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AT THE HUB OF SUCCESS

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EUROPEAN COOPERATION IN THE FIELD OF SCIENTIFIC AND TECHNICAL RESEARCH

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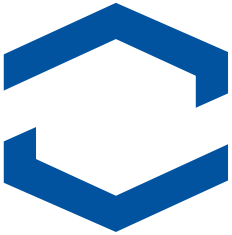

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NETWORKING FOR A **BETTER EUROPE**

Research results have long been the basis for improvements in quality of life and the economic growth which underpin European society. Good-quality research thrives on contacts between scientists – sharing ideas, methodologies and findings – and cooperation between research teams allows them to reach their common goals more quickly. The stronger European research is, the stronger our society becomes.

The COST initiative – which was launched in 1971, making it one of the longest-standing European instruments supporting scientific cooperation – helps researchers working on related topics in different European countries to come together. COST funding can be used to organise networking activities over a period of several years, such as conferences, short-term scientific exchanges and publication of results.

The crucial advantage of COST for researchers is that there are no predetermined areas for cooperation. Research teams themselves can propose to set up a COST Action in any scientific field. And as research becomes ever more multi-disciplinary, this bottom-up principle makes COST ideally suited to breaking down the barriers between disciplines. Moreover, since COST funds only the networking activities, rather than the research itself, COST Actions are flexible so new partners can join throughout the life of an Action as the field develops.

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Every year, COST brings together tens of thousands of researchers from across Europe and beyond. With a budget of just €20 million per year, COST nonetheless contributes to research activities worth 100 times that, helping research teams speed up progress on their work, and reducing wasteful duplication of efforts – a practical contribution to the development of the European Research Area (ERA).

A common perception of Europe is one in which basic research is healthy, measured for example in the number of peer-reviewed papers and books published each year by Europe-based scientists. On the other hand, innovation – new products and processes – derived from research results is seen to be weak, with far too little of researchers' hard-won prospects crossing all the hurdles to success in the market place.

Among the major challenges facing Europe in the coming years, one of the most critical is the threat from younger, more dynamic, more creative economies taking advantage of the fast-developing global market. Countering this threat depends on Europeans producing more high-value goods and services. Substantially increasing research and innovation efforts is vital in achieving this goal, and these are at the heart of the European Union's so-called Lisbon Strategy, which aims to create stronger economic growth and more and better jobs. A key component of this strategy is to raise investment on R&D by half, to reach the overall EU target of 3% of gross domestic product (GDP). Particular efforts are needed to raise investment by the private sector, which lags far behind that of firms elsewhere in the world.

As a key instrument within the developing ERA, COST is already making a major contribution towards realising these European goals. In particular, COST networking support targets researchers in the very early stages of their careers. Revitalised, with funding secured for the coming years from the EU's Seventh Framework Programme, COST will continue to play its part in developing a stronger, fairer, better European society.

This brochure presents a selection of COST Actions across a wide range of fields, which have either recently been completed or which have already achieved significant successes. It is just a selection, however, and there are many more high-quality Actions in COST's portfolio.

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- → Is advancing science by bringing together research teams, speeding up work in cutting-edge fields
- → Supports European industry, helping firms obtain new technologies to innovate
- → Contributes to creating a better society for all who live in Europe
- → Is helping clean up the planet and reduce environmental damage
- → Performs a key role in setting standards at European level, giving European industry a strong base
- → Provides a short cut for the development of new technologies through cooperation
- → Helps preserve cultural heritage, vital for society and for tourism
- → Sets out to transfer European research results to where they are needed throughout the world
- → Opens up European research networks to scientists from around the world, and
- → Brings together research teams from many varied disciplines to work together.

ADVANCING **SCIENCE** IN EUROPE

Researchers at the frontiers of science thrive on the exchange of ideas, theories and results with their peers. COST support allows wide-ranging contacts amongst scientists across Europe and beyond. And in new areas of science – where comparatively few teams operate – sharing ideas is a vital asset to avoid duplication of efforts and lost time. COST provides a flexible mechanism through which researchers can meet and discuss their ideas, providing the foundations to build strong networks where members can gain trust in each other. New members can easily join such a network as the science develops, thereby ensuring that it remains as effective throughout its life as when the initial plans were drawn up. COST support provides a short cut to making contacts across the scientific world. No matter what the discipline, COST can assist, since the initiative responds to scientific demand, rather than setting out areas for support in advance. COST Actions involve leading research teams from all over Europe, but they are not just for the 'elite'. By bringing together wide-ranging participants, such networking helps them all make faster progress in their work.

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UNDERSTANDING RISK

Citizens of industrialised societies have greater concerns about 'risk' and interests in reducing or mitigating it than ever before. Both individually and collectively, people are seeking to develop much more sophisticated understanding of the risks they face, just how acute they are, and how to predict the arrival of traumatic events such as earthquakes or stock market crashes.

Statistical physics is a long-standing discipline concerned with the behaviour of atoms, but physicists are now working with scientists from other disciplines, such as psychology and economics, to apply their tools in different areas.

"Most of our community work in the area of financial risk," explains Prof. Peter Richmond of Trinity College Dublin, chair of **COST Action P10** on the 'physics of risk', "partly because that is where data availability is best, so we can look at systems with some precision. They are looking at what drives stock prices up or down. Essentially, though, it is about behaviour of people – it is analogous to looking at molecules in a gas." Work in this area has shown that the probability of a major fluctuation from the norm, such as a crash, is more likely than previously thought.

Community of disciplines

But the work of these teams has far wider application than the financial world. For instance, one team is studying the fluctuation of heartbeats, with a view to identifying precursors to eventual heart failure. Another analysis has looked at the probability of airliner crashes. In fact, this shows that statistically there is no greater or lesser likelihood of a passenger being involved in a terrorist incident than in a crash due to technical failure.

