COST

Networks for success

EUROPEAN CO-OPERATION
IN THE FIELD OF SCIENTIFIC
AND TECHNICAL RESEARCH

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COST: Effective networking for European scientists

COST is one of the longest-running European instruments supporting co-operation among scientists and researchers across Europe. Set up in 1971 by 19 countries together with the European Communities (which had only six Member States at the time), COST now has 34 member countries, spanning the whole of Europe.

Rather than funding research itself, COST brings together research teams in different countries working on specific topics, supporting networking, conferences, short-term scientific exchanges and publications. Every year, with a budget of some €12 million, COST contributes to research activities with a value of more than 100 times that amount, bringing together tens of thousands of researchers from all over Europe.

One of COST's greatest strengths is its flexibility: there are no set areas for co-operation, so scientists themselves put forward proposals for COST Actions (bottom-up principle). Only five member countries need to participate, although in some Actions research teams from three to five times that number are involved. And participation is not limited to member countries: COST Actions are essentially open and scientists may co-operate with teams from anywhere in the world (*à la carte* co-operation).

In recent years, the European Commission has promoted the development of a European Research Area (ERA), where national frontiers are opened up, scientists can move around freely and exchange ideas, and research activities are no longer fenced in by differing national policies. It is "a framework within which national and regional governments can co-ordinate their research policies and integrate their activities", according to EU Research Commissioner, Philippe Busquin. "I am convinced that COST has the potential to make a strong contribution," he adds. The dream behind ERA is to foster European-level networks bringing together the best European scientists, working in close contact, spurring each other on to world-beating results. And, of course, these results need to be taken up by European companies, to introduce new ideas, products and processes to improve European competitiveness in the global market place.

Developing stronger co-operation amongst European scientists is paramount to building the European Research Area. COST has pioneered this approach, and its value is demonstrated in the enthusiasm and commitment of researchers: participating in a COST Action requires time and resources, but does not bring additional funding for their research. The fact that some of Europe's best scientists are involved in COST surely demonstrates its benefits. "I have heard it said on many occasions that if COST did not exist it would have to be invented," says Gösta Diehl, who chairs the COST Committee of Senior Officials.

Currently there are close to 200 COST Actions under way. This brochure presents a selection of Actions across the range of domains.

- **COST** facilitates co-operation between national research activities
- **COST** supports intergovernmental contact for policy-making
- **COST** co-operation is multidisciplinary
- **COST** boosts research efforts for very little additional money
- **COST** research is prizewinning science
- **COST** is flexible and responsive to scientific demand
- **COST** helps European industry set global standards
- **COST** activities are much wider than the EU
- **COST** can act before others, piloting co-operation in new fields

COST facilitates co-operation between national research activities

Science thrives on interaction between colleagues spurring each other on. Theories and ideas need to be tested against the best in the field if they are to be accepted. In many European countries, the size of the scientific community inevitably means that contacts need to be made across frontiers. Also, many research tasks address problems with a European dimension. The more opportunities European scientists have to interact – both formally and informally – with their colleagues, the faster new results may be reliably verified. That means promoting co-operation, lowering the fences around national research projects, and ensuring that researchers are better informed of activities across Europe. COST provides a mechanism for scientists to work closely with their counterparts in other countries. With representatives of 34 member countries – and Israel as a co-operating state – meeting regularly, either at official level or in specific technical domains, COST presents widespread opportunities for fostering co-operation in Europe and beyond.

Stretching your horizons

If you work all week, you like to make plans for your weekends. Today's medium-range weather forecasting techniques mean you can already start planning for the next weekend on a Monday. And if it is important to the individual, imagine how important accurate forecasts are to farmers, whose decision on when to sow or harvest a crop is vital to their livelihood, to hydrologists monitoring flood defences, or even to highway authorities which need to plan snow-clearing to keep traffic moving.

A series of COST Actions have played a major role in improving weather forecast accuracy in Europe. "Meteorology, by its very nature, does not respect national frontiers," says Professor Chris Collier of the University of Salford's School of Environment and Life Sciences, who chaired two Actions in this field. "COST succeeded in bringing together meteorologists from across Europe – researchers from both university and meteorological offices. It has helped raise awareness of the need for co-operation and interaction."

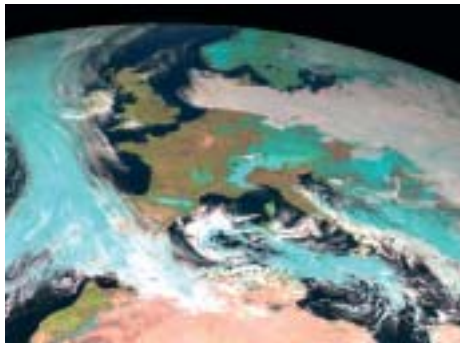
European forecasting centre

Collier believes COST's greatest achievement in meteorology has been the creation of the European Centre for Medium-range Weather Forecasts (ECMWF). Based in Berkshire, outside London, the Centre receives data from across Europe, and is a world leader in weather prediction modelling. In 20 years, the Centre has been able to extend the quality, i.e. reliability, of forecasts from two to six days in advance, and hence the ability to know with much greater certainty what the weather will be like next weekend.

