processes, in particular by incorporating technological knowledge, improving performance and reliability and by means of the efficient integration of decision-making aids.

Area 1.5: Human and organizational factors within production systems

One of the major challenges facing industry is to improve business organization and man/machine and man/factory interfaces. There are many process-control situations where the use of a system is restricted by its operator's level of confidence — or otherwise — in the information given to him or her. The solution is not simply more automation, but systems which the operator can understand and on which he or she can easily be trained. Likewise it means that operators must be freed from repetitive or unsafe work and be redirected towards more interesting activities. A major effort is needed to provide a degree and form of automation which is suited to the wide range of skills in the workforce and which will ensure that the operator at any level feels confident that he or she and not the machine is in control. As part of a total quality approach and to increase flexibility, new ways of addressing human and organizational aspects within production systems and labour will be taken into account, as well as research into innovative solutions.

The aims of the research are as follows:

— improving the quality of production systems via research into ergonomics, technologies and work organization, account being taken of cultural factors, operator skills and the inherent requirements of the job itself;

— improving working conditions, health and safety, man/machine and man/factory interfaces, by means of harmonization of codes of good practice in company organization and the optimum harnessing of advanced manufacturing, processing and construction technologies;

— research into planning and logistical methods and their incorporation into industrial enterprises and their environment.

Area 2: Materials and technologies for product innovation

1. *Background*

The competitiveness of European industry will depend on the ability to make new products with a higher added value reflecting the increasing level of quality demanded by the market. This objective can be achieved by developing new design and engineering methods based on the lifecycle of products and aimed at reducing the variety and complexity of materials, costs and production times and increasing the quality and reliability of clean products reflecting environmental concerns and the need for sustainable growth. Materials research can help to provide new solutions capable of optimizing the application of various current technologies and to reduce the complexity of advanced materials themselves, harmful emissions, and even production costs by enabling materials to be recovered and reused, which is particularly relevant to components with high added-value.

The industrial sectors in the field of materials and materials-related technologies constitute a key component of European industry. As an example, the advanced-materials sector alone will represent a market worth ECU 200 billion worldwide by the year 2000. Europe must maintain its presence in this strategic area, firstly by improving the processes generally used in the materials-working or processing industries (metalworking, building, textiles etc.), secondly by ensuring that the most advanced materials can be used cost-effectively by both traditional industries and the high-tech industries in producing the products of the future, and thirdly, by contributing to the competitiveness and balance of the global system.

2. *Proposed activities*

By adopting an approach which takes account of the entire product lifecycle, the research activities shuld seek to harness the best and most appropriate means of ensuring the conservation of resources and satisfying consumer requirements in order to make quality products at a reasonable cost and to act responsibly with regard to the natural and social environment, especially in respect of employment and social exclusion. Priority will be given to research topics relating to product design and manufacturing based on improved or advanced components and materials, clean treatment processes and, in the longer-term, processes of an exploratory nature which may quickly yield practical applications and thereby strengthen European industry's technological lead, above all by identifying the products of the future. Examples of this are molecular engineering and biotreatment, new technologies which were not in existence 10 years ago and which are expected to play an important part over the next 10 years. The activities will also concern manufacturing processes making it possible to improve the properties and functionality of traditional materials, possibly resulting in the generation of new products. The programme will also place emphasis on the treatment of waste, and on product recycling and re-use based on product lifecycles, and will include projects relating to the quality, ease of use and reliability of products.

