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European Research Consortium
for Informatics and Mathematics

ERCIM

EDGE:
European
Distributed
Generic
Environment

European

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CONTENTS

ANNEX

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1. BACKGROUND

1.1 Introduction

The ERCIM institutes have had a long term involvement in European framework programmes. They have been involved in more than 300 ESPRIT and other European projects. Of these, 45 have had two or more ERCIM partners involved. The need to strengthen these ties and to create better links with industry has resulted in the formation of ERCIM. Over this period, the pace of technological change and innovation in the IT area has been staggering, with massive increases in the availability of processor power, memory, storage, and communication speeds. The application of computing technology has also increased markedly with computers now impacting the lives of the majority of the population. Most industries in Europe are dependent on IT for their existence.

The ERCIM partners have strong interactions with the European IT industry and manufacturing industry in general through their participation in European projects. Locally, many of the ERCIM partners have strong links with specific SMEs in the industrial sector. Many SMEs owe their existence to the incubation achieved by a close liaison with an ERCIM partner. ERCIM partners thus act as a bridge between basic research and short-term pre-production developments feeding prototypes into industry.

In consequence, ERCIM has a good understanding of the way the European research programmes have evolved and their effectiveness in achieving their goals particularly in relation to industry.

1.2 Strengths

The major strengths of a programme such as ESPRIT have been:

(1) **Community Creation:** there now exists a European-wide community rather than national IT communities. Industry and academia have realised how to work together. Private industry and the research laboratories, both public sector and independent, have established good working relationships.

(2) **Enhanced Academic Strength:** the Basic Research programme has enhanced the position of European academics relative to their American and Japanese colleagues.
(3) **Pioneering Results:** many ESPRIT projects have resulted in commercial products. In addition, European developments have been greatly enhanced by the ESPRIT programme (transputers, CHORUS and PCTE, for example).

1.3 Concerns

Many projects have failed to result in innovative commercial products even when there have been clear possibilities. Some reasons which are specific to ESPRIT are:

(1) **Limited Independent Assessment:** assessment of research results is carried out by advanced users within a specific project. In consequence, the number of organisations that can benefit from and assess the prototype products is limited.
(2) **Poor Dissemination of Experience:** because the experiments carried out by partners in a consortium are considered to be the property of the consortium, the results are seldom made available to a wider audience.
(3) **Discouragement of Real Innovation:** the market-driven focus and breaking down into relatively small projects has resulted in less innovative projects, and the number of novel experiments has decreased. The tight workplans and the way some projects interpret them can preclude genuine innovative approaches that do not fit. (The fact that the work plan is formulated much earlier inhibits truly innovative approaches.)
(4) **Balance between Large Companies and SMEs:** flexibility and speed are needed in making strategic and innovative advances. These are often not the characteristics of large organisations. A major role of such companies is to enter the market once it has been established. In consequence, the over emphasis of large companies rather than SMEs in the strategic rather than near-market part of the programme builds in a greater chance of failure to exploit.
(5) **Insufficient Support for Product Development:** the extent of the SPRINT and VALUE programmes is insufficient and not integrated with the main research programmes.
(6) **Heavy Project Management:** the large number of projects and the approach adopted by project officer and project manager often results in a large management overhead in current CEC programmes, causing SMEs to shy away from being involved and, in particular, acting as Project Managers.

1.4 Improving innovation

The following general points need to be taken into account when defining any new programme:

(1) **Complementarity:** all aspects of the innovation process must be addressed.
(2) **Freedom:** to support innovation, more freedom must be provided. An over-rigid structure precludes this. Detailed work plans, with their long lead times, are inappropriate for innovation. Too many small projects limit the ability to innovate.
(3) **Maximise Assets:** the research community in Europe is a major asset that should be exploited to the full. In particular, the public and independent laboratories present a major asset that is not always effectively exploited.
(4) **Greater User Involvement:** the narrow integration of users into specific projects needs to be changed to allow a more open assessment and greater visibility for the products. Independent users are vital to a deep understanding of some user requirements and the evaluation of results.
(5) **Cross-Fertilisation:** the Community supports many specific projects which could benefit from the results of others. Putting these projects into water-tight compartments inhibits this being achieved.

