COUNCIL DECISION

of 19 December 1991

adopting the work programme for the implementation of the specific programme of research and technological development in the field of industrial and materials technologies (1991 to 1994)

(91/679/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community,

Having regard to Council Decision 91/506/EEC of 9 September 1991 adopting a specific programme of research and technological development in the field of industrial and materials technologies (1991 to 1994) [1], and in particular Article 6 (4) thereof,

Having regard to the proposal of the Commission,

Whereas Article 5 (2) of the abovementioned Decision provides that a work programme shall be drawn up setting out the detailed objectives and types of projects to be undertaken, and the financial arrangements to be made for them;

Whereas the first indent of Article 7 (1) of the said Decision provides that the procedure laid down in Article 6 thereof shall apply to the preparation and updating of the work programme;

Whereas, in conformity with this procedure, a draft work programme was submitted to the Committee assisting the Commission and whereas the former did not deliver a favourable opinion within a time limit which the Chairman laid down, and, following this same procedure, it is incumbent upon the Commission to submit to the Council a proposal on the measures to be taken,

HAS DECIDED AS FOLLOWS:

Sole Article

The work programme set out in the Annex is hereby adopted.

Done at Brussels, 19 December 1991.

For the Council

The President

P. DANKERT

---

(1) OJ No L 269, 25. 9. 1991, p. 30.

ANNEX

I. BACKGROUND

This programme is a direct follow-up to the Brite/Euram and Raw Materials-Recycling programmes. Its general objective is to contritube to the rejuvenation of European manufacturing industry by strengthening its scientific base through research and technological development. Research and technological development effort will be directed towards integration of all aspects of the life cycle of materials and products and will also take account of the more severe constraints as regards acceptability of technological developments. These will include protection of the environment, working conditions, the continuous adaptation of the skills of the workforce to technological change, and new methods of management and organization to ensure a smooth and effective relationship between technology and the working world.

The present work programme is prepared in compliance with Article 5 (2) of Decision 91/506/EEC. It includes the following sections:

— detailed objectives and research tasks,

— implementation: call for proposals, types of projects, financial arrangements.

While a single research proposal need address only one element of the life cycle, it is to be expected that preference will be given to proposals anticipating results arising from a multidisciplinary approach with a breadth of eventual applications. Particular attention will be paid to initiatives which provide the widest accessibility of results to potential exploiters and eventual users, taking account of the legitimate rights for the protection of intellectual and industrial property.

II. DETAILED OBJECTIVES AND RESEARCH TASKS

AREA 1: MATERIALS — RAW MATERIALS

The focus is on improving the performance of both advanced and traditional materials at a cost which permits competitive industrial exploitation over a broad range of applications. This extends to impriving the technologies to ensure the supply of raw material resources and for recycling, so promoting an integrated approach to the whole life cycle of materials. It also includes the cost effective use of new materials in a broad range of products and applications and their diffusion to new application fields.

RAW MATERIALS AND RECYCLING

1.1. RAW MATERIALS

1.1.1. **Exploration technology**

Objectives

To provide new or improved low-cost tools and better geological concepts for use in the mining industry in exploration. To improve the know-how and hardware in this field and detection-monitoring techniques and mapping of polluted mine areas.

Research tasks

1.1.1.1. To develop and test advanced approaches for the exploration and the discovery of deposits and evaluation of known targets.

1.1.1.2. To refine deposit models and exploration concepts.

1.1.1.3. To refine methods and techniques for the calculation of ore reserves.

1.1.1.4. To develop and improve integrated systems based on multidata analysis.

1.1.1.5. To develop and test new and improved cost effective geophysical and geochemical exploration methods such as transient electromagnetic measurements (TEM), optical spectrometry and analysis of platinum group elements (PGE).

1.1.1.6. To apply and assess recently developed exploration techniques such as ground geophysical like georadar, seismic methods and airborne systems and to evaluate their potential for broader application.

1.1.1.7. To develop advanced exploration equipment like miniaturization of instruments such as spectrometers and downhole logging tools, and to develop more cost-effective drilling techniques.

1.1.1.8. To develop and test exploration techniques for environmental monitoring, detection and mapping of polluted areas around mines and quarries (see also 1.1.2.7. and 1.2.2.8.).

1.1.2. **Mining technology**

Objectives

To develop techniques which can bring about an increase in productivity, such as an amelioration in the operating costs of mining operations, having regard to environmental and safety aspects and the ability to assess the social and economic impact of mining and quarrying.