Area 2.1: Materials engincering

Advanced materials are used in industrial components and their characteristics often determine the critical threshold for increasingly complex systems such as propulsion units, or electronic, mechatronic or medical devices. Account must be taken of their behaviour throughout the product lifecycle. Often the progress made in materials research sets the speed at which the key sectors of the economy can develop. This is particularly true for the high-tech sectors but it also applies to basic industries such as chemicals, construction or mechanical engineering. Therefore, RTD in advanced materials engineering (e.g. molecular engineering), or in more forward-looking areas is essential to the future prosperity of industry. However, market demands is forcing industry to reduce the use of excessively exotic materials and try to improve existing traditional and advanced materials. Research and development should focus on the following areas:

— innovations and integrated approaches to techniques for the design, the preparation and treatment of materials, including traditional materials, (e.g. near-net-shape production, powder metallurgy, surface engineering, etc.) aimed at improving the properties, characteristics and functionality of materials, process efficiency and product quality;

— functional and intelligent materials with a view to obtaining more efficient products for multisectoral applications in electric motors, actuators, sensors and other electrical or mechanical devices, including superconducting materials;

— multidisciplinary research into materials aimed at enabling natural materials to be used cost-effectively in industrial products, at eliminating harmful substances, at increasing their suitability for recycling and at predicting the effects of repeated recycling on the structural and functional characteristics of materials;

— research into the synthesis of new, high-performance materials and chemicals using, for example, computer-aided technologies in order to incorporate specific properties into materials, and minimizing their impact on the environment and health, in particular through their biodegradability and suitability for recycling and reuse;

— support for the development of products and materials of the future, in particular using molecular, macromolecular and supramolecular engineering; research will also focus on biocompatible materials for medical applications and on biotechnology materials aimed at industrial products and processes.

Area 2.2: New methodologies for product design and manufacture

The competitiveness of manufacturing industry will be improved through optimum use of new technologies and improved synergy with knowledge-based activities (such as services, engineering and training). The challenge in particular is to reduce the lead time between the design and marketing of a new product or process. Market competitiveness is increasingly determined by the time factor. This means that engineers must deal with the design and planning of production and marketing at one and the same time. However, research into the optimization of performance also has to consider the entire lifecycle of products and processes, and thus has to endeavour to solve all the related problems. In manufacturing, an important part of lifecycle costs and of reliability and quality problems arise during the critical product design period. The design of products with high added-value and for products of the future calls for research centred on the following points:

— research into, and application and incorporation of new design and engineering methodologies, in particular by making use of recent developments in cognitive engineering and computer-aided technologies, and rapid prototyping, account being made of the planning and implementation of the critical stages of production systems and of the whole product lifecycle;

— research into methods of analysing and modelling phenomena connected with the transformation of materials (e.g. solidification) and product behaviour (e.g. deformation, vibration);

— support for product innovation by developing multidisciplinary approaches involving comprehensive research into materials, design, processing and manufacturing methods, effects on employment and health and safety in the workplace, quality control and product recycling in order to improve cost-effectiveness and reduce environmental and social impacts;

Area 2.3: Reliability and quality of materials and products

Linked with the need for increased reliability, safety, health protection and cost-effectiveness, the need for a deeper knowledge of material, component and product behaviour is of growing importance. This area, studied at length in the past, is becoming increasingly important given the current economic, social and environmental challenges. The research topics in this field should be:

— studies combining microstructural and macrostructural modelling, improving detection of microdefects and enabling the phenomena involved to be understood and improvements to be made to the reliability and safety of materials;

— multidisciplinary approaches in order to control the deterioration of products, structures and industrial components and to improve their sustainability (corrosion, fatigue, wear, etc.) based on the modelling of actual behaviour and a better understanding of materials property relationships and how these affect ultimate behaviour;

— development of new approaches to guarantee the quality of products and materials, including non destructive testing.