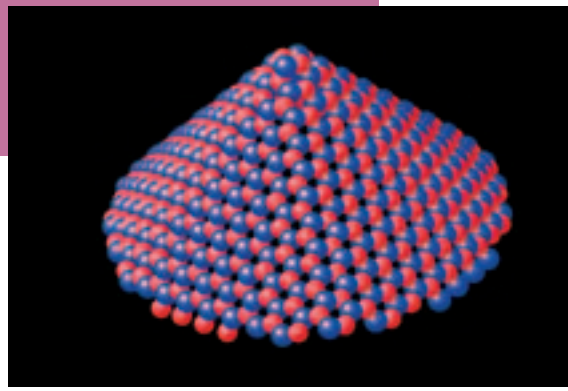
"We aim to bring our tools to those with problems. Of course, we often find we have to redevelop certain facets of them to operate in a new area, and that is an iterative process," Richmond underlines. The key to this work is bringing together people form different disciplines, to develop understanding.

"Working together in this COST Action has certainly raised the profile of the subject. We now have strong activity in this field in Europe; it certainly matches anything in Japan or elsewhere," notes Richmond. "With the network established, many participants have had the opportunity to make short visits (one week to one month) to others. That really helps to cement relationships. Also, we hope to see the subject introduced in undergraduate courses, which would be a route to employment in the financial sector."

Another application of these tools – which may well bring psephologists and politicians into the fold – is the prediction of voting behaviour. A French participant in this action, Serge Galam, has developed a model of the 'propagation of minority opinions in a democracy'. Some three months before the French public voted against the EU Constitutional Treaty in May 2005, he predicted in *Le Monde* that the 'no' camp would come from behind to win.

NANO-CHEMICALS

The drive to nanotechnologies and their application means traditional methods of chemistry need to be reassessed. "Usually the properties of a material depend on its chemical composition, but at the nanoscale, particle size is more significant," explains Prof. Rolf Hempelmann of the University of Saarbrücken, chair of **Cost Action D19** on 'chemical functionality at the nanometer scale'. This Action is working with organic, inorganic and hybrid substances to develop understanding of chemical properties at this scale, and to help researchers across the nanotechnologies field gain a broader view of the materials available to them.



COST
SUPPORTING INDUSTRY

The European Union now constitutes the largest common market in the world, but to maintain a leading position European industry must stay up to date with the latest high-tech innovations. The COST initiative plays an important role in supporting European industry, and maintaining the economic success and prosperity of its citizens and businesses. In a highly competitive world, new advances in biotechnologies, nanotechnologies, and material and chemical sciences must be integrated into all major industrial sectors rapidly, enabling European businesses to respond to the needs of a complex society while capitalising on real and lucrative economic opportunities. By bringing together enterprises and commercial interests, both large and small, high-level researchers and policy-minded institutions, COST helps keep Europe and its economy at the leading edge of an expanding global market.

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MICROCAPSULES IN BIOTECHNOLOGY

For many if not most biological systems, immobilisation is the natural state; cells are confined within the bodies of organisms, retained by membranes that hold them together and provide protection. Without such retaining structures, cells would simply flow away like water.

"Today, many biotechnology processes also need to be carried out in enclosed spaces where biocatalysts are held immobile and in proximity to one another," explains Prof. Denis Poncelet of GEPEA CNRS in France. Encapsulation, using microcapsules, he says, was first introduced in 1964 and it remains a powerful tool in different fields:

> Soil inoculation is often unsuccessful because cells are washed out by rain. Cell encapsulation allows successful inoculation through a ten-fold increase in cell concentrations.

> Cell immobilisation, imitating the natural cell environment, improves the efficiency of plant cultures used in the production of metabolites for medical, pharmacological and cosmetic purposes.

> Immobilisation is the technique of choice in many food and beverage processes, including beer, wine, vinegar and sparkling wine production.

> In ethanol and solvent production, sugar conversion or wastewater treatment, encapsulation allows continuous fermentation, preventing washout of biological catalysts.

New methods

Poncelet coordinated **COST Action 840** (Bioencapsulation innovations and technologies), aimed at advancing the development of new bioencapsulation methods in Europe. The Action, now completed, worked to foster cooperation through yearly meetings and scientific contributions to international conferences. Specific aims included:

> Increasing awareness of new materials in biocatalyst encapsulation;

> Identification of new processes allowing the use of these materials under mild and biocompatible conditions;

> Support for collaborative development and testing of encapsulation processes on a large scale;

> Characterisation and optimisation of microcapsule materials and related processes to suit applications in biotechnology, agriculture and nutrition;

> Dissemination of acquired knowledge among the European scientific community;

> Evaluation of different biocapsule applications in terms of economy, social impact, technological limitations, feasibility, potential partners, etc.;

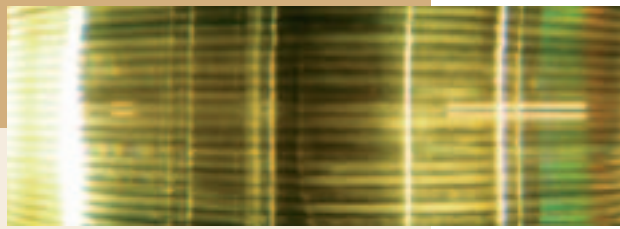
> Identification of potential markets and recruitment of new industrial partners, particularly SMEs.

As a secondary objective, the project looked at bioencapsulation methods for medical (i.e. artificial organs), pharmaceutical (e.g. vaccine delivery) and cosmetic (e.g. protection of active compounds) applications.

ACTION 528: HIGH-LEVEL EXCHANGE IN A 'THIN' FIELD

Extremely thin films, less than 20µm thick, are now used in many high-tech sectors, including: precursor chemistry and processing; micro- and nano-structures; physics, metrology and modelling; micro- and optoelectronics; and micro-systems.