Research tasks

1.1.2.1. To develop techniques and systems for rock cutting and continuous quarrying and mining.

1.1.2.2. To develop specialized techniques to improve safety and working conditions, and environmental protection.

1.1.2.3. To develop selective exploitation methods minimizing waste production (see also 1.1.3.6).

1.1.2.4. To develop new concepts for open pit mining as well as new concepts to optimize and integrate mining unit operations such as backfilling, drilling, blasting and transportation.

1.1.2.5. To improve the modelling and practical technologies for supporting systems, rock reinforcement and stability.

1.1.2.6. To develop multidata analysis and advanced modelling and simulation for computer aided management and planning of mining operations.

1.1.2.7. To develop simulation and modelling, and experimental techniques to optimize the rehabilitation of redundant sites of mines including their use for waste disposal (see also 1.1.1.8).

1.1.2.8. To develop techniques which assess the social and economic consequences of placing environmental constraints on mines and quarries (see also 1.1.1.8).

1.1.3. **Mineral processing**

Objectives

To improve existing processes and to develop innovative technologies to be applied to full scale operations based on laboratory scale research and to optimize methods and techniques used in the various treatments of mineral concentrates, tailings and residues of mines and metallurgical plants in order to reduce production costs of new and existing plants and alleviate environmental problems.

Research tasks

1.1.3.1. To characterize industrial minerals and stones in order to improve their processing technology and suitability for alternative uses.

1.1.3.2. To improve physical and chemical mineral separation techniques.

1.1.3.3 To improve techniques for mineral processing and extractive metallurgy such as hydro-, biohydro-, and electro and pyrometallurgy (including slag chemistry).

1.1.3.4. To develop technologies which will reduce emissions and energy consumption and increase the range of acceptability of feed materials and stone processing plants.

1.1.3.5. To develop methods and techniques for the fixation and stabilization of metals and toxic compounds in final residues, mining wastes, slags and tailings.

1.1.3.6. To develop new process routes and equipment which optimize quality yield, and minimize production of waste (see also 1.1.2.3.).

1.1.3.7. To develop instrumentation, particularly sensors, for monitoring processes, materials and product quality.

1.1.3.8. To develop methematical models and simulations processing and extractive metallurgy unit processes and their integration into operating plants. To develop expert and automated systems.

1.2. RECYCLING

1.2.1. **Recycling and recovery of industrial waste including non-ferrous metals**

Objectives

To develop new technologies for physical and/or chemical treatment of residues, scraps and industrial waste in order to improve the recovery rates and minimize environmental problems. Research in this respect will cover pyrometallurgy, hydrometallurgy and refining techniques applied to processing of complex residues, alloys and multi-element scraps.

Research tasks

1.2.1.1. To characterize, identify, classify and quantify secondary materials and used non-ferrous metals airising from industrial activities. To develop quality contol methods for secondary materials before recycling, utilization or controlled disposal.

1.2.1.2. To optimize existing separation, concentration and recycling processes at industrial level, in respect to energy saving, flexibility of feed, concentration and reduction of emissions.

1.2.1.3. To develop new separation, concentration and recycling processes for more efficient recovery of valuable materials from scraps and industrial wastes including linings of refractory materials avoiding external contamination.

1.2.1.4. To develop cost effective pyrometallurgical processes such as plasma and laser processes capable of accepting fluctuations of feed concentrations to recover basic, special and precious metals originating from industrial sectors, metal industry wastes, complex residues, spent catalysts, used goods and equipment.

1.2.1.5. To develop cost effective biohydrometallurgical, photocatalytic and hydrometallurgical processes to treat slags, residues, industrial liquid effluents and wastes for recovery of metals, salts and valuable materials, and decontamination to minimize pollution.

1.2.1.6. To develop advanced technologies for reduction and refining secondary products and wastes e.g. by: fluid-bed technology, aqueous electrolysis, vacuum distillation, plasma technology, molten-salt electrolysis, and chloride technology.

1.2.1.7. To develop technologies which recover and recycle metals from materials containing organic and metalplastic compound structures while minimizing environmental damage.

1.2.1.8. To develop computer bases models to assess the economic viability and availability of secondary materials for recycling and metallurgical models to predict the effect of multiple recycling on the characteristics and processibility of raw materials.

1.2.2. **Recycling, recovery and reuse of advanced materials.**

Objectives

To improve recycling technologies seeking to reuse advanced materials waste in order to enhance the quality of the new products or compounds having a high level of quality and economic value.

Research tasks

1.2.2.1. To characterize, classify and quantify advanced materials wastes and to develop quality control methods for secondary materials before recycling, reuse or controlled disposal.

1.2.2.2. To develop analytical and marking techniques for identification. To develop safe, cost-effective technologies for the recycling of residues and scraps, originating from organic and inorganic composite and other advanced materials.

