# COUNCIL DECISION

## of 23 November 1994

## adopting a specific programme for research and technological development, including demonstration, in the field of information technologies (1994 to 1998)

(94/802/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 [1],

Having regard to the opinion of the European Parliament [2],

Having regard to the opinion of the Economic and Social Committee [3],

Whereas, by Decision No 1110/94/EC [1], the European Parliament and the Council have adopted a fourth framework programame for Community activities in the field of research, technological development and demonstration (RTD) for the period 1994 to 1998 specifying *inter alia* the activities to be carried out in the field of information 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 shall be implemented through specific programmes developed within each activity under the framework programme and that each specific programme shall 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 1 911 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 the conditions set out in Article 1 (3) of Decision No 1110/94/EC;

Whereas information technologies increasingly underpin the competitiveness of all industry and services and, in addition, they are becoming the vehicle for an increasing number of social activities; whereas they could help to enhance the quality of life and improve working conditions; whereas they therefore require major efforts in research, the dissemination and optimization of results and training;

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 this should be accompanied by new ways of organizing production and work so as to facilitate the acquisition of these new technologies by the greatest number of people;

Whereas the European Council of Brussels on 10 and 11 December 1993 decided, on the basis of the White Paper on 'Growth, competitiveness and employment', to implement an action plan to develop information infrastructures at European Union and Member State level; whereas information technology research provides the essential technological basis for the development of these emerging information infrastructures;

Whereas it is important that there be maximum user involvement in the various stages of RTD projects, so that their requirements are taken into account, and that they be trained to make use of the results thereof;

Whereas software, component and subsystem technologies, multimedia systems, open microprocessor systems, high-performance computing and networking, technologies for business processes, integration in manufacturing and the corresponding long-term research were considered as priorities in Decision No 1110/94/EC;

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 information technologies;

Whereas Decision No 1110/94/EC lays down that a Community action is justified if, *inter alia*, research contributes to the strengthening of the economic and

(1) OJ No C 228, 17. 8. 1994, p. 34, and OJ No C 262, 20. 9. 1994, p. 6.
(2) OJ No C 205, 25. 7. 1994.
(3) Opinion delivered on 14 and 15 September 1994 (not yet published in the Official Journal).
(4) OJ No L 126, 18. 5. 1994, p. 1.

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 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 promote 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;

Whereas this programme will help to strengthen synergy between the RTD activities carried out in the field of information technologies by research centres, universities and enterprises, in particular SMEs, in the Member States and between these and the corresponding Community RTD activities;

Whereas, in view of the increasing convergence between information technologies, telecommunications technologies and telematics, the programme should be implemented in close coordination with research programmes in the field of advanced communications technologies and services and telematic applications of common interest, so as to reinforce the synergetic effects thereof;

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 activities for the dissemination and exploitation of RTD results , in particular towards SMEs, notably those in the Member States and 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 there is also a need to carry out research, in liaison with the targeted socio-economic research programme, firstly into the social impact of information technologies (particularly on regional planning and the organization of production and labour) and secondly into the interaction between the European citizen and the information infrastructure;

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 the 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 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 information technologies, as set out in Annex I, is hereby adopted for the period from the date of adoption of this Decision to 31 December 1998.

*Article 2*

1. The amount deemed necessary for carrying out the programme is ECU 1 911 million, including a maximum of 6,9 % for the Commission's 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 No 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 No 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, progress within the programme in relation to the objectives set out in Annex 1, 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 No 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 No 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 proposed 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 which the chairman may lay down according to the urgency of the matter. The opinion shall be delivered by the majority laid down in Article 148 (2) of the Treaty in the case of decisions which the Council is required to adopt on a proprosal 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 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 (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 2 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 2 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*

Participation in this programme may be open on a project-by-project basis, without financial support from the Community, to legal entities established in third countries, where such participation contributes effectively to the implementation of the programme and taking into account the principle of mutual benefit.

*Article 9*

This Decision is addressed to the Member States.

Done at Brussels, 23 November 1994.

*For the Council*

*The President*

J. BORCHERT

*ANNEX I*

## SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES AND CONTENT

This specific programme fully reflects the orientations of the fourth framework programme, in applying the selection criteria and in specifying its scientific and technological objectives.

Section 1.C of Annex III, first activity of the fourth framework programme, is an integral part of this programme.