COST Action 528 (Chemical solution deposition of thin films) brings together European technical specialists and industrial partners working with thin films in these and other fields, fostering exchange and encouraging the exploitation of real market opportunities.



A fruitful exercise

Participants now describe COST Action 840 as very successful, resulting in several workshops, two books, over 40 articles and papers, and many collaborative projects. "Moreover," says Poncelet, "we have had many requests from scientists from a number of countries to join in future COST Actions and we are now proposing a new expanded Action in this field."

COST WORKING FOR SOCIETY

Science underpins almost every aspect of our modern lives. Without it, many of the products and services we take for granted would be unthinkable. COST Actions focus on scientific research that can affect various aspects of society, from the economy and politics to culture and communication. COST research involves work on the development and behaviour of individuals, access for the old and disabled, cultural diversity and European integration. Work in telecommunications addresses specific challenges in a constantly expanding domain, including fundamental research and technology standards. COST activities have been instrumental in bringing together scientists and citizens to tackle issues of relevance across Europe and, in some cases, the world. Work in European urban areas, for example, with their particular ecological, socio-economic and cultural environments, has a great impact on quality of life. Civil engineering initiatives address urban reconstruction and renewal, maintenance of our cultural heritage, safety, security and disaster management, as well as urban information systems.

MODERN COMMUNICATIONS FOR ALL

Future generations of mobile communications systems will transmit data, text, voice, pictures and video between fixed or moving terminals. Customers will access variable bandwidth instantly and will be charged accordingly and automatically. Mobile systems will provide internet access as well as point-to-point communication, and they will be linked with wireless broadcast services.

A major concern as we move towards a fully mobile and fully linked society is maintaining accessibility for all. According to Viviane Reding, European Commissioner for Information Society and Media, "People with disabilities and the elderly are at risk of exclusion from the new world of electronic communications, unless special note is taken of their needs." The aim of several recent initiatives, including **COST Action 219ter**, says Reding "is to integrate all users into the Information Society, providing everyone with suitable access to information and communication technology products and services".

COST Action 219ter means access

"Future technologies will embrace short-range links allowing mobile equipment to automatically identify and communicate with appliances at home or in the street," explains 219ter chair Patrick Roe of the Swiss Federal Institute of Technology. "These systems will be general conduits for information carriage, and will not be function-specific. They could become the ideal foundation for an inclusive telecommunications arena."

The Action, says Roe, is promoting a communications infrastructure that is comprehensive and inclusive – meaning accessible to all – including the elderly and the disabled. "219ter

is based on 'Design for all'," he explains, "now a leading-edge concept in European telecommunications, thanks to the work of research programmes like TIDE (Technology initiative for disabled and elderly persons), the EU's Telematics programme, and ongoing initiatives, including eEurope and eAccessibility."

'Design for all' emphasises guidelines and standards to ensure that as many people as possible can use and benefit from new systems and services, decreasing the need for special adaptations and ad-hoc solutions.

According to Roe, various organisations and programmes are active in this field but they often focus on just a single aspect, such as standardisation, legal issues, research or education. "In this sense," he says, "the COST structure is ideal for implementing a comprehensive approach, bringing together all the players from across Europe."

219ter builds on work carried out by two previous COST Actions, 219 and 219bis. Its specific objectives are: to extend the existing COST 219 database, including knowledge for designers on special-needs consumers and their requirements; and support the exchange of expertise on inclusion and accessibility among developers, researchers and representatives of the tele-communications industries.

Ultimately, Action 219ter will allow disabled and elderly people to share the benefits of the new mobile communication society as discriminating, but not discriminated, users.

TRANSNATIONAL COMMUNITIES: HOW DO THEY DO IT?

Increasing internationalism has led to the growth of social, cultural and economic communications across borders. Examples include satellite television networks of diasporic minorities and the use of internet cafés by 'cyber-activists'.

Under **COST Action A16** (Policy and regulatory responses to the use of electronic communication technologies by transnational communities in Europe) scientists and other experts have looked at the electronic media, their impact on dispersed communities, and the reactions of governments.

COST HELPS THE ENVIRONMENT

Natural resources are vital for humanity's survival and for the continuing economic and social development of nations. The COST initiative supports improved environmental protection and management through a strong programme of interdisciplinary research. A number of environment-related COST Actions, across several scientific and technological domains, are now addressing important, policy-relevant issues such as environmental processes and conditions, interactions between humans and the environment, and environmental management for sustainable development. Importantly, work in this area includes qualitative and quantitative aspects of risk assessment, of direct relevance to protecting and exploiting natural resources. Ultimately, COST aims to identify and recommend practical ideas and technologies to help solve environmental problems facing Europe and the world. Part of the process is seeking out and identifying potential environment-related collaborative initiatives with organisations such as the European Science Foundation, the European Environment Agency, Eureka and the EU's Research Framework Programme.

BETTER CROPS FOR MORE SUSTAINABLE AGRICULTURE

Cereals represent an important share of food production and the wider economy in Europe. Today, reducing the input of pesticides and chemical fertilisers is of great interest and there is significant public support for increasing the amount of crops grown under organic conditions.

"For the last 50 years, cereals have been specifically developed to produce high yields using pesticides and synthetic fertilisers," explains Hanne Østergård of Risø National Laboratory in Denmark. "As a result, these inputs are now necessary to achieve optimal yields, regardless of the actual conditions in the farmer's field." In other words, crops currently available may not be best suited to ensure stable and acceptable yields under low-input conditions.

In many countries, national projects are investigating the sustainable low-input approach to commercial agriculture. Now, these projects are being coordinated under **COST Action 860**, the SUSVAR network (Sustainable low-input cereal production: required varietal characteristics and crop diversity).