1.2.2.3. To develop models to access the economic viability and availability of advanced materials for recycling and to predict the effects of multiple recycling on the physical characteristics and processibility of the initial materials.

NEW AND IMPROVED MATERIALS AND THEIR PROCESSING

1.3. STRUCTURAL MATERIALS

1.1.3. **Metals and metal matrix composites**

Objectives

To secure the advances needed to exploit fully the potential of new alloys, composites and their processing; and, in particular, the technologies to address the problems associated with series

production. Additionally, to develop high temperature resistant superalloys, intermetallics, metallic powders, metal glasses, hard metals, wear resistant alloys and coatings which are required for specific applications with complex design specifications.

Research tasks

1.3.1.1. To develop cost-effective technologies for the synthesis and production of metallic materials and alloys aimed at a broader range of final products with high quality and performance.

1.3.1.2. To develop alloys, structural intermetallics and metal matrix composite systems with specific performance properties, such as improved stiffness, increased strength-to-weight ratio, environmental and high temperature resistance.

1.3.1.3. To improve performance through the control of powder morphology and interface properties of metal matrix composites.

1.3.1.4. To develop thin or thick coating systems with improved functional properties for metallic substrates.

1.3.1.5. To apply computer simulation techniques linking micro and macro structural modelling.

1.3.1.6. To develop techniques for assessing the long term stability and behaviour of metallic materials.

1.3.2. **Ceramics, ceramic matrix composites and advanced glasses**

Objectives

To advance the understanding and technologies of areas of critical importance such as quality, processing and reliability with particular emphasis on economic processing and tough, defect-free products.

Research tasks

1.3.2.1. To develop high temperature materials with increased strength, toughness, ductility and resistance to corrosion and erosion.

1.3.2.2. To optimize powders as starting materials.

1.3.2.3. To develop cost-effective and high-yield processing techniques for high quality materials and which permit their diffusion into new application fields.

1.3.2.4. To improve consistency and reliability of components including long term in-service stability.

1.3.2.5. To improve thermal schock restistance, creep resistance, thermal insulation and high temperature oxidation and corrosion behaviour

1.3.2.6. To develop prohabilistic design methodologies for high performance engineering components.

1.3.2.7. To develop surface treatment technologies to aid manufacture and use in services..

1.3.2.8. To apply computer simulation techniques linking micro and macrostructural modelling.

1.3.2.9. To develop techniques for assessing the long term stability and behaviour of ceramic materials.

1.3.3. **Polymers and polymer matrix composites**

Objectives

To achieve a better understanding of the performance structure capabilities of these materials and to extend the understanding of the relationship between materials properties and their process routes. Such advances could come about by innovative design and processing practices. To respond to environmental concerns with new technical thermoplastics which retain their mechanical properties at higher temerpature, and which can be produced through the lower cost thermal processing routes.

Research tasks

1.3.3.1. To develop cost-effective polymeric materials, composites and fibres and adhesives for a broader range of application fields which have improved material properties such as resistance to aggressive environments, temperature, pressure, impact loading and solvents.

1.3.3.2. To develop polymeric materials with specific properties which minimise environmental impact, such as biodegradability, recyclability and reusability.

1.3.3.3. To develop cost-effective and high-yield processing techniques for high quality materials.

1.3.3.4. To investigate new types of composites such as molecular and self-reinforcing composites.

1.3.3.5. To assess composite fibre/matrix interfaces through development of non intrusive techniques.

1.3.3.6. To develop intelligent pre-impregnated semi-finished products for composite components, with applications where high strength and high toughness are required.

1.3.3.7. To develop intelligent process design and control techniques for polymeric materials and their composites.

1.3.3.8. To apply specific treatments for upgrading low-cost polymeric material into tailor-made high performance components.

1.3.3.9. To apply mathematical modelling for material, product and process optimization.

1.3.3.10 To develop combined and fully integrated transformation techniques. such as injection moulding, lamination, and multi-layer and sandwich formation, for innovative high performance structural materials.

1.4. FUNCTIONAL MATERIALS FOR MAGNETIC, SUPERCONDUCTING, OPTICAL, ELECTRICAL AND BIOMATERIAL APPLICATIONS

1.4.1. Magnetic materials

Objectives

To meet the requirement for new materials with improved magnetic properties, which are easily processed, as advanced magnetic materials including hard, semi-hard and soft magnets and their integration into components and systems.

Research tasks

1.4.1.1. To develop advanced magnetic materials, such as the new rare-earth types, with cost-efficient processing.

1.4.1.2. To develop materials and their processing with improved high temperature magnetic performance and to develop improved permanent magnetic bulk materials with increased energy product and improved volumetric efficiency for specific applications such as electric motors and other electrical devices.