The use of radar is now firmly established across Europe to monitor cloud movement, and therefore precipitation. Radar images showing the movement of clouds across Europe, in both recent and future days, are commonly seen on television weather forecast bulletins. Three COST Actions, running in series since the mid-1970s, have led the development of radar forecasting techniques. "When we started looking at radar applications within COST in the early 1970s, there was only one meteorological radar in use in Europe," says Collier. "By 1991, after 15 years of COST work, there were over 100 in operation."

Networking radar systems

The first of these three COST Actions focused on demonstrating the feasibility of bringing together the different national plans for radar systems into a coherent network. Much of the work was on developing common standards and interoperable systems. "European radar manufacturers played a significant role at that stage," Collier recalls. "This COST Action was very successful in bringing researchers and industry together, and I believe it made European manufacturers more competitive on the world market."



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The subsequent COST Actions refined and extended the network, as well as improving modelling capabilities – which are vital for making accurate predictions from the data obtained with radar. Today, work in meteorology Actions continues, looking at more advanced technologies and prediction methods to provide Europeans with ever more accurate weather forecasts.

"COST certainly speeded up our work," says Collier, "through encouraging interaction between people across Europe approaching the subject in different ways."

Monitoring sea level

Closely related to meteorology, rising sea levels are a major concern in Europe whose many coastal communities are at risk from the threat of global warming. COST researchers working in the oceanography field have set up a network to monitor the sea level around the European coastline. By working together, these teams are able to benefit more rapidly from the introduction of the latest technologies and the sharing of new techniques, to ensure European efforts to combat the rise in sea level are as well informed as possible.

COST supports intergovernmental contact for policy-making

Government policies often require significant scientific or technical work, but policy-makers need to be in close contact with researchers, as well as the beneficiaries of such policies, to avoid the risk of an outcome which suits nobody and takes longer to achieve. This need for contact is multiplied when the scale of the problem requires European-level action to find solutions. As an intergovernmental instrument, COST provides a mechanism which encourages the relevant government officials to work directly with researchers, industry and consumers, and facilitates these contacts. Each party can then contribute throughout the work, allowing common understandings and joint goals to develop more quickly. This type of co-operation has become a prerequisite for effective and successful policy-making and implementation.

A step up

Citizens must make more journeys on public transport, instead of in private cars, if urban areas are to be freed of congestion and the resultant pollution. But for a huge proportion of the EU population – those with permanent or temporary mobility impairment – traditional public transport vehicles are not easily accessible. This group can amount to as many as 40% of EU citizens, taking in elderly and disabled people, as well as those with injuries, with babies in prams, or even carrying bulky luggage or parcels.

Increasing public transport use requires that vehicles and stations are made more accessible and attractive to these groups. In some cases their alternative will be the car, but many have no alternative to public transport. Increasing the participation of these disadvantaged groups in society is a key political priority, and improving the provision of transport is crucial in achieving it.

Urban transport

Low-floor buses are now a common sight in European cities, and it was a COST Action which did much to set the standards. "In the transport field, a unilateral approach is neither efficient nor effective,"

says Ad van Herk of the Dutch Ministry of Transport. "Working within COST allowed us to bring together not just the governments, but also manufacturers and passenger organisations. Public transport vehicles are produced by a limited number of manufacturers and they often operate across borders, so international co-operation makes sense."

In this sector, COST work focused on identifying examples of good practice from around Europe and the world. The teams involved developed a set of common standards for low-floor urban buses. Whilst these standards have been published they are voluntary only. Nevertheless, van Herk believes they are both influential and widely followed. "In the Netherlands we used them as the basis for our own national standards, which will apply to all orders for new buses throughout the country." These standards now form the basis of an EU Directive.

Going further

The success of COST work on low-floor buses – with the majority of new buses produced in COST member countries now of the low-floor design – prompted its extension to other forms of public transport. Heavy rail was the next to be addressed by a COST Action. Here the focus was as much on station accessibility as on trains, and since the modification of existing infrastructure without major disruption to passengers is very complex, its results have taken longer to be implemented. But new stations are now being designed to accommodate the needs of disabled passengers.

The third COST Action in this area, chaired by van Herk, seeks to extend the accessibility now seen in urban buses to long-distance coaches. This market is particularly significant for those with lower incomes, as it is often the cheapest mode for long-distance travel. The technical work needed to convert coaches is more complex than for urban buses, but COST work is now under way to identify solutions.

City planning for pedestrians

In recent years, city centres have become more pedestrian friendly. But further out, in suburban areas, car use continues to grow, as many citizens feel insecure walking or are too attached to the comfort of the car, even for the shortest of journeys. The urban motorway, designed to speed traffic through built-up areas, is the worst offender, but in too many suburban areas, attractiveness and convenience for pedestrians are not taken into account by planners. A recent COST Action, involving ministries, local policy-makers and research institutes, set out to spread examples of good planning across Europe, to help develop a systematic approach to urban quality for pedestrians.

COST co-operation is multidisciplinary

In today's Europe, national frontiers are becoming less significant. At the same time, the boundaries between scientific disciplines are becoming more and more fluid and, in many areas, crossover is common. The nature of scientific problems often requires a multidisciplinary approach, but in too many cases there is a lack of contact and understanding between the disciplines involved which slows down the work required. COST has long supported interdisciplinary contacts, and its flexible structure makes it well suited to doing so. By supporting only the co-operation between research teams with their own funding, COST avoids many of the difficulties that would arise in trying to set up a single project bringing together the different disciplines. And since it is easy to join a COST Action already under way, new research teams in different disciplines can come in to pick up new challenges identified in the course of its work. In many cases, COST is the only European instrument open to multidisciplinary groups of research teams.