"SUSVAR's aim," says coordinator Østergård, "is to establish methods for selecting varieties, lines and populations, and to develop ways to increase and make use of crop diversity and genotype-environment interactions. In this way, we hope to ensure stable and acceptable yields of low-input, especially organic, cereals."

Through exchange of materials and by combining national experimental results, SUSVAR partners are developing ways to increase and make use of crop diversity, e.g. variety mixtures, crop populations or intercropping, and establishing methods for selecting varieties, lines and populations.

The network is organised into six working groups, covering plant genetics and plant breeding; biostatistics; plant nutrition and soil microbiology; weed biology and plant competition; plant pathology and plant disease resistance biology; and variety testing and certification.

"It is essential that scientists from many disciplines work together to investigate the complex interactions between the crop and its environment," says Østergård, "in order to be able to exploit the natural mechanisms for stabilising and increasing yield and quality."

Making chemicals safe, safely

Agriculture is not the only area where COST is responding to pressing environmental issues. In the chemicals sector, **COST Action D29** (Sustainable/green chemistry and chemical technology) is developing sustainable industrial chemicals and chemical-based consumer products utilising sustainable and environmentally friendly processes.

According to Istvan T. Horvath of Eötvös Lorand University in Hungary, this Action will help establish a common understanding of the current status and the future research, development, and educational needs of the chemicals sector in Europe. It will also establish and manage a selection process for identifying potential sustainable, green industrial chemicals and chemical products. Finally, D29 will coordinate new joint research efforts for designing and developing environmentally friendly chemical production processes.

FORESTRY AND THE GREENHOUSE EFFECT

COST Action E21 is quantifying carbon storage in forest ecosystems and working to understand the links between human activities and climate change. Two working groups provide an inventory of carbon pools, pool changes, and forest management practices, considering carbon storage as an added value of forestry. The Action also maintains a 'clearing house', comprising a searchable database of information on the role of forests in mitigating the greenhouse effect.

SETTING **STANDARDS**

New products and services, the fruit of research results, are the key to innovation and economic growth. Long experience shows that where different systems, using different technical standards, compete on the market, consumers are more hesitant to purchase and therefore the market grows more slowly. On the other hand, where companies co-operate and agree to use a single standard, each can compete with their own products and services, but consumers feel more secure in purchasing and markets develop more quickly. By bringing together researchers working in a given field, COST is able to help them explore common interests and work on the development of standards at European level. And once such standards are agreed, firms gain not only a strong base for the European market, but can also attack the global market.

GUIDING INTERMODAL TRANSPORT RESEARCH

Road congestion is increasing across the European Union. People and businesses prefer the flexibility and convenience of cars and lorries to alternative modes such as railways and inland waterways. Using a variety of modes, mixing road journeys with the use of trains, ferries, etc. whenever appropriate, can ease the pressure on Europe's road network. Certainly it is a key objective of the EU's transport policy to improve the integration of existing transport modes so that road, rail and waterways can link together in a more efficient manner than they do today.

COST Action 340 – 'Towards an intermodal transport network: lessons from history', aimed to examine the obstacles encountered by intermodal transport in Europe's recent past. Project members studied national and European policies relating to the development of network connections between transport modes since 1945. The researchers also sought to identify conditions that best suited interoperability between both different geographic networks and different transport modes.

Learning the lessons

COST 340 ran from 2000 to 2005, and brought together teams from 13 European countries, who were able to identify a number of barriers to the creation of efficient intermodal transport networks. With different modes developing separately, often in fierce competition with each other, the researchers focused on the technological obstacles to intermodality, both between modes and within modes, as they developed in different countries. For example, different rail gauges have hampered the creation of rail connections between some nations. What is more, public bodies in charge of transport policy tend not to prioritise intermodal transport over the needs of individual modes. And transport modes still tend to be dealt with on an individual basis by government departments and agencies.

Dr Michèle Merger, chair of Action 340, believes getting a research team together under the COST banner has proved to be a valuable exercise. The results should help policy-makers devise more effective intermodal transport strategies.

"Thanks to COST we have had the opportunity to meet and to organise international conferences," explains Dr Merger. "These conferences have allowed us to underline the necessity for an historical approach to dealing with European transport and European transport policy."

And according to Dr Merger, COST Action 340 has produced real synergy. "We have created the T2M (Transport, Traffic and Mobility) association – a collegial association of scholars and practitioners, linked to the *Journal of Transport History* – and we have also founded the International Railway History Association."

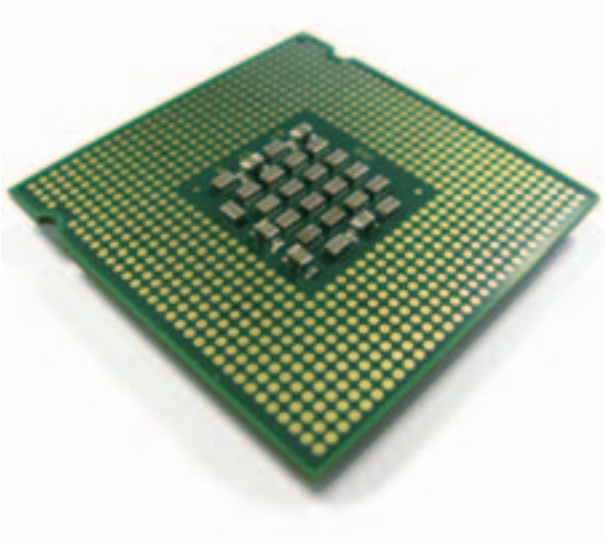
DEVELOPING ANIMAL WELFARE RESEARCH

In recent years, animal welfare has become an ever more important issue to Europeans. However, research progress has been hampered by problems relating to the measurement of animal welfare. Different laboratories and institutes have been using different methods and parameters to conduct research. **COST Action B24** – 'Laboratory animal science and welfare' – and **COST Action 846** – 'Measuring and monitoring farm animal welfare' – set out to address these issues.