### Introduction

The new focus of RTD in the specific programme on information technologies is the emerging information infrastructure, which will provide the basis of the information society of the future. The RTD areas proposed are those most vital to the development of the infrastructure, taking into account the need for selectivity and concentration of effort, and with the objective of improving the competitiveness of industry and the employment situation in the European Union, and of enhancing the quality of life for citizens, in particular by facilitating their access to the information infrastructure.

### CONTEXT

Since the emergence of digital computing in the late 1940s, the use of information technologies has been extending ever further into economic and social life. For the first three decades this was largely a matter of individual computers with limited local networking, installed in companies and administrations to do specific tasks. They were small islands of information technology, difficult to use and expensive to run. In the last 10 years, with the emergence of the personal computer, digital communications networks, international standards, and open systems, all driven by the sometimes astonishing pace of technological advance, the islands have grown and are beginning to merge.

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

We are at the beginning of the transition to a new information infrastructure of society and industry, a point which marks the onset of a qualitative transformation in the impact of information technologies after 40 years of quantitative growth. The information infrastructure is the set of services and technologies providing easy access to usable information to any citizen or enterprise, at any time, in any place. For the citizen it is the long-anticipated 'global village', for the enterprise it is the 'global workbench'. The infrastructure brings together information processing, information storage and retrieval, information transmission and the information content itself. The most crucial aspect of the infrastructure will be the usability and manageability of information: information technology (IT) has enabled us to make very large amounts of information available — the next challenge is to enable us to make sense of it. Social issues are also at stake. The question of the European citizen's acquisition of these new information technologies is becoming a major political challenge. In future, therefore, special attention should be paid to the relationship between the citizen-user and the new information society. Three aspects are particulary important. In tomorrow's increasingly complex society, the individual will have a greater need for information and interactive services giving him access to information.

'Universal' access to this information environment must become a political priority, failing which the differences between social strata within a country, and between countries and regions, could widen. Consideration should then be given to the vast potential for creativity and for the enrichment of social life, over and above the mere utilitarian and professional aspects, as a result of the interaction between the individual citizen and the information society. Lastly, the information infrastructure will play an increasingly important role in the implementation of public policies in respect of the European citizen's needs. Interaction between individuals and various forms of information and communication will become a determining issue in questions of public interest such as education and training, indvidual freedom of movement, and the ageing of society.

This new stage in the growth of the information society compares in some of its aspects with the transition in the 1930s to a new industrial-economic system based on cheap oil and mass production, and before that

in the 1880s from craft production to cheap iron and bulk production. As on those two previous occasions, the transition is accompanied by economic downturn, unemployment, and drastic restructuring in industry.

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

The return to a strong economy and fuller employment, not just in the information technology sector but in all industries, will be heavily influenced by the speed and success with which structural transformation can be completed and the new information infrastructure can be put into place. The development of new services and new jobs will be heavily influenced by prompt action to put the new information infrastructure into place and by the pace of structural change within the economy, in particular with regard to reorganizing production methods and working time.

The creation of new activities will also depend, however, on the ease with which the greatest number of users can gain access to the new information infrastructure.

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

Under the fourth framework programme the IT programme proposes new approaches and orientations in order to meet the new requirements of the 1990s, while building on the past achievements of Esprit.

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

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

The new technologies, processes and techniques to be developed within the proposed IT programme are selected on the basis of their potential for contributing to competitiveness by helping increase the productivity of European industry. They have an indirect effect on productivity through their capacity for improving the working environment and so creating a more effective work force. They provide the basis for the transition to new business processes and new modes of industrial operation — a transition that European enterprises must master to remain globally competitive. The technologies and processes are an essential element in the creation of the high value-added economy. In addition, by stimulating technology transfer and the training of engineers the programme helps generate the skills and human resources needed for the emerging information society, and prepare Europe's work force for the jobs of the future. In cooperation with the programme on targeted socio-economic research, multidisciplinary research will be conducted not only into the complex interaction between the citizen-user and the emerging 'information space', but also into the impact of the new information technologies on the organization of production and of work.

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

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

To add the maximum value to its RTD activities, the programme proposes where appropriate to pursue coordination with Eureka, offering the scope to bring results closer to market, as well as with relevant initiatives in Member States.

ORGANIZATIONAL APPROACH

To meet these changing requirements the IT programme proposes new orientations both in technical content and in implementation. Turning first to implementation, the programme proposes to put a greater emphasis on networks of excellence, and to make use of supplier-user collaborations and streamlined management procedures. It will introduce a number of focused clusters, a new way of organizing RTD which builds on the experience of the Open Microprocessor Systems Initiative (OMI). In all RTD activities a strong commitment on the part of industry to exploit the results of collaboration will be expected. On the other side if calls are going to be more selective at least a short- and medium-term implementation scheme should be provided by the Commission.

