Innovation & Technology Transfer

3/98

ISSN 1013-6452

Biotechnology Is the Tide Turning?

Plus:

- Measuring Europe's R&D
- Improving access to the JRC's expertise and facilities
- Research information systems
- Weather monitoring for agriculture
- High-performance computing

and more

PUBLISHED BY THE EUROPEAN COMMISSION

INNOVATION PROGRAMME • MAY 1998

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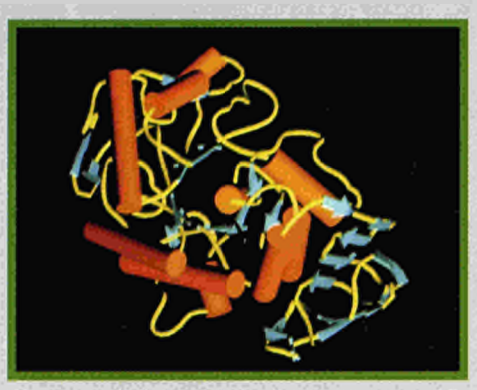

Commercialising biotechnology, page 16.

Cover: European Service Network.

SMEs and New Technology

SMEs account for over 99.8% of all European businesses. They are a key source of future European employment and prosperity.

In terms of how many times it participates in EU-funded research, the SME sector is now an equal partner with large companies, universities and research centres. In the Innovation Programme itself, 53% of all projects have been led by an SME.

In the field of biotechnology, SMEs' most important role may not be as a direct source of employment and growth, but as the source of the new technologies which are essential to the continuing competitiveness of Europe's more mature industries.

But in biotechnology, as in other fields, young high-tech companies find it too hard to attract the financial backing they need. The I-TEC initiative, and the newly-established Biotechnology and Finance Forum, represent attempts to stimulate improved support from venture capital for the commercial exploitation of European inventions. The JRC's new technology transfer initiative should also improve SMEs' access to very advanced research facilities.

Of course, not all SMEs are technology suppliers. A second important group contains the smaller enterprises which must exploit, develop and spread the use of new technologies, if Europe is to benefit fully from its world-class research. The ESPRIT programme's HPCN initiative offers an excellent example of the way in which the take-up of new technologies by smaller firms can be successfully promoted.

Edith Cresson

INNOVATION & TECHNOLOGY TRANSFER

The European Commission's Innovation Programme is under the responsibility of Edith Cresson, Member of the Commission responsible for Research, Innovation, Education, Training and Youth.

Innovation & Technology Transfer is published six times a year in English, French and German by the Innovation Programme. The Programme aims to strengthen Europe's innovation infrastructure and foster the application of research results to industry.

PUBLISHED BY:
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EUROPEAN SCIENCE AND TECHNOLOGY

Indicate Before Overtaking

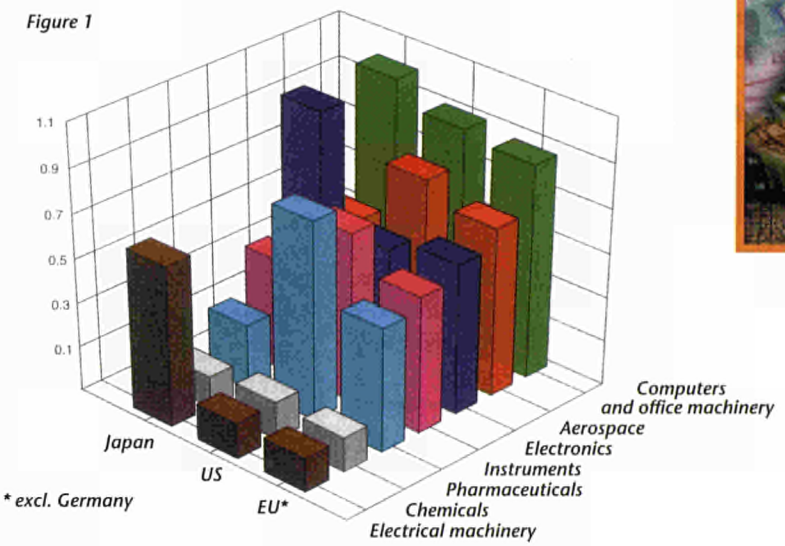
How good is Europe's scientific and technological performance? How does it compare with the performance of other regions? And how should public funding be allocated in order to make technology work for the economy, for jobs, and for society as a whole?

To help policy-makers answer such questions, the European Commission has produced an updated and enhanced edition of its European Report on Science and Technology Indicators (1).

Commissioner Edith Cresson, who requested the report, stresses that its focus is on the priorities of the EU's next research framework programme (2) - the economic impacts of research and innovation, European and global industrial partnerships, and employment, training and the development of human resources.

Overall, its findings are both encouraging and worrying, she says. Europe remains the world's second scientific power, and the growth of a European community of companies and institutes engaged in transnational collaborative research has strengthened its position. On the other hand, Europe is falling behind the United States and other competitor regions, both in the resources invested in science and technology, and in the efficiency with which these are converted into success in the marketplace.

Figure 1



High-tech products as a percentage of total exports in technology-intensive sectors in Japan, the US and the EU (excluding Germany)

source: DG XII-AS4/Eurostat/OECD

Could Do Better

Part I of the report analyses the development of EU science and technology relative to global trends, covering non-EU countries in Europe and the emerging Asian economies as well as the US and Japan.

- The global economy will increasingly be divided along lines determined by access to scientific and technological knowledge and the ability to exploit this knowledge.
- Both as a percentage of GDP and per capita, the EU invests less in S&T than the US or Japan.
- Job creation - an area in which EU performance relative to that of the US and Japan is especially weak - is stronger in countries where information and communication technologies absorb a higher proportion of investment.
- Europe's science and engineering graduation rates are significantly lower than those of the Developed Asian Economies (DAE) or of the US and Canada, and it has a smaller percentage of research scientists in its working population, especially in the private sector.
- EU patent activity remains concentrated in established fields - aerospace, chemicals, pharmaceuticals and car manufacturing. Its relative weakness in computers, electronics and instruments worsened between 1993 and 1995.
- High-tech products constitute 12% of total EU exports, compared with 24% in the US and 25% in Japan. Only two Member States - Sweden and the UK - achieved an average trade surplus in high-tech products in the years 1991-95.

Part II examines the relationships between investment, innovation capacity and economic performance in countries, industrial sectors and companies, and analyses innovation and technological competitiveness in multinational companies, in new technology based firms (NTBFs), and in the SME sector.

- Of all research-intensive sectors, EU R&D intensity (R&D/sales) is higher than that of both the US and Japan in only one - electronics (see Figure 2).
- Europe's failure to convert high-quality research into marketable technologies and products - the 'European Paradox' - persists, but not in all countries and industries. Perfor-

mance is strongest in Denmark, Finland and the Netherlands, and in the automotive and chemicals sectors.

■ Despite this, EU high-tech exports have grown rapidly since 1990, especially in computers and electronics, though growth is heavily concentrated in the Netherlands and the UK.

Part III looks at national research and innovation policies and systems in the EU Member States, and assesses progress towards cohesion. Europe's non-EU countries are also considered, and the Mediterranean countries are the subject of a special Dossier.

Solid Framework

Part IV analyses EU research and other European-level public sector schemes. It also looks at technological R&D co-operation between companies, and at mobility and co-operation between researchers.

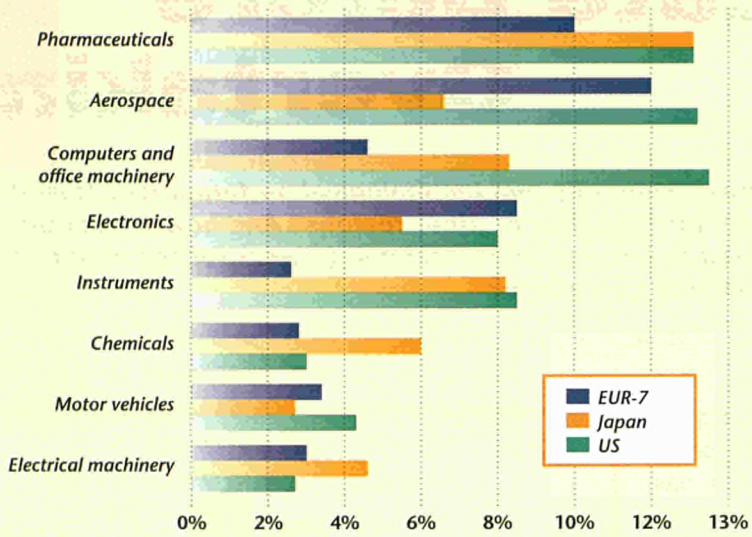
■ The EU research Framework Programmes now constitute a key source of R&D funding. Including the Structural Funds, the Commission's share of all public investment in EU civil R&D has more than doubled from 4.6% in 1987-90 to 9.7% in 1995-96.

■ In the past 10 years, participation in EU shared-cost R&D has become progressively more equal - between large firms and SMEs, between industry and academic researchers, and between Member States (see map).

■ Transnational R&D co-operation between companies, universities and research centres is now a fundamental and dynamic feature of the EU. The Framework Programmes have been a decisive factor in its development, and are leading to improved co-ordination of national and Community R&D policies.

■ Technology-based alliances - and inter-sectoral ones in particular - are increasingly important. Growth in the formation of such alliances in the EU is keeping pace with that in the DAE and NAFTA, although from a significantly lower base than the latter.

