European Commission

HORIZON magazine

Special Issue

March 2015

EU Research Framework Programmes

1984 -2014

Research and Innovation

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Luxembourg: Publications Office of the European Union, 2015

44 – 210 x 275 mm

ISBN 978-92-79-40824-3
doi 10.2777/95988

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EDITORIAL

The very first Europe-wide Framework Programme for research was launched 30 years ago to bring together expertise from across the European Community, as it was then known, and make Europe more competitive in key technologies.

Since then, the Framework Programmes have become a major part of research cooperation in Europe, growing progressively in size, scope and ambition. Their objective has also evolved from supporting cross-border collaboration in research and technology to now encouraging a truly European coordination of activities and policies. The reason for this is simple: research, technology and innovation are at the core of Europe's economy and are vital for a successful society.

Today, Horizon 2020, the eighth Framework Programme, is the biggest and most ambitious with a budget of EUR 80 billion.

It represents a significant step forward because it brings all EU support for research and innovation together within a single programme. With Horizon 2020, research and innovation will play a vital role in European Commission President Jean-Claude Juncker's agenda to strengthen Europe's competitiveness and boost jobs and growth, and will help us find the answers to major societal challenges such as health, climate change and energy security.

This special issue of Horizon magazine celebrates 30 years of the Framework Programmes. Through articles and interviews with key players, it tells the story of their conception and evolution, highlighting some of their major achievements through the years.

But this special issue is not an exhaustive review of the Framework Programmes – you would need far more than 44 pages to describe all the major achievements of these programmes, and do justice to the thousands of people who have contributed to their success. Nonetheless, we hope it will give you a flavour of this flagship European endeavour, which has gone from strength to strength over the last 30 years.

We would like to pay tribute to the many people who helped to make this possible, including Commissioner Máire Geoghegan-Quinn, who has been instrumental in shaping Horizon 2020.

And finally, we wish to acknowledge the thousands of people whose talents have turned Framework Programme funding into excellent research and new technologies and products that improve our lives. They deserve our greatest thanks.

Carlos Moedas
European Commissioner
for Science, Research and Innovation

Robert-Jan Smits
Director-General,
Directorate-General for Research
and Innovation, European Commission

EUROPE'S FRAMEWORK PROGRAMMES

A KEY ELEMENT
of research policy in Europe

BY PETER O'DONNELL & BEN DEIGHTON

Over the last 30 years a sense of deliberate collaboration in research has emerged.

European research funding evolved from a handful of separate programmes to become a major component of the research and innovation landscape in Europe.

'The European Framework Programme is now a key reference for countries outside the European Union,' said Professor Jean-Pierre Contzen, a former director-general of the EU's in-house research service, the Joint Research Centre, who was involved in setting up the First Framework Programme.

Research has a long history in Europe, but the emergence of what is now the European Union has created a novel concept of European research. Over recent decades, it has gradually acquired the sense of deliberate collaboration between European countries linking first their research activities, then their policies in this field.

This wasn't always the case. In the 1950s, early EU research funding was limited to a few industrial sectors: coal, steel and atomic energy. In the decades that followed, separate research programmes were launched in energy, environment and molecular biology.

When Étienne Davignon became the European Commissioner for Industrial Affairs and Energy in 1981, he decided to rationalise these initiatives by putting them together in a single coherent framework. Two years later, the First Framework Programme was drafted by Prof. Contzen along with a colleague Louis Villecourt.

From its debut in 1984, the Framework Programme has expanded in scope and scale – matching the evolution of the EU itself. Its legal basis was strengthened and its objectives were refined and extended. In 1986, the Single European Act included for the first time a specific chapter on research, which put the emphasis on applied research aiming at supporting the competitiveness of European industry.

In the 1980s there was only a small programme to support fundamental research. By 2007, the European Research Council (ERC) had been launched. The ERC, which represents 17 % of the EUR 80 billion budget of the current Horizon 2020 Framework Programme, supports fundamental research carried out by individual teams.