A number of networks of excellence was launched as part of Esprit in the third framework programme. A network of excellence brings together industry, users, universities and research centres with a common research objective. A network combines the critical mass of centres of excellence with the benefits for training and technology transfer deriving from geographical spread. Networks of excellence can be particularly beneficial for groups in outlying regions through the channel they provide for training, technology transfer, and access to expertise and resources.

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

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

Focused clusters aim at achieving a maximum of synergies in this specific programme and are building on the experience of the OMI, which provides in effect an early prototype. A focused cluster is a set of R&D projects and related activities such as networks of excellence, associations of suppliers and users, cooperation with Eureka, coordination with national activities, international cooperation, dissemination of results, or training initiatives. It covers a number of technology areas bound together by a single well-defined industrial goal. The different activities, while maintaining their independence, are combined in a complementary and interdisciplinary way, contributing to the common goal of the cluster. Clusters will seek industrial guidance on their development and coordinaton of activities through advisory panels. The clusters will be managed and coordinated by the Commission in a flexible way to favour openness and allow for responsiveness to change, including entry of qualified newcomers.

Individual activities within a cluster may have a duration shorter than the life span of the whole cluster. Activities initiated at the outset will terminate while the cluster is still active, and new activities will be started up. Flexibility will be provided, giving participants, industry, governments and the Community the opportunity to refine or redefine options in response to changing needs or a new understanding of needs.

The infrastructure and best practice approach that characterizes the new programme provides SMEs with readier and more open access to RTD activities. To make effective use of this improved access, specific procedures will be put in place to stimulate SME participation in the programme, taking account of the needs of those from less advanced regions and taking into account the complexity and cost of forming consortia and preparing proposals. Networks of excellence, supplier-user collaborations and focused clusters provide further stimulus for SME participation.

RTD ACTIVITIES

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

Software is a major element in the information infrastructure, and already represents over half the value of computers and embedded systems. The programme concentrates on techniques and best practice in a limited number of software technologies enabling the production of reliable, correct, efficient and usable software. Electronic components and subsystems are the physical building blocks of the information infrastructure needed for systems and applications across all industrial sectors. The programme concentrates on RTD into microelectronics in areas where European industry needs the capability and can be competitive, with a particular emphasis on advanced integrated circuits for specific applications; peripherals, and in particular the flat panel displays and compact memory systems; and the emerging field of microsystems.

Multimedia technologies will provide the human interface to the information infrastructure. The programme concentrates on the development and integration of technologies needed for the creation, manipulation, display and storage of multimedia information. Multimedia data transmission and applications will be covered in the telecommunications and telematics programmes. Integration of these technologies in multimedia systems and prototypes will be demonstrated and validated. Generic multimedia data transmission and applications will be covered in the advanced communications and telematics programmes.

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

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

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

SOFTWARE TECHNOLOGIES

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

Software is increasingly becoming the major cost component in IT systems, a trend further emphasized by IT users, who produce 70 % of all software and exert a growing influence in this area. The demand for the development and monitoring of software intensive systems is growing much faster than the supply. In consequence all industrial countries are facing the need for improved productivity and higher quality. Methods and tools for the production of adaptable and evolving software intensive systems at an affordable price are now an essential requirement for all enterprises. Specified skills and well established industrial

approaches are furthermore needed. New applications introduce a continuing stream of new technical challenges for the professional software producer.

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

To address these issues work will concentrate on a number of areas: technology transfer and dissemination of software best practice; methods and tools for best practice; emerging software technologies; open distributed computing platforms; technologies for distributed and object-oriented database systems; and advanced techniques for human-computer interaction. There will be close coordination with related work in other specific prorammes.

According to needs work will be reinforced by accompanying measures to accelerate the take-up of new technologies, to maintain awareness of new potentialities, to develop synergies with other European and national initiatives, to promote participation in the standardization process including an international context.

Technology transfer initiatives will be deployed to promote the take-up of new software production technologies and to increase skill levels on a broad scale. Industrial experiments will be targeted at improving and upgrading software development practice through incorporation of new processes, methods and support tooling. Dissemination actions aimed at raising awareness of best practice by establishing communities of common interest across industrial sectors and national boundaries will also be put in place as will training for the introduction of new practice aimed, in particular, at the management level. The activities will be closely coordinated with, and complementary to, existing dissemination mechanisms, wherever possible, taking into account *inter alia* the experience of ESSI.