The following key points related to IT also need to be taken into consideration:

(1) **Importance of IT:** the IT market is important for Europe both in the design and manufacture of products. Also, the range of products that will include IT or be IT products in their own right will increase significantly.
(2) **Improved delivery of products:** the major problem facing Europe is not basic research or production but, instead, the consolidation phase that takes innovative ideas and produces industrial quality prototypes and then makes these available to end-users for assessment and use in a wide range of environments. For example, there is a need for technology transfer from state-of-art academic research groups to IT providers in industry and from them to the product developer.
(3) **Better integration:** any future programme must ensure that the whole is greater than the sum of the parts. By ensuring different projects and programmes feed off each other, a better use of funds and application of results will ensue.

If these points are addressed, there is likely to be a significant increase in the delivery of products based on innovative ideas.

1.5 A priority technology project: EDGE

The Commission has incorporated into the 1993/1994 planning a new instrument, namely the **Priority Technology Project (PTP)**, to sharpen the focus of Research and Development. ERCIM has looked at this as a possible way forward to propose a project which removes many of the problems highlighted above. The proposal (**EDGE: European Distributed Generic Environment**) aims to channel support into a generic technology of wide application to many users across the whole community. The proposed PTP is aimed at bringing together the array of expertise required to achieve a significant advance in the area of engineering design through the production of a generic environment that would be also applicable to information providers.

The architecture of this particular PTP capitalises not only on the tremendous potential and synergies within ERCIM but on the existence of strong relationships with the relevant sector of SMEs. The PTP will also involve as major partners a number of end-user organisations.

By organising the activity as a PTP, the top management of the proposing institutes (large research laboratories, SMEs and end-users) can give their commitment to the enterprise knowing that it will have the coherence, genericity, timeliness, flexibility and applicability which are the hallmarks of the PTP instrument.

2. OUTLINE PROPOSAL

2.1 Design

Europe has invested considerable resources into improving the competitiveness of European industry in the *production* aspects of product manufacturing. Much less effort has been expended on improving competitiveness in *design*. Current practice for the design of complex products such as ships or cars involves the use of many different subcomponents. Subcomponents interact in complex ways in multiple paradigms (for example, a wall in a building is a structural element, a thermal barrier and a movement constrictor). Information exchange between different design packages still represents a major impediment to producing effective designs at competitive cost. In many large design organisations, the design task is itself decentralised, with different subsystems being designed in different parts of the organisation, or even perhaps in different organisations. A design is refined from higher levels of abstraction to details. Different tools are required for different levels, even when the tool domain is the same (for example, knowledge based thermal analysis of outline design of a building, simulation based thermal analysis of detailed design).

Computer support for cooperative design tasks offers a significant opportunity to increase the competitiveness of the European design industry. Such technology also offers an important opportunity to increase competitiveness by sharing the skills of expert designers and computer-based design assistants amongst less-skilled colleagues. In addition, capturing data online encourages links to automated production and computer-aided manufacture. In any complex design task, information needs to flow in time (even where there is one location or designer) as well as geographically. This is another type of information exchange with its unique problems.

2.2 Product information

To capitalise fully on the creation of the single European market, it is necessary for suppliers to be able to advertise their products across the whole market, and for potential purchasers of end-products, components and parts to be able to choose amongst offerings from suppliers in different member states. Having chosen a catalogue item and supplier, it is necessary to be able to order and secure delivery of the item efficiently, bearing in mind the different trading practices and languages of different Member States. For example, a UK designer could provide designs for an Italian client using Italian components and standards if the product and standards information was available locally throughout Europe.

2.3 A generic environment

In both these areas (design and product information), services based on high bandwidth networking coupled with multimedia and multimodal cooperative working, object-oriented techniques, advanced database and knowledge base technologies provide the key generic technologies. Integrating these will provide the foundation for products which will enhance competitiveness in areas such as the two described above. This needs to be linked to the current trends towards multidisciplinary design teams and concurrent engineering.

The primary objective of the ERCIM proposal is therefore to:

> *establish a European-wide facility of cooperative working environments supporting multimedia and multimodal dialogues. This would consist of advanced information servers linked by high-speed distributed communication networks, provided by public ISDN and private means, and providing transparent access to high performance computers.*

The establishment of the facility will be done in close partnership with the European telecommunications operators and their research establishments, namely EUROSCOM. It must also address the problems currently perceived of the lack of take up of IT in design due to:

(1) *Lack of integration into current design process* (with its emphasis on paper-based communication, separation of responsibilities between professions, legal requirements etc).