"Our main achievement was to get people together who were working on the same sort of research and asking the same sort of questions," explains Dr Henry Blokhuis, chair of COST 846.

Networking proved to be a success, and helped COST Action members to develop a full-blown European research project on animal welfare that has attracted more than €35 million of EU funding. COST Action B24 made an important contribution to formulating the specific objectives of the 7th Framework Programme in the field of animal science and welfare.
http://www.welfarequality.net/
http://biomedicum.ut.ee/costb24/

DEVELOPING
NEW TECHNOLOGIES



Science seeks to develop new technologies to improve people's quality of life and to help society tackle some of its most daunting problems. However, creating innovative products, process and materials is a complex business. Fortunately, COST can support the creation of networks that aim to address specific research challenges which require the development of new technologies.

As research teams strive to bring about technological innovation, they may encounter challenges outside their fields of expertise. However, COST's flexible approach makes it relatively easy for existing networks to recruit new talent to tackle problems as and when they arise. And, of course, COST embraces a multi-disciplinary approach, which is often a key facet of the modern research and development process.

COST also has a strong tradition of bringing researchers from academia and industry together – a vital part of the innovation process that helps ensure ideas move from 'drawing board' to finished product.

BOOSTING BUILDING QUALITY

Millions of Europeans live in prefabricated houses constructed with the use of in-poured concrete. Many of these multi-storey dwellings were built in the period from around 1950 to 1980, when the emphasis was not necessarily on quality construction. Now many of these building have problems and need repair or demolition. **COST Action C16**, 'Improving the quality of existing urban building envelopes', focuses on developing techniques to improve the quality and longevity of these types of non-traditional buildings. The Action aims to disseminate any new restoration methods and technical options to architects, engineers and planners across Europe.

The C16 network, which brings together partners from 16 countries, is coordinating nationally funded research on a European level. This is important because in many European countries new technologies and restoration solutions have been developed but are only being used locally. If all of Europe's urban environments are to benefit, it is important that good-quality solutions are shared, and that more general approaches to improving buildings are developed.

COST C16 certainly offers the chance to share knowledge and to pool a great deal of data. As well as looking at technical matters, the network is examining the social and safety aspects that surround the use of these dwellings. The Action will also study relevant environmental and sustainability issues, including energy use.

Prof. Leo Verhoef, chair of C16 notes: "The plan is to produce four books with about 1 200 pages of information in the form of case studies and schemes."

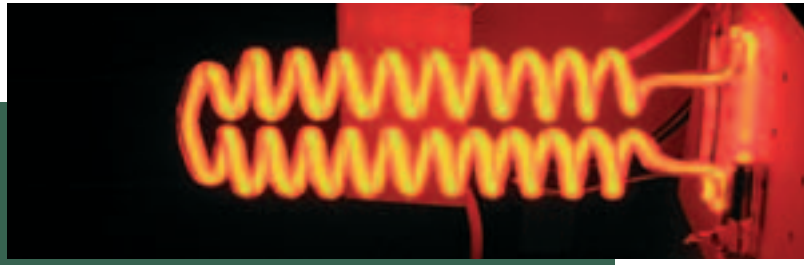
C16's drive to improve existing materials should reduce the need to demolish these houses and build replacements, an option which has higher social, environmental and financial costs.

LET THERE BE (MORE EFFICIENT) LIGHT

It is difficult for most people to imagine life without the electric light. This relatively simple technology is one of the cornerstones of the modern world, vital for society and economy alike. Unfortunately, the energy needed to power the world's electric lights produces around 550 million tonnes of CO_2 every year. In fact, electric lighting uses something like 15 per cent of the world's electricity production, and demand is continuing to rise.

COST **Action 529** – 'Efficient lighting for the 21st century' – intends to make the most of Europe's position as a world leader in lighting technology. The aim is to help develop materials and concepts that could reduce the energy consumption required by electric lighting, without compromising on light quality.

"Before this COST Action, the lighting research community was not well structured," explains Action chair Prof. Georges Zissis. "One of our first activities was to create a 'Who is who' so we knew who was working in this field."



Zissis thinks this is the biggest achievement of the Action because it has helped research teams find valuable partners. Indeed, networking produced enough critical mass for consortium members to develop large-scale projects that have attracted funding from the EU's Research Framework Programmes.

The pre-competitive nature of this action also helped bring industrial partners together. "One of our real achievements was to create what we call the COST standard lamp, which allows researchers to compare measurements and calculations," notes Zissis.

The lamp – which is not a commercial product – was made by Philips in a limited number and distributed for free within the COST partnership, which includes some of Philips' commercial rivals.

PRESERVING **CULTURAL** HERITAGE

Cultural heritage has an important place in Europe's society and economy. Artefacts, paintings, historical documents and ancient monuments can tell Europeans a great deal about where they came from. People also have an insatiable appetite to gaze upon great works of art and to visit places such as castles, cathedrals and ancient landscapes. That translates into important tourism revenue – the lifeblood of many local economies. However, time, the weather, environmental pollution and the demands of visitors can put items of cultural heritage in danger. Thus teams of conservators are employed to preserve works of art and structures of historical importance. These professionals are open to what science can offer in terms of developing new conservation techniques and technologies. COST is proving to be a useful instrument in this field as it encourages multi-disciplinary approaches to scientific endeavour and problem solving. Building research networks – a COST forte – plays a crucial role in cultural heritage research, because scientists from the technical disciplines must work with the likes of conservators, archaeologists and historians to obtain results in practice.

UNDERSTANDING PRE-INDUSTRIAL STRUCTURES

People are fascinated by ancient buildings and artefacts, and such objects play an important role in developing our understanding of the past. But what about the landscapes in which such discoveries are made? The way people used land and shaped its development can also reveal a lot about European history and culture.