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

A third area will aim to develop and experiment with emerging software technologies in particular those for incorporating digital signal processing techniques into embedded software. These technologies are at the heart of new developments in the progressive 'digitalization' of the societal infrastructure. As generic technologies they will also contribute to focused clusters involving high-performance computing and networking. This area also includes emerging software technologies, providing reasoning capabilities, allowing intelligence, flexibility and adaptation, and supporting modelling, reuse, and sharing of various levels of knowledge. Frameworks and integration techniques to build cooperating or distributed intelligent systems and to model enterprise-wide or application sector knowledge assets will be addressed. This RTD mid-term work will be driven by generic needs such as the development and demonstration of complex, distributed decision intensive applications which are present in every sector of human activities and which will have a positive impact on European competitiveness as well as on integration and cohesion.

Work on open distributed computing platforms will address the architecture of open distributed systems with particular reference to issues of portability, dependability, interoperability and standards; the

development of key components, in particular, middleware components for the management of information, access, and distribution of function. Special attention will be paid to the development and promotion of packaged software. To complement the RTD activities, actions will be initiated to establish dialogues with key user and standards groups concerned with open systems, including X/Open and EWOS.

Major applications demonstrators will be developed and improvements in the practice of building open, distributed systems will be achieved via specific themes in the software best practice activity. The open systems movement is global and will be based on the establishment of internationally accepted standards. Links will be made with the key activities in both the USA and Japan. Cooperation with developing countries and those of central and eastern Europe will be promoted.

A further area is concerned with advanced technologies for distributed database systems. Activities will cover technologies for large scale object based repositories; techniques for knowledge embedding in and extraction from such repositories; interoperability, resilience and recovery of distributed systems; and methods and tools for supporting and applying these advances.

Work will be carried out on tools for the management of distributed statistical data and on the way in which advanced technologies could benefit the collection, analysis, diffusion and representation of data.

The final area addresses technologies that will offer increased human comfort and security in dealing with information technology systems. An essential factor in the acquisition of these new technologies is the user-system interface. Dialogue with machines should become easier and more easily absorbed, including for non-professional users. This issue must be examined equally from both the user's and the supplier's standpoint. Human behaviour, in particular cognitive aspects, and artistic/creative ability constitute essential research topics. These research areas will also be important in terms of acceptance and acquisition of future multimedia systems. In achieving this, new opportunities are opened up with the promise of increased and wider markets for IT based products. RTD work will be carried out to better understand the user-system interaction, such as *inter alia* cognitive modelling, interaction models, media and metaphors, and cooperative work. The development and consolidation of emerging technologies will be pursued. These activities will be closely related to upstream research, and will build on and contribute to standards and help maintain awareness of the potentialities of the new technologies.

## TECHNOLOGIES FOR IT COMPONENTS AND SUBSYSTEMS

The objective of this sector is to provide European industry with the state-of-the-art technologies and capabilities to design and produce components and subsystems in three key areas: microelectronics, microsystems and peripherals. The approach to be taken is system oriented and takes account of the added value which microelectronics, microsystems and peripherals will generate in systems. Growth opportunities and European strength in areas like telecommunications, automotive, consumer electronics, medical and other industrial applications determine the priorities.

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

The potential economic impact of integrated microsystems technologies rests both on the direct market segment it addresses and on the leveraging effect it creates on other industrial sectors. Products incorporating microsystems will range from hearing aids, analytical and medical instruments to consumer electronic products and automotive subsystems, and will cover both mass produced goods and a wide variety of specialized microsystems for high added value applications where the combination of performance, size, flexibility and robustness are critical factors of success. Medical diagnostic and delivery systems, artificial organs, new sensors for medical applications, environmental and industrial monitoring and control, safety and security issues, and reduced energy consumption requirements are the main systems application fields where the impact will translate into improved quality of life. Flat-panel displays have wide application in portable and high definition projection television sets, in graphic and multimedia systems, and in interactive CD. In the semi-professional field, flat-panel displays will be found in video phones,

automotive applications and electronic workstations. They will become a fully integrated part of new products, requiring a close cooperation between components and device manufacturers: as microelectronics, display technologies play a substantial role for the competitiveness of all industries. A European competence is therefore essential to be developed. Actions to catch up the necessary know-how and production technologies are needed and should therefore be strengthened.