1.4.1.3. To improve the structural capability of magnetic materials through innovative design of their synthesis, processing and control of composition.

1.4.1.4. To improve functional capabilities of magnetic materials through multilayer formation.

1.4.2. High temperature superconducting materials

Objectives

To develop high critical temperature and high-current and flux density superconductors for power applications capable of being combined with other materials at low processing temperatures. To understand the new superconducting materials and their intrinsic properties.

Research tasks

1.4.2.1. To develop reliable and cost-effective processing for the manufacture on high-current superconductor material components such as wires, cables and layers.

1.4.2.2. To establish a design methodology for increased component reliability, specially for the preparation of wires, cables, thin and thick-layers.

1.4.2.3. To develop processing routes such as sol-gel, mixing, sintering, spraying techniques for the preparation of well characterized and controlled powders for superconductors.

1.4.2.4. To increase the understanding of basic property/structure/stoichiometry relationships, including electrical and magnetic properties, as a function of phase segregation, anisotropy and grain boundary effects.

1.4.3. Electrical and ionic conducting materials

Objectives

To advance the synthesis/processing technology for electrically conducting materials and conducting material matrices which are at an early stage of technological development. The open up application

areas such as electric wires, energy storage and acoustic devices. To develop the materials necessary for fuel cell systems for the production of clean electricity. To better understand the limits of present technology and the means by which the limits can be surpassed by new processing methods.

Research tasks

1.4.3.1. To develop electrical materials with better conductivity, higher strength and fatigue properties, corrosion and thermal resistance and spark erosion behaviour.

1.4.3.2. To develop solid ionic conductor for solid electrolytes in energy conversion devices.

1.4.3.3. To develop conducting polymeric materials systems containing inorganic fillers for high-volume or for use in packaging and joining.

1.4.3.4. To establish the relationship between polymeric material structures and their electrical and acoustic properties.

1.4.3.5. To develop age-hardened alloys and multi-layered composite materials which combine high electrical and thermal conductivity or electron emissivity together with improved mechanical properties and corrosion resistance.

1.4.4. **Optical materials**

Objectives

To address the outstanding problems which include the availability of ultra-pure materials with low optical losses for transmission systems, and materials processing including materials fabrication by chemical vapour deposition processing for 2 or 3 dimensions.

Research tasks

1.4.4.1. To develop new glass types with variable light transmission properties along with cost effective technologies for their application.

1.4.4.2. To develop and characterize non-linear optical materials, including organic materials and intermediate products.

1.4.4.3. To develop active coatings such as magnetic, piezoelectric and chemical dye surface layers for sensors.

1.4.4.4. To optimize electroluminiscent, electrochromic, photochromic and thermochromic phenomena for producing optical materials with controllable light transmission and generation.

1.4.5. Biomaterials

Objectives

To meet the requirements for new biomaterials including metal alloys, ceramics, composites, glasses, polymers and adhesives for applications such as orthopaedic and dental implants, soft tissue and body fluid replacements, internal or external devices of permanent or temporary nature. To develop technologies for cost-effective operations for item manufacturing, clinical procedures and rehabilitative systems.

Research tasks

1.4.5.1. To develop special and medical grade materials with biocompatible and biofunctional properties for devices and load-bearing implants.

1.4.5.2. To develop techniques for innovative design, modelling and clinical testing of new structures and complex shapes components and devices combining all aspects of reliable bio-operational ability: human tissues and implant compatibility.

1.4.5.3. To develop surface treatment techniques for medical devices to prevent erosion and corrosion and improved bio-integration properties.

1.5. MASS COMMODITY MATERIALS

1.5.1. **Packaging materials**

Objectives

To improve the technologies needed for cost effective processing including automation and on-line control, including the introduction of natural materials, the substitution of toxic materials and the improved recycling of materials systems.

Research tasks

1.5.1.1. To develop environmental friendly packaging materials which are reusable, recyclable or degradable, and non toxie in use and disposal.

1.5.1.2. To improve current processing methods for increased productivity and for high added value packaging products.

1.5.2. **New construction industry materials**

Objectives

To improve materials currently used for civil construction and to develop new materials, including composites, able to combine functional and structural characteristics.

Research tasks

1.5.2.1. To develop new material technologies aiming at improved thermal insulation, sound shielding and mechanical integrity.

1.5.2.2. To develop introduction of novel production and assembly methods allowing a high degree of automation.

1.5.2.3. To investigate the degradation of construction materials and systems exposed to air, water, pollution, ultra violet radiation, temperature and humidity.