COST Action A27 – Understanding pre-industrial structures in rural and mining landscapes – began its work in 2004 and will finish in 2008. Partners from 20 countries have signed up to the Action, which aims to identify and evaluate pre-industrial structures in the European landscape that are threatened by the abandonment of traditional mining and agricultural activities. The research network is keen to understand how such landscapes have undergone change, and how they are likely to change in the future. Researchers will analyse technologies related to the use of landscape, and study the historical development of relevant legal and administrative practices. In addition, team members will examine how landscapes have been perceived down the years by the communities that inhabited, exploited or visited them.

Action A27 should produce tools and models that can be used to protect and develop these landscapes, taking account of the living conditions and resource needs of local people. Results will also be used to inform strategies aimed at attracting sustainable tourism to important cultural landscapes. The scientific community will benefit from this Action through the development of common working methodologies, the production of databases and the establishment of networking activities.

Research opportunities

The Action brings together experts from the social sciences and humanities, fields which do not always find it easy to get support for networking and joint research.

"Some COST tools are especially useful," explains Dr Almudena Orejas, chair of Action A27. "Short-term scientific measures offer excellent opportunities, especially for young researchers, but also for the establishment and consolidation of deeper collaboration, both within the present Action and for the future."

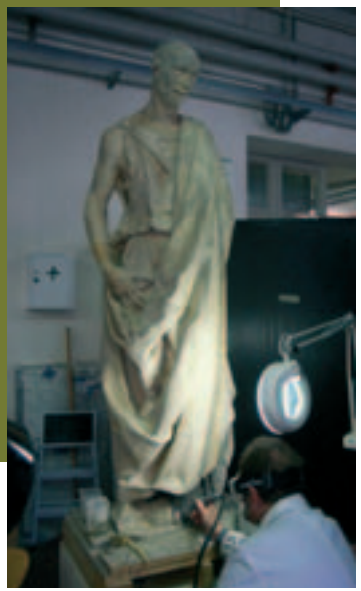
According to Orejas, the opportunity to publish the results of collective working is a major attraction of COST, as is the support provided for management committee and workgroup meetings. "These are the forums for the establishment or consolidation of bilateral or multilateral scientific relations, and for sharing scientific expertise."

And COST-supported workshops and conferences allow the Action members and external experts to share scientific findings in an effective manner.

LASER CONSERVATION

COST Action G7 was established to examine the use of laser techniques for artwork conservation. "Under the G7 initiative, laser techniques have proved to be very useful for diagnostics, for the cleaning of deteriorated materials, and for the monitoring of the deterioration," explains Action G7 chair, Dr Renzo Salimbeni. "And laser cleaning has been validated in a number of restoration case studies."

He adds: "Without a network like ours the techniques would still be limited and experimental, known only to a number of advanced scientific laboratories." However, conservation institutions and restoration companies throughout Europe are now using lasers thanks to G7's endeavours.



COST RESEARCH IN A GLOBAL CONTEXT

Much of the research done in Europe can be applied to a wider geographical environment. Many new ideas could benefit developing countries and some topics being investigated are global – greenhouse gases slip through frontier controls. Actions with a global element have the advantage of bringing scientists from different parts of the world into closer contact to learn from each other's different approaches to similar problems. Sharing methods and results can advance knowledge more quickly, creating links that can lead to further scientific collaboration. COST Actions in such fields can help to bring more isolated researchers into the mainstream of international science. Increased trade with third countries and economic benefits can also follow. Even fairly small-scale science can transcend political and cultural differences and contribute to a greater understanding between Europeans and the other nations of the world.

WEATHER MODELLING IN THE SKY

The threat of global warming has made climate prediction an area of prime importance. This kind of long-term forecasting depends on accurate measurements of what is happening now and careful modelling of past trends, extended into the future. Meteorology has had a growing success in weather forecasting, which has become far more reliable in recent years. The challenge is to transfer this achievement into a more accurate determination of future patterns of climate change.

The weather that we experience happens in the troposphere, the 15-20km deep layer of atmosphere closest to the Earth. An area of critical interest to meteorologists is where the troposphere meets the stratosphere above it. "We need to understand what goes on in this boundary region," says Dr William Lahoz, chair of **COST Action 723** – Data exploitation and modelling in the upper troposphere and lower stratosphere (UTLS). "Changes in water vapour and other chemicals that act as greenhouse gases in this region affect how heat from the Sun is absorbed and reflected and hence control the temperature on Earth."

Measuring and modelling

Making global measurements of the Earth is no easy matter. Clouds and contamination from other molecules may impede observations from satellites in space. Ground-based instruments cannot get a global picture, and neither can aircraft or sondes. "We need to improve our modelling in order to perceive large-scale circulation patterns," explains Dr Lahoz. "COST 723 has succeeded in bringing together the different communities in the field. The people who made the measurements often worked separately from those who did the simulation and modelling. The applied scientists and theoreticians now talk to each other more, making better use of their expertise. This will help us to understand the pathways molecules take between the two regions, giving us a better understanding of the ozone layer and the greenhouse effect."

One innovation of COST 723 was to end with a summer school instead of a workshop and a report. Academics and students from North and South America, Asia and Oceania, as well as Europe came to absorb the information and skills that the Action had brought together. "By holding our final meeting in Bulgaria, we were also able to bring scientists there into the network of European and worldwide meteorologists," concludes Dr Lahoz.