Figure 2 **1994 R&D spending as a percentage of operating revenues in eight manufacturing sectors.**

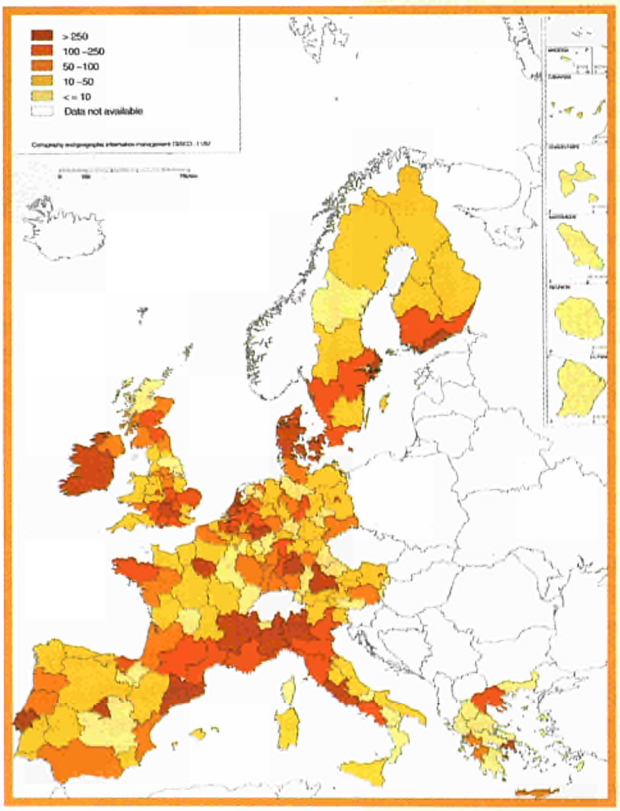


Electronics is the only research-intensive sector in which Europe's R&D is higher (as a proportion of sales revenues) than that of both the US and Japan.

Fits All Pockets

The depth of the analysis applied to the statistical data reflects feedback from the European research community on the First European Report on S&T Indicators, published in 1994. But at nearly 750 pages, plus 200 pages of annexes, the 1997 Report is much more comprehensive.

The new edition does include a number of further innovations which will make it much more accessible. The report itself includes an executive summary, and the Commission is also producing a pocket-sized compendium of 'Key Figures' and an interactive CD-ROM. □



Regional distribution of participations in shared-cost research under the Fourth Framework Programme.

(1) Second European Report on S&T Indicators 1997 (EUR 17639) - 2 volumes plus CD-ROM - price 60 ECU, only from EUR-OP Sales Agents (see Note, page 24).
(2) The Fifth Framework Programme, now in preparation (see Notebook, page 6).

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▶ JOINT RESEARCH CENTRE

Catalytic Conversion

The JRC is the European Commission's own research centre. Now it is to launch a series of schemes designed to help industry benefit from its facilities and expertise, to stimulate EU-wide collaborative research, and to facilitate market exploitation of the technologies which it develops.

The European Technology Transfer Initiative, adopted by the Commission on 7 January, is the result of a review of the JRC's technology transfer potential carried out during 1997 in consultation with industry.

The study was originally intended to assess the feasibility of establishing a European technology park on the JRC's Ispra site in Italy. More generally, it sought to identify ways to make better use of the JRC's human and technical capacity, and to forge stronger links with European industry, especially SMEs.

The creation of a conventional technology park was not, in the end, found to be the most effective way of achieving these objectives. But adding value to the JRC's role as the Commission's research centre, through greater practical engagement with Europe's industrial and academic research community, was considered not only feasible but indispensable.

More Accessible

Instead of a technology park, the study recommended a package of 'flexible access mechanisms', designed to enhance the JRC's contribution to technology transfer and collaborative research, very much in line with the Commission's Innovation Action Plan (1).

■ First, the JRC will develop a scheme to give outside companies **supported or collaborative access** to its many large and sophisticated facilities and laboratories.

■ The establishment of a **technology transfer fund** was recommended, as a source of seed capital for the exploitation of JRC technologies by smaller companies, and as a way of giving outside investors opportunities to participate in such projects.

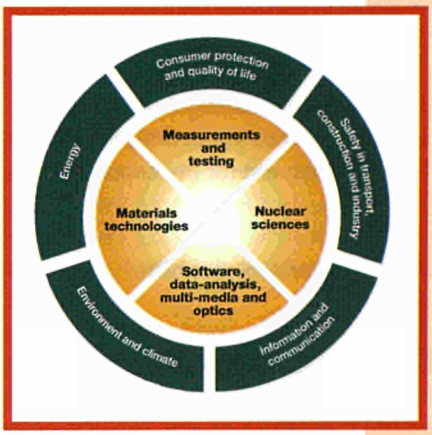
■ The JRC will create a **virtual technology park**, developing and demonstrating an innovative 'remote research' methodology, employing advanced telecommunications to stimulate collaboration and the transfer of technologies regardless of physical distance.

■ It will explore various **'business incubator'** strategies, offering its infrastructure and support services both as an environment for start-up companies and as a temporary base for research teams.

■ Lastly, it will undertake a programme of **training and education** comprising secondment from industry, targeted training for industry in the JRC's key areas of competence, and scientific training, including modules on entrepreneurship and technology transfer.

Each of these activities will be the subject of a detailed operational study or a pilot phase before it is implemented in full, but work in all five areas will start in 1998.

Together, they promise to bring the JRC's staff, facilities and technologies into closer contact with industrial and academic researchers, harnessing these unique resources to the cause of European competitiveness. □



The JRC's core competences - addressing five application areas and based on four underlying generic technologies.

The JRC's European Solar Test Installation - a centre of excellence in the field of solar energy - has always been at the service of European industry. New technology transfer plans are already very advanced.

(1) See Special Edition of December 1996

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Fifth Framework Programme

In February, EU research ministers agreed to propose a budget of ECU 14 billion for the Fifth Research Framework Programme (5FP), to run from 1998 to 2002. This is well short of the ECU 16.3 billion proposed by the European Commission and ECU 16.7 billion proposed by the European Parliament, and is less in real terms than the budget of the current Fourth Framework Programme.

Edith Cresson, Member of the Commission responsible for research and innovation, warned that this low figure for the budget sends a negative signal to European industry and jeopardises certain research activities.

Under the co-decision procedure involving the Council and the Parliament which is being used to adopt 5FP, the Council's proposal is sent to the Parliament for the second reading stage.

http://www.cordis.lu/fifth/src/ whatsnew.htm

European Technology Facility

The European Investment Fund has begun to invest the recently-created facility of 125 MECU which it is managing for the European Investment Bank (EIB). It has negotiated minority stakes in a number of venture capital funds specialising in early-stage and high technology projects.

The EIF aims to stimulate greater venture capital activity outside the UK and the Netherlands, the only Member States with mature markets. Its choice of funds is driven by the goal of increasing venture capital investment in high-tech start-ups and other innovative SMEs. Companies with fewer than 250 employees are especially targeted.

The European Investment Fund has strong links with the Commission's Innovation Financing scheme, I-TEC (see page 15). Funds in which the EIF invests will be eligible to apply for participation in I-TEC.

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Financial Support for SMEs

The Council of Ministers was expected to reach a decision on 21 April on the new Growth and Employment initiative, adopted by the Commission with a budget of 420 MECU for the three years 1998-2000. It comprises three linked programmes:

- A risk capital scheme — ETF Start-Up, will reinforce the existing ETF (see above) by targeting smaller, mono-technology and institute-specific funds, where risks are higher.
- Support for cross-border collaboration - Joint European Venture (JEV), which will be managed on behalf of the Commission by banks and other financial institutions in Member States, will make financial contributions to the establishment of transnational joint ventures by SMEs.
- A loan guarantee scheme for small and newly established firms — SME Guarantee Facility, to be managed by the EIF, will share risk with national and mutual guarantee schemes as a way of improving access to loan finance for newly established firms and those with fewer than 100 employees.

Rules for Participation in 5FP

The proposal for a single set of rules governing participation in all the specific programmes of the Fifth Framework Programme, adopted by the Commission in December, includes some new measures of special relevance in the context of innovation and technology transfer:

- adjustment of the rules on dissemination and exploitation depending on the distance from market of the project, which is normally reflected in the rate of the EU's financial contribution
- encouragement for the exploitation of results through the option to make exclusive agreements, under certain conditions, especially when projects are close to market
- a requirement for the dissemination of results when the commitment to exploit them is not successfully fulfilled
- strengthening of the role of the 'technological implementation plan' as a detailed and structured policy instrument for monitoring research results

Creating Innovation Environments

The Innovation Programme has announced the results of the calls for proposals of September 1997 for projects under the European Networks and Services (ENS) and Regional Innovation action lines.

The ENS call resulted in 74 proposals, of which 17 have been selected, with a further 3 on the reserve list. In total, 100 partners are involved. Activities will include workshops, exchanges of information via appropriate communication tools, and the exchange and training of personnel.

The Regional Innovation call, undertaken in collaboration with DG XVI (Regional Policy), covered both regional innovation and technology transfer strategies and infrastructures (RITTS), and a new action line called Trans Regional Innovation Projects, designed to support practical co-operation between European regions in the field of innovation.

From the 101 proposals received, 42 were selected, with estimated EU funding of 11.2 MECU, and a further seven were placed on a reserve list.

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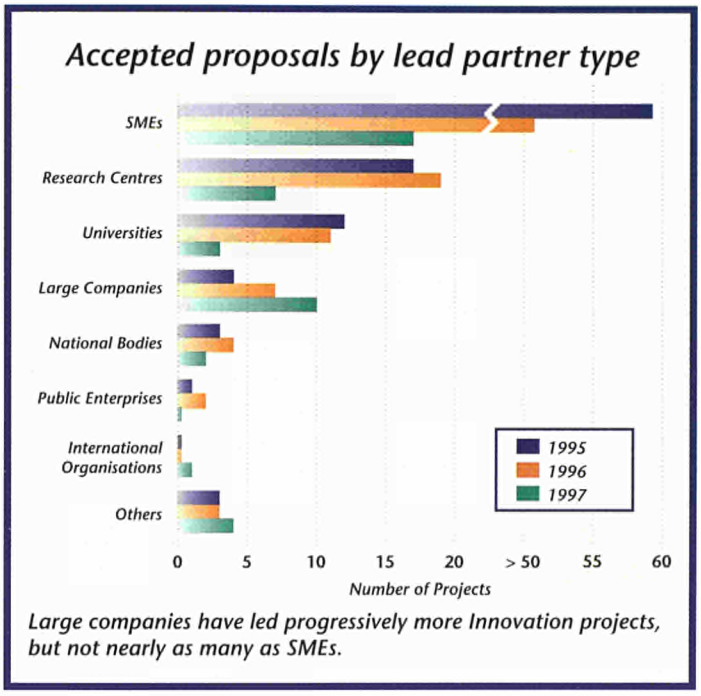
► INNOVATION PROJECTS

A European Technology Transfer Community

The results of the third and final call for technology validation and technology transfer projects were published mid-February. This provides an opportunity to review participation in such projects under the Fourth Framework Programme as a whole.



