The European RESEARCH AREA

An internal knowledge market

European Commission
The European Research Area

An internal knowledge market

- Fifteen research policies
- The European Research Area – a sea change in research policy
- The framework programme, a new tool for integration
Science and technology are in the throes of a revolution unprecedented in the history of mankind. New discoveries and innovations in life sciences, information technologies, as well as the physical world, are turning existing social, economic, political and ethical structures upside-down. Indeed research – directed at the acquisition and application of knowledge – is now the fundamental driving force of social development.

How is Europe reacting to this growing role of science and technology? Member States generally have their own research policies and structures, quite often of a high standard, but on a European level this leads to fragmentation and inefficient use of resources.

For the past two decades, the European Union, via its framework programme, has had a policy of supporting science and technology aimed essentially at encouraging co-operation between European research players. While valuable and necessary, this approach often falls short of today’s needs. For this reason, in March 2000 the Lisbon European Council adopted the European Research Area (ERA), thereby laying the foundation for a common science and technology policy across the European Union.

The ERA is working to coordinate national research policies in the direction of shared objectives, expertise and resources. In keeping with this thinking, heads of state and government have confirmed a new ambition which will give a decisive impetus to the ERA’s dynamic: the European Union is to increase its global expenditure on research to 3% of GDP - or one and a half times the current level - by 2010. This substantial increase will enable us to bridge the gap with the United States and Japan. It is through changes such as these that the concept of European research will become as familiar in the future as notions of the single market and single currency are today.

Philippe Busquin, European research commissioner
As a major scientific centre, Europe produces almost one-third of the world’s scientific knowledge. It has acknowledged expertise in medical research and environmental sciences, and advanced skills in many sectors of chemistry and physics. Aerospace, telecommunications, transport and pharmacy are some of its key strengths in the field of industrial technology.

Successes to date – Achievements like Airbus and Ariane, or again the high energy physics developed at CERN, are a few of Europe’s more visible successes. These examples demonstrate that, by joining forces, Europeans can compete with the best the world can offer. The quality of Europe’s human resources and of its education and training systems is also well known. Its varied research traditions and cultural diversity give rise to a particularly creative and open approach to problem solving. The map of Europe is dotted with prestigious scientific institutions attaining high levels of excellence.

Alarm bells

But Europe ‘can do better’. Many indicators show that its research lacks the dynamism found in the United States and Japan. Why? Insufficient financial and human resources, lack of innovation, dispersion of effort.

The aura of CERN

Created in 1954 and financed by 20 European countries, with US and Japanese participation in certain of its activities, CERN (European particle physics laboratory) is one of Europe’s brightest shining centres of excellence. More than 7000 scientists from the world over work at its Geneva installation. It is here that computer scientist Tim Berners-Lee, convinced of the need for co-operation between researchers and of the potential source of wealth in exchanging information between them, conceived the World Wide Web in 1990. CERN is also a driving force behind the development of the new GRID network, that should one day overtake and replace the Internet for shared management of the enormous masses of data accumulated by scientific and technological computing.

www.cern.ch
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European take-offs

1972. The first Airbus offered enhanced passenger comfort, easier freight transport and higher profitability. Thirty years on, the innovative approach of the European consortium has spawned a wide range of "made-to-measure" transporters. By the end of 2000, Airbus had won 4000 orders, catching up with historical leader Boeing. The A380, the largest civilian carrier ever, recently received the production go-ahead, confirming the performance of Europe’s aerospace industry and generating around 145,000 jobs in Europe.

www.airbus.com

Financial resources – The figures don’t look good. Across the Union, research funding is stagnating at an average of 1.8% of gross domestic product (GDP), while it is growing in both the United States (2.7%) and Japan (3.1%) (see table 1). In 1999, with a similar GDP, the USA spent 75 billion euro more on research and development than the EU(1). This gap has been widening since 1994. The United States and Japan also devote much larger parts of their so-called venture capital resources to new enterprise creation, in particular in high technology.