Area 2.4: Technologies for recovering products at the end of their lifecycle

In the past, technological advances often had adverse effects on the environment during the materials treatment phase, the manufacturing process or the disposal of obsolete products. However, it is possible to develop materials, processes and products which satisfy both the needs of the economy and of the environment in accordance with society's demand for sustainable development. Science and technology now offer opportunities for designing products taking into account the entire lifecycle and the reuse of materials at the end of the lifecycle. This means that research efforts will focus on the design of new products and materials which can be recycled many times and the development of new products with a longer lifespan, e.g. using repair, partial or total reuse techniques. Research will focus on the following as a matter of priority:

— support for research into new product design methodologies and technologies based on the possibility of reusing or repairing products, in particular by simplifying assembly and disassembly and reducing the number of components and the diversity of materials in a product;

— new techniques for recovering and recycling materials from products at the end of their lifecycle, quality control and methodology to satisfy standards or specifications for reuse;

— more research into cost-effective and safe construction, repair and disassembly techniques allowing the total or partial reuse of components of industrial systems, structures and products.

Area 3: Technologies for means of transport

1. *Background*

European integration and current trends in the economy are creating a growing demand for flexible and efficient transport systems. The progress made by the various modes of transport is doubtlessly contributing to the economic development of the regions and European countries, particularly those situated at the periphery, but at the same time it is increasingly exacerbating current environmental and mobility problems. The environmental impact of the various modes of transport is a factor which limits the growth of this sector of activity. Society will accept the future modes of transport if medium and long term solutions are found to the problems of energy consumption and local and global pollution. The rational use of the different modes of transport is the key element in bringing about improvements with regard to capacity, energy consumption, cost-effectiveness, comfort, quality, safety, volume, speed, and environmental compatibility, in liaison with the other European policies concerning industrial competitiveness, transport, environment and social impact and energy saving. By vehicle is meant: aircraft, ship, road and rail transport mean.

2. *Proposed activities*

The main objective is to strengthen the scientific and technological base of European industry concerned with the production of means of transport. The research carried out in this domain will be closely coordinated with that in the two preceding domains and with the other specific programmes. In the case of the aeronautics, automotive, railway and shipbuilding industries, research will focus as a matter of priority on design, materials applications, and the production and maintenance of advanced means of transport in order to improve their life cycle and cost-effectiveness. Special emphasis will be given to aeronautics research with the objective of responding to the essential advanced technological requirements of the aeronautics industry and enabling it to demonstrate, the feasibility of advanced generic technologies capable of being applied to other transport sectors. Actions previously undertaken will have their continuity assured within the specific programmes of the Fourth Framework programme according to their content.

The competitiveness of each transport mode will depend on the ability to produce vehicles at competitive costs and ensure passengers safety, ease of access and comfort under optimum conditions of speed, range, overall load capacity, reliability and efficiency. The vehicles of the future will also have to meet new needs arising from the creation of the

trans-European networks foreseen in the White Paper. To this end, research and development will focus on the following areas:

Area 3.1: Vehicle design and systems integration

Excellence in design is one of the primary means of improving industrial competitiveness and profitability. Transport vehicles present a quite specific challenge in terms of design because of their multi-functional capability and dependence on the effective integration of, and interaction between, complex on-board and external systems. The research must therefore aim to bring together multidisciplinary modelling, analysis and simulation tools within an Integrated Vehicle Design environment, fully exploiting state-of-the-art high performance computing and multimedia communications technologies. Research should be carried out in the following areas:

— development of design tools adapted to support systems for configuration and concept design of vehicles and their components, equipment, subsystems and system interfaces, facilitating rapid and easy definition of users' needs and product specifications;

— development of methodologies for a vehicle design knowledge base, incorporating best practice with regard to materials, safety, standards, environmental protection, manufacture and maintenance, in order to optimize overall vehicle design;

— development of multidisciplinary analysis and optimization tools capable of supporting design/engineering decisions throughout the design cycle from initial concept design to final prototype validation. These will include, for example, modelling, manufacturing methods and whole life cycle cost estimation;

— application of rapid prototyping techniques such as virtual reality and stereo lithography for the validation of design, simulation of component functionality and optimal vehicle operation;

— research into innovative materials applications, metallic and non metallic materials, composites or multimaterials, in particular for fatigue and severe working conditions, for high-temperature or high-pressure applications;

— research into light structures, including composite structures, to reduce the weight of vehicles and specific subsystems.