1.5.2.4. To develop structural adhesives which act as binders and reinforcement for hybrid prefabricated systems.

1.5.2.5. To develop techniques for the use of metallic or organic materials as reinforcement for concrete, glasses and ceramics, leading to systems with high corrosion resistance, good thermal and sound insulation and increased fire security.

AREA 2: DESIGN AND MANUFACTURING

The objective is to improve the capability of industry to design and manufacture products which are, at the same time, of high quality, easy to maintain, highly competitive and environmentally and socially acceptable.

2.1. DESIGN OF PRODUCTS AND PROCESSES

2.1.1. **Innovative design tools and techniques**

Objectives

To develop design tools such as decision support systems to promote more efficient design methods, more economic manufacture, assembly and dismantling, and reliable and ergonomic products.

Research tasks

2.1.1.1. To develop decision support systems for design in the areas of materials and standardized components which incorporate mathematical modelling, production characteristics, product performance and anthropometric data.

2.1.1.2. To establish methods for validation and certification of design support, modelling and analysis tools.

2.1.1.3. To develop techniques for minimizing the 'design to product' time based on value analysis, modelling, simulation and rapid prototyping techniques.

2.1.1.4. To develop a methodology for modelling of the whole engineering process from conceptual to detailed desing, including representation of functional tolerancing, and to validate the approach.

2.1.2. **Design methodologies for complex components**

Objectives

To develop approaches for the incorporation of multi-functional components in product design. To advance the capability of high precision and micro-engineering systems together with design for micro-miniaturization.

Research tasks

2.1.2.1. To establish new approaches to, and applications for, the design of multi-functional components.

2.1.2.2. To develop multi-disciplinary approaches to the design of integrated systems such as mechatronics, optomatronics, and multi-component systems.

2.1.2.3. To develop design methodologies for high precision and micro-engineering systeme relating to mechanics and materials behaviour at micro-structural level.

2.1.3. **Maintainability and reliability**

Objectives

To develop the support tools, including sensor systems, for improved product performance, reliability and maintainability. To advance the capability and applicability of mathematical modelling to support desing, including the integration of modelling techniques with defect and failure mode analysis needed for reliability and predictive maintenance.

Research tasks

2.1.3.1. To improve design methods and modelling capabilities for products and processes with respect to quality, reliability, durability, maintainability and safety.

2.1.3.2. To develop reliability support systems which provide information on component behaviour based on the analysis of their deterioration and failure.

2.1.3.3. To develop techniques for predictive maintenance including condition monitoring and vibration analyses.

2.1.3.4. To develop integrated system design incorporating sensors with improved performance and reliability.

2.1.3.5. To develop techniques for minimizing noise and vibration generated by products and manufacturing equipment.

2.2. MANUFACTURING

2.2.1. **Tools, techniques and systems for high quality manufacturing**

Objectives

To develop skill supporting technologies to make human skills and judgement more effective in the manufacturing process. To develop innovative tools and techniques for high quality and cost effective manufacturing systems to give better process control, higher precision and faster operation and the integration of new processing technologies with established manufacturing processes.

Research tasks

2.2.1.1. To develop improved models to exploit knowledge based systems for manufacturing processes.

2.2.1.2. To improve systems, which may include robotics, for workpiece fixturing, transport and safe handling in manufacturing.

2.2.1.3. To develop cost-effective manufacturing processes such as cutting, machining, grinding, forming, joining and bonding to improve productivity, quality and precision.

2.2.1.4. To develop cost effective high power beam processes, fibre optics for beam delivery systems, and associated acoustical and opitcal inspection and test techniques.

2.2.1.5. To develop and integrate technologies relating to high quality surface treatments within the manufacturing process.

2.2.1.6. To develop flexible and economic manufacturing systems for small batches of a large number of variants.

2.2.2. **Manufacturing techniques for industrial use of advanced materials**

Objectives

To develop cost-effective and efficient manufacturing techniques for advanced materials to help realise their full potential.

Research tasks

2.2.2.1. To improve and extend the capability for net and near net shape forming of advanced materials, including the automation of pre-formed manufacture.

2.2.2.2. To develop cost-effective machining techniques for difficult and advanced materials associated wherever possible with process modelling.

2.2.2.3. To develop and automate equipment for the economic manufacture of composites and ceramics.

2.2.2.4. To improve assembly and joining technologies for advanced materials and components.

2.2.2.5. To develop non-destructive tests and quality assurance techniques for adhesive bonds and composite materials.

2.2.2.6. To develop and extend surface treatment and surface finishing techniques suitable for advanced materials and methods for their inspection.