The United States is also several lengths ahead in investment in ‘knowledge’, in the broad sense of the term (research, education and training, development of logic tools, etc.). This has enabled it, in particular, to reduce unemployment over the past decade (see table 2).

Human resources – A similar weakness exists in terms of human resources. Researchers represent a much smaller percentage of the active population in Europe than in the United States or Japan (see table 3), even though the number of science students is proportionally higher. With investment in research stagnating, it is hardly surprising that young people are not interested in research careers and that we are faced with the worrying phenomenon of the ‘brain drain’. For example, 83,101 European researchers and engineers were working in the United States in 1997, compared with 77,283 in 1993. And half of the 8,760 European students completing doctorates in the USA between 1988 and 1995 opted to continue their careers in that country.

(1) In 2000 the 15 Member States of the European Union had a total population of 377 million, the United States 272 million and Japan 126 million.

Investment in research

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<th>Year</th>
<th>US</th>
<th>Japan</th>
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In GDP terms, the European Union’s research expenditure has been shrinking over the past ten years. Expenditure has been far higher, and expanding, in the United States and Japan.

Source: Eurostat
An intrinsic dispersion

Centres of excellence can be found in all Member States. But rarely do they rank as global number one in a specific domain. This is explained, among other things, by Europe’s intrinsic dispersion, its fragmented peoples, languages, cultures and scientific traditions.

Puzzle 15+1 – The fragmentation of expertise among the 15 Member States, governed by an equal number of varying legislative, regulatory, educational, financial and patents systems – represents a major handicap.

Weak concrete results

Two indicators traditionally serve to reflect the dynamism of knowledge creation: the number of scientific research publications and the number of international patent registrations.

Publications – While Europe scores very well in the first area, it trails badly in the second.

Patents – In the high technology sector, Europe can claim for itself just a little over one-third of the patents registered in its territory (36%), level pegging with the United States (Japan follows with 21%). By comparison, it generates just 9% and 2% respectively of the patents registered in the USA and Japan (see table 4).

These figures, which do not exactly flatter the Old World, are due not just to a certain lack of culture of innovation, but also to the very high cost and complexity of registering a patent in all Member States – a situation which significantly penalises Europeans vis-à-vis their competitors.

Investment in knowledge

Knowledge embraces research, but also education, training and software development. In this area, Europe’s sluggishness contrasts with the dynamism of its competitors.

Source: Eurostat
European countries lodge, via the European Patent Office (EPO), just 36% of the high-technology patents registered in their territory, and only 9% and 2% of the patents registered at the American Patent Office (APO) and Japanese Patent Office (JPO) respectively. The bulk of the remaining 63% of high-tech patents at the EPO is by the United States (36%) and Japan (21%).

Table 3

<table>
<thead>
<tr>
<th>Number of researchers</th>
<th>1997</th>
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As a percentage of its active population, Europe has considerably fewer researchers than the USA or Japan.

Unlike in the United States or Japan, European research represents a jigsaw of 15 often very different national scientific and technological policies. Aside from a handful of intergovernmental agreements confined to specific areas like space, astronomy or particle physics, the limited support provided by the Union via its framework programmes for scientific and technological co-operation(1) represents a sort of ‘15 + 1’ research policy, coming on top of national efforts, but not dynamic enough to have a truly integrating effect.

In such conditions it is hard to assemble the ‘critical mass’ of human, technological and financial resources that major scientific advances demand today. It is difficult to respond with the requisite speed and flexibility to the new challenges posed by the constant advance of knowledge.

This ‘15 + 1’ structure adds up to compartmentalisation, dispersion and duplication of effort. National frontiers, still very real in many ways, block researcher mobility. The difficulty of translating scientific progress into widely marketable products and processes is reducing the profitability of research and is keeping venture capital away.