Area 3.2: Vehicle production

The production of transport vehicles varies considerably in terms of scale, size, volume and precision. The ability to respond rapidly to orders for individually customized vehicles is increasingly influencing competitiveness and favours a more modular and flexible approach to manufacture and assembly. The demand for vehicles which are lighter, faster, more efficient and yet competitively priced, necessitates the use of alternative structural materials, introducing new challenges for volume production and flexible assembly. Research in this area will therefore address:

— the development of innovative cost effective modular, flexible and reconfigurable systems for the fabrication and assembly of components, subsystems and vehicles from homogeneous or heterogeneous materials such as composites or advanced materials;

— the development of advanced materials production and fabrication techniques for niche applications and integration in vehicles such as energy storage/converter devices, including batteries, alternative fuel tanks and ancillary equipment;

— development and validation of innovative tools and more efficient and cost-effective procedures for the quality control and testing of components of large complex structures.

Area 3.3: Technologies to improve vehicle efficiency

The efficiency and cost-effectiveness of transport vehicles are crucial factors for an efficient transport system and the competitiveness of the respective supply industries. Research will address:

— the development of technologies for highly energy efficient propulsion systems with low environmental impact and which require less maintenance;

— the development of modelling and experimental techniques to improve the understanding of complex aerodynamic, aerothermodynamic and hydrodynamic flow phenomena, including aspects such as combustion, laminar flow control, shock wave propagation and structure-fluid interaction;

— development of shape optimization techniques aiming at drag reduction and improvement of vehicle stability and whole body dynamics;

— advanced, highly integrated, high-integrity information processing and control sub-systems for optimal vehicle operation, applying established information and communications technologies;

— development of methods and tools for propulsion/transmission integration, aiming at optimal propulsion efficiency.

Area 3.4: Environmental technologies

As transport provision grows, criteria such as efficiency and economy need to be accompanied by reduced environmental impact. Research in this area is also concerned with user needs in terms of comfort, convenience and efficiency, with particular emphasis on measures to improve user acceptability. Related research topics will include:

— a reduction in the volume of emissions leading to an ultra-low level of harmful atmospheric emissions, by using optimization techniques for engines such as variable cycle concepts and advanced combustion chamber design;

— the development of environmental monitoring techniques to detect in situ malfunctions liable to cause increased pollution;

— noise source identification and propagation path analysis, active and passive noise and vibration control;

— development of technologies to improve the dynamics, comfort and ergonomics of vehicles;

— development of new, lightweight equipment for improving passenger comfort, including air conditioning and pressurization.

Area 3.5: Technologies for vehicle safety

The objective of this research will be to contribute to a significant improvement in transport safety by means of structured approaches that address the different components of the transport system, including vehicles, interacting with human aspects and operational infrastructures. This encompasses a combination of safety analysis and deployment techniques, cognitive research, vehicle repair and maintenance strategies, including the different approaches to operational and human management that underline the major factors affecting safety and performance. The research in question will include the development of:

— structure approaches for risk assessment of complex vehicles operation and their associated operational systems, leading to the development of computer aided safety audit and analysis tools;

— passive and active systems and structures, safety techniques aiming at significant improvements in aspects such as vehicle crashworthiness and fireworthiness and occupant survivability;

— methods and tools to identify and control human errors, including data collection, error scenario development, contributing factor analysis and impact assessment methodologies;

— inspection techniques, repair and maintenance strategies for critical systems and components, including large structures and enabling feedback to vehicle design;

— development of simulators for operator training and behavioural response analysis, including electro-mechanical components and their integration with control systems software.