Great oaks from little acorns

A generic life-cycle assessment (LCA) methodology was first developed in the early 1990s under the auspices of the International Organisation for Standardisation (ISO), as a way of evaluating and comparing the total environmental impacts of products. "From our point of view, the trouble was that it concentrated on industrial processes," says Professor Arno Frühwald, of the Institute of Wood Physics at the University of Hamburg.

Cross-cutting

The aim of the COST Action led by Frühwald was to develop and test an LCA methodology for the forestry and timber products sector. Here, raw materials and end-of-life aspects, not thoroughly dealt with by the ISO scheme, are crucial. "Take a piece of furniture. Life-cycle assessment has to cover everything from the preparation of the site for planting, through the harvesting and processing of the timber and the construction and use of the final product, to its final disposal or recycling," Frühwald explains. A multidisciplinary approach was essential. "We wanted to spread the use of LCAs beyond the research community to the forestry and manufacturing sectors, and to equip LCA practitioners with specific tools for the forest–wood supply chain, which had never been addressed before."

By the time the four-year Action came to an end in 2001, over 100 organisations from all over Europe were involved, around one-third of them from forestry and industry. Assembling a multidisciplinary team was a huge challenge," Frühwald recalls. "LCAs were completely unknown in forestry, so we had to educate forest managers before we could even start to develop an appropriate methodology."

Now, those efforts have paid off. The team's work on CO_2 fluxes and sequestration (absorption of CO_2 from the atmosphere) for forests and timber products has contributed to decisions by the Intergovernmental Panel on Climate Change based on acceptance of the role of forests as 'carbon sinks'. Forest managers are already applying both the methodology and pilot study results to improve management strategies, reducing environmental impacts.

Small footprint

The timber industry is also making significant use of LCAs in the design and marketing of new products. "Public authorities, as well as an increasing number of final consumers, are specifying building materials and household goods with minimal environmental impacts," explains Frühwald. Some companies are already providing their customers with data from LCA studies to facilitate comparison of their products with alternatives made of other materials.

"Conventional research projects involve five or six partners – normally just research institutes," says Frühwald. "For a project of this size, cutting across traditional disciplinary boundaries, the COST system was ideal." He says that 60-70% of the network's members are continuing to collaborate actively. Many are involved in a new Action on end-of-life strategies and recovered wood.

Electronics at the nanoscale

Recent work in atomic physics at submicron and nanometer scales promises major advances in a range of fields, including chemistry, biology and materials sciences. But for this to happen, physicists need to work with researchers from these different disciplines. A COST Action on mesoscopic electronics played a key role in establishing a network of European laboratories as the field developed, ensuring that European researchers are at the forefront of work in 'microscopic' electronics.

COST boosts research efforts for very little additional money

COST does not fund research itself. With its limited resources, it provides assistance for research teams from different European countries to work together. For example, COST may fund participation in conferences and workshops, networking activities, the exchange of scientists between teams, particularly young scientists, and the publication and dissemination of results from a COST Action. Although these are relatively low-cost activities, they are often very difficult for researchers working in separate national contexts to finance themselves, since their own funds are tied to specific work. By supporting co-operative work, COST helps European scientists build the teams needed to reach solid results quickly. Many of the fields tackled by COST Actions require European-level solutions, and in numerous cases no other mechanism supports this work. Despite its relatively low budget, COST has a significant leverage effect, providing the catalyst to bring together large numbers of researchers and jointly harnessing their efforts and funding to achieve large-scale results.

Spreading influence

Chemistry has a central position in many research efforts today, with the need for molecular-level understanding crucial in areas such as medicine, biology, environmental protection, food and agriculture, or pharmaceuticals. Although chemists have only been working with COST in the past ten years or so, chemistry is now one of the most successful COST domains, with widespread involvement across Europe.

Enthusiastic participation

"Chemistry is a very active COST domain," says Professor Gerard van Koten of the Debye Institute at Utrecht University, who chaired the COST technical committee in chemistry until recently. "The different Actions all have very strong support: there are now around 1,200 research teams and 3,400 chemists participating in the 22 Actions running in the chemistry domain. Over the past five years, almost 700 joint publications – by colleagues from different institutions – have come out of chemistry Actions. And, of course, many thousands more have been published individually.

"Another important aspect is support for exchanges to enable young scientists to work for a short period in a lab in another country. Although the COST funds cover only a short period, their award helps the host institution to raise more to extend the stay," according to van Koten.

Spirit of openness

"There is a lot of enthusiasm in the field: sometimes I think that is not fully recognised," van Koten believes. "Colleagues devote a lot of time to COST work, which is not matched by the money received directly. But the benefit is that COST gives a little money to a lot of people, so they are all involved.

"At first people were not used to working with colleagues from other disciplines," claims van Koten. "The first set of chemistry Actions were very monodisciplinary, but they have helped researchers become more open. Today, the newest COST Actions in chemistry are much more multidisciplinary."