Memory subsystems represent a second field of peripherals technology which is crucial for the whole of the electronics industry. They are associated with all the applications mentioned above. High resolution displays, graphics systems and multimedia systems in particular demand very high capacity high speed memories. Digital memory subsystems are currently used for audio, image and video information including in portable applications. In addition there will be selected activities in the field of home system peripherals, addressing the integration of home automation devices and appliances into a unified system, so for example helping to rationalize energy consumption. Specific work in these areas will be taken up, if there are commitments from the European players involved.

Work on microelectronics will concentrate on those technologies likely to be in major use towards the end of the decade and to have a major impact on applications. These include silicon-based technologies and the most promising compound semiconductor technologies, in particular gallium arsenide. All aspects of the process, including design, packaging and interconnection testing, manufacturing and equipment as well as the development of new manufacturing and testing equipment and materials, will be covered. Some work may be undertaken in conjunction with Eureka initiatives, including the one on silicon based technologies. This aims at a qualified integrated 0,35 micron CMOS process by 1996. Integration of advanced components into advanced integrated circuits for specific applications will be emphasized.

RTD tasks will focus on the following areas:

— generic technologies aimed at lower size, lower cost, higher functionality and complexity, as well as higher speed, lower power millimetric and microwave integrated circuits for high frequency applications,

— generic system integration technologies with an emphasis on electrical and optical interconnectivity and packaging at all levels of interconnection,

— systems consisting of active and passive components including opto-silicon hybrids, research into passive and power components will be directed towards integration and interconnection with other components and technologies,

— advanced system design methodologies, tools and tests, for digital, analogue and mixed applications,

— electronic and photonic device technologies and system integration, in particular for advanced peripheral and storage systems, communication networks, optical information processing, and microsystems,

— effective manufacturability of next generation ICs for small and large volume production, including advanced and effective manufacturing equipment and materials,

— concepts and technologies for flexible fast turn around manufacturing facilities for advanced integrated circuits for specific applications, in particular providing easy and cheap access for SMEs,

— integration of design and technology capabilities in pilot demonstrations aimed at specific applications of significant economic and social impact, or at extending the impact of microelectronics to more traditional industrial sectors,

— microelectronics aspects of sensors and microsystems; and multifunction system applications.

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

collaboration will be established in specific fields, and there will be appropriate coordination with national initiatives in Member States.

Work on integrated microsystems will focus on the multidisciplinary design, manufacture and test of microsystems, and integration and packaging methods, in coordination with the progamme on industrial and materials technologies and with other specific programmes concerned. RTD will be directed primarily towards the technological needs of major application fields: such as automotive, where microsystems will have a key role in the realization of the clean safe car of the future; medical engineering, where microsystems are needed for portable intelligent medical diagnostic and delivery systems; and the monitoring and control of industrial processes especially with attention to those influencing the cleanness of the environment.

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

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

The potentially wide applicabilitiy of microsystems and the inherent difficulties in mastering microsystems technologies necessitate the creation of efficient Community-wide mechanisms for dissemination and technology tranfer. Of particular importance is the stimulation of conditions for SMEs to develop innovative microsystems at low cost and to incorporate them into their products. These needs will be addressed by the dissemination and transfer of technology through technical interest groups and networks of excellence. Access to low cost manufacturing and other assistance, particularly for SMEs, will be provided through the creation or enhancement of specialized mini-fabrication facilities combined with appropriate service mechanisms.

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

Work in the area of flat-panel displays will build on results achieved in the third framework programme, in particular in the field of Active Matrix LCD for applications needing large full-colour high-resolution displays. Activities will be directed towards the development of low-cost high-resolution thin-screen display components, emphasizing improvement in visual quality of displays, especially for portable equipment, and increased screen size and flatness. Size targets for volume production up to 1997 are 2,8″ to 5,8″ for electronic definition TV/extended graphic area projection displays, and up to 15″ for full-colour interactive displays for electronic work stations. Active matrix LCD technology is of particular importance, exhibiting the most attractive features in term of colour and resolution, but other display technologies may also be addressed, such as Field Effect Displays, Electro-Luminescent Displays and Ferro Electric Displays for very low-cost and low-power applications. Requirements will be defined through cooperation betweeen the user and supplier industry. In the field of memory subsystems work could cover increased capacity, compactness and read/write performance to support multimedia systems and real-time high definition video. Technologies to be addressed include magneto-optic and magnetic disks. Work on home systems peripherals could concentrate on technologies for the devices required to link home appliances into a domestic system and for the peripherals needed to support user interactivity.