Common research market – Europe still largely lacks a proper market for knowledge capital and technological development. Developing such a market and getting it to function call for the definition of a genuine European research policy.

(1) These represent around 5% of total European public research effort.
Towards greater co-operation and openness

With often substantial resources at their disposal, national research programmes are undertaken to a large extent independently of one another. This dispersion effect is definitely a key factor in the present under-performance of Europe’s scientific and technological potential compared with the world’s other research centres, and is preventing Europe from fully exploiting the Union’s human and material resources. The longer-term objective is therefore to achieve greater co-operation between Member States’ research strategies and a mutual opening up of programmes.

The European Research Area is the outcome of a long process, originally plotted out by researchers many years ago. Indeed, even before the Union came into being, scientists were creating a dynamic community co-operating in joint cross-border projects and active knowledge-pooling networks.

Over the past two decades, this tradition of co-operation has received a massive boost from European treaties which have progressively incorporated common science and technology policy objectives.

Actively encouraging cross-border co-operation since 1984, the Commission has launched a succession of multi-annual research and technological development framework programmes. Even if the budgets look small against the combined expenditure of all Member States, the Union has contributed in this way to developing co-operation links in concrete, targeted projects in the key fields of medical, environmental, industrial and socio-economic research. Major support has also been given to researcher mobility, to SME participation in projects and to international scientific co-operation.

A huge need for integration

Despite this achievement, does a specific European research policy really exist? Not in the full sense of the term. Boosting science and technology’s part in the advancement of European research and technology calls today for a more ambitious approach and greater co-operation.

The basic idea underpinning the ERA is that the issues and challenges of the future cannot be met without much greater integration of Europe’s research efforts and capacities. The objective is to move into a new stage by introducing a coherent and concerted approach at Union level from which genuine joint strategies can be developed. Without this political will, Europe is condemned to increasing marginalisation in a global world economy. With the ERA, on the other hand, Europe gives itself the resources with which to fully exploit its exceptional potential and to become – in the words of the Lisbon European Summit of March 2000 – ‘the world’s most competitive and dynamic economy’.

The European Research Area implements the European Union’s declared ambition of achieving a genuine common research policy. This includes the indispensable and long-awaited integration of Member States’ scientific and technological capacities.

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Concerted effort

For the past two years, ERA has been at the heart of a concerted effort which culminated in the definition of the sixth framework programme (2002-2006).

Priority areas – In a concern for efficiency, and to avoid dispersion and duplication of effort, support from the Union will concentrate on seven priority areas (see box right). These are all research fields in which the Union’s intervention can provide genuine European added value (encouraging, among other things, a multi-disciplined, complementary approach to research). The aim is to promote integrated, cross-border projects which benefit from shared resources and ‘critical mass’.

These fields are not only important for the European economy’s competitiveness, they are also central to the attention that is beginning to be paid to the way science and society relate. They correspond to the expectations that Europeans have of scientific and technological development.

What European added value?

The fundamental principle of ‘European added value’ is pretty much synonymous with that of subsidiarity. This states that, in all fields, action undertaken by the Union is intended to complement that undertaken by Member States. In the field of research, this principle can apply in several cases:

> where the ‘critical mass’ of a particular research project, in terms of financial and human resources, exceeds the means of a single country;
> where co-operation is economically meaningful (scale economies) and offers positive effects in terms of stimulating private research;
> where complementary national skills can be combined, in particular in interdisciplinary situations;
> where joint research is of interest given the cross-border nature of the problems involved (environment, epidemiology, etc.);
> where the research links in with the Union’s priorities and implementation of its policies.