As the EU enlarged, candidate countries had the chance to participate in research collaborations through the Framework Programmes, sometimes years before they became members. A wider international dimension was progressively built into EU research policy. Transnational cooperation was progressively extended to more and more countries beyond the EU, across the entire world. That process culminated in the opening of all EU research programmes to the participation of teams from non-EU countries.

In recent years, the Framework Programmes have also featured new forms of support in the field of result-oriented research. They have pioneered the creation of large joint undertakings that bring public and private actors together in subject-specific partnerships – ranging from aeronautics to nanoelectronics and pharmaceutical research. Schemes for collaboration between public national research organisations and programmes have also been set up.

‘There has been a positive evolution in the sense that there is perhaps more cooperation between what is done at the European level and what is done at the national level.’

– **Professor Jean-Pierre Contzen,**
former director-general of the Joint Research Centre

COORDINATION

As they have evolved, the Framework Programmes have enabled better coordination of research between the European Commission and national governments. Member States have gradually increased the level of research coordination and the growing scale and scope of the Framework Programmes has been instrumental in this.

A key step in this respect was, in early 2000, the launch of the European Research Area (ERA) initiative by Commissioner Philippe Busquin, on the basis of ideas from two of his predecessors, Ralf Dahrendorf in the 1970s and Antonio Ruberti in the 1990s. The ERA was at the heart of the Lisbon Agenda and was included in the 2007 Treaty on the European Union (Treaty of Lisbon).

‘Most of the Member States still continue to decide by themselves their priorities, but there has been a positive evolution in the sense that there is perhaps more cooperation between what is done at the European level and what is done at the national level,’ said Prof. Contzen. ‘Also, I think that Member States have accepted that, in some areas, the lead should be at the level of the EU.’

The impact of the Framework Programmes is clearly visible in 30 years of cross-border collaborations between Europe’s scientists, in the rise in research activity across Europe – particularly in the newer Member States – and in the emergence of an increased reflex for cooperation among researchers and heads of research organisations in Europe.

National research strategies have increasingly borne Europe in mind, and the growing synergy between research policy and innovation policy has led to greater convergence of objectives, as demonstrated by the current Horizon 2020 Programme with its emphasis on delivery of solutions for the major societal challenges that Europe faces.

After 30 years of development, the EU’s Framework Programmes have become a key element of research policy in Europe. ■

Dr Walter Mönig

The Framework Programmes have shaped the way research is done

BY PETER O’DONNELL

Academics and companies have learnt to cooperate across the EU, making Europe more innovative and more efficient, according to Dr Walter Mönig, Chairman of the Board of Governors, the EU’s Joint Research Centre.

How have the Framework Programmes influenced the development of EU research?

‘Although EU finance represents only around 5 % of the overall public money for research in Europe, the Framework Programmes have changed the direction and structure of European research. The requirements for projects to engage participants from several countries, together with support for mobility of researchers, have made an international approach to research the norm in Europe. Reliance on merely voluntary guidelines could not have achieved the same degree of coordination.’

What are the specific achievements of the Framework Programmes? What has changed?

‘Overall the structural and integrating impact of the Framework Programmes has made some developments possible that would otherwise not have occurred. They have set standards for effective competitive funding, and are now role models for national programmes – helping create a real European Research Area. Companies and academics have learnt to cooperate with unknown partners in other countries, changing the research mindset and making research more efficient.

‘The concentration of research activities within a single Framework Programme has created a critical mass of stakeholders who are able to negotiate an ever-growing share of the EU budget, and the establishment of the European Research Council (ERC) and the allocation of grants for individual researchers and teams on subjects of their choice have strengthened Europe’s attractiveness for top scientists across the world.’

Which forces have driven the evolution of the Framework Programmes?

‘The Commission has leveraged scarce EU funds so that national funding reflects the chosen EU priority areas. The growth in the programmes also responds to broader recognition of the needs of a knowledge society and of the importance of international collaboration.

‘However, the early focus on strengthening the competitiveness of European industry has given way to an approach which makes more room for social challenges and basic research.’