2.2.3. **Integrated approach to chemical and process engineering**

Objectives

To tailor manufacturing technology to the requirement of chemical engineering and to integrate design with process control. To advance the understanding needed to design and control chemical processes with increasing complexity to include avoidance and prevention of pollution.

Research tasks

2.2.3.1. To improve the design and control of chemical and biochemical reactors for increased flexibility, productivity and better product quality

2.2.3.2. To develop techniques to combine individual chemical process steps in material synthesis, material processing and particle technology through a better understanding of basic chemical and physical phenomena.

2.2.3.3. To develop innovative separation techniques (see also 1.1.3.2.).

2.2.3.4. To model chemical reactions which are important to manufacturing processes such as reaction injection moulding, etching, deposition and bonding.

2.2.3.5. To develop models of multi-phase systems and interfacial phenomena for process design and control

2.2.3.6. To develop a better understanding of processes in which reactions, catalysis and transport phenomena are strongly coupled, and where the product quality depends strongly on the coupling.

2.2.3.7. To optimize chemical engineering processes through an integrated approach to process design, modelling and control for recycling, environmental protection and process safety

2.3. ENGINEERING AND MANAGEMENT STRATEGIES FOR THE WHOLE PRODUCT LIFE CYCLE

2.3.1. **Design integrating strategies**

Objectives

To develop new and more holistic approaches to support the integration of engineering tasks for the whole product life cycle, such as simultaneous engineering concepts which bring together design, engineering and manufacturing.

Research tasks

2.3.1.1. To develop design optimization strategies and constraint modelling techniques for the whole product life cycle, including recycling and disposal.

2.3.1.2. To develop systematic approaches in the context of the extended enterprise to reduce design to product lead time, and increase manufacturing flexibility.

2.3.1.3. To extend multi-disciplinary approaches such as simultaneous engineering for integrating engineering tasks and engineering management tasks.

2.3.1.4. To extend novel design, redesign and costing practices, taking account of whole product life cycle, including recycling or disposal.

2.3.2. **Engineering**

Objectives

To bring an integrated approach making full use of new materials, new design and manufacturing technologies and process and product control to traditional manufacturing industries, with particular attention to new requirements for environmental control and improved working conditions.

Research tasks

2.3.2.1. To extend the field of application for flexible manufacturing techniques taking full use of new materials and new technologies.

2.3.2.2. To develop new design and engineering methods for ease of manufacture, assembly, use and dismantling of products, including ergonomic such as innovative approaches to prefabrication and modular design.

2.3.2.3. To develop interactive engineering techniques that will improve working conditions and ergonomics.

2.3.2.4. To develop engineering methodologies for extending the application of the total quality concept throughout the whole product cycle.

2.3.3. **Human factors in engineering and manufacturing management**

Objectives

To accelerate the take up of new technology by developing new management techniques which allow identification and reconciliation of potential areas of conflict between new technologies and human resources. To improve methods for the evaluation of the performance of products and processes and their linkage to the overall business.

Research tasks

2.3.3.1. To develop strategies for improving the management and organization of design, manufacture and construction so as to make the best use of available resources and new technologies.

2.3.3.2. To develop management supoort systems for the evaluation, control, forecasting and measurement of production requirements and resources within industry.

2.3.3.3. To develop techniques for quantifying, evaluating and matching human skills and experience with specific job requirements.

AREA 3: AERONAUTICS

The objective is to strengthen the technology base of the European aeronautical industry and to contribute to the knowledge base which supports actions to minimize environmental impact and enhance the safety and efficiency of aircraft operations.

3.1. ENVIRONMENT RELATED TECHNOLOGIES

Objectives

To provide new or improved tools and techniques for analysis, prediction and control of air vehicle exterior noise, interior noise and exhaust emissions.

Research tasks

3.1.1. To develop improved tools and techniques for prediction and control of exterior noise from advanced propellers, prop-fans and helicopter rotors.

3.1.2. To develop and evaluate cost effective for reducing aircraft interior noise.

3.1.3. To develop low emission combustor technology.

3.2. TECHNOLOGIES OF AIRCRAFT OPERATION

Objectives

To provide new or improved tools and techniques for monitoring the health of aircraft systems, designing structures resistant to fatigue, crash and fire, and for integration of the air vehicle in future advanced ATC systems.

Research tasks

3.2.1. To develop and validate improved design tools for treating acoustic fatigue.

3.2.2. To develop improved techniques for health and usage monitoring.

3.2.3. To develop improved techniques for crashworthiness analysis.

2.3.4. To develop improved techniques for fire risk analysis and detection.

2.3.5. To develop improved flight management/ATC interface techniques.

3.3. AERODYNAMICS AND AEROTHERMODYNAMICS

Objectives

To advance CFD techniques, laminar flow technology, tools for analysis of propulsion integration and techniques for analysis of the aerothermodynamics of turbomachinery.