Seven research priorities for Europe

> genomics and biotechnology for health;
> Information Society Technologies;
> nanotechnologies, intelligent materials and new production processes;
> aeronautics and space;
> food safety and health risks;
> sustainable development;
> citizens and governance in the European knowledge-based society.
Raising visibility

The ‘mapping of excellence’ in Europe is an ERA initiative that aims to identify and define the best centres of scientific expertise in the EU and also in candidate countries. The first ‘maps’, which are already in the pipeline, will relate to themes that are emerging in areas of particularly rapid progress, such as life sciences, nanotechnologies and socio-economic research. The objective is to make European centres of excellence visible to scientists, industrialists, investors and political decision-makers, something that is lacking today.

Benchmarking skills

Europe has rich and diverse science and technology cultures. In each country, and at times in each region, the public authorities and scientific communities have developed special strategies for training researchers, promoting investment in key areas, and promoting the conversion of research results into innovations. At ERA level, a ‘benchmarking’ of the performances of the various research systems – in other words, a comparison of the best existing practices – was published for the first time in 2001. This approach represents a key tool for progress and rapprochement. The idea is not to establish a ranking of the ‘best and the winners’, but rather an ongoing process aimed at quantifying and analysing, in an open fashion, the results of different science policy approaches and disseminating those that prove successful. Example: benchmarking the growth in the number of researchers in Member States provides a significant indicator of the effectiveness of the effort and money devoted to training and recruiting researchers.

Federating excellence

Sometimes Europe comes across as too modest. When, in fact, it has world-class centres of excellence in most fields of science. But there are not enough inter-disciplinary synergies. Also many of these centres fail to adequately publicise their expertise beyond national borders, in particular towards business enterprises that could benefit from it.

Mapping and networking

Identifying and then mapping (see box) and networking expertise, in the defined priority areas, is a major ERA objective.

The creation of ‘networks of excellence’, which can work together on ‘joint activity programmes’ with the help of the Union, is one of the new tools developed by the sixth framework programme in order to stimulate sustainable integration of the research capacities of Europe’s regions. With the help of new communication technologies and interactive tools, genuine ‘platforms of virtual excellence’ for advancing European research are right now on the drawing board.
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Strengthening scientific tools

In many areas, scientific research calls for complex infrastructures involving huge investments and heavy operating costs. A joint strategy for developing a large number of such infrastructures – pooling their use and operating costs – is a priority for strengthening the ERA.

Europe already has major shared infrastructures, which are managed on an intergovernmental basis: CERN (particle physics), ESO (astronomy), the European Molecular Biology Laboratory (EMBL) and the European Synchrotron at Grenoble (ESRF). But many national scientific installations also exist, and the EU supports access by European researchers to them.

New approach – The ERA will make it possible to take a further step forward in pooling efforts that will give Europe the infrastructures which its scientists need. A Europe-wide evaluation is currently under way to promote the optimal use of existing equipment and to identify new needs. In future, support from the Union will also be available for part-financing certain investments and applications, with a view to achieving maximum coherence and complementarity.

The notion of infrastructure is not limited to the traditional concept of large scientific machinery: it also embraces ‘intangibles’ in the form of a growing number of knowledge centres, the capacity of which need to be permanently adapted to the rapid development of information technologies. One topical example of access to these cognitive infrastructures is the implementation of the GRID, a new very-high-speed network that has been developed in response to the growing need to exchange very large amounts of scientific data between European research centres.

The JRC – a European reference platform

Science and technology cannot be shared in Europe without conventions of shared scientific references. These conventions, which are vital to cooperation between researchers, also ensure that European decision-makers, who have increasingly to choose between political options involving complex scientific questions – in particular in terms of citizen safety – do so with the best possible information at hand.

Producing and validating these references is a primary mission of the Joint Research Centre (JRC) – the scientific institution that has been serving the European Commission since the signing of the Treaty of Rome. In the context of the ERA, the JRC is building networks of national research organisations in response to the vital need to bring together and share knowledge and expertise relevant to Union policies.
Supporting innovation in SMEs

Europe’s million SMEs play a vital and dynamic role in the process of innovation within the European Research Area. Many indicators, however, are showing that their research investments, their ability to participate in trans-European networks and the rate of creation of high-tech companies by researchers are insufficient when compared, for example, with American SMEs. The Union is paying – and will continue to pay – particular attention to their participation in ERA.