During the development of the Framework Programmes, are there things you would have preferred to see happen differently, or opportunities missed?

‘Instead of defining specific programmes with hundreds of details for a period of seven years, a Framework Programme, in my opinion, should do no more than outline the objectives and set the upper limit of funding. Details should be regulated by delegated acts and work programmes, reducing the involvement of the Council and the European Parliament. And sustainable structures with a clear long-term remit – like the ERC – should be established for an indefinite period.’

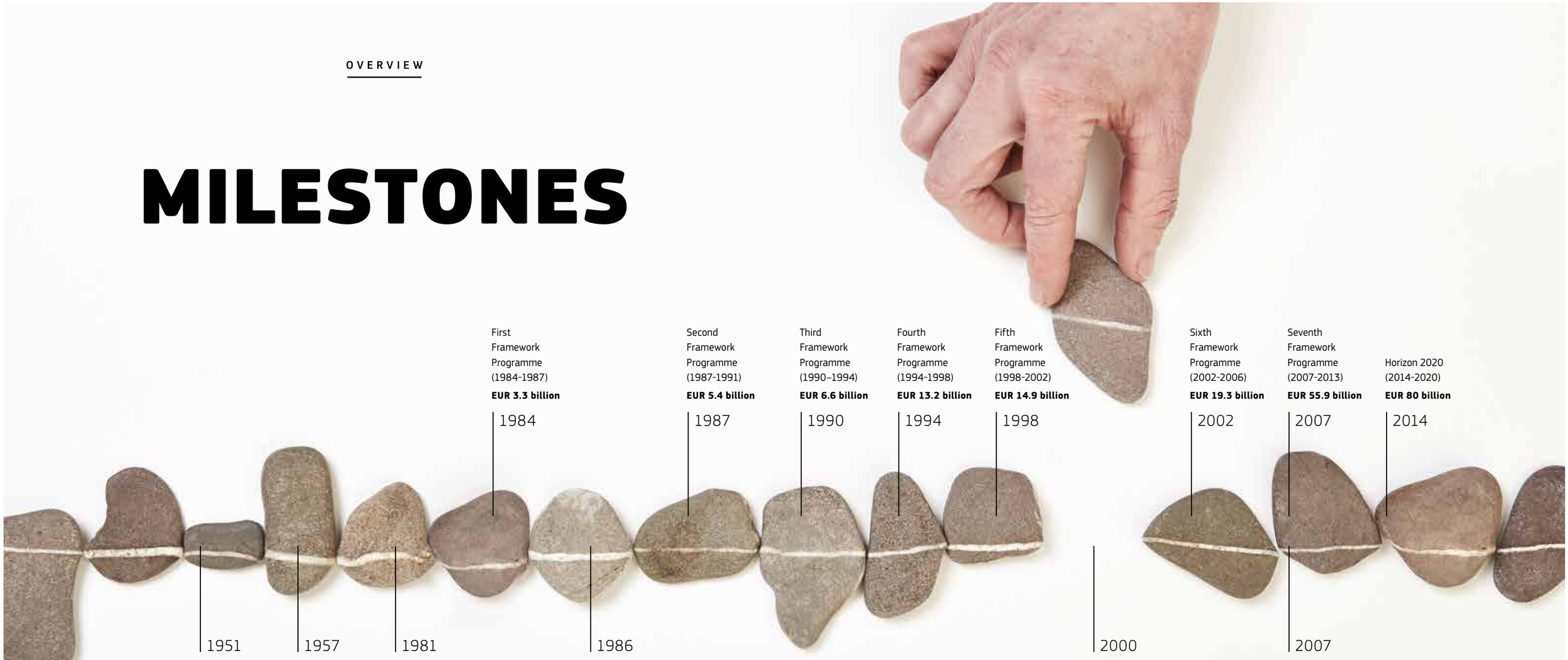
‘The structural and integrating impact of the Framework Programmes has made possible some developments that would otherwise not have occurred.’