Area 3.6: Technologies for vehicle operation

An important component of transport system effectiveness is provided by the control of transport means and the operational systems within which the transport vehicles operate. Research in this area will address:

— advanced on-board vehicle command and control systems design, taking into account logistic management tools and the requirements for their integration with navigation and communications systems, such as those developed in the telematics programme;

— development of intermodal cargo handling systems, integrated to the vehicle, enabling efficient and flexible transhipment and consignment tracking;

— advanced techniques and methods for predictive maintenance and real-time health and usage monitoring, including advanced non-destructive test techniques and smart structure concepts.

In the development of the abovementioned technologies, due account will be taken of the requirements of the various transport industries:

— Where the aircraft industry is concerned, research will concern advanced technologies, in particular for environmental protection, to reduce both noise and polluting emissions, and, as regards design, to reduce overall energy consumption. The activities in question will aim to improve safety, increase the capacity and cost-effectiveness of the air transport system, and facilitate the production, operation, reliability and maintenance of future generations of aircraft and equipment (complementing the activities foreseen under the telematics programme and the programme of research for transport policy).

— As regards the motor vehicle sector, particular emphasis will be placed on efficient and flexible production technologies and the technologies needed to develop intelligent, clean and safe vehicles, taking into account the activities developed in the other specific programmes. Particular attention will be given to lightweight safe structures, innovative propulsion and energy control systems. Simultaneously engineering for products and process will provide low cost, clean and flexible manufacturing technologies both for mass and low volume production.

— Turning to the railways, efforts will focus in particular on techniques contributing to intermodal operation and interoperability as well as the efficiency of high-speed and urban trains (including electric traction, and on-board control and command and braking systems).

— With regard to the shipbuilding industry, efforts will focus in particular on the development of a new generation of vessels with specific automated and integrated functions (intermodal operation, interoperability and the interface with port infrastructure). Relevant effort will be placed on efficient and flexible production technologies and on the other technologies needed to develop such vehicles.

ANNEX II

INDICATIVE BREAKDOWN OF THE AMOUNT DEEMED NECESSARY

Area	ECU million
1. Production technologies	590
2. Materials and technologies for product innovation	566
3. Technologies for transport means	461 (1)
Total	1 617 (2) (3)

(1) Of which 50 % for the aeronautics sector.

(2) Of which:
- a maximum of 5,08 % for staff and administrative expenditure;
- a maximum of 5 % for coordination activities;
- 3 % for preparatory, accompanying and support measures, including 1 % for the dissemination and optimization of results;
- 10 % for basic research of industrial relevance;
- 15 % on average for activities in respect of SMEs.

(3) A sum of ECU 90 million, the difference between the amount deemed necessary for this programme and the amount foreseen in the fourth RTD framework programme for industrial and materials technologies, is earmarked for the specific RTD programme to be carried out through direct action and science/technology (S/T) support activities in the context of a competitive approach.

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

ANNEX III

SPECIFIC RULES FOR IMPLEMENTING THE PROGRAMME

The programme will be executed through indirect action, whereby the Community makes a financial contribution to RTD activities carried out by third parties or by JRC institutes in association with third parties:

1. Shared-cost actions of the following types:

   (a) RTD projects carried out by undertakings, research centres and universities, including, where appropriate, basic research of an industrial relevance.

   As a general rule, projects should involve at least two non-affiliated industrial firms from two different Member States.

   Community funding will normally not exceed 50 % of the cost of the project, with progressively lower participation the nearer the project is to the market place. Those universities and other similar institutions which do not have analytical budget accountancy will be reimbursed on the basis of 100 % of the additional costs.

   (b) Thematic networks, bringing together manufacturers, end-users, universities and research centres on a single technological or industrial objective in order to facilitate the incorporation and transfer of knowledge and mobility of researchers, and to ensure that greater account is taken of market needs.

   Community funding will normally not exceed ECU 20 000, in average per partner and per year, covering up to 100 % of the additional costs for the coordination of the action, and the implementation of the above activities. Members of a network could also apply for research project under normal procedures.