Medical imaging

"Most of today's novelties stem from interdisciplinary work," says Professor André Merbach from the Molecular and Biological Chemistry Institute in the *École polytechnique fédérale* of Lausanne, who helped set up a COST Action looking at metals used as contrast agents – administered to patients to indicate specific conditions and/or target specific parts of the body – in magnetic resonance imaging (MRI) treatments. "Scientific collaboration is not new, but the COST structure helps bring people together. It is an enormous advantage to have it, and there is no comparable mechanism elsewhere – in the USA for example."

This Action involved some 95 research institutions in 22 European countries. COST funding over the five years the Action ran totalled €700,000, but this brought together research teams working on activities costing €230 million overall. "Chemistry needs distributed laboratories and teams: we need to tackle common problems with different methods," Merbach emphasises, "and by talking to others we learn faster."

Developing MRI contrast agents is a field in which Europe leads. Most patents have been granted to European researchers, and the networks created with COST support have made a strong contribution to their work, Merbach believes.

Wearing down costs

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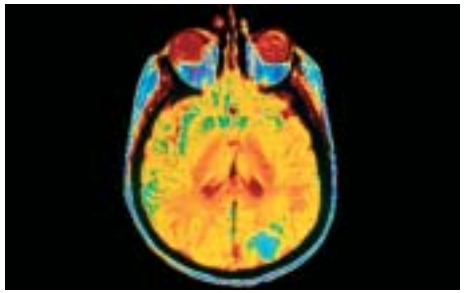
Friction and wear from inadequate lubrication is a constant problem in vehicle engines and transmissions, with huge costs in repair and replacement parts. A COST Action in the field of tribology – the study of friction and lubrication – will help European manufacturers to improve the efficiency of engines reducing both costs and consumption of oil, both as lubricant and as power source. Bringing together researchers from 26 member countries together with the Ukraine, this has one of the widest participation ranges of all Actions, and will allow European industry to take the lead in developing more sustainable engines.

COST research is prizewinning science

Creating networks of European researchers aims at stimulating creativity and encouraging scientific progress. Working in co-operation with colleagues from other countries spurs scientists on, to pick up the challenges laid down by others. Co-operation in a COST Action should be about teams of scientists working together to achieve better results than they could by working separately. Only by bringing together Europe's best scientists will COST achieve the high results it strives for. Two prizewinners from within COST Actions, recently recognised by internationally renowned organisations, demonstrate that COST's scientific strengths are well recognised by the scientific community. Of course, these two prizes are not solely down to the recipients' work in COST Actions, but they demonstrate clearly that participating in COST is a benefit to scientists working at the leading edge of their field.

Better, faster, cheaper

For more than two decades, Professor Christer Halldin's group in the Department of Clinical Neuroscience at Stockholm's Karolinska Institute has been at the forefront of efforts to develop and use radioligands – molecules labelled with short-lived radionuclides whose uptake in the human body can be studied using positron-emission tomography (PET) imaging.

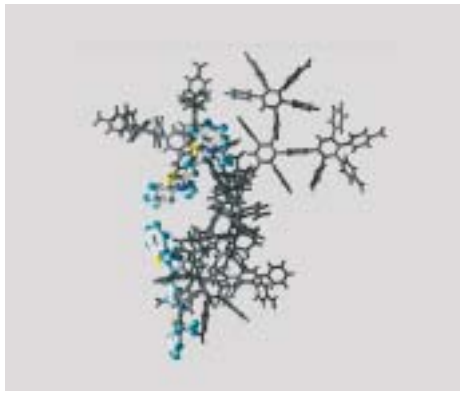


In 2001, Halldin and his French and Finnish colleagues from COST Action B12 received the annual Marie Curie Award from the European Association of Nuclear Medicine for their ground-breaking work on Carbon-11 tracers for brain serotonin transporters. "C-11 tracers are now being used in the clinical investigation of depression and related conditions," he explains. "They are also helping drug companies to develop treatments with fewer side effects, and to determine the optimal dose of new drugs." PET has become a vital tool both in the selection of candidate molecules and in the early assessment of candidate efficacy, enabling the pharmaceuticals industry to bring new treatments to market more quickly and more cheaply.

Halldin appreciates the flexibility of COST, which allows researchers themselves to define the goals of their joint work. "When the Action ends in a year's time, collaboration will become much more difficult," he says. "To share results, we will again have to wait for one another to publish."

Knowledge transfer

Professor Frans De Schryver of the Department of Chemistry at the Catholic University of Leuven is a pioneer of single molecule spectroscopy (SMS), a technique which makes it possible to study fundamental photo-physical processes in individual molecules. "SMS is a key analytical tool in nanotech, nano-biotechnology and materials science," he explains. "This is basic science, but it will have important industrial applications in the future especially in biotechnology, for example in the detection of dye-marked proteins or DNA fragments at extremely low concentrations."



In 2001, De Schryver's work in COST Action D14 won him the Max Planck Research Prize in the chemistry field, an annual award for "outstanding, internationally recognised scientific achievements".

COST has been instrumental in the development of his team's close collaboration with top synthetic development groups around Europe, he says. "It has helped to make transnational academic exchanges a routine component of the research conducted by all our doctoral and post-doctoral students. The Action has allowed us to coordinate complementary know-how around shared goals in a way that greatly accelerates the transfer of knowledge."