(2) *Restricted scope of tools* (structural analysis needs geometry and material data, but these are frequently not available when the structural form is being designed).

(3) *Conceptual mismatch between tool and user.* This frequently results in a steep learning curve (for example, few heating engineers, and fewer architects, know a great deal about thermal simulation).

Exploitation of the facility will focus on three main goals:

(1) *Industrial design and production*: to demonstrate the increase in productivity obtainable by raising the productivity of skilled manpower by enabling design and production activities to be carried out throughout Europe in geographically distributed heterogeneous working environments.
(2) *European catalogue*: to demonstrate a European-wide mechanism for marketing, cataloguing, ordering and supplying, allowing suppliers and buyers within Europe to communicate using the most advanced IT and communications support that can be provided. Such a network would be a facilitator for an integrated European market, independent of distances, regional boundaries and other such factors that tend to inhibit the free flow of products in the market.
(3) *Organisational integration*: to demonstrate the organisational benefits accruing from the use of advanced communications infrastructure in a distributed organisation, by use of the facility within ERCIM for day-to-day collaboration amongst researchers, management and administrators.

Potential members of the project consortium are the ERCIM institutes, SMEs who will bring the key generic technologies developed to market and user organisations who will participate in the prototype demonstrators of the facility and through skills transfer will form the nucleus for the creation of new markets. A prerequisite is the need for telecommunications operators or others to provide the basic high bandwidth communications infrastructure as a pervasive European network.

3. DETAILED PROPOSAL

3.1 The EDGE kernel

The kernel of the facility consists of three layers:

(1) High bandwidth networking environment
(2) Multimedia and multimodal cooperative working environment
(3) Transparent access to heterogeneous object-oriented data and knowledge bases

This environment is given the name European Distributed Generic Environment (EDGE).

3.1.1 The networking environment

In many European countries, high bandwidth networks based on ATM technology are starting to become available and new challenging and demanding applications for this technology are being sought. Examples are the UK SuperJANET project, the Stockholm Gigabit network and the BERKOM in Berlin. ERCIM institutes have experience of using trans-European public data networks in distributed systems through projects such as ARGOSI (ESPRIT Project 2463), but there are no examples anywhere of integrated trans-European high bandwidth networks.

A prerequisite for the project, which will need to be carried out in close partnership with the European telecommunications providers, is the installation of high bandwidth connectivity and basic communications services between the sites of the collaborating organisations.

3.1.2 Multimedia and multimodal cooperative working environment

A major requirement of engineering design is the ability to modify and reuse existing designs for new projects. Reuse in engineering design breaks down into 2 broad categories:

(1) **Parametric design:** where an existing design is parameterised and reuse means identifying the appropriate design and associated parameters. This occurs mainly in mechanical and electrical design (pumps etc).

(2) **Conceptual design:** where the design concepts are reused. This occurs mainly in large capital engineering projects (buildings, ships, aerospace).

Much of design is a cooperative process between design teams where individual experts need to make cooperative decisions. The design process itself frequently requires simulation of components and visualisation of results. There is also the need to check against local standards and store design information (for audit trail, artefact management, refurbishment etc).

This leads to the need for an environment for engineering design based on modern object-oriented techniques and linked to the new capabilities offered by multimedia and multimodal working. Much of the software becoming available is not oriented to the needs of the engineer being more aimed at the information worker. The effort required to integrate product data exchange facilities with computer aided design, simulation and visualisation into a coherent infrastructure is sufficiently large that a successor to products such as AUTOCAD with the appropriate links and designed in an object-oriented framework is a significant amount of work. The ERCIM partners have several prototype environments that have been developed for specific applications and these could form the basis for the kernel (examples are the Energy Kernel System for energy calculations in buildings - the object oriented kernel was developed at RAL, the Computer Aided Routing (CAR) system for optimising freight transport developed at CWI and the O2 object-oriented database system developed in conjunction with INRIA).

Design support environments are a current research focus (for example JOULE-COMBINE). To succeed in developing a good design environment, it is essential to define a suitable IT environment to underpin it. Current design environments are painstakingly handcrafted amalgams of conventional tools (for example, AUTOCAD) which inherit and propagate the rigidities of their constituents. The consequences are:

(1) They are unable to adapt to new IT technology (for example, multi media).
(2) They cannot adapt to new user demands (for example, AUTOCAD succeeded initially because it was sufficiently simple and restricted in its objectives that it satisfied the immediate needs. As users wanted more linkage to other tools, such as simulation, its ability to adapt was severely limited).