– **Dr Walter Mönig,**
Chairman of the Board of Governors, the EU’s Joint Research Centre

Are there lessons for the future in the history of the Framework Programmes?

‘The development of European research policy through the growth and diversification of the Framework Programmes is a unique success story. The programmes have boosted the competitiveness of European industry, widening their priorities to include societal challenges and frontier research in a process of organic growth. And further improvements are constantly made from the experience gained.’ ■

MILESTONES



1951

Treaty establishing the European Coal and Steel Community (ECSC) signed.
It provides for the funding of research for the coal and steel industries.

1957

Treaty establishing the European Atomic Energy Community (EURATOM) signed.
It provides for research into nuclear energy between countries.

The Joint Research Centre (JRC) is launched.
It provides independent scientific and technical advice to the European Commission.

1981

Étienne Davignon becomes European Commissioner for Industrial Affairs and Energy and decides to rationalise research funding under a single framework.

1984

First Framework Programme (1984-1987)
EUR 3.3 billion

1986

Single European Act signed.
It includes, for the first time in an EU Treaty, a chapter on research.

1987

Second Framework Programme (1987-1991)
EUR 5.4 billion

1990

Third Framework Programme (1990–1994)
EUR 6.6 billion

1994

Fourth Framework Programme (1994-1998)
EUR 13.2 billion

1998

Fifth Framework Programme (1998-2002)
EUR 14.9 billion

2000

The Lisbon European Council launches the European Research Area (ERA).

2002

Sixth Framework Programme (2002-2006)
EUR 19.3 billion

2007

Treaty on the European Union (Treaty of Lisbon) signed.

The European Research Council (ERC) is launched.
It funds frontier research.

2007

Seventh Framework Programme (2007-2013)
EUR 55.9 billion

2014

Horizon 2020 (2014-2020)
EUR 80 billion

Máire Geoghegan-Quinn

The scale of Horizon 2020 is a vote of CONFIDENCE for research

BY BEN DEIGHTON

Member States' agreement to boost research funding by 30% shows just how crucial research and innovation are to Europe, according to Máire Geoghegan-Quinn, European Commissioner for Research, Innovation and Science 2010-2014.

Together with President Barroso, you were the driving force behind Europe's biggest-ever research programme. How hard was it to convince Member States?

'The 30% budget increase for Horizon 2020 is a real vote of confidence in the power of research and innovation. Going into the budget negotiations the signs weren't good. There were different groups of Member States fighting for agriculture, for Structural Funds, and those wanting to cut the overall EU budget. Research was at risk of becoming a casualty of this battle, but in the end it was one of very few budget areas to see a significant increase.

'We had to work very hard to achieve this, and the research and business communities also spoke out loud and clear on the risks to the European economy if research and innovation was cut. The European Parliament also backed the Commission proposals and in the end we saw that Member States realised how important this area is for jobs and growth.'

What was the pivotal moment?

'There were a few moments, but I will never forget a marathon Competitiveness Council meeting in Luxembourg in October 2012, under the Cyprus Presidency. After we had long discussions around the table and in the corridors, Member States agreed on the rules of participation in Horizon 2020, including the radical simplification measures proposed by the Commission.

The other key moment for me was the political agreement between the Council and the European Parliament in June 2013 under the Irish Presidency, effectively sealing the deal on Horizon 2020.'

'I think we'll be able to look back in years to come and see a programme that delivered what it promised.'

– **Máire Geoghegan-Quinn,**
European Commissioner
for Research, Innovation and Science
2010-2014

Did you achieve everything you set out to do when you started as research commissioner in 2010?

'We certainly achieved what we set out to do with Horizon 2020, including a larger budget, radical simplification, more attention to innovation and societal challenges, a focus on SMEs and gender equality. I think we'll be able to look back in years to come and see a programme that delivered what it promised.

'We have also taken a decisive step forward on the European Research Area (ERA). While this is a continuous process we have now created the conditions at European level to make the ERA a reality. What we need now is implementation at Member State level.'

You championed the under-representation of women during your time as research commissioner. What still needs to be done in this area?