COST is flexible and responsive to scientific demand

Scientific investigation leads to unexpected results. One breakthrough can open up a whole new set of challenges and unknown quantities to attract researchers. Since COST Actions can be set up in any scientific field, it is ideally placed to support international co-operation in new areas of science. As COST has no fixed domains, resources are not tied up in old areas longer than is necessary, and new areas can be opened up easily. Likewise, when it comes to multidisciplinary research, COST has the flexibility to bring together researchers from different fields in a single Action quickly. At the level of a COST Action, researchers need only to gather colleagues from four other member countries to launch the Action. Of course, if the topic is big, many more can be involved – and there is no limit to participants from any individual country. When a new direction opens up, a new team can join an Action; if part of the work is concluded, a partner may leave without harming that Action. In fact, at any point during an Action, additional menber countries may join.

Food for crops

Sometimes policies to improve quality of life and the environment have unexpected consequences. Following the introduction of measures to improve air quality by reducing harmful sulphur emissions from industry, crops across Europe were found to have a sulphur deficiency. Sulphur is an essential nutrient for plant growth and the production of good quality crops, although sulphur requirements vary significantly between species.

Recent phenomenon

"It was only ten or 15 years ago that this problem was noticed, and one of the main reasons was the anti-pollution measures," according to Dr Malcolm Hawkesford of the UK Biotechnology and Biological Sciences Research Council, who leads one of four groups in a COST Action addressing plant sulphur research. "This COST Action has been very good for the field since it was launched just as awareness of the problem was growing. Many research groups across Europe were interested in sulphur, but COST was the only mechanism through which these groups from different fields and countries could come together. In fact, the Action has helped to raise awareness of the problem, and there are now more teams in this field than there were when we started.

"Correcting the sulphur deficiency in crops is relatively simple," says Hawkesford, "since sulphur can be added to the fertiliser regime. But farmers need to know how much they should add, and at what stage in the growth cycle, for optimum crop quality." Adding too much sulphur could be just as damaging to a plant as the lack of sulphur the grower wants to correct, and could also be environmentally harmful.

New connections

"The COST Action has brought together researchers from different disciplines – which is good in itself, since we had very little contact before then," Hawkesford emphasises. "Within the Action we have teams coming from both the traditional agronomy/plant nutrition side and molecular biologists interested in the genetic composition of plant species."

On one hand, teams are trying to optimise the process of feeding the nutrients to crops, and on the other, different teams are investigating the sulphur requirements of different species. By ascertaining the optimum levels of sulphur for each plant species, the biologists determine not only the quantities to be added to fertilisers but also the levels needed for the best quality food harvest. Other researchers within the Action are looking at the development of environmentally friendly methods of fertilising – since traditionally most industrial fertilisers have not had added sulphur.

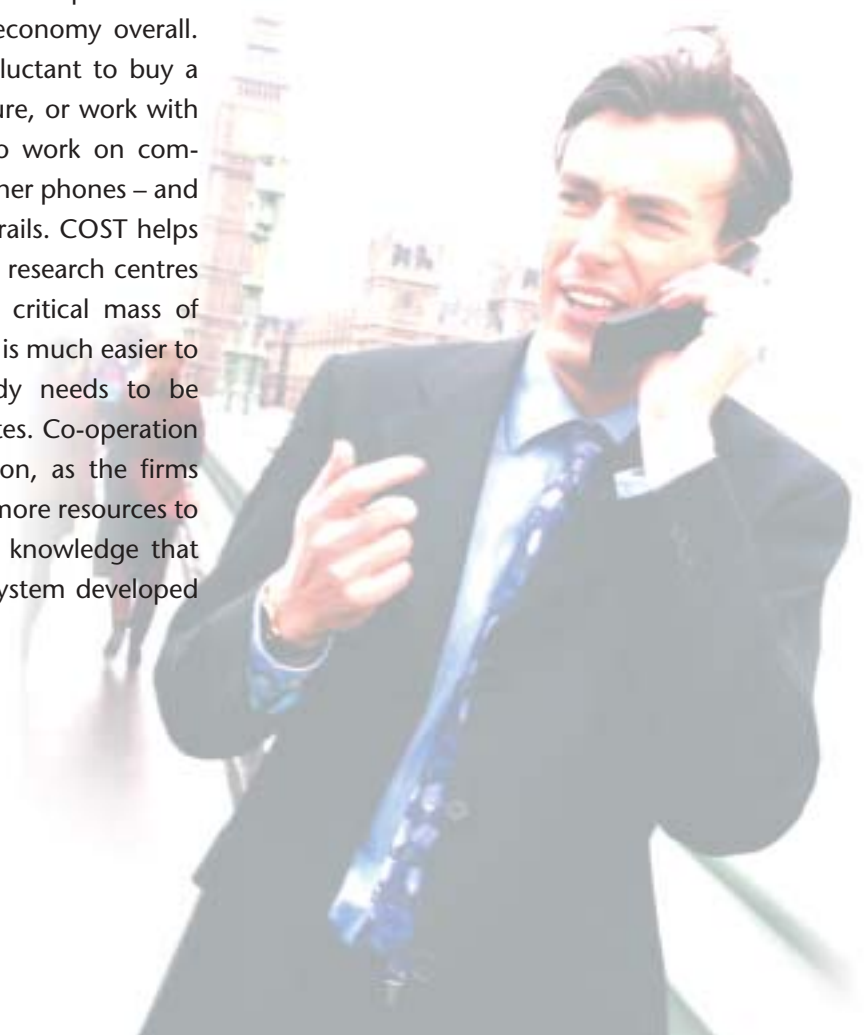
With over 40 research teams involved, the Action has helped integrate this whole field across Europe, Hawkesford believes. As the COST Action draws to a close after six years, the scientists involved aim to set up a network and apply for funding from the EU's Sixth Framework Programme. "Many of the labs are now working together to find ways of continuing our work and developing spin-offs from it," Hawkesford concludes.