Achieving a soundly based design environment based on modern IT is a major challenge. Support for cooperative working including technologies such as desktop video conferencing is an important element of this.

3.1.3 Heterogeneous object-oriented data and knowledge bases

Frequently, the engineering designer needs access to data where the key to the data is imprecise, incomplete and inexact (for example, which components best fit these requirements, which design fits best in this context). Product and design data of this type is large, often contains real and complex numbers, sometimes contains schematics and images, occasionally is incomplete. Simulation codes often need to be tested against benchmark data which put special requirements on the data handler.

It is in this context that the kernel needs a flexible and intelligent interface to data and/or objects which is more complex once the data is multimedia.

Two fundamental aspects of the management of multimedia object bases are the storage and the retrieval of multimedia objects. Because of the very demanding space requirements of text, graphics, image, and voice data, multimedia objects are going to be very large in size. A multimedia object base is expected to reach a size of order of terabytes. To exploit efficiently the new secondary and tertiary storage technologies, new storage models must be developed that uniformly integrate multilevel storage hierarchies (large main memories, magnetic and optical disks, juke-boxes of optical disks, etc) into advanced hardware and software architectures (large-scale parallelism in I/O and processing). The problems that need to be addressed by these models include: object placement strategies for multi-level storage, migration representation, reorganisation, scheduling and merging strategies. An accurate measurement of the performance of these models is also required, to exploit most effectively the potentiality of the emerging storage technologies.

Data and knowledge bases can be seen as representations of a slice of reality at different levels of abstraction to serve the informational needs of their applications. In contrast, multimedia object bases contain facts in a rough form, encoded in text or images; hence the extraction of information from a multimedia object base is a typical information retrieval problem. Traditional information retrieval models typically employ keywords to represent the content of text and probabilistic or statistical inference procedures. These models exhibit severe limitations as to the effectiveness of the retrieval, due to the poverty of the text representation and the built-in theoretical limitations of the inference process they adopt. In order to endow multimedia object bases with an effective retrieval functionality, new models of retrieval must be developed that overcome the limitations of traditional models and allow a content-based retrieval on non-textual multimedia data types. These models must provide a semantically rich representation of the content of multimedia objects, and a well-founded inference apparatus, whose underlying logic captures the notion of relevance of an object to a user request.

3.2 Demonstrator projects for industrial design and production

3.2.1 Background

At present, the application of IT in the manufacturing industries like the automobile and shipbuilding industries, is very much fragmented. The result of this fragmentation is that the potential of the knowledge and skills available in Europe is not used to its full extent, and that the lead time from initial idea to market introduction is much longer than it could be. For example, in the design and manufacture of a complex product such as a ship, the parties involved include the ship owners (often with their own preliminary design office) who define the product, design consultants who produce the overall design and the shipyard who builds it. Associated with this activity are research institutes, classification societies and a whole range of subcontractors who are frequently specialised SMEs with their own practices and IT platforms. For something as large and complex as a ship, there will be a range from PC-based CAD systems at SMEs to supercomputer-based CFD applications at research institutes (for prediction of flow around the ship hull). Other areas would exhibit similar diversity of platforms.

The interchange of data between these various systems and other IT systems for evaluating the performance of the new product (Finite Element Analysis for evaluating the structural strength, Computational Fluid Dynamics analysis running on supercomputers for reducing fuel consumption, crash analysis etc.), or for controlling the manufacturing process, is often a problem. Transparent interchange of data between CAD systems is of vital importance. The current absence often results in the use of inappropriate tools for some part of the design. This problem is often aggravated when the various stages of the design/engineering/production process are handled by different organisations, which may even be located in different countries. In addition, these organisations deploy different computer platforms, which are not compatible. The envisaged cooperative environment, EDGE, would greatly enhance the efficient collaboration of all parties involved and would result in shorter lead times, higher quality and improved competitive position.

It is proposed that a set of demonstrator projects are incorporated into the overall project aimed at exercising the generic environment in specific areas.