'The situation is improving, albeit much too slowly. Fewer than a third of researchers in the EU are female, despite the fact that women graduates outnumber their male colleagues. The higher up you go, the worse it gets: only 10% of the rectors of universities are women. That is why we need a push to promote gender equality in research and we're leading by example in Horizon 2020 and in our work on the ERA.'

What advice would you give to your successor Carlos Moedas?

'I've met Carlos Moedas on a number of occasions now, and was very impressed by his performance at his European Parliament hearing. He has outlined the key issues perfectly: improve the framework conditions for research and innovation in Europe; deliver on Horizon 2020's promise; and defend the principle of excellence in research. So I don't think he needs very much advice from me – he has an excellent team supporting him in the European Commission.' ■

ENERGY IS AS IMPORTANT FOR EUROPE NOW AS IT WAS IN THE 1950s

BY PETER O'DONNELL & BEN DEIGHTON

In the 1950s, energy research was a force for peace in Europe, but climate change and the need for energy security mean it is at least as important now as it was then.

'Energy research needs to be one of the main factors of European integration,' said Professor Pierre Papon, the former director-general of the French National Center for Scientific Research (CNRS). 'This is a key point and history has shown it.'

With the European Coal and Steel Community, set up in 1951 to secure peace after the ravages of World War II, and the EURATOM organisation created in 1957, energy was among the first areas of transnational research cooperation in Europe.

Nuclear energy remains a major field of collaborative research, with the EU playing a leading role in nuclear fusion research, and making a major contribution to ITER, the experimental fusion reactor currently being built in Cadarache, France. EU research on nuclear fission concentrates on security and safety.

However, the search for clean, sustainable energy was still in its infancy when the Framework Programmes started in the 1980s.

It wouldn't be until the 1990s, when the newly established UN Intergovernmental Panel on Climate Change began to issue assessment reports, that climate change made its way into public consciousness, and government policy.

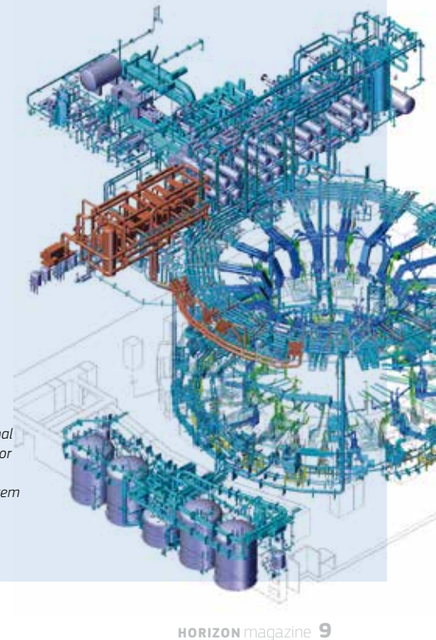
Under the Joule programme that started under the Second Framework Programme in 1987, research into energy efficiency and renewable energies became increasingly prominent, and by the Fifth Framework Programme EUR 1 billion had been invested in energy research.

The need to accelerate the development of sustainable energy and work out ways to efficiently manage the energy grid prompted the EU in 2007 to launch its Strategic Energy Technology Plan (SET Plan), which aims at accelerating the development and deployment of cost-effective low-carbon technologies. It is within this overall energy policy framework that EU research on new energy technologies has taken place since the start of the Seventh Framework Programme.

Europe still has work to do before it reaches its 2020 goal of 20% of its energy coming from renewable sources, with investment needed if an energy transition is to be achieved. That's why secure, clean and efficient energy has been named as one of the seven societal challenges of Horizon 2020, with almost EUR 6 billion of funding allocated to it. Given what's at stake, energy needs to be a policy priority once again for Europe. Its importance has been recognised by the new Commission with President Jean-Claude Juncker stating: 'I want to reform and reorganise Europe's energy policy in a new European Energy Union.' ■

'I want to reform and reorganise Europe's energy policy in a new European Energy Union.'