What's cooking?

Modern lifestyles demand convenience foods which often have to be processed to improve their shelf lives. Heating is usually a key part of this process, and critical to the taste, texture and even nutritional properties of foodstuffs, but recent findings by food scientists suggest that heating itself may lead to the formation of contaminants. Acrylamide is one particularly harmful component, found especially in fried potatoes. A new COST Action is already being set up to investigate this new problem and to determine its significance for human health.

COST helps European industry set global standards

Europe's companies need to develop world-leading products and services both to improve their own position in the markets and to develop the European economy overall. Customers, on the other hand, are often reluctant to buy a new product if they are unsure if it will endure, or work with their existing equipment. Software needs to work on computers, phones need to communicate with other phones – and even curtain hooks need to fit on to curtain rails. COST helps European firms to work together – alongside research centres – to set reliable, robust standards. Once a critical mass of manufacturers base their products on these it is much easier to gain the confidence of consumers: nobody needs to be reminded of the introduction of video cassettes. Co-operation in standard-setting often benefits competition, as the firms involved in setting the standards can devote more resources to developing their individual products, in the knowledge that customers will not be waiting to see if the system developed by their competitors will be better.



Just a phone call away

In many countries there are now more mobile phones than landlines. Fundamental to their success is the ability to use a mobile practically anywhere – in town or in the country. Whether you cross a frontier on a two-hour shopping trip or travel round the world on holiday, the mobile phone keeps you in touch with family, friends and work, for better or worse.

The reason for mobile phones' huge popularity is the GSM standard. This is why mobiles can connect through base stations and networks around the world, and why a handset from any manufacturer may be used throughout Europe. GSM is a standard developed in Europe, enabling European manufacturers to remain consistently at the forefront both in sales and in developing new products.

A European success

"GSM has been such a big success for Europe because we set our standards – at European level – early," says Professor Francesco Fedi of Italy's Ministry of Education, Universities and Research, who chairs the COST technical committee in the telecommunications and information science and technology (TIST) domain. "The standardisation work was led by the European Telecommunications Standards Institute, and a series of COST Actions made major contributions to this work.

"In the beginning of GSM's development there were many doubts, for instance about whether speech could be compressed sufficiently, or whether reception could be reliable in built-up areas," recalls Fedi. "The network of laboratories established under the COST Action were heavily involved in testing proposed standards, using common simulation programmes. Many people believe that the standardisation process would have been slower without the assistance of COST in supporting that network." The co-operation throughout Europe on GSM has put Europe's industry in a leading position for future developments. Indeed, work is already under way on developing standards for fourth-generation mobile telephones (GSM was second generation). However, the third-generation system, UMTS, has been slow to take off, and Fedi believes one reason is the lack of a novel application. Or perhaps UMTS is just a victim of GSM's success?

Healthy phones

One of the most controversial issues surrounding mobile phones is the potential health risk associated with electromagnetic fields (EMF) emitted by antennae and handsets. With more and more devices in use, people are increasingly worried about possible associated health risks. COST has been working closely with the World Health Organisation's EMF project and European standards bodies to validate and develop standards for exposure to the public, and safety testing of mobile devices.

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"COST is an ideal structure for this," says Peter Wintlev-Jensen of the COST-TIST Secretariat, "as we need to bring together biophysicists and technical specialists. The work within this COST Action is basically long-term laboratory studies, using very strict protocols. Essentially it is about statistical comparisons of test results, and aggregating the results from many countries. COST work has also helped in setting a common research agenda for Europe, and has worked to make the difficult science more accessible to policy-makers and the public, he believes. "Despite the lack of identified negative health effects, it is important to continue research to ensure the safety of the public, and COST provides an ideal instrument," he emphasises.

Breathing cleanly

Factory workers, particularly those working with harmful raw materials or processes, must breathe air that is as clean as possible, both for their own health and the efficiency of their work. It is equally important to ensure that the neighbours outside a factory do not suffer from impure air either. The first-ever comprehensive guidebook of standards for industrial ventilation systems was developed by a COST Action, and includes a design methodology and options for energy-use optimisation and environmental amelioration.

COST activities are much wider than the EU

Right from its launch in 1971, COST has been distinct from – although linked to – the European Union (or European Communities then). Most obviously, the distinction has been, and still is, seen in its membership. Of the non-EU countries, Switzerland is a significant contributor to European science and has been a COST member since the beginning. The ten countries expected to join the EU in May 2004 have also been full COST members for years, with their scientists and institutions fully integrated in a wide range of domains. As the Balkan region recovers from conflict, most former Yugoslav states are now COST members and their researchers are involved in many COST activities. But participation in COST Actions is not limited to member countries. Researchers from Europe's neighbours are becoming more and more involved in COST. Good science needs the best research teams: whether they happen to be in Australia, in Brazil, or in Canada, they should be able to participate.