Collective and co-operative research – The Union is well placed to support research carried out collectively by national or regional centres of excellence on behalf of industrial associations, both European and national, on subjects that are of interest to large numbers of SMEs. So-called ‘co-operative’ research actions, extensive experience of which has already been gathered during earlier framework programmes, can provide a response to the scientific and technological needs of groups of SMEs from various countries.

Unblocking access to venture capital – In Europe, a lack of access to venture capital funds often means that enterprises do not grow out of advances in research. The European Investment Bank is therefore making available larger volumes of financing, within the ERA framework, to encourage investment in science- and technology-oriented companies. Other activities include introducing tax systems that are favourable to start-ups, facilitating the development of incubator structures and regional technology parks and in 2002 the eagerly awaited unblocking of an agreement between Member States on a single, simple and inexpensive Community patent.
Maximising human capital

First and foremost, the ERA is based on exploiting the know-how of men and women.

Mobility – Mobility of scientists is a prerequisite for quality research. Mobility enables scientists to complete their training, to constantly develop their skills, and to pursue their career paths in the best possible environment. Mobility raises the general level of European research through the transfer of expertise and the creation of networks – both formal and informal – for scientists.

However, academic, administrative and social obstacles remain that prevent complete freedom of movement. Making improvements to host facilities will reduce the difficulties faced by researchers working abroad.

Equal opportunity – These difficulties are often acutely felt by female researchers – hardly surprising in a world where equal opportunity is still far from a reality. While representing 50% of university graduates – and more in certain disciplines – women are currently under-represented in scientific careers. Over 90% of senior university teaching posts are held by men in countries as egalitarian as those of Northern Europe. This situation represents both a flagrant injustice and a deplorable waste of grey matter. Much remains to be done in terms of orientation of studies and changing mentalities before women can fully deploy their skills and talent for the benefit of science and research.

Young people – Another loss of potential talent comes from young people’s lack of interest in science. In Germany, the number of physics students has halved since 1991. In France, the number of students studying scientific disciplines fell from 150,000 in 1995 to 126,000 in 1999. Science vocations need people, and the teaching body is growing older. At the same time, Europe faces a growing deficit of qualified computer specialists. Europe needs to reassess the way it teaches science to children from the earliest age, and to give greater importance to science in our societies, placing the accent on its dissemination (media, museums and science centres, etc.).
Expanding

The ERA is not limited to Union countries. For several years now, Community research programmes have been opened up to central and eastern European countries. Europe is already benefiting today from these countries’ high-quality science and technology traditions, even though enlargement has not yet taken place. The ERA is also enabling scientists from these countries to update and improve their skills and, in return, these links are giving the Union new impetus. In practice, the simplification and harmonisation of entry formalities will mark an important concrete step in the direction of ‘brain hosting’.

A significant opening up to the world

The creation of the ERA must increase the importance, influence and attractiveness of European science and technology at international level. This strengthening of its global position will be achieved by pursuing a dual strategy aimed at:

> increased participation in international scientific cooperation, especially research on vital global issues such as health or combating poverty, major space or energy projects, etc.
> making European science a centre of attraction for researchers worldwide as it traditionally was in the past.

Science and society – a vital alliance

Health, food, safety, environment, protection of privacy… Increasingly, in areas that crucially impact our daily lives, decisions by policymakers and managers are based on input from the scientific community. How does one assess, select, compare this input unless starting from a common language? How can this decision-making be integrated into democratic debate?

Science and technology are increasingly influencing the way society operates. This development – directed theoretically towards improving the quality of life, but also increasing its complexity – has produced, however, a mixed bag of misinformation, expectations and concerns within European public opinion. These contrasting attitudes in any event point to the very real problem of transparency – and hence of the information for and involvement of citizens – regarding the scientific and technological issues of our times.