– **Jean-Claude Juncker,**
President of the European Commission



The hydrogen inside the International Thermonuclear Experimental Reactor (ITER) will be heated to 150 million degrees Celsius, but its cooling system will freeze parts of the plant to just four degrees above absolute zero.

From single technologies to large-scale PUBLIC-PRIVATE partnerships:

how industrial research is converging to keep Europe ahead of the game

BY REX MERRIFIELD

Europe's large-scale collaborations with industry are the culmination of 30 years of continuous research funding.

Europe's support for industry has evolved from single technology programmes to large-scale partnerships involving whole sectors and hundreds of researchers, and it's helping Europe's industry keep a leading position in sectors such as energy and transport.

Over a quarter of Europe's biggest ever funding programme – Horizon 2020 – has been allocated to help fund research partnerships between the EU and industry.

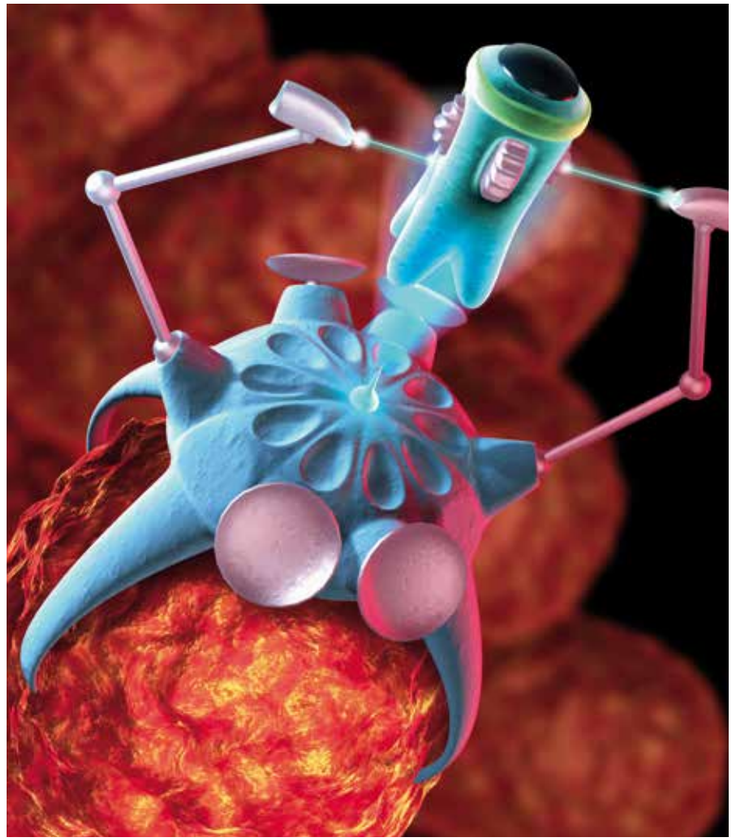
These public-private partnerships (PPPs) bring together EU research funding and entire industries in Joint Technology Initiatives (JTIs) and contract-based PPPs in sectors such as pharmaceuticals, aeronautics, electronics, hydrogen fuel cells, new factories, construction, chemicals and other process industries, and have ambitious goals such as developing new drugs, making industries cleaner and cutting emissions.

'The timescales of developing some technologies can be very long for a business and difficult to sustain, so support from the Framework Programmes can be a good way to get research going and to keep it going,' said Dr Léopold Demiddeleer, a former executive at Belgian chemicals group Solvay who has led the industrial research and development of hydrogen fuel cells and organic electronics.

However, these large-scale initiatives are the culmination of 30 years of continuous European research funding for industry.

Industrial research was already at the heart of the Framework Programmes in its first incarnation in the early 1980s. The focus then was on so-called pre-competitive research in single technology areas.

Étienne Davignon, European Commissioner for Industrial Affairs and Energy 1981-1985, who introduced the First Framework Programme in 1984, first put forward the argument that European research funding should help make industry more competitive.



A nanorobot manufacturing unit would be able to