Power for the future

Hydrogen is used to send rockets into orbit, and hydrogen-powered demonstration vehicles are now common around the world. However, compared to conventional fuels, producing hydrogen on an industrial scale is still very expensive – and on top of that storage and distribution networks also represent massive investment costs before hydrogen can become an everyday fuel.

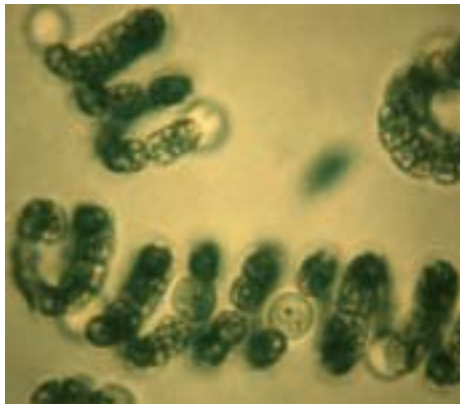
Natural process

Hydrogen is the most common element in the universe, with the highest energy content relative to weight. It is produced widely in nature, so harnessing that natural process to fulfil society's energy needs is clearly a very attractive prospect. Hydrogenases are enzymes which act as the catalyst in a process which produces hydrogen from organic matter. There are many different forms of hydrogenase, but research has found that they operate in similar ways.

"We can already grow these organisms on a pilot scale – we know it works," says Professor Wielfried Hagen of the Department of Biotechnology at Delft's University of Technology, who chairs a COST Action investigating hydrogenases. "The challenge is to scale up the process to produce hydrogen on an industrial scale from biomass, and to develop a reliable, stable process." Within the Action, some teams are trying to recreate a hydrogenase-like catalyst using biochemical techniques, while others are looking at the possibility of modifying hydrogenases to produce a more stable catalyst.

Global scale

COST work in the field was launched by a Hungarian research team, which instituted a series of international conferences on hydrogenase in 1985. The leader of this team, Professor Kornel Kovacs of the University of Szeged, chaired a first COST Action on the subject and remains closely involved in the current Action. In fact, this was the first Action initiated in a central European country. COST funding has supported the subsequent conferences on hydrogenase, now held every three years.



It is not just European countries that are interested in this field. "We have contacts with major research groups in the USA, Japan and Russia working on hydrogenases," according to Hagen. "I would say something like 85% of researchers in the field across the world are involved." Teams involved in the COST Action also co-operate through a United Nations Economic Commission for Europe initiative on hydrogen power.

Earth moving

With a long history of mining, central European scientists have much expertise in studying micro-displacements of the ground due to tectonic activity. Czech, Polish and Slovak scientists are taking the lead in a COST Action which is helping those Mediterranean countries where seismic processes are more active to develop their monitoring activities. The central European scientists have developed highly sensitive monitoring equipment which can play a role in preserving historic structures that are widespread in the Mediterranean region.

Knowing society

COST also supports co-operation among social scientists and, in this field, central and eastern European countries have less experience than in other scientific disciplines. COST has therefore been able to play a significant role in bringing social scientists from these countries into European networks. One Action, for example, was able to introduce policy-makers from the region to a wide range of vocational education and training systems, offering the opportunity to develop new policies to answer the challenges of globalisation.

COST can act before others, piloting co-operation in new fields

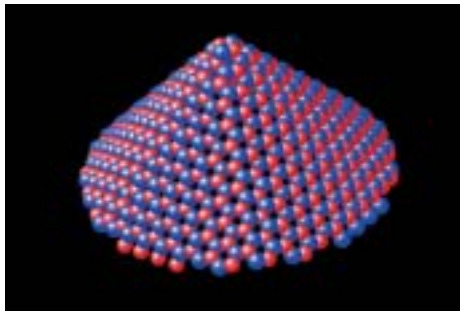
Its flexible structure, in which scientists choose the fields for co-operation, means COST is not tied to predefined areas. As new fields develop – particularly in multidisciplinary areas – it is often clear that pan-European collaboration is needed if European research activities are to reach the critical mass needed to advance. In contrast to many other mechanisms, COST can set up support for co-operative work in new fields quickly. Whilst it cannot fund large-scale activities, what it can do very well is to prepare the ground for future programmes using other instruments which may not be able to react so quickly. COST Actions are extensive enough to demonstrate both the interest and value of research in a new field. Having worked together, the networks of scientists created within COST are then well placed to apply for funding under other mechanisms, such as the EU Framework Programme, when new programmes are opened up in that field.

Smaller together

Nanotechnology – working in the microscopic scale (a nanometer is one millionth of a millimetre) – has taken off in the past ten years or so. Nanotech is not a new discipline, but rather, as a result of scientific advances, brings together several disciplines to work in a new dimension. Initial work was led by chemists and physicists, but developing nanotech applications now brings in scientists from many other fields. COST's ability to bring together research teams from different disciplines makes it ideally suited to stimulating multidisciplinary collaboration in the nanotechnologies area. With this in mind, in the mid 1990s, COST set up a working group to explore what impetus it could give to European nanotechnology research.