Large companies have led progressively more Innovation projects, but not nearly as many as SMEs.

Funding has been approved for 44 projects selected from proposals submitted in response to the call of June 1997. With the Fourth Framework Programme nearing its end, a more limited budget was available than for the two earlier calls. Despite this, the response was strong, with 245 applications received.

The majority of the selected projects will make a contribution to improving the interface between research and innovation, and to promoting an 'innovation culture'.

As for previous calls, successful projects will be required to complete a short Definition Phase of up to five months. This will be used to develop clear financial plans and work programmes, and to demonstrate the technical and financial viability of the consortia. Subject to successful review, projects will then proceed to the main Implementation Phase.

Key Facts

- Industrial interest is particularly strong. 60% of the partners in the 245 consortia which submitted proposals under the third call are companies, and 43% are SMEs. 86% of consortia include an SME.
- In the projects selected for a definition phase, 57% of partners are companies, and 35% SMEs.
- The Innovation programme is clearly addressing a real need for academic-industrial technology transfer. There were 304 universities and research centres among the partners in the applicant consortia.
- Taking the three calls together, a total of 1,062 proposals have been received, of which 240 (23%) have been chosen to carry out a definition phase.
- To date, 68 of these projects (28%) have proceeded to the implementation phase, although this number may nearly double by the end of 1998.
- Of the projects selected under all three calls, the majority (53%) were led by SMEs. Large companies have led progressively more projects in each successive call (see figure).
- The proportion of all selected projects led by SMEs has fallen steadily from its high point of 60% in the first call, but remains larger than that of any other type under the third call, at 40%.
- Taking the three calls together, the greatest number of projects are co-ordinated in Germany, the UK, France, Spain and Italy. Not surprisingly, the same five countries also submitted the largest number of proposals. □

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The Innovation Programme In Brief

The Innovation Programme implements the Third of the four Activities of the Fourth Framework Programme (1994-1998). Run by DG XIII/D, the Innovation Programme encourages the exchange of research information and the absorption of new technologies by European companies.

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Innovation Home Page
Http://www.cordis.lu/innovation/home.html

► RESEARCH INFORMATION

CRIS 98: A Hard Nut to Crack

Almost 200 delegates from across Europe and as far afield as Taiwan, Israel and the United States met in Luxembourg last March for CRIS 98, the fourth in a series of workshop conferences on Current Research Information Systems in Europe.

More background information can be found in the CRIS 98 Cybercafé at http://www.cordis.lu/cris98/. The conference proceedings will be built around the Cybercafé, and should be published on CD-ROM later this year.

> *"The CRIS Conference is a worthwhile investment for the future"*
>
> *David Moore of the UK's Office of Science and Technology, opening the conference*

"Research information systems are the nutcrackers that offer rapid and easy access to a wealth of research and technical information of potentially great benefit to European industry", noted Mario Bellardinelli, Head of the European Commission's R&D Information Service (CORDIS), during the conference's opening address.

The three days of CRIS 98 saw a consensus form on a range of strategic priorities: harmonisation and standardisation, user-specificity, user-friendliness, and the need for good practice. Not surprisingly, divergent opinions emerged as to how - and how quickly - these priorities should be addressed.

Points of Departure

Keynote speaker Dominique Foray, currently research director at France's Centre National de la Recherche Scientifique and a professor at the University of Paris-Dauphine, set the scene by calling for efficient, open and relevant knowledge-based systems for generating, transforming, transmitting and storing information. Such systems were, he argued, a key determinant of economic performance and, as such, should be the priority goal of technology and innovation policy if optimal benefits are to be derived from cost-intensive research.

Fellow keynote speaker Professor Jürgen Krause, chairman inter alia of the German Academic Association for Information Science and scientific director of the Bonn-based Informationszentrum Sozialwissenschaften (Social Science Information Centre), saw four lines of potential development:

- Innovative research information systems featuring extensive texts/facts integration to enable users looking for text documents on a specific topic to retrieve all data available in different databases;
- Systems which heuristically (i.e., by trial and error) integrate intellectual indexing and automatic probabilistic indexing and retrieval, and which enable multilingual retrieval - queries in one language yield relevant documents in other languages;
- Visualisation systems to enhance user interface design;
- Retrieval systems able to cope with many different data sources.

Enter the Internet

"As a result of evolving information technology, the accessibility of research information systems has changed substantially", said Lieve Van Woensel of the European Commission's Innovation Programme and coordinator of CRIS 98. "Only a decade ago, research information sources were consulted almost exclusively by specialist information providers. Today, these user-friendly and easily-accessible information systems are consulted by a vast community of both specialist and non-specialist end-users. As a result, it is essential to reappraise and accommodate the resultant changes in end-user needs."

That access to technology-oriented information is no longer restricted to a privileged few can be attributed to a large degree to the exponential growth of the Internet and the fact that dissemination and retrieval of information via websites and dedicated search engines is low-cost and - ostensibly - simple.

Van Woensel and other speakers stressed, however, that the revolution in technology transfer implicit in the advent of the Information Super-

highway also implies new skills: it should not be assumed that the ability to focus search criteria and identify appropriate search platforms are acquired virtually overnight. On the other hand, systems and programmes described and/or demonstrated during CRIS 98 were clear evidence of progress towards an improved pan-European research information environment.

CRIS or Crisis?

Users of research information are increasingly confronted at both the national and international level with various kinds of on- and off-line databases which differ substantially. "Even more frustrating is that many users do not have at their disposal a complete listing of the international research information systems currently available", noted Renze Brandsha of the Netherlands Institute for Scientific Information, who recalled a 1993 survey by the Netherlands Agency for Research Information which revealed the existence of no fewer than 92 research information systems worldwide.

That was a nagging problem, agreed keynote speaker Keith Jeffery, head of information systems engineering in the computation and information department of the Oxford-based Rutherford Appleton Laboratory (United Kingdom). But there are other potentially more serious problems that need immediate attention. "CRIS are not much used when compared with other information sources ... It would be reasonable to expect everyone in the R&D community in the broadest sense to access CRIS perhaps once or twice per week. At the moment we are not achieving such a target by several orders of magnitude. What is wrong?"

Part of the explanation, he submitted, was that CRIS suppliers - "with one or two notable exceptions" - have not moved with the times, persisting in the view that they need only provide a library-type service. Far from it. "At both CRIS 93 in Amsterdam and CRIS 95 in Milan, I argued for metadata-assisted, user-friendly interfaces and hypermedia result presentation ... If metadata describing the information available in an information provider system is not visible on the web, the information itself is invisible to the world. People do not have the time, energy or motivation to search out information from suppliers with arcane access procedures."

For Jeffery and others, metadata systems hold the key in that they enable intelligently-assisted querying, on-line help and intelligent interpretation of results. "Metadata helps in quality control and allows systems to exchange information or participate in global queries. Metadata can advertise information and is in every sense a gateway to CRIS. Metadata, in a word, is the future."

Questions for 2000

"So," Mario Bellardinelli asked the panel discussion at the end of the conference, "where do we go from here? Have we made progress?"

The response - from Jostein Hauge, secretary of the Euro-CRIS platform - was positive. Seven years ago the first CRIS Conference was an achievement simply by bringing people together from across Europe, he pointed out. Today there is increasing specialisation, and the focus has progressed to user needs.

User-orientation, it was agreed, is now a major objective. What do the different user groups - suppliers (researchers) on the one hand, users (SMEs) on the other - actually need? How important is multilinguality? How much - if anything - should the user have to pay? Can CRIS be used to help the general public understand science and technology - perhaps through pitching CRIS at journalists as well as companies?

By the time the next conference is held in the year 2000, some of these questions will hopefully be answered, and the worlds of national R&D will be more transparent across Europe. □

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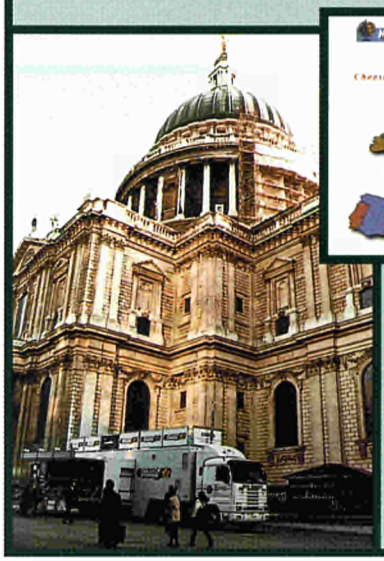
CORDIS: IMPROVED USER FRIENDLINESS

CORDIS, the Community R&D Information Service (http://www.cordis.lu/) is now even easier to use, offering access to R&D Partner, Project and Results searches via a clickable map.

A single mouse click on the map of Europe (inset) takes you to a second page, where search criteria can be completed by filling in a simple form and/or by selecting a particular region from a more detailed map of the selected country.



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The CORDIS service has just completed a highly successful roadshow tour of Luxembourg, the UK, Germany, France, Italy and Belgium. The exhibition vehicle's many visitors were able to try CORDIS for themselves via on-line facilities. A further European Tour is planned for the autumn.

Good Practice Makes Perfect

As the initiative to promote Innovation Management Techniques nears its end, SMEs and innovation management advisers are being offered opportunities to observe, discuss and absorb best practice.

The IMT projects were designed to introduce improved methods for the management of innovation to companies not already familiar with them, especially SMEs. Together, the projects were intended to raise the standards of the professional support available to SMEs in all EU Member States, by identifying and spreading best practice.