Research tasks

3.3.1. To develop and validate new and improved CFD tools for flow solution, post processing and aerodynamic design optimization.

3.3.2. To develop improved techniques for natural and hybrid laminar flow control.

3.3.3. To develop improved experimental means for study of propulsion system integration.

3.3.4. To develop improved techniques for analysis of wing-mounted, ducted propulsion systems.

3.3.5. To develop improved tools for analysis of helicopter rotor/fuselage interaction.

3.3.6. To develop improved tools for analysis of axial and mixed flow compressor aerothermodynamics.

3.3.7. To develop improved tools for analysis of turbine aerothermodynamics.

3.3.8. To develop improved turbulence models (focused fundamental research only).

3.4. AERONAUTICAL STRUCTURES AND MANUFACTURING TECHNOLOGIES

Objectives

To advance techniques for realization of large pressurized composite fuselage structures.

Research tasks

3.4.1. To develop design concepts for pressurized fuselage structures of composite and/or metal laminate.

3.5. AVIONIC SYSTEM TECHNOLOGIES

Objectives

To provide new or improved techniques for design of modular, high integrity airborne information processing and sensing systems and for analysis and design of man-machine interaction on the flight deck.

Research tasks

3.5.1. To develop techniques and tools for integration and evaluation of complex, flight critical, fault tolerant avionic equipments and systems.

3.5.2. To develop and evaluate new and improved techniques for electronic and/or optical sensing and date processing, including standardization issues.

3.5.3. To develop improved techniques and architecture for flight critical signal processing and data fusion.

3.5.4. To develop advanced flight deck concepts and related techniques for optimizing man-machine interaction.

3.5.5. To develop improved techniques for design and analysis of the helicopter cockpit and its functioning.

3.6. MECHANICAL, UTILITY AND ACTUATION TECHNOLOGIES

Objectives

To provide new or improved techniques for design of key equipment components of the air vehicle system.

Research tasks

3.6.1. To develop and validate new concepts and modelling techniques for provision of the landing gear function.

3.6.2. To develop non-bleed air based techniques for de-icing and/or cabin conditioning.

3.6.3. To develop and validate advanced techniques for integrated fuel management systems.

3.6.4. To develop advanced techniques for electrically powered actuators with integrated electronic information processing.

4. TARGETED RESEARCH ACTIONS

The concept of targeted research actions is to secure added value by helping participants in complementary projects covering different technologies of the programme to coordinate their activities around one specific objective. This will be of importance to a range of industries made up of users and producers — including small and medium-sized enterprises (SMEs).

The scientific and technical content of the projects will draw on the research topics of Areas 1 and 2 of the programme and potential themes will be published with the normal call for proposals. Depending on the quality of proposals received, it is expected that approximately four targets will be selected for the first round.

Targeted research actions will seek, wherever possible, to encompass as wide a range of industrial activity compatible with achieving their specific objectives. Actions will normally come under one of the following categories, although, on the basis of proposals received, the Commission might suggest other subjects for this form of action:

4.1. **Environmentally friendly technologies**

(a) Manufacturing and materials technologies necessary for machines including vehicles, trains and ships, with reduced environmental impact particularly in terms of pollution, waste, safety, noise and consumption of materials along with user safety and acceptability. Accordingly, research and development could include:

— advanced design technologies leading to 'lean' supply,

— assembly technologies,

— recycling technologies,

— materials technologies covering composite material systems with the potential for improved performance and styling flexibility,

— manufacturing technologies for mass or 'lean' batch production to meet relevant quality, flexibility and cost constraints,

— mechanical and electrical systems as well as advanced braking systems, and

— internal and external noise and vibration suppression.

(b) Technologies for construction which are better suited to the needs of the user in terms of a controllable working environment and flexibility, and can be designed, constructed, maintained and reused in a safe and efficient manner with minimum impact on the environment. Research might include:

— design, materials, manufacturing and construction techniques;

— the development of specifications for performance requirements,

— simulation and calculation models for structural design, the scope and durability of new materials,

— flexible manufacturing and assembly systems and repair technologies.

4.2. **Flexible and clean manufacturing**

Technologies for reduced environmental impact, greater flexibility, efficiency and accuracy along with improved quality, productivity and fast response of each stage of product manufacture, for instance in the textile, clothing and distribution chain. Research could cover:

— process technologies, including precision machinery,

— materials development,

— automation,

— materials handling, including cutting and joining,

— quality control, and

— process management.