SUNSHINE MAKES WATER SAFER TO DRINK

One in five people on earth have no safe drinking water and are at serious risk from water-borne diseases. A surprisingly simple solution to providing safe water has been discovered – just leave plastic bottles filled with water out in the tropical sun for a few hours. "The combination of UV radiation and high temperature does the trick," explains Dr Kevin McGuigan of the Royal College of Surgeons in Ireland who led the project to advance knowledge of the technique. "We have yet to come across a water-borne microbiological pathogen that solar disinfection does not inactivate," he adds. The project, dubbed SODIS, falls within **COST Action P9**, Radiation damage in bimolecular systems – in this case the damage is harmful to bacteria but beneficial to humans. "We consulted aid agencies to find out what they needed," says McGuigan, "and are now looking at viruses. Polio is inactivated by the treatment, next we shall try its effect on hepatitis." This low-cost disinfection method has the potential to save millions of lives, especially of children, in tropical regions.

LARGE **GLOBAL** PARTICIPATION

Some research fields have such a wide span that they are best approached by international teams of scientists. An important benefit of COST is to facilitate collaboration and the sharing of information among the people who work in global disciplines so that progress can be made in the most cost-effective way. Many developments in 'big' science would never have occurred if they had depended upon the efforts of one country alone – the investment would have been too great. The pace of growth of knowledge has increased, so that advances on a broader front are more effective and proceed more quickly. This is true in basic science, understanding processes that take place at a microscopic genetic level, and in technology, where the exploding field of information technology demands intensive efforts from European scientists. COST helps European teams to keep up with and even overtake those in the US or the Far East.

THE LOW-ENERGY WAY TO MAKE HYDROGEN

As long ago as the oil crisis of the 1970s, interest was aroused in the potential of the abundant, reactive element hydrogen as an alternative energy source. Some methods of making molecular hydrogen, from splitting water or natural gas, require a high-energy input in themselves. But the natural world contains enzymes – hydrogenases – that work to produce hydrogen at normal temperatures and pressures. The trick would be to harness them on a sufficient scale to produce industrial quantities of hydrogen.

"What can we learn from nature for the benefit of mankind?" asks Prof. Wilfred Hagen, chairman of **COST Action 841**, 'Biological and biochemical diversity of hydrogen metabolism'. "Thirty years ago nobody knew anything about how micro-organisms could use complex biomacromolecules to produce or consume hydrogen. We discovered that the enzymes have a distinctive and unusual organometallic structure, containing two metal ions bound to small carbon molecules, quite different from the more common proteins."

Once the structure was clarified, it was possible to study the active sites in the enzyme, and then to work out how to synthesise artificial hydrogenases. There are several possible routes to using these enzymes for bulk manufacture of hydrogen. The classic biotechnology is to grow large quantities of certain micro-organisms with sunlight and cheap feedstock, such as green household waste, and to let them produce hydrogen, but they are relatively fragile. Recently, gene technology is being explored to make the organisms more efficient and sturdy under practical industrial conditions. Alternatively, a very promising method is to construct a more robust chemical analogue with the same active sites, which could be both cheaper and more productive. "We can say we have reached the proof of principle with this method," says Hagen. "The first functional models have been synthesised in the past few years and several groups are working on the topic."

Harnessing hydrogen's power

The new synthetic enzymes could be used simply to produce hydrogen in large quantities for clean fuel in a system coupled to a photovoltaic device with sunlight as the energy input. They might also perform as catalysts in fuel cells, or even be mobilised in structures that can store hydrogen and release it on demand. Hydrogen metabolism has potential uses in pollution control, for nitrogen fixation, removing chemicals from industrial wastewater, denitrification of drinking water and conversion of natural or biogas to methanol. The enzyme reactions could also be used to make high-value compounds such as pharmaceuticals. "Focusing the efforts of scientists from Europe and Turkey in this COST Action has helped us to make great advances in the potential use of biohydrogen, operating on a large scale as a long-term goal," concludes Hagen.

FASTER DATA PATHWAYS

The world demands ever-greater capacity for sending data to communicate around the globe. We need to make the most efficient use of satellites, whether they are geostationary or move relative to the Earth, to bring down the cost and improve the volume that can be handled. "Researchers need to get together to identify key requirements for future packet-oriented satellite systems," say Dr Erina Ferro, chair of **COST Action 272**, the fourth in a series of Actions which have provided a forum for European-wide cooperation on satellite-based communication systems since 1991. This cooperation has delivered major improvements to the modelling of satellite traffic flows, inter-satellite link networking and efficient resource management. And the series of Actions resulted in the setting up of the SatNEx Network of Excellence in FP6. "Much work in the field was carried out within COST 272 and its predecessor Actions, and this has been very valuable preparation for setting up SatNEx," says Erich Lutz, SatNEx coordinator.

PROMOTING INTERDISCIPLINARY **SCIENCE**

There are few fields where pure science still prevails. Since the birth of biochemistry, teams of researchers with different specialities have made important discoveries working together. Like hybrid vigour in plant breeding, the fruits of their work can be bigger than the sum of its parts. International collaboration is of special value in interdisciplinary research because the more rarefied and unlikely the combination of subjects, the fewer experts there are likely to be in the world.

The field of human health is one that has long interested sociologists, biologists and engineers as well as medical specialists. It now overlaps so many branches of science and the humanities that it is scarcely possible to list them. Food for the body and food for the soul both feature in the current list of COST Actions. An ambitious Action to enhance plant properties to do useful tasks is joined by one to use the attraction of a green environment to encourage exercise and relaxation.

HARNESSING THE POWER OF PLANTS

Some plants have the capacity to mop up chemicals from the soil in much larger quantities than is usual. They can be used to clean in polluted soil or water from a range of toxic metals and organic contaminants and can be considered as 'green livers'. Recently there has also been interest in producing 'healthier' food plants with enhanced concentrations of essential elements like iron, zinc and selenium that may not be fully supplied by the average diet. The reverse of this process is found in plants that can grow on polluted soil without picking up any toxic substances. Research to improve the traits that turn plants into little engines to do the tasks we want is collectively known as phytotechnology.