Industrial Design

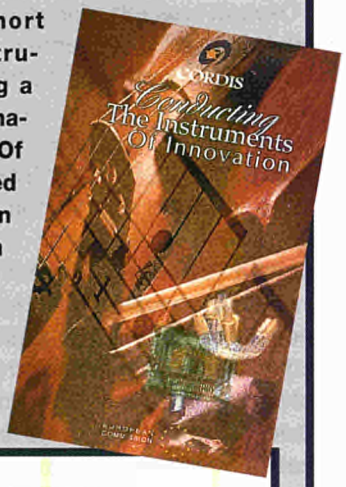
The European Design Innovation Tool (EDIT) is an IMT project which aims to improve design and innovation management in SMEs by applying a new methodology based on techniques, tools and best practices. The eight design promotion centres which form the project consortium are drawn from seven European countries and are led by the Spanish State Agency for Design and Innovation Development (DDI).

A conference, to present the project's work to design and innovation policy-makers, national design centres, Innovation Relay Centres and others involved in design associations and consultancies, will be held in Stockholm on 8 June.

Conference sessions will include:

- an introduction to the EDIT methodology
- discussion of the integration of industrial design into R&D projects
- a review of activities to strengthen competitiveness in the field of industrial design, including the co-ordination of support organisations in different European countries

CORDIS has released a short video, 'Conducting the Instruments of Innovation', offering a guided tour of the R&D information service's main features. Of interest to new and experienced users, the video is available in English and French. It will soon be possible to view a digitised version on-line on the CORDIS server.



A special viewing of the video during the Research Council meeting of 12 February in Brussels.

State of the IMT Art

Promotion and co-ordination of the Europe-wide delivery of IMTs is the aim of the ACCESS project. It has created a European network of IMT providers, produces a regular newsletter, and has organised a series of transnational conferences and workshops, as a forum for the exchange of experience from projects funded under the Innovation Programme's IMT action line.

The third and final ACCESS conference - to be held in Kensington, central London, on 19 and 20 October - will focus on the findings of IMT projects from around Europe. The event is aimed at organisations which promote the use of innovation management techniques by SMEs, and delegates will be encouraged to present and discuss their own experiences.

The conference will also include a session devoted to common features and the state of the art in innovation management, including presentations of the results of recent studies. □

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DEBATING TECHNOLOGICAL CHANGE

Setting the Scene for Science

Science and technology are transforming Europe. But the tomorrow which new technologies bring will meet Europe's needs only if - today - the process of change engages the active interest of ordinary people, as well as of scientists and politicians.

The Innovation Programme is helping to provide the tools needed to create a social environment in which technological change is well understood and actively managed by all the people whom it will directly affect. Through a series of Training and Dissemination Schemes, the programme is encouraging the development and use of mechanisms for consultation and debate about science and technology.

The FLEXIMODO method is empowering - and fun.

Creative Dialogue

The FLEXIMODO project builds on earlier work, which led to new methods for raising awareness and articulating demand about technological innovation in the context of the urban environment (European Awareness Scenario Workshops - EASW).

FLEXIMODO's focus is sustainable development, and it has extended the workshop approach to offer municipalities a flexible structure for discussions between citizens, politicians, business representatives and NGOs about the challenges and opportunities presented to their city or town by new technologies.

"These groups would normally have no opportunity to discuss such issues. The informal workshop setting makes real dialogue possible," says Yvonne van Delft of the International Institute for the Urban Environment (IIUE), the project's co-ordinator. "They may have very different expectations and fears about the impacts of technological change. But they have a shared interest in anticipating and influencing that change, and each has a valuable contribution to make to the debate."

Over two days, the workshop guides them through the identification of local problems, trends and possible future scenarios, vision-making, ideas generation and action planning.

In van Delft's view, the action planning is critical. "Workshops are unlikely to produce concrete results if they are treated as one-off events," she says. "People find them enjoyable and empowering, and that creative energy needs an outlet. An action plan offers a clear path for exploration and implementation of the ideas generated."

The workshops have worked particularly well where there is a firm commitment to follow-up.

Good Result

For each of three subjects - mobility, information and communication, and regeneration - FLEXIMODO offers four basic scenarios, which can be tailored to suit local circumstances. Forty towns and cities have already used the methodology in the framework of the EASW initiative. In 1996 a small town in Austria organised a workshop to consider the possible construction of a biomass plant. Just before she spoke to *Innovation & Technology Transfer*, van Delft had received a fax announcing that the plant had opened.

FLEXIMODO itself will run nine workshops. The first was held in Sesto San Giovanni, near Milan, in December 1997. Others will be run in Portugal, Denmark and Spain during 1998. Two workshop sites have yet to be chosen, and Ms van

From left, Peder Falk, Professor Lars Olson (head of the neurological department at Stockholm's Karolinska Institute) and Helge Skoog, in a scene from the Klara Soppteater's production Brainspotting.

Delft is keen to hear from any European municipality interested in organising such an event.

Science Live

The European Theatre of Science project (ETS) is developing another novel way of improving public understanding of science - by getting top scientists to appear live on stage.

The Klara Soppteater, part of the Stockholm City Theatre, has worked with the Swedish Council for the Planning and Co-ordination of Research for a decade. In 1988, its actors took part in the Council's annual Popular Science Week, performing sketches and improvisations between lectures. They went on to develop a full-length production - 'The Gene Scene', which deals with biotechnology.

In this and five subsequent productions, well-known scientists perform alongside the actors. Helge Skoog, the co-ordinator of the ETS project, calls it a cross between theatre and scientific lecture.

"As actors, we can ask the naïve questions which members of the audience might not dare to ask. ETS encourages scientists to climb down from the ivory tower and confront the concerns of ordinary people," he says. "It is about democracy. Biotechnology, for example, raises important social issues(1). People need to discuss its social and environmental impacts, so it is vital that they have some grasp of the underlying science."

On Tour

Not all scientists would be willing to appear on stage, but Skoog has found ones who are. "They love it," he says. "They see the value of explaining science to the public. And they have a surprising talent for stand-up comedy."

The six plays are in repertory at the Soppteater's daily lunchtime show. Covering the universe, the greenhouse effect, food and health, evolution and the human brain in addition to biotechnology, they are regularly sold out.

The other two ETS partners are also established companies. Spectrum Drama and Theatre Projects is the resident company of the London Science Museum, and specialises in science theatre for education. With a team of over 40 actors, it tours its groundbreaking work to museums and schools throughout the UK.

Amsterdam's Pandemonia Science Theatre has created over 50 productions since 1988. Supported by Stichting WeTeN, the Dutch Foundation for Public Understanding of Science, it has strong links with the Dutch business and science communities, and performs regularly in schools, museums and universities.

Each company has a different emphasis and approach, but all three are keen to spread the idea of science theatre. They are jointly developing best practice guidelines, supported by a manual and an on-line database of scripts and background materials, and are creating a European network to ensure on-going dissemination of their methods.

And they will tour Europe to promote their work. "We will invite actors, scientists, museum staff, teachers and science journalists to join us in a two-day science theatre workshop," says Skoog. "Our aim is to help them to get to know one another, and to share our enthusiasm for this new way of promoting science." □

(1) See this edition's Dossier, pages 16-21

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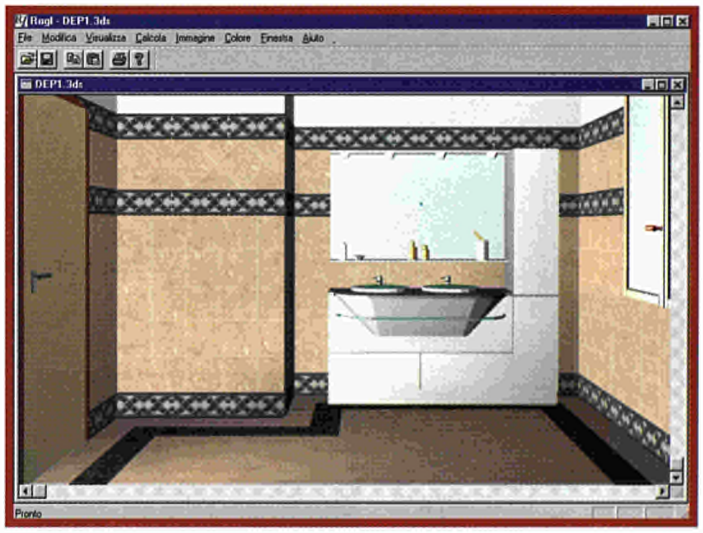
IRC CASE STUDY

Visualising the Impact of Ceramics

The Italian Innovation Relay Centre ENEA/IRENE has helped the ceramics industry by overseeing the development of an elegant multi-purpose software package that takes the trouble out of tiling.

Ceramic tiles make a perfect covering for bathroom and kitchen floors and walls. Many people choose patterned tiles, often with a complex design. The visual effect can be stunning, but selecting and arranging the tiles can be difficult and time-consuming. Enter a new computer system, which creates a 3-D simulation of the room, allowing the owner to visualise the effect of tiling with many different designs.

The *Decorazione E Ambientazione* (Design and Arrangement), or DEA, system is modular, and versions are available for all major computer systems. Tile manufacturers can use it to assemble a comprehensive electronic catalogue for their retailers, enabling customers to see a far greater number of designs. Marketing support software uses a two- or three-dimensional CAD (Computer-Aided Design) system to simulate the finished floor and wall arrangements in a scale model constructed using the customer's own measurements.



Beautiful bathrooms - DEA in action

Market Access

DEA was originally conceived by ENEA, the Italian national agency for research and innovation, which had worked on computer applications in the Italian textiles industry. It put together a large team to transfer similar technology to the ceramics sector, with the aim of encouraging local tile manufacturers to expand into European markets.

Assopiastrelle, the Italian tile manufacturers' association, was involved in both system specification and distribution to potential customers. ENEA also brought in the Italian graphic designers' association, CNA, the tile retailers association, Federcomated and the Emilia-Romagna regional development corporation, Ervet (Politiche per le imprese) SpA.

Ervet itself acted as an interface with local end-users, but it was soon clear that the technical expertise available locally would not be sufficient to meet demand, and that the project needed outside help. Andriana Zini of Ervet says that ENEA was critical in building the partnership. "It was able to bring in the Spanish computer firm EMC Consultores SA and Interaction, the Rhône-Alpes regional development technology agency. ENEA also played a vital role in securing EC funding and in drafting the partnership agreements."