Technologies to integrate these stages, so that the manufacturing chain can respond quickly and efficiently to market needs and to environmental considerations with safer, less polluting and less wasteful processes, can also be envisaged.

III. IMPLEMENTATION

The programme will be implemented by means of research projects, concerned actions and accompanying measures.

1. R&D PROJECTS AND CONCERTED ACTIONS

With the exception of the accompanying measures, research will be implemented by means of shared-cost contracts and concerted actions. The indicative budget envidsaged for these activities over the duration of the programme is: raw-materials and recycling — ECU 80 million; materials — ECU 228,8 million; design and manufacturing — ECU 301,5 million; aeronautics (over three years) — ECU 53 million.

For shared-cost projects, Community financial participation will not normally be more than 50 % of total costs. Universities and other research centres participating in shared-cost projects will have the opinion of requesting, for each project, either 50 % funding of total expenditure or 100 % funding of the additional marginal costs. Shared-cost projects will include the following types of action:

— industrial research projects will have a minimum size of at least 10 man-years and must be in the range of ECU 1 to 5 million total costs in Areas 1 and 2 (for Area 3, projects should be typically in the range ECU 3 to 5 million), cover a period of approximately 3 years and include at least two industrial partners from different Member States,

— focused fundamental research projects, upstream of industrial research and requiring industrial endorsement, will be at least 10 man-years and ECU 0,5 million, and up to ECU 1 million, cover a period of two to four years and include at least two organizations from different Member States.

In the case of proposals, which by their nature, means of implementations or urgency, address an issue important to reinforce the scientific and technological basis of European industry and thereby the development of its international competitiveness, the Commission reserves the possibility to consider them, subject to the exemption procedure in accordance with Article 7 of Decision 91/506/EEC.

Cooperative research is intended for groups of undertakings, in particular SMEs, which do not have their own research facilities in order to resolve common technical problems. One or more outside organisations (research association, universities or undertakings) will be appointed to carry out the research. 50 % of the research costs of these projects, total costs up to ECU 1 million, will be covered for a period normally not exceeding two years. Proposals must be submitted by undertakings which are to take part in planning and piloting the research and implementing the results.

Concerted actions: consist of coordination by the Commission of research activities carried out in the Member States in specific areas. They may benefit from dunding of up to 100 % of coordinating expenditure (travel, workshops, publications) normally not exceeding ECU 0,4 million over a period of up to four years.

2. ACCOMPANYING MEASURES

The accompanying measures are intended to improve the effectiveness of the programme in particular by improving its accessibility and impact. They build on experience within Brite/Euram and raw materials and recycling. During the programme new ideas are expected to arise. The accompanying measures will be a continuous process over the duration of the programme.

The work will be carried out by way of:

— feasibility awards for SMEs whose principal activity is in manufacturing or processing of up to ECU 30 000 or 75 % of the costs of research undertaken within mine months to establish the feasibility of an innovative device, concept or process. The overall aim being to facilitate the participation of SMEs in collaborative research,

— specific, multi-disciplinary training will include the training role within projects and in particular to link research activities with other industrial functions oriented towards exploitation, transfer of results, codes and standards, industrial property rights etc.; specialized courses to provide the training necessary for the effective application of the technologies developed, and research fellowships which focus on the technical areas of the programme,

— seminars, workshops and scientific conferences,

— meetings of ad-hoc groups of experts (eg. on preparation of norms and standards, materials data bases, emerging technologies, definition of research priorities),

— study contracts,

— promotion of exploitation of results,

— an independent evaluation of the scientific and strategic aspects of the programme.

The indicative budget envisaged for these accompanying measures is ECU 20 million with 2 % of the total programme budget being allocated to training activities.

Schedule

A schedule of the activities, with indicative budgets for contracts, is shown in the following table:

Activity	Indicative budget MECU for contracts	Areas	Call opens	Deadline	Review and selection of proposals	Likely start of contracts
Industrial research	266	1, 2, 3*	July 1991*	mid-February 1992*	March/April 1992*	October 1992*
Focused fundamental research	33.5	1, 2, 3*				
Concerted action	3	1, 2				
Industrial research	221	1, 2	July 1992	mid-February 1993*	March/April 1993	November 1993
Focused fundamental research	28.5	1, 2				
Concerted action	3	1, 2				
Cooperative research	57	1, 2	Continues open until February 1993 with selection twice/year		from December 1991	from September 1992
Feasibility Awards	5	1, 2			from December 1991	from February 1992
Specific Training	11	1, 2, 3			from December 1991	from February 1992

* Area 3 will have an earlier call