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

MULTIMEDIA SYSTMS

The objective of this sector is to support strategic R&D to develop and integrate information and communications technologies which underpin multimedia end-user systems and applications with a view to offering users new services based on information technologies. Specific work will be undertaken on technologies for integrated personal systems, which will give the individual citizen personal access, whatever the location to information infrastructure services and local information processing and, for this reason, represent one of the main market opportunities in the area of multimedia systems. This work shall contribute to establish a significant market position of the European industry.

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

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

Activities in the sector will be coordinated with work in other specific programmes. Whereas the IT programme is concerned with work on tools and standards for basic multimedia processing, the advanced communications programme covers technologies for multimedia transmission and service management, and those relating to digital video services, and the telematics programme addresses the issue of integrating such research results into multimedia systems and services for selected applications areas. It is expected that over the period of the programme there wil be considerable convergence of the IT, communications, consumer electronics, information publishing and entertainment industries, a trend which will be fully taken into account.

The sector will develop and integrate generic technologies to allow the creation, manipulation, editing, display, storage of multimedia information and integration of multimedia technologies through validation projects involving user-supplier collaboration. RTD includes the specification of algorithms and of appropriate components, for example video compression/decompression chips, high capacity optical memory and processors, liquid crystal displays, information appliances (including multimedia terminals) and their integration into advanced multimedia systems; standards for multimedia storage, representation, and compression/decompression; and generic multimedia software including tools supporting man-machine interfaces. The area of software includes multimedia extensions to existing system software and tools; creative tools providing software objects in the various media video, audio, animation, painting and drawing; and authoring tools which allow multimedia user-friendly custom applications to be built from the individual media objects. The integration of hardware and software elements will be demonstrated in systems for a variety of end-user applications. This will be complemented by projects demonstrating the integration capabilities of multimedia technologies and best practice. Software technologies which afford enhanced human convenience and security with regard to multimedia systems and which will therefore play an important role, are an essential factor in the acceptance of multimedia systems.

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

Work on integrated personal systems will concentrate on two topics: the development of technologies for multi-function, integrated user, access devices capable of handling multimedia data, including the electronic wallet and personal and group communicators as well as mobile communications in offices; and the application of technological advances in the information provider industry to enable them to satisfy the ever

increasing user demand for efficient services. These two aspects cover the application sides of the complete system solution that, for its full deployment, will rely on existing wireless network and telecommunication infrastructures, and will take into account new development activities in these areas which are covered in the telecommunications and telematics programmes.

Supporting activities include the training of designers and authors of multimedia applications. Technology suppliers and the authorizing industry will provide information dissemination to support industrial cooperation to pave the way for standards. Close links will be established with other generic technology initiatives, particularly those on peripherals, microelectronics, software engineering and microprocessors.

LONG-TERM RESEARCH

The intensive RTD effort needed to increase the turnover from the laboratory to the market, in a rapidly changing technological scene, engenders the risk of 'short-termism'.

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

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

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

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

Thematic networks of excellence will provide frameworks for coordinating RTD, technology transfer, training, as well as a common infrastructure. They are dynamically maintained by the technological community itself (suppliers, users and researchers). These coordination frameworks, in which the vision of industry will be an important consideration, are expected to play a central role.

Upstream RTD projects will fall into two categories:

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

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

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

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

**Focused cluster**

*Open microprocessor systems initiative (OMI)*

The objective of OMI is to provide Europe with a recognized capability in microprocessor systems, and to promote their broad acceptance in applications systems, both within Europe and world-wide.

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

OMI will build on work started under the third framework programme, which itself draws on activities supported by a number of Member States, and on results in microelectronics, software, applications systems integration, and standards from all parts of Esprit and elsewhere. Its aim is to concentrate and coordinate efforts in microprocessor systems RTD throughout the Community in order to provide the critical mass which will enable European industry to compete effectively worldwide.

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

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

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

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

Efficient mechanisms will be provided to disseminate and transfer results throughout the Community and world-wide. This will be achieved by conferences, technical interest groups and networks of excellence; by regional design and conformance testing centres to assist particularly SMEs in the exploitation of OMI

technology; and by an OMI portability action, which will promote on-chip microprocessor systems standards as well as the virtual binary interface standard, demonstrating value in portability experiments. Activities will be coordinated as appropriate with initiatives in Member States.