The partners started by defining a standard for the electronic catalogues. ENEA, Ervet and Assopiastrelle then produced software which would enable any company to build and maintain its own catalogue. The system was evaluated by large tile manufacturers before smaller users in Italy, France, Spain, Portugal and Greece used early versions in a pilot scheme.

Promoting DEA

ENEA has promoted DEA to tile manufacturers and distributors, and has established a marketing network in Italy and abroad. Ervet has organised presentations at exhibitions in places as widespread as Bologna, Miami, Berlin and Valencia.

The DEA software is selling well throughout Europe, South Africa, Australia, South America and East Asia. Software and documentation are available in English, Spanish and German, and translations into French, Greek and Portuguese are in progress. ENEA has recently set up new marketing agreements to sell DEA in Japan, Singapore, Korea, China, and Scandinavia.

ENEA has also established an Internet site for DEA. It contains details of the different products available, examples of images and designs and downloadable demonstrations of some of the software. □

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INNOVATION PROJECT

Growing Intelligence

The Single Market presents a huge opportunity to producers of top-quality fruit and vegetables, and a serious threat to less careful growers. Using predictive models, new weather monitoring networks will help Mediterranean farmers to improve quality - and to use fewer chemical sprays.

Standing at the top of the vineyard, the old man wrinkles his nose and looks off into the early morning mist.

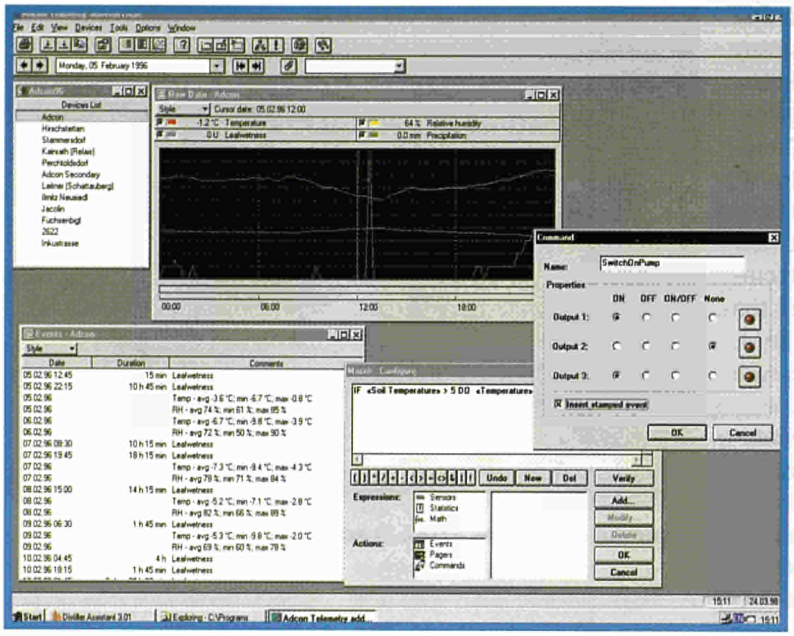
"It is time to spray again," he says. "I can feel the mildew coming."

"No, father. I have just logged on to the network, and the threat is small. We should wait for a spraying recommendation."

"Oh, your expensive toys. I have been farming here for over 40 years, you know."

But after three years of following the computer's advice, the farmer is coming to appreciate it. The farms which have clubbed together to invest in the monitoring system spray less frequently than their neighbours, which saves money. But their vines are disease-free. Grape quality and yields are up, and profits - well, profits have never been so good.

"I would like you to take over the farm next season," he says suddenly.



The predictive modelling software is easy to use, and runs on inexpensive PCs.

Precision Farming

Austrian company Adcon Telemetry's AgroExpert disease forecasting system has been used in parts of northern Europe for as long as five years. It employs a network of solar-powered weather stations to monitor rainfall, temperature, humidity, wind speed and other factors, over a range of up to 100 kilometres.

Every 15 minutes, data is transmitted by radio to a PC at the base station, where it is compared with a mathematical model of the conditions which favour attack by a specific disease. The system issues a recommendation to spray at the precise moment when the chemical will be most effective. Farmers may be contacted by phone or pager, or can access the system directly via a PC and modem.

"There are installations in Germany, France, the UK and Austria," says Bernd Hartmann of Adcon, the co-ordinator of the Innovation project TOCAP South. "We have developed models for diseases which do tremendous damage to crops such as apples, tomatoes, potatoes, sugar beet and grapes."

The northern European experience is that disease forecasting based on accurate climatic data boosts farm profits and reduces environmental impacts. "In most years, German vineyards which use the system to protect against the mildew Peronospara have applied fewer chemicals," Hartmann says. "The manufacturer might specify eight applications per season, while AgroExpert might recommend only five. That is a huge saving."

Costs are not always lower. In difficult years, more sprayings than normal may be recommended. But quality and yield are always maximised, at minimum cost, giving farmers a big competitive advantage. "This is precision farming," says Hartmann. "It is good for the farmer, good for the environment, and good for the consumer. German wine producers have even started to advertise their use of the system."

Climate of Change

TOCAP's aim is to introduce this technology to southern Europe for the first time. The project's end-users are large farms - two in Sicily and two in Spain.

"Most farming in these areas is very traditional, with plots of just 1-5 hectares, and farmers tend to be sceptical," Hartmann explains. "We chose to work with innovators, who are already producing for international markets. They can afford to invest in the system, and have most to gain from using it. But we hope that when smaller growers see that it really works, they will join together to set up community networks."

Local technology relay centres (TRCs) - Agricultural Data

Management Srl in Sicily and Inforural in Spain - each with considerable expertise in farm sector software development, will manage the installation and validation of the pilot networks, and will disseminate project results across the two regions to stimulate take-up.

The two-year project was launched in June 1996. The networks were quickly installed, and by spring 1997 operators had been trained. The second phase spanned the 1997 growing season. Weather data was monitored at each site, and the farmers followed the application advice generated by existing models, comparing results with those of the standard spraying regimes employed by neighbouring farms.

In Sicily, even in this first year, small savings on chemicals were achieved. "The farmers were delighted," Hartmann recalls. "But our real aim was to validate the models, adjusting parameters to suit local conditions. This would normally take up to four full seasons. Unfortunately, the project ends in June, half way through the second season."

Installing one of the wireless, solar-powered monitoring stations in a sugar-beet field in Spain. Installation is quick and easy.

The project's final phase - full local validation of existing models, and development of new models for diseases specific to the Mediterranean climate - will be completed, although in part outside the funded period. Adcon has provided the TRCs with software which will enable them to develop and maintain their own models. In due course, irrigation management modules can easily be added. □

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INNOVATION FINANCING

From Strength to Strength

I-TEC, the Innovation Programme's Innovation and Technology Equity Capital pilot project, is expanding the number of its participating venture capital funds.

The selection of new member funds in Belgium, Sweden, Denmark and the UK brings the total number to 13, and further growth is expected soon.

The European Investment Fund (EIF) will invest in the selected funds from a facility of 75 MECU earmarked for early stage investment in technologically innovative SMEs. I-TEC, meanwhile, will contribute up to 0.5 MECU per fund to the costs of appraising and managing such investments (1). Established funds must increase their holdings in this type of project by 50%, while new funds commit 25% of their total capital.

If the Cap FITs

The Innovation Programme also plans to launch a call for tenders for the Financing, Innovation and Technology (FIT) project in May or June. This has been designed to address a major obstacle to the financing of new technology based firms (NTBFs) - the poor mutual understanding and paucity of sustained links between investors and the innovation and technology community.

The project will focus on the key themes of guarantee mechanisms, technology appraisal methods, and the role of informal investors. In relation to each theme the project will comprise:

- **survey and analysis** of experience and good practice in establishing and maintaining such links, in Europe and beyond
- **workshops** to bring together venture capitalists, NTBF entrepreneurs and policy makers
- **structured dissemination** to promote good practice □

(1) See editions 6/97 (Dossier: Financing Innovation in Europe) and 1/98.

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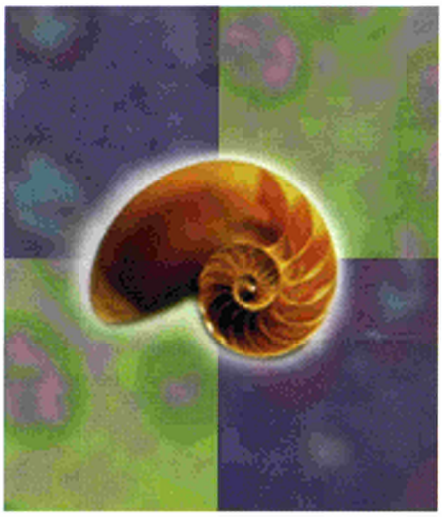


Biotechnology:

To date, Europe has largely failed to convert its world-class bioscience into world-beating commercial biotechnologies. But there are signs that the situation is improving.

The failure to commercialise scientific achievements has been called the European Paradox (1), and in the sphere of biotechnology it is no illusion. New technologies emerging from universities and research institutes, and the new companies formed to develop them, are bought by multinationals and exploited elsewhere - commonly in the United States.

Certainly, this is not always the case. But why does it happen so often? What prevents Europe from reaping the economic and employment rewards of its own inventiveness?

In summary, the principal obstacles faced by biotechnology in Europe are:

- uncertainty and lack of transparency in the regulatory framework
- problems of public perception, involving concern over ethical and health issues
- a high level of aversion to risk among European investors
- a lack of entrepreneurial motivation and skills at the industrial-academic interface

I. Life, But Not As We Know It

Biotechnology is not new, but today presents Europe with one of its greatest opportunities to achieve sustainable, high value-added economic growth.

Table 1: Specialist biotech companies - US/Europe comparison

Europe	**1995**	**1996**	**growth**
Turnover (MECU)	1,471	1,721	17%
R&D expenditure (MECU)	1,252	1,508	20%
Number of companies	584	716	23%
Employees	17,200	27,500	60%
US	**1995**	**1996**	**growth**
Turnover (MECU)	10,160	11,680	15%
R&D expenditure (MECU)	6,160	6,320	3%
Number of companies	1,308	1,287	-2%
Employees	108,000	118,000	9%

source: Ernst & Young BioBusiness

It is thousands of years since we harnessed yeasts and other micro-organisms to make beer and wine, bread, cheese and yoghurt, and learned to breed selectively to improve the quality and yield of useful plant and animal species. Modern techniques have vastly increased the speed with which nature can be persuaded to serve human ends, and greatly extended the range of activities in which biotechnology can be applied.