3.2.2 Objectives and benefits of demonstrator projects

The main objective of the present proposal is to create a transparent network in which designers, researchers, suppliers, subcontractors, and manufacturers can cooperate effectively and efficiently across Europe. As a result, the best tools and knowledge available in industry and research institutes can be mobilised in order to arrive at new competitive products of high quality with a much decreased lead time. Concurrent engineering requires intense user interaction with timely delivery of information and good tracking and auditing of information flows and decisions. Including some of the leading edge technologies will give the European manufacturing industries an unprecedented competitive advantage:

(1) The **integral approach** provided in the present project will create the possibility of creating flexible partnerships, thus turning the existence of a great diversity of industries, SMEs and research establishments in Europe into a competitive advantage.
(2) **High performance networking** and video conferencing will improve the communication between co-workers in a project across companies and even countries, and will facilitate exchange of data from one stage of a project to a subsequent one.
(3) By providing **transparent access** to a range of CAD tools, with good integration and interworking, the speed of the design process and the reliability of the result will be greatly enhanced.
(4) The **network** will provide **transparent access** to high performance computing facilities in order to perform advanced engineering simulations such as car crash analysis or fluid dynamic computations.
(5) The **network** will enable various **cycles in the design** and engineering process to be repeated in an iterative way in short time in order to optimise the design as well as the production process of a new product.

(6) Application of state-of-the-art **multimedia tools** will allow the creation of a *virtual reality* representation of the new product, thus allowing an evaluation of various human aspects of the new design; at the same time, these tools can be used to promote and market the new product even before a prototype is available.

In consequence, the overall proposal acts as a demonstrator project at two different levels. The engineering area overall is a demonstrator of the ability of the EDGE environment to be effective in the engineering area. Individual demonstrator projects will exercise the environment stringently in specific areas.

3.3 The entire European catalogue

A major goal of this proposal is to promote **a European-wide mechanism for marketing, cataloguing, ordering and supply monitoring of goods** allowing vendors and customers within Europe to communicate using the most advanced support available both from telecommunications and IT sectors. It will allow easy and powerful interchange of commercial information aiming to locate, identify, retrieve and exchange data concerning products and services available in the European market.

The end users will be both buyers and suppliers of finished goods and services of any type and/or of sub-components (parts) to be integrated in final products.

The system will provide for multimedia data entry/access by the suppliers resident either at their own facilities or at regional databases. The multimedia interaction should provide visual, textual, audio or other types of information allowing different levels of information refinement. Additionally, a peer to peer conversation should be easily set up.

The buyers will dynamically negotiate their mode of access with the networking facility that will enable them to pursue inquiries in a normalised form with the various information providers and suppliers connected to the system. It is only natural to expect the European-wide backbone of this system to be provided by wideband ISDN facilities and ATM systems under development in Europe.

The availability of such a heterogeneous distributed electronic catalogue of goods and parts throughout Europe will improve the knowledge of available products both as finished goods and parts, shortening the path to the market and quickening the design/products cycle by allowing adaptation to the specificities of the available sub-components. Moreover, the system will enable faster commercial transactions, reduce marketing, distribution and manufacturing costs, and increase the competitiveness of European industry and service providers.

It will also improve the European-wide sense of complementarity, and not just provide local, facilitating commercial interchange. Moreover, it will weaken the importance of geographical distances and/or origin of products in terms of nation or groups of nations.

From the IT and Telecommunications side, there is a set of technical requirements:

- Broad band communication infrastructure
- Sophisticated network management
- Image and interactive video support
- Browsing facilities
- High capacity, high speed storage media
- Dynamically adaptable communication capacity, negotiable upon needs and users capabilities.

The users of the system should provide:

- Heterogeneous multimedia electronic based catalogues
- Browsing facilities
- Tried and tested interactions with commercial departments

This will require special training for:

- Electronic based cooperative work
- Imaginative new marketing techniques

The European catalogue also gives a unique opportunity for promoting standards in this area. Constraints could be put on the information available within the catalogue to encourage the use of standard parts, standard data formats, standard data exchange etc in much the same way as the CALS initiative has been an enabling influence in the USA.

3.4 Organisational integration

Monitoring the use of the facilities in the EDGE kernel in the pursuit of the management and technical objectives of the project will enable the organisational impacts of this technology to be assessed.

4. JUSTIFICATION

The main justifications for the EDGE PTP are:

(1) The proposed PTP is capitalising on the result of many basic research projects carried out under the previous framework programme. While it often takes 5 to 10 years for the results of fundamental research to come to fruition, the aim is for this PTP to bring results to the market within four years.

(2) The project proposes to involve research institutes as partners with both manufacturing industry and the business world, thus creating excellent conditions for transfer of knowledge and implementation of results.