   (c) Technology stimulation to encourage and facilitate participation of SMEs in RTD activities

      (a) by granting awards for carrying out the exploratory phase of a collaborative RTD activity, including the search for partners, during a period of up to 12 months. The award will be granted following the selection of an outline proposal to be submitted normally by at least two non-affiliated SMEs from two different Member States. The award will cover up to 75 % of the cost of the exploratory phase, without exceeding ECU 45 000 or ECU 22 500 in the exceptional case of a single applicant SME, and

      (b) by supporting cooperative research projects, whereby SMEs having similar technical problems but not having adequate own research facilities, engage other legal entities to carry out RTD on their behalf. Community funding for cooperative research projects, involving at least four non-affiliated SME's from at least two different Member States, will normally cover 50 % of the cost of the research.

   Following an initial call, in both cases proposals may be submitted at any time.

   These activities will be complemented by specific preparatory, accompanying and support measures.

2. Preparatory, accompanying and support measures, such as:

   — studies in support of this programme and in preparation for future activities;

   — support for exchanges of information, conferences, seminars, workshops or other scientific or technical meetings, including intersectoral or multidisciplinary coordination meetings;

   — use of external expertise, including access to scientific databases;

   — scientific publications and activities for the dissemination, promotion and exploitation of results, in coordination with the activities carried out under the third action; the factors liable to encourage use of results will be taken into account from the outset and throughout the duration of RTD projects, the partners in which will constitute a key network for diffusion and exploitation of results;

— analysis of possible socio-economic consequences and technological risks associated with the programme, which will also contribute to the programme 'Targeted Socioeconomic Research';

— training actions related to research recovered by this programme in order to enhance employment skills and to facilitate technology transfer to industry;

— independent evaluation of the management and execution of the programme and of the implementation of the activities;

— measures in support of the operation of networks for increasing awareness and providing decentralized assistance to SMEs, in coordination with the Euromanagement auditing activity of RTD.

Community funding may cover up to 100 % of the costs of these measures.

3. Concerted actions, consisting of the coordination of RTD projects already funded by public authorities or private bodies. The Member States will help the Commission to identify relevant laboratories or institutes, in order to ensure that no major activities are left out of this concertation process.

The concerted action option can also be used under the programme as a way of establishing the feasibility and defining the content of shared-cost research activities.

Community funding will cover up to 100 % of the costs of the concertation.

Annex

Extract from the proposal for a Council Decision for the JRC programme (COM(94) 68 final — 94/0095(CNS) concerning the activities envisaged for the Joint Research Centre (JRC) in the areas covered by the industrial and material technologies specific programme

The contribution of the JRC to this sector is aimed at improving the competitiveness of European industry, conducted in close coordination with the corresponding shared cost action programmes. It will focus on prenormative research which, save exceptions, will be undertaken within the framework of networks of European bodies with interests and capabilities in this type of research and in association with standards organizations, in particular the European Committee for Standardization (CEN). This will guarantee that the overall requirements of industry are taken into account from the start.

Research into materials will be directed mainly at the following sectors, which have a prenormative dimension and good potential as enabling technologies, with an emphasis on clean technologies:

— ceramics, metals and composite materials: process development, study of interfaces and joints, improvement of technological properties, characterization and demonstration;

— surface modification and characterization technology: ion implantation and laser beam, protective coating, non-destructive evaluation methods;

— prenormative research leading to standards on material recyclability, including the development of a database on recyclable materials (ecological characteristics and estimation of useful life).

This research is aimed at acquiring, in close cooperation with the national laboratories concerned, the scientific knowledge necessary for these materials to be used industrially, and to provide the standards bodies with knowledge which is essential for standardization in this field.

Furthermore, the development of non-destructive evaluation techniques to study the reliability and useful life of mechanical constructions will continue with a view to the development of component inspection techniques and the harmonization of qualification procedures. This research will continue to be conducted in the framework of the laboratory networks which have existed for a number of years, which will be gradually enlarged in line with needs.