Today, it is again revolutionising agriculture and food production. But it is also producing dramatic breakthroughs in the treatment of disease, and offering new ways to reduce and clean up environmental pollution. There are few industrial sectors which are not either dependent on biotechnology as a source of innovation and growth already, or likely to become so in the next century.

Cultural Revolution

Biotechnology may be as old as human culture, but the explosion of scientific achievement, products and processes, and company formation and employment is relatively new.

It is only 22 years since Genentech, the first successful biotech company, was founded. By 1996, there were 1,300 specialist biotechnology compa-

(1) See page 4

Is the Tide Turning in Europe's Favour?

Case Study

BioSensation!

Opening the way for the expansion of biosensors into industrial applications.

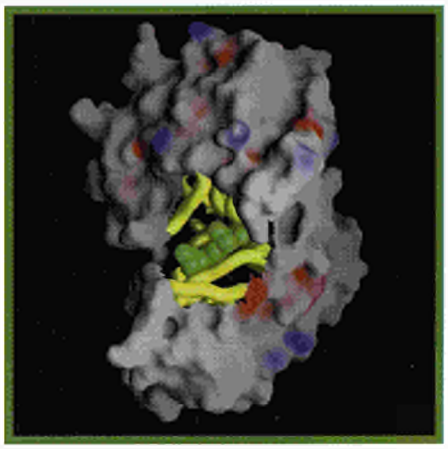
A biosensor converts the reaction of a biological molecule to a target chemical into a measurable electrical current. The greater the concentration of the substance under study, the more electrons flow between the system's biochemical and microelectronic components, and the higher the reading given.

In time, the technology will offer rapid, highly sensitive and relatively inexpensive detection and monitoring instrumentation for a wide range of medical, environmental and industrial applications.

Nano-sandwich

"A biosensor generally has several layers," says Dr Tim Gibson of British university spin-off company Applied Enzyme Technology Ltd. "On top is an enzyme which reacts specifically to one compound. At the bottom is an electronic transducer. Between them, transferring electrons from one to the other, sits a second enzyme which acts as a mediator. There are two principal challenges - to stabilise the primary enzyme, and to improve the efficiency of the mediator at the enzyme-transducer interface."

Today, the most successful biosensors available commercially are disposable glucose sensors, used by diabetics to test their blood-sugar level. The enzyme they employ, glucose oxidase, is inherently stable. But those needed to detect other compounds, such as alcohol, fructose or choline, have not yet been successfully stabilised outside the laboratory. The goal of the Biotech project Diamonds, which Gibson co-ordinates, is to develop the basic technologies needed for commercial production of biosensors for a much wider range of uses.



The three-dimensional structure of the horseradish peroxidase enzyme, mapping its electrostatic surface potential. Negatively charged areas are shown in red, and positively charged in blue. Part of the surface has been cut away to reveal the heme group. The molecule will be orientated to bring the protein main chain (yellow) as close as possible to the surface of the biosensor's electronic transducer.

The partnership includes six research institutions and a German SME, electrochemical instrument manufacturer Trace Analysensysteme GmbH. AET's own expertise is in protein stabilisation, and Gibson is confident that its patented methods can deliver stability, manufacturability and efficiency in commercial products.

"We are now focusing on the second challenge," he explains. "We are studying the 3-D structure of mediators such as horseradish peroxidase, and of the materials used for the transducer surface - gold, carbon and highly doped polycrystalline silicon (HDPS), a material developed by the Nanometer Consortium Group in Lund, Sweden. We have to manipulate the peroxidase molecules to create a close and permanent handshake with the transducer, so that they can exchange electrons efficiently."

Fast Food

Dr Gibson emphasises that the project's goal is to understand and control the fundamental structures and processes. "Product development will follow, once we have developed new, patentable interfaces," he says. "But a number of food industry giants are taking a keen interest, and we are already starting to think about a follow-up demonstration phase."

The value of biosensors in the food and drinks sector is clear. At present, production monitoring relies upon periodic sampling and laboratory analysis. Identifying a problem, and adjusting or shutting down a process, takes time. The Diamonds biosensor technology holds out the exciting prospect of on-line differential sugar analysis, for example - and ultimately of the automated micro-adjustment of process parameters.

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nies in the US, directly employing 118,000 people and with combined annual sales of nearly 12 billion ECU. In Europe, by contrast, just over half that number of companies employed less than a quarter as many people, and generated only 15% as much revenue (see table p. 16).

Particularly alarming is the discrepancy between European and US biotech R&D expenditure, with estimated total 1996 US spending around three times that in Europe. Industrial investment in R&D averaged 4.9 MECU per company in the US, and just 2.1 MECU in Europe.

Such figures must be treated with caution. "Biotechnology is not a sector, but a set of enabling technologies," explains Dr Mark Cantley of the OECD. "People define it in different ways, so producing comparable statistics is almost impossible."

What is not in dispute is that Europe still lags far behind the US. But it may be starting to catch up. "The number of European biotech companies is growing by 30% each year," says Mike Ward, European editor of BioCentury. "National governments are putting huge effort into biotech development. Financial markets are being created, and venture capital funds are starting to invest in younger firms."

Case Study

New Heart Treatment

An Innovation project has completed early clinical trials of a new clot-dissolving agent.

"The immediate cause of a heart attack is not the narrowing of the coronary arteries produced by arteriosclerosis," says Professor Désiré Collen of the Centre for Molecular and Vascular Biology at the University of Leuven. "The attack occurs when one of the plaques breaks open, exposing the fatty material beneath. In an attempt to heal the wound, the blood forms a clot, and it is this which occludes the artery, preventing oxygen from reaching part of the heart muscle."

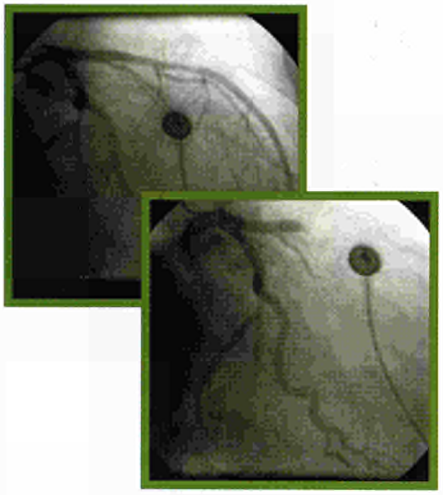
Angioplasty disperses such clots mechanically by inflating a small balloon in the blocked artery. But it must be performed within a few hours of the attack, and requires special equipment and trained staff.

The alternative is drugs which dissolve the clot in the bloodstream. World-wide, thrombolytic therapy is used to treat over half a million patients each year, and according to Professor Collen three times as many would benefit from it. "But none of the currently available drugs is perfect," he says.

Better Targeting

Clots are formed by a network of fibrin molecules. Thrombolytic drugs work by stimulating conversion of plasminogen in the blood to plasmin, which dissolves fibrin. The most effective, Tissue-type Plasminogen Activator (TPA), is so expensive that it is not much used outside the US. Others stimulate an immune response, and can only be used for brief periods.

The project - supported by the Innovation programme and co-ordinated by Professor Collen and Professor Behnke of the Hans Knöll Institute (HKI) in Jena, Germany - is developing a new drug. "We had been studying a bacterial protein called staphylokinase since 1990," he says, "and had found it to be a potent and uniquely fibrin-selective plasminogen activator. Instead of generating plasmin systemically it acts on the clot in a targeted way, so it is extremely efficient. With support from the Innovation programme, we and our partners have defined the Good Manufacturing Practice (GMP) procedure needed for approval by the European authorities, and are developing the methods for large-scale production."



The left anterior descendens coronary artery before (above) and after (below) a clot was successfully dissolved through an infusion of staphylokinase.

European Patent

Initial clinical trials involving 300 patients were successful, US and EPO patents have been issued, and production facilities have been established at HKI. Collen is certain that the new drug could not have reached this stage so quickly in any other way. "A large pharmaceutical company could not have done it," he says. "And our consortium, which consists of a university laboratory, a small university spin-off company, and a research institute, was only able to do so with EU funding."

The decision to go ahead with a full-scale efficacy study when the project ends in June has not yet been taken. This would involve comparative trials involving 10,000 patients, and would require a large injection of venture capital or the sale of a license to exploit the technology. The partners may instead develop less immunogenic versions of the staphylokinase treatment, whose effectiveness they have already demonstrated in pilot studies.

In either case, improved treatment for the victims of heart attacks is likely to be available early in the next century.

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The scope for further technological and commercial innovation is enormous, and with Europe leading the way in massive cornerstone projects such as the sequencing of the yeast *Bacillus subtilis* (2) and *Arabidopsis thaliana* genomes, the future looks bright.

Elixir of Youth

It is not in Europe's long-term interests to raise expectations unduly, however. It took the US biotech sector five years to recover from the collapse of early enthusiasm in the equity markets. UK biotech firms still find it hard to raise money after a similar collapse in 1995. With attention now switching to mainland Europe there is a danger that history may repeat itself in Germany and France.

Dr Helma Hermans, secretary to three of the Industrial Platforms (IPs) associated with the EU's Biotech programme, agrees. "Biotechnology is hugely important, and its importance will grow. But treating it as a growth industry is misleading. A few companies will thrive as biotech specialists. But the larger opportunities lie in the application of biotechnologies by established companies in existing industries."

The importance of biotech start-ups is not so much as a source of employment and growth themselves, Hermans believes, but as suppliers of research expertise to large manufacturers of consumer products. "To survive, big companies must continuously renew their products and processes," she says. "But they are not nimble enough to undertake all the research themselves. To stay profitable, they need regular injections of top-quality new technology, and get them by investing in start-up research firms whose results are commercially promising."