(3) The proposed PTP clearly satisfies the subsidiarity criterion: the pressure to create a transnational high bandwidth network and cooperation between research institutes and SMEs in all member states of the EC clearly surmounts the possibilities and responsibilities of national governments.

(4) The project is employing generic technologies of wide applicability in both the industrial realm of manufacturing companies (mechanical, automobile, aircraft, shipbuilding) as well as the service and trade sectors.

(5) The project has a sharp focus on improving the competitiveness of European industry. By enhancing the productivity and effectiveness of its designers, both cheaper and better products will be possible.

(6) The project is providing clear benefits to SMEs in exploiting the results of the project.

(7) There is synergy between the proposed PTP and many projects in other Community programs (in particular ESPRIT, BRITE/EURAM) as well as EUREKA. The JOULE-COMBINE project, for example, is looking at data exchange and design environments relevant in the heating, ventilation and air conditioning area.

(8) Since the proposal falls within the scope of a number of specific programmes and is multidisciplinary in nature, it qualifies as a PTP.

(9) Since the ERCIM organisation includes the major national research institutes in the field of Information Technology that have the most relevant industrial connections, and since therefore it is difficult to envisage a credible competitive consortium, an open call would be a nugatory exercise for the present proposal.

5. FUNDING

At this initial stage, no attempt has been made to provide a detailed breakdown of the costs. The duration of the PTP is expected to be 4 years and the manpower, on average, at each of the ten ERCIM institutes is estimated at 30 MY per year for the development of the environment. The anticipated user and application development part of the programme is estimated at about a third to a quarter of that activity. With hardware requirements etc the overall cost of the PTP is estimated as 300 MECU.

The three strands to the work programme are:

(1) Feasibility study
(2) Prototyping the environment
(3) Production of the environment

All that is sought at this stage in terms of funding is support to perform a detailed feasibility study of the overall project in order to firm up the above figures and fill out the details of the proposed project.

6. ECONOMIC IMPACT

The aim of the project is to provide an environment which makes it easier for European suppliers to compete both through the quality and timeliness of their products.

Given the size of the European market and the ability of European industry to react, it should be possible for the industrial sector to enhance its share of the European market and expand its performance internationally to more than justify the outlay on an enabling project of this form specifically aimed at manufacturing industry.

ANNEX

WHAT IS ERCIM?

ERCIM is the European Consortium for Informatics and Mathematics. It is a group of ten leading research organisations in Europe, strongly involved in basic and strategic research and advanced developments with industry. ERCIM members participate in more than 250 European projects within programmes such as EUREKA, ESPRIT, DRIVE, RACE etc. Acting as a bridge between academia and industry, ERCIM is a major force for technology transfer in Europe. ERCIM members are:

AEDIMA:	A consortium of Spanish universities and research laboratories with a strong interest in strategic research.
CNR-PISA:	Consiglio Nazionale Delle Ricerche (CNR), Roma, Italy acting through its Research Laboratories at Pisa.
CWI:	Stichting Mathematische Centrum acting through its Institute Centrum voor Wiskunde en Informatica, Amsterdam, The Netherlands
FORTH-ICS:	Foundation for Research and Technology - Hellas acting through its Institute of Computer Science at Heraklion, Crete.
GMD:	Gesellschaft fur Mathematik und Datenverarbeitung MBH, Sankt Augustin, Germany
INESC:	Instituto de Engenharia de Sistemas de Computadores, Lisbon, Portugal
INRIA:	Institut National de Recherche en Informatique et en Automatique, Rocquencourt, France
RAL:	Science and Engineering Research Council acting through its Rutherford Appleton Laboratory, Chilton, United Kingdom
SICS:	Swedish Institute for Computer Science, Stockhom, Sweden
SINTEF:	SINTEF Group represented by its department SINTEF DELAB, Trondheim, Norway

The European Research Consortium for Informatics and Mathematics (ERCIM) is an organisation dedicated to the advancement of European research and development, in the areas of information technology and applied mathematics. Through the definition of common scientific goals and strategies, its national member institutions aim to foster collaborative work within the European research community and to increase co-operation with European industry. To further these objectives, ERCIM organises joint technical Workshops and Advanced Courses, sponsors a Fellowship Programme for talented young researchers, undertakes joint strategic projects, and publishes a newsletter.

ERCIM presently consists of eight research organisations from as many European countries:

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