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

**Focused cluster**

*High-performance computing and networking (HPCN)*

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

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

The priorities of the cluster are as follows:

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

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

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

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

The first set of activities concerns simulation and design applications. The objective is to demonstrate new applications which need HPCN capabilities for cost-effective solution, and which have a clear impact on industrial performance, shorter time to market and better product quality. The emphasis will be on computational fluid dynamics, signal processing, system simulations, materials dynamics, electromagnetics, molecular modelling and other chemical-pharmaceutical applications.

The rapidly increasing flow of skilled personnel able to use HPCN systems will make possible distributed applications in accordance with user requirements. A longer-term objective is to address advanced complex, and ultimately complete, simulation systems combining several disciplines.

Activities in information management applications aim to demonstrate the economic viability of HPCN techniques in the fields of complex decision support and high-performance online transaction. The focus of activities is determined by the need for complex multi-functional adaptable, highly reliable and safe solutions. Activities include the application of HPCN to complex data analysis, storage and retrieval of information in large and distributed bases and the application of image-based human-computer interfaces. Leading edge applications in suitable sectors such as banking, insurance, power distributing and other piloting sectors will be addressed. Sensitivity to new solutions and approaches at management level need to be developed through specific actions.

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

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

Supporting activities will complement the work to support the development of a pan-European HPCN environment and infrastructure by achieving appropriate coordination with complementary activities and programmes. In this context, concerted actions will be organized in the form of networks which aim at spurring training by research and technology transfer to industrial users. Applications experiments normally building on existing infrastructures and institutions requiring a Community dimension will be supported and will help users to evaluate the opportunities, facilitate the accelerated uptake of HPCN technologies and give guidance to create a market for European system suppliers. Those experiments would also facilitate user-supplier relations in Europe.

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

**Focused cluster**

*Technologies for business processes*

To increase productivity and quality and to ensure competitiveness many enterprises are re-engineering their business processes, resulting in new work arrangements. A major feature of this re-engineering is the integration of business processes across the business functions such as sales, product development and finance. Another feature is more group working, often across departments. A third feature is a move from the high level of division of labour that has been common up to the 1980s, to an integration of tasks, with several of the tasks being carried out by the same individual. Information technology is an essential underpinning for most of these new arrangements, which are otherwise either not feasible or uneconomic.

The new business processes often involve complex decisions, are knowledge intensive, require rapid response, and are related to work flow. Many of the new processes need to be supported by new technologies or new combinations of technologies; integration of technologies is the central support required. Tools to support cooperative working and document management are of particular importance. Considerable scope exists for improvement in the efficiency of document management services in particular.

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

Research into IT for business processes is multidisciplinary, and includes modelling of business processes, organization 'engineering', architecture of information and communication processes in the enterprise, integrating software components for business requirements, and integrating document management into multilingual organizations and administrations. Differences between countries in business organization and business practices will also be incorporated into the research. The integration of mobile personal systems will also be addressed.

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

New approaches to methods for integrating and developing software are required to support the new forms of business process automation, including the integration of object-orientation, knowledge-based systems, graphical user interfaces, and distributed computing. The integration with other technologies of teleconferencing, of spatial information systems such as geographical information systems, and of mobile technologies, is also required. This necessitates a strong relationship to the work on methods and tools and on knowledge-based systems in other parts of the IT programme. Work will also be done as appropriate on standards.

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

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

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

**Focused cluster**

*Integration in manufactering*

For a high-wage economy, employment in the productive sector relies on the rapid shift towards technology-based products of high engineering content or added-value, and on the ability of manufacturers

to operate in an optimal way in a dynamically changing global network of business partners, suppliers, customers, and researchers. The profound restructuring which is taking place thoughout industry creates both the climate and the opportunity for change. New manufacturing paradigms are emerging to support a more lean and agile approach; collaborative supply chains, intelligent manufacturing, collaborative working and total quality management. All are predicated on the availability of advanced IT and communications.

Previous work was based on the concept of the integration of traditional engineering functions. These 'computer integrated' technologies of the 1980s are now sufficiently mature to be able to be exploited downstream in an industrial environment. A new culture of work is emerging which pervades all business processes including manufacturing and engineering; this needs advanced ICT and, correspondingly, determines new upstream ICT developments. Advanced ICT developments must be influenced at their inception, so that European industrial competitiveness and the quality of life for the industrial worker are well-served.