But the market for new technologies is global. Corporate investment in European biotech R&D already exceeds public expenditure, but it could be far higher. In 1995, Europe's pharmaceutical giants alone invested more than 3 billion ECU in US biotechnology firms.

(2) See edition 6/97

Context

Biotechnology: The Issues

What is biotechnology?

Definitions vary. The word refers to any technique using naturally occurring organisms, their cells and their products, to create useful substances or effects. The OECD calls it "the application of scientific and engineering principles to the processing of materials by biological agents". It draws on scientific expertise in the fields of biology, biochemistry, genetics, microbiology and biochemical engineering. Recombinant DNA technology, one of biotechnology's basic tools, uses enzymes to remove specific genetic information from one organism and transfer it to another.

Does biotechnology raise special ethical issues?

Some people believe it does. Others see no difference between today's techniques and traditional methods of genetic manipulation - and believe that the costs and risks should be weighed rationally against the huge benefits.

In Europe, public mistrust of biotechnology, far greater than that in the US, constitutes a real constraint on the commercialisation of its products. In practice, concern is focused on emotive areas such as genetic screening and genetically modified (GM) crops. The application of biotechnology in the search for new cancer treatments or a malaria vaccine is generally welcomed, for example.

EuropaBio, representing industrial players, has recently adopted a set of Core Ethical Values. Individual companies are also trying a more open approach - for example, to food labelling - believing that better information may overcome consumer mistrust.

The European Federation of Biotechnology has established a Task Group on Public Perceptions of Biotechnology, which is supported by the Biotech programme, and in 1992 the Commission itself set up a panel of expert advisers on bio-ethics (1). But the polarised views of farmers, food distributors and consumer groups continue to hamper the development of a clear EU policy on the labelling of GM foods.

Can biotechnology inventions be patented at European level?

Not yet. There are still major differences between Member States' laws on the patenting of biotechnological inventions.

The Council of Ministers has recently agreed a common position on a proposed EU Directive on patent protection. If adopted by the European Parliament, the Directive would harmonise national rules. Patent protection of 'discoveries' such as the harnessing of naturally occurring substances would not be possible. As a result of amendments already adopted by the European Parliament, cloning of human beings and any manipulation of genetic identity will be forbidden.

The Forum for European Bioindustry Co-ordination (FEBC) believes that continued uncertainty about the patentability of some inventions will stifle investment in European R&D, and make it hard for Europe to benefit from the commercial and employment opportunities which biotechnology offers.

(1) The Group of Advisers on the Ethical Implications of Biotechnology was replaced in February 1998 by the European Group on Ethics in Science and New Technologies, which will provide advice on ethical issues in all areas of science and research.

Contact

Task Group on Public Perceptions of Biotechnology
http://www.kluyver.stm.tudelft.nl/efb/tgppb/home.htm

II. The EU: Making a Difference

Europe must foster its world-class resources of scientific expertise.

Europe has to build the pan-European infrastructure needed for large-scale research, and develop financial institutions to support the early growth of specialist biotech companies. But it must also create a business and market environment in which the results of pre-competitive research can be successfully commercialised.

"The US lead is largely due to a significantly more supportive external business environment," according to a recent report for EuropaBio, the European Association for Bioindustries[3]. But while the key factors for small specialist companies are the quality of the science base and access to equity capital, large ones are affected more by consumer attitudes, intellectual property protection and the regulatory framework, the report says.

Case Study

Cold Water Wash

Enzymes secreted by Antarctic bacteria hold the key to reducing the cost of the family wash.

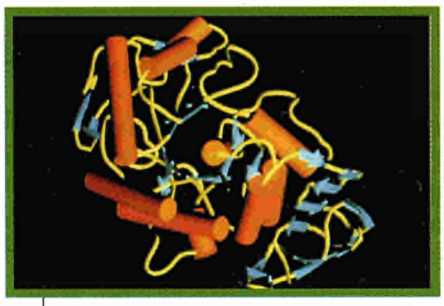
Enzymes are widely used both in industrial applications and in domestic products such as washing powder. But almost all are derived from organisms which live at relatively high temperatures, and work best above 40° C.

Reducing the temperature at which they operate would produce huge energy savings - washing machines would no longer need heating elements, for example. It would also allow enzymes to be used for the first time in low-temperature applications in the food and pharmaceutical industries, and in biosensors for environmental monitoring.

The Biotech project Coldzyme, co-ordinated by Professor Nick Russell of Wye College, University of London, is making rapid progress towards establishing the technical platform for the development of a range of new products and processes.

(Prof N Russell, Wye College)

Sea-ice below Mount Melbourne, Edmonson Point, Antarctica



(Dr N Aghajari, IBSM-CNRS)

3-D computer simulation of α-amylase.

Bacteria living in Antarctic sea-ice secrete enzymes like α-amylase, which degrade starch for biotechnological processing at low temperatures.

(Dr N Aghajari, IBSM-CNRS)

Crystal of α-amylase used for x-ray diffraction to determine 3-D structure.

Frozen but Flexible

"In order to carry out its catalytic function, a protein molecule must remain flexible," Russell explains. "We are isolating and characterising enzymes secreted by bacteria collected in the Alps and Antarctica. They are folded in such a way that they stay flexible at temperatures at which those produced by normal bacteria stop working. If we can find out how, we will be able to engineer low-temperature activity into other enzymes."

The project's partners are also studying the cold-loving bacteria themselves, with a view to using them as 'cell factories' to produce large quantities of genetically-engineered cold-active enzymes.

Lastly, Russell expects their work to lead to novel biotechnologies. "Certain enzymes show new specificities when operated cold," he explains. "For some compounds, specific isomers could be produced by running bio-transformations at lower temperatures, changing or improving the purity of the product."

Coldzyme has already succeeded in crystallising enzymes that degrade starch and protein. Unilever, one of the project's industrial partners, is providing nuclear magnetic resonance facilities used to analyse protein flexibility. But the company is undoubtedly also interested in this enzyme for a future cold-water washing powder.

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Funding for Growth

The European Commission's shared-cost funding of research, and its associated initiatives in the fields of training, network-building and financing, are widely seen as vital to the development of European biotech.

Though small compared to expenditure by Member States, EU funding devoted to biotechnology has grown rapidly since 1982 (see Figure), and a total of 1.7 billion ECU is earmarked for life science R&D under the Fourth Framework Programme. The Commission has proposed a budget of 2.7 billion ECU for the life sciences area for the Fifth Framework Programme (5FP) (4).

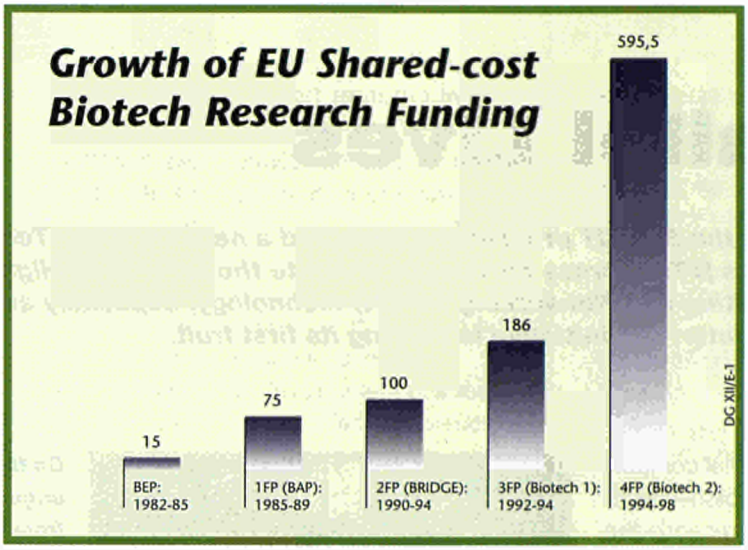
"Basic research and commercial exploitation are very closely related," wrote Bruno Hansen, Director for Life Sciences and Technologies, in the Commission's Directorate-General for research (5). "It is vital that European companies can access a critical mass of European research which is able to compete on the world stage. There is great strength when networks of the best European brains collaborate on projects of recognised international importance. This is the added value that European research programmes provide."

Dr Hermans agrees. "EU-funded projects can bring together the best scientists working in a particular field. The Industrial Platforms enable industry to suggest the broad direction which this shared-cost basic research should pursue in order to bring the greatest benefits to the greatest number of European companies."

Dr Tim Gibson of UK university spin-off AET (see BioSensation!) believes the EU programmes have done much to ease the flow of new research into the marketplace. "They have made academic scientists realise the urgency of bringing these technologies out of the laboratory, where they can find industrial application," he says.

Biotechnology and Finance

For many early stage biotech companies, EU funding has made the difference between survival and failure. An EU research contract is very exacting, but unlike a venture capital fund the Commission does not demand a 50% stake in the company and a 25-30% return on its investment.



Specific EU funding of biotech R&D has grown rapidly since 1982.

Venture capital is still badly needed, however, and can be painfully hard to attract. "In the US, investors accept failures, confident that they will come out ahead in the long term. But in Europe," Gibson complains, "neither venture capital nor private investors are willing to look at anything with less than a 90% chance of success. They would rather put their money into mechanical diggers."

The creation of pan-European financial markets such as EASDAQ will make the re-financing of established biotech companies easier. But in a joint initiative with the European Association of Securities Dealers (EASD), the Commission has recently set up the Biotechnology and Finance Forum (6), to improve the access to capital of young biotech firms, and to promote better understanding between scientists and financial institutions.

The Forum should help biotech researchers and campus companies to adopt a more business-oriented approach, and to achieve better capitalisation. Its first conference, which takes place mid-May in Brussels (7), will bring together industrialists, researchers, Member States and the financial community for presentations by individual biotech companies, and to review trends and examine regional experience.

Patently Frustrating

The Commission's role as co-ordinator and intermediary is vital. But problems remain, and it has attracted criticism for prolonging uncertainty over the regulation and patenting of biotechnology, at a time when clarity is vital (see Biotechnology: The Issues).

Dr Hermans is deeply frustrated by the lack of progress. "This is the tenth year of discussions about draft biotech patent legislation," she points out, "and agreement has still not been reached. That imposes a huge penalty on European firms, and severely limits Europe's innovation potential. Without proper patent protection you might just as well throw your research investment down the drain."