Widespread inputs

As a rapidly developing field, it is impossible to foresee how nanotechnology research efforts will develop. Consequently, there is a need to monitor progress, find bottlenecks and propose solutions. Identifying promising new areas and, just as



importantly, gaps where research should be taking place, is also vital if Europe is to play a leading role in nanotechnology.

The structures set up within COST to promote nanotech research have brought together representatives from over 30 different Actions, in domains such as medicine, agriculture, materials and information technology, as well as chemistry and physics. The ability to bring together such diverse fields illustrates one of COST's fundamental strengths. Furthermore, as the experts involved were not just from existing COST Actions, they were able to put forward fresh viewpoints.

Raising awareness

One of the key initiatives launched within COST was the NanoForum nanotech information service, centred on a website[1]. The researchers working in NanoForum were able to consolidate their network, receiving funds from the EU's Fifth Research Framework Programme to set up a 'thematic network'.

More significantly, the influence of the network has been a significant factor in raising awareness of the need for nanotech research in Europe, and the extent of the opportunities and potential applications in the pipeline. One result of the increased knowledge of nanotech is that it is included in one of the seven thematic priorities to receive funding within the Sixth Research Framework Programme (FP6). That will bring €700 million in funding for research projects in nanosciences and nanotechnologies over the four years to 2006. In addition, FP6 funding will help raise awareness of nanotech further, building on the pioneering work done by COST.

(1) http://www.nanoforum.org/

Surgical enhancement

A relatively new multidisciplinary field in which COST is developing new structures is that of biomaterials. These are advanced materials which need to be accepted by the human body, used either in medical tools in operations and treatment, or as prosthetic or implanted devices. Clearly co-operation between materials scientists, biotechnologists and medical scientists is fundamental to this field. COST has set up a mechanism to support the development of biomaterials science in Europe, with the involvement of all the relevant support frameworks, and to improve the availability of information on the field.

A strong future for **COST**

Over more than three decades, COST has developed a reliable and valued method for bringing together research teams from across Europe. It represents remarkable value for money, with over 20,000 scientists on average participating in COST networks each year. The funds provided by COST to support those networking activities represent an average of less than €1,000 per researcher each year.

Adding value

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. A major reason for that is the flexibility inherent in COST's structure. In principle, there are no barriers to participation: any group of scientists from across Europe, working in any field, may apply for COST support at a time of their choosing.

Another reason for COST's success is the enduring nature of the networks it helps establish. Once a COST Action has been concluded, the participants will almost always seek to continue their work together, although not necessarily in an identical set-up. Networks supported by COST will often include members from outside the world of science, bringing researchers together with policy-makers, consumer groups and industry to develop common understandings and approaches to problem solving. Thanks to this, COST is able to react quickly to new problems and phenomena, responding to the needs of European society.

Encouraging participation

Young researchers are the future of European science. COST has always sought to support their professional development, in particular through scientific exchanges between laboratories. A fundamental principle of COST is its openness – just as individual researchers who participate vary in their experience in their field, so too do the institutions that host the research teams which participate. From the smallest to the largest, COST welcomes them all.

Although it remains fundamentally a European initiative, COST is reacting to Europe's growing openness to its close neighbours. It is already open to researchers from around the world, but coming years will see efforts to encourage greater participation from neighbouring countries. These countries share many common concerns with COST member countries, and encouraging research co-operation will help all of us to solve these problems faster. In particular COST is helping to bring scientists from the former Yugoslav nations into the European mainstream, as it has already done with those from the central European countries.

COST has a track record of more than 30 years supporting excellence in European science. Its place is at the centre of the developing ERA as an instrument which supports its core principle: developing co-operation between national research activities.

COST Actions cited in this brochure

Domain	Action No	Title	Page
Agriculture and biotechnology	829	Fundamental, agronomical and environmental aspects of sulphur nutrition and assimilation in plants	15
	841	Biological and biochemical diversity of hydrogen metabolism	19
Chemistry	D8	Chemistry of metals in medicine	11
	D14	Functional molecular materials	13
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Food sciences	927	Molecular effects of nutrition	15
Forests and forestry products	E9	Life-cycle assessment of forestry and forest products	9
Materials	532	Triboscience and tribotechnology: superior friction and wear control in engines and transmissions	11
Medical research	B12	Development of new radiotracers for the *in vivo* assessment of biological functions and drug interactions	13
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	72	Measurement of precipitation by radar	5
	73	Weather radar networking	5
	75	Advanced weather radar systems	5
Oceanography	40	European sea-level observing system	5
Physics	P5	Mesoscopic electronics	9
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	235	Radiowave propagation effects on next-generation fixed service terrestrial telecommunications systems	17
	259	Wireless flexible personalised communications	17
	281	Potential health implications from mobile communication systems	17
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	349	The accessibility of coaches and long-distance buses for people with reduced mobility	7
Urban civil engineering	C6	Town and infrastructure planning for safety and urban quality for pedestrians	7
	G3	Industrial ventilation	17

This brochure presents a small selection of COST Actions. Full details of these and all Actions can be found on the COST website, at: http://cost.cordis.lu/

European co-operation in the field of scientific and technical research (COST) is an initiative with 34 member countries which has supported networking activities amongst European research teams for more than three decades. This brochure underlines the role of COST in the developing European Research Area, and presents a range of Actions supported by COST.

Further information on COST can be found at **http://cost.cordis.lu/**

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