This plant power is being studied in a large five-year Action, 'Phytotechnologies to promote sustainable land use and improve food safety' (**COST 859**). "We have already enlisted 240 scientists in many disciplines into this Action," says the chair, Dr Jean-Paul Schwitzguébel of the Swiss Federal Institute of Technology, Lausanne, Switzerland. "They come from 35 countries, from the East, Russia, Algeria and Ukraine as well as EU Member States. They are working together in four groups to improve understanding of the mechanisms that underlie plant remediation activity." The first group is studying the way that plants take up, or exclude, nutrients and contaminants, and how these substances move around the different parts of the plant. The second uses molecular techniques to study plant function at a genetic level, while the third addresses nutritional quality and safety of food crops. The last group will contribute to the implementation and assessment of phytotechnologies on a larger scale. These groups will all combine to integrate the results and look at ways to manage the use of land in a more sustainable way.

Long-term benefit

"We are including many food crops that are important, not just in Europe but worldwide, in our work," explains Schwitzguébel. "As well as staples like wheat, maize, sunflower and brassicas, people are studying fast-growing willow and poplar as biomass to produce renewable energy and trying to reduce their need for so much water. The challenge is to go from the laboratory scale, working on plants like *Arabidopsis* that have been fully sequenced, to a real application over many hectares. The goal is a more secure and nutritious food supply, by bringing more land into agricultural production to feed the growing world population and developing mitigation strategies applicable to different polluted environments."

WALK IN THE WOODS FOR HEALTH

Modern disorders like obesity and severe stress are hard to cure with conventional medicine because they often spring from an unhealthy lifestyle rather than underlying disease. The new **COST Action E39** – Forests, trees and human health and well-being – takes the unusual route of bringing environmentalists and health authorities together to try and provide a natural and durable cure. "Today's society faces a lot of lifestyle diseases," explains E39 chair Dr Kjell Nilsson of Denmark's Royal Veterinary and Agricultural University, where he heads the Parks and Urban Landscapes Department. "Overweight people are embarrassed to go to the gym, but regular walks, especially in wooded places, have proved to help them towards a permanent change in their way of life."

This Action involves urban planners and landscape architects who could provide the right environment, and medical experts who would encourage its use, and promote therapy and rehabilitation exercises. "We could save money on health care and still have a healthier population," concludes Nilsson.

COST – A FUTURE FOR EUROPEAN SCIENCE

Europe has a long-standing tradition of excellence in research and innovation, and European teams continue to lead progress in many fields of science and technology. However, research centres in Europe are scattered across the whole continent and, all too often, their efforts fail because of the absence of adequate networking and cooperation opportunities.

That is why COST has an important role to play. It brings together research teams from all over Europe, enabling scientists to collaborate in a wide spectrum of activities. COST is a cornerstone in the development of the European Research Area and a key instrument for achieving the ambitious objectives set by the Lisbon European Council.

THE FUTURE IS YOUNG

In the future, COST will play an even more active role in coordinating national efforts to support the Lisbon objectives. COST has a proven record of being an 'enabling' agent, supporting European integration. Young researchers are the future of European science, and COST has always tried to support their scientific exchanges between laboratories. New ideas generated by young teams, in particular from the new EU Member States, will be endorsed, helping them to gain experience and recognition. Developing even stronger cooperation among European scientists is paramount to building the European Research Area. COST activities depend on the enthusiasm and commitment of the participating researchers. Currently, COST supports more than 200 of these project-oriented networks. Every year, approximately 45 new activities are approved and started. In summer 2006, COST is planning a pilot project and organising a call for proposals aimed at young scientists from all scientific fields. Young Investigators Networks (YINs) will exclusively address postdoctoral scientists, with PhDs gained within the past five years.

COMMUNICATING SCIENCE

People's perceptions of science are complex and constantly shifting. In order to enhance the science-society interface, public perceptions need to be constantly canvassed and monitored. Communication and visibility are two challenges confronting COST. The dissemination and transfer of knowledge is a key value of COST, and the use of results by industry, policy-makers and society needs to be increased. Therefore, COST will strengthen its efforts to communicate science. In spring 2006, COST is organising an exhibition in the European Parliament, 'COST – a vision for European Science', which will provide the opportunity to increase its general awareness, especially in the political environment. It will address European policy-makers and convince them of the importance of COST as a vital and complementary instrument within European research. In addition to this event, several national/regional COST days are planned and COST press activities will be reinforced.

CONCLUSIONS

It is vital to realise that knowledge is Europe's greatest resource. Stronger emphasis than in the past has to be put on research relevant to Europe's needs, to help it compete internationally, and develop its role as a world leader in critical sectors. The challenge is to bring the best brains from around the world to Europe, offering them attractive career perspectives and networking opportunities.

The added value to scientific work from improving contacts and developing collaboration among researchers from across Europe cannot be underestimated. The extent of their participation shows the value European scientists place on COST.

COST is of great importance for building consolidated scientific traditions in Europe in many key areas at the frontiers of scientific knowledge, for the establishment of networks of thousands of leading scientists, for increasing the mobility of researchers in Europe, and for the improvement of both cooperation in science and technology and of understanding among European countries.

Based on the outstanding results of COST it can be expected that, in the future, the EU in its Framework Programme will demonstrate its appreciation of COST's potential and fully recognise its role in the European Research Area, and increase support to COST activities.

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COST –
A FUTURE
FOR EUROPEAN
SCIENCE

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COST creates scientific networks and enables scientists to collaborate in a wide spectrum of activities in research and technology.

COST activities are administered by the COST Office.

For further information, see the COST website, at http://www.cost.esf.org/

Contact:
COST Office
149 Avenue Louise
B-1050 Brussels
Tel. +32 2 533 38 00
Fax +32 2 533 38 90

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