"The regulation of some biotech applications is a mess too," she continues. "In the US, as soon as a product has cleared all the hurdles it is approved, and can be sold in every State. Here, the Commission and the Member States keep changing the rules. Some plant biotechnology products have been stuck in the approval process since 1995. That is why the biotech investments of major European companies are flowing to the US." □

(3) 'Benchmarking the Competitiveness of Biotechnology in Europe', EuropaBio, June 1997
(4) Thematic programme 1: Improving the quality of life and management of living resources
(5) In 'European Biotech 97: A New Economy', Ernst & Young, April 1997
(6) See edition 1/98
(7) 'Promoting Entrepreneurial Initiatives in Biotechnology', Brussels, 12-14 May 1998. Contact EASD: Fx. +32 2 227 6524 E-m. easd@tornado.be http://www.easd.com/

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ESPRIT

Parallel Lives

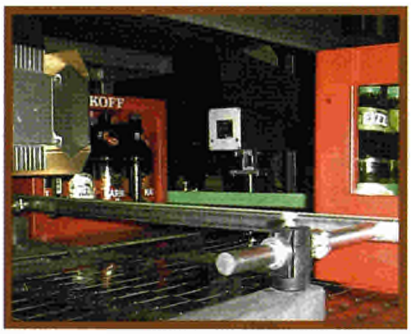
Early in 1997, the ESPRIT programme launched a network of 20 Technology Transfer Nodes (TTN) across Europe, to promote the take-up of High-performance Computing and Networking (HPCN) technology, especially among SMEs. A year later, the initiative is bearing its first fruit.

HPCN, or parallel computing, is an established technology. But until recently the high cost of hardware has restricted its use to large organisations. Now the appearance of commodity multi-processor computers has brought powerful HPCN systems within the reach of a much wider group of industrial users.

HPCN can improve the productivity and cost-effectiveness of existing operations, or provide the platform for tasks which were simply not feasible with earlier systems. Application areas include advanced engineering design, product inspection and quality control, and data mining. Two TTN-mediated projects illustrate its potential benefits for small companies.

© Property of Taurus Film and Joanneum Research

On the left, an original frame from the Austrian film 'Opernball'. On the right, the same frame restored.



The ImSpector imaging spectrograph (centre) sorts 60 crates per minute, according to the colour of the bottles they contain.

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Frame by FRAME

An irreplaceable part of our historical and cultural heritage is stored on film. But like old books, old films deteriorate. They are attacked by humidity, mould and dust, and receive new scratches every time they are shown. The problem affects both classic movies and historical footage stored in museums and national archives. Until now, however, restoration has been an imperfect and expensive manual process.

Joanneum Research, the technology provider in the FRAME project, has developed a semi-automatic restoration system. "We wanted it to be capable of restoring each digitised frame in a few seconds," explains Walter Plaschzug. "But although our algorithms work extremely well, they require a lot of computer power. Without HPCN, each frame took several minutes to process - restoration was still not commercially attractive to the media corporations which own the old movies."

For the project's end-user, French film and video laboratory Centrimage, the HPCN technology offers access to a growing market. "Hand restoration, both of old film and of new footage damaged during shooting, is an important part of our business," says Bruno Despas. "We are very hopeful that when FRAME finishes at the end of 1998, the system will allow us to reduce our prices for the service, opening up new markets."

"The cost per frame will fall dramatically," Plaschzug confirms, "creating a huge demand for restoration. And because HPCN is fully scaleable, the system can be adjusted to fit any budget or to achieve any throughput you want."

Colour Sorted

Spectral Imaging for Industrial On-line Sorting (SIMON) has installed two pilot applications to demonstrate the potential of imaging spectrometry in colour-related classification and sorting applications.

The ImSpector spectrograph was developed by Finnish co-ordinator Spectral Imaging Ltd. principally for industrial process control and quality monitoring. It has been used by LCG Srl in Italy to grade ceramic floor tiles according to colour and texture, and by Orbis Oy, also in Finland, to check the colour of glass and plastic bottles as they move down a production line.

Processing the very high volume of data generated by spectral imaging has only become possible with the advent of affordable HPCN. □

► CONFERENCES

Research and Development Management 30 September - 2 October, Avila (Spain)

Organised by the partners in the Innovation Management Techniques (IMT) project TEMAGUIDE, the conference will examine the various aspects of business strategy and alliances which can influence research and development, technology and innovation management. It will include discussion of practical problems and consideration of the implications for R&D management.

Topics are likely to include:

- working effectively in strategic alliances
- working with technology suppliers
- smaller company perspectives
- resource allocation and project evaluation
- reengineering an established partnership agreement

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ITPS'98 - International Technology Partner Search 18-19 June, Neuchâtel (Switzerland)

Organised by CENTREDOC in collaboration with CORDIS and TII - Technology, Innovation, Information, the event will bring Swiss companies into contact with potential business partners from Europe, North and South America, Asia, the Middle East and Africa.

It aims to attract companies and R&D centres wishing to commercialise know-how or technologies, to sell patents, and to acquire or sell licences. Participants will be able to meet foreign technology transfer brokers in close contact with industry, R&D centres and institutions from the respective regions of their countries, as well as multinational corporations and venture capitalists.

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World conference on science and technology parks 18-23 October, Perth (Australia)

The theme of this 15th world conference, organised by the International Association of Science and Technology Parks (IASP), will be 'Business partnerships for global opportunities'. The event will address five main topics:

- commercialisation of knowledge
- developing strategies for regional innovation
- business partnerships, networking and globalisation
- economics of science parks
- science park case studies

A trade exhibition, with exhibits from companies providing services and products of interest to science and technology-focused organisations, will be held in parallel.

Contact: XV IASP World Conference on Science and Technology Parks
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http://www.techparkwa.org.au/iaspconf98/

Intertechnology'98 - Investment opportunities in Poland 4-6 June, Lodz (Poland)

INTERTECHNOLOGY'98, an international trade fair on new technologies, innovations and inventions, organised with support from the Innovation Relay Centre network, will provide an ideal forum for the exploration of high-technology investment opportunities in Poland.

Featuring an extensive exhibition area, it will also include lectures covering:

- development of a technology transfer infrastructure in Poland
- implementation of technology transfer on different levels
- new possibilities of co-operation between research and industry
- business and innovation centres: regional support to SMEs
- special economic zones and technology parks in Poland
- industrial design in the modern enterprise

Participants will have the opportunity to present products and technologies during company promotion seminars and informal discussions.

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Industrial structure, innovation dynamics and technology policy 16-17 October, Lisbon (Portugal)

The conference, organised by the Institute for New Technologies of the United Nations University (UNU/INTECH) with EU support, provides an opportunity for an exchange of views on:

- the appreciative theory of technological change
- the economics of industrial dynamics and macroeconomic growth
- 'systemic' views of learning, institutions and competitiveness

Papers are invited.

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ACTS Mobile Communications Summit 1998 8-11 June, Rhodes (Greece)

The annual ACTS Mobile Communications Summit is a major forum for dissemination of the results of European research initiatives, undertaken within the context of the ACTS programme, towards Third Generation Mobile Communication Systems such as UMTS, MBS and WLANs, including their satellite components.

The main emphasis of the 1998 Summit will be on the implementation of prototype communication systems, some of which are expected to be given on-site demonstrations.

A one-day workshop on Software Radio Technologies will take place on 11 June, featuring contributions from Europe, the US and the Asia/Pacific region, and ending with a Round Table discussion with an international panel of experts.

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http://www.intracom.gr/mobsummit98/

NOTE

Publications are free unless otherwise stated. If specific contact information for obtaining a publication is not supplied, and there is a price listed in ECU, then the publication can be purchased from the sales and subscription office in your country of the Office for Official Publications of the European Communities (Eur-OP). Addresses can be found in most EC publications, on the WWW (http://eur-op.eu.int/en/general/s-ad.htm) and by contacting Eur-Op (fax: +352 2929 42759).

CD-AJ-98-003-EN-C

► PUBLICATIONS

Trans-European networks for integrated broadband communications (TEN-IBC)

DG XIII has published a booklet describing the results of trials conducted by nine Trans-European Networks for Integrated Broadband Communications (TEN-IBC) projects completed in 1997. The trials made wide use of the JAMES ATM network, set up under the ACTS programme to provide the infrastructure to test new communications applications and services.

The projects have developed a better understanding of broadband communications needs and barriers. Remaining obstacles to the development of advanced services are mostly non-technical - in particular legal issues and the need for re-engineering to benefit fully from the Information Society.

The booklet shows that some market sectors are now ready for such advanced services provided the legal issues are addressed, and the experiences it presents will allow actors in the field to develop business plans and to implement them in a cost-effective manner.

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Euroabstracts - 1997 Annual Index

CD-AB-97-007-EN-C; 10 ECU

The Annual Index provides a guide to all 1,624 abstracts of EU scientific publications contained in the six editions of *Euroabstracts* published during 1997, searchable by title, author, subject area, and programme.

The December 1997 edition of *Euroabstracts* was the last to use the established format. A 'new-look' *Euroabstracts* was launched in April, with a more accessible but less comprehensive format, grouping reviews of recently published books, magazines, CD-ROMs and websites thematically. Abstracts of all EU scientific publications will continue to be available via the CORDIS RTD-Publications database (http://www.cordis.lu/).

Society - the endless frontier

EUR 17655, ISBN 92 828 1187 5; 16.50 ECU

DG XII of the European Commission has published a report presenting European policies for research and innovation in the 21st century, and outlining the general context in which these are being developed.

The report, 'Society, the endless frontier - a European vision of research and innovation policies for the 21st century', is currently available only in French, but English and German versions will be published shortly.

It provides a basis for reflection on the policy options being put forward for the Community's Fifth Framework Programme for research and development (5FP). The authors describe the economic and geopolitical context in which European research efforts are evolving - in particular, the emergence of new powers in Asia.

The report examines the complex and changing relationships between research and society and describes how 5FP, by adopting a new approach based on 'Key Actions', is attempting to ensure that Europe undertakes the level and quality of research needed to achieve competitiveness in the global market.

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