Convinced of the political importance of restoring a healthy dialogue between science and society, the Union’s leaders have mandated the Commission to include this priority within the European Research Area. In December 2001, therefore, the Commission put forward a concrete action plan for meeting this challenge. This plan is directed in particular at:

> promoting the scientific education and culture of European citizens, in particular by promoting dialogue and the interface role of the media and by encouraging new pedagogical approaches in science teaching;
> strengthening citizen participation in the debates raised by scientific advances;
> greater attention to the ethical discussion that needs to be at the heart of scientific strategies, as well as a renewed approach to “risk management” and to the essential role of managers in decision-making;
> a growing involvement of women, who are not sufficiently represented in scientific development.

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As work proceeded throughout 2001 on preparing the Union’s sixth framework programme, major consultations took place between the Commission, the Council of Ministers and the European Parliament on adapting this essential Community policy tool to the requirements of ERA. While continuing certain traditional actions from earlier framework programmes (in particular those aimed at encouraging SME participation), this new programme, with a budget of €17.5 billion, is directed at three main areas of action: integrating European research, structuring the ERA and strengthening its foundations.

New ERA instruments

Union support for research activities – this, the largest part, will receive a budget appropriation of almost €13 billion – will concentrate first and foremost on the seven priority areas of research that have been identified (see page 10). In particular, three new instruments for allocating Community aid have been introduced into the sixth framework programme in order to help integrate European research:

> support for integrated projects, involving a critical mass of scientific and industrial partners, and directed toward significant products, processes or service applications;

> participation by the Union in specific science and technology co-operation programmes set up jointly by certain governments or national research organisations.

The sixth framework programme also contains various action lines, either existing lines which have been strengthened in terms of support for researcher training and mobility, and new lines for development aid and for creating European scientific and technological infrastructures. A large part of the programme will also be devoted to identifying future Union science and technology policy priorities. Finally, significant resources will be earmarked for coordination and the reciprocal opening up of national programmes.

(1) Pursuant to Article 169 of the Treaty of the European Union.
I. Integrating research & innovation

II. Structuring the ERA
- Benchmarking
- Open coordination
- Reference cartography

Emerging priorities
- Greater competitiveness
- Better public policies
- Quality of life

Evaluation and benchmarking
- Research results and innovations
- New products, new ideas

Support for SMEs
- Entreprises, universities, and research centres

Making research in Europe more attractive
- A Europe that is open to the world

III. Strengthening the foundations of the ERA
- Strengthening the cohesion of the EEA:
  - mobility
  - infrastructures
  - innovation
  - science and society
  - networking between national programmes

Candidate and associated countries
To find out more about ERA

The European Commission’s Internet site on Europa Research Page – The site of the EC’s Directorate-General for Research – which is accessible in English, French and German – permanently and exhaustively covers ERA developments, as well as the preparation, adoption and implementation of the sixth framework programme 2002-2006.

http://europa.eu.int/comm/research/

To find out more about European research

A magazine, RDT info, is published in English, French and German. As well as presenting the main lines of the Union’s science and technology policy, it publishes reports on advances in European research and discusses scientific questions for a non-specialist audience. It is available free of charge and by subscription from the Information and Communication Unit of DG Research of the European Commission.

Fax: +32 2 295 8220

E-mail: research@cec.eu.int

RDT info is also available on Internet:

http://europa.eu.int/comm/research/rtdinfo_en.html
In a rapidly changing world, in which research is proving to be an increasingly vital element, Europe possesses considerable advantages. But to exploit these to the full, it needs to overcome the fragmentation of its Member States’ science and technology policies. The European Research Area (ERA) is intended to co-ordinate these national research policies in the direction of shared objectives, expertise and resources.

Once ERA has been achieved, the concept of European research will be as familiar as those of the single market or the single currency are today.