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

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

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

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

Work on the enterprise integration framework will concentrate on the provision of methods and tools to support modular system design for the ICT systems supporting manufacturing and production enterprises. Design and implementation of integrated quality management systems will also be supported by this advanced information technologies. Users and vendors will be encouraged in their efforts to reach consensus on requirements and functional specifications for the components for such systems, and support will be given to advanced implementations aimed at validating, quality assessment and testing the results.

Work in the field of integrated product data modelling will concentrate on formalizing and standardizing the data structures used to describe products and their components, thus extending the functionality of product data modelling systems to a higher level of semantics, including knowledge representation and sharing.

Information interfaces have to be defined and have to be implemented to ensure quality standards. This will enable the engineering functions of the entire life-cycle of products and processes to be supported from a common platform.

Both the productivity of manufacturing and production systems and their ability to operate safely and without hazard to human life or the environment depend on the quality of their control systems. Work on intelligent control will concentrate on the development and integration of distributed hierarchical control systems, beginning at the level of sensors and actuators, extending through the control of the production process, and at a higher level dealing with the flow of goods and orders through complete factories or plants and also through the entire logistics supply chain.

The rate of uptake of the technology developed in the three areas above is largely dependent on the speed with which agreement can be reached on standards for the use of emerging technologies. Harmonization of quality management systems is necessary to obtain comparable assessments of supplier industries within Europe. Measures will be taken to enable experimentation with emerging standards, and a close linkage between users and vendors will be established to accelerate this process. Measures to support the diffusion of best practice to all regions of the Community will be undertaken in order to support European enterprises collaborating and competing internationally. Coordination and collaboration with Member State and international initiatives will be established as appropriate.

*ANNEX II*

## INDICATIVE BREAKDOWN OF THE AMOUNT DEEMED NECESSARY

| Area | ECU million |
|---|---|
| 1. Software technologies | 268 |
| 2. Technologies for components and subsystems | 487 |
| 3. Multimedia systems | 153 |
| 4. Long-term research | 191 |
| 5. Open microprocessor systems initiative | 172 |
| 6. High performance computing and networking | 244 |
| 7. Technologies for business processes | 167 |
| 8. Integration in manufacturing | 229 |
| Total | 1 911 (1) (2) |

(1) Of which:
- a maximum of 3,9 % for staff expenditure and 3 % for administrative expenditure,
- at least 2 % for training activities forming part of the programme,
- ECU 18 million for the dissemination and optimization of results,
- up to 12 % for specific measures in respect of SMEs.

(2) A sum of ECU 21 million, the difference between the amount deemed necessary for this programme and the amount foreseen in the fourth RTD framework programme for information technologies, is earmarked for the specific RTD programme 'to be carried out on the one hand by means of direct action (JRC), and on the other by means of activities within the framework of a competitive approach and intended for S/T support to Community policies (1995 to 1998)'.

This breakdown does not exclude the possibility 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 institutions which do not have analytical budget accountancy will be reimbursed on the basis of 100 % of the additional costs.

   (b) Technology stimulation to encourage and facilitate participation of SME's in RTD activities:

   (i) 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 SME's 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

   (ii) by supporting cooperative research projects, whereby SME's 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 normally 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 during the period covered by the work programme being implemented.

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

2. Measures appropriate for this specific programme:

   — measures in support of standardization and measures aimed at the establishment of usage protocols of general value to the objectives of the programme.

   The Community's contribution may cover up to 100 % of the cost of the measures.

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

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

   — support for exchange 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 activity; 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 socio-economic research',

— training actions related to research covered by this programme in order to stimulate technology transfer and enhance employment skills,

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

— assessment of the environmental impact of activities in the programme,

— preparatory studies and pilot activities to study the interaction between user-citizens and the information infrastructure and to experiment with new ways of using information technologies (in close collaboration with the programmes on advanced communication technologies and services and on telematics application of common interest and with the programme on targeted socio-economic research),

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

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

4. Concerted actions consisting of the coordination, notably through 'concertation networks', of RTD projects in the programme and those already financed by public authorities or private bodies. Concerted actions may also serve as the necessary coordination for the operation of common interest groups (networks of excellence) which, through shared-cost RTD projects (see 1 (a)) bring together around the same technological or industrial objective manufacturers, service providers, users, universities and research centres.

Community participation may cover up to 100 % of the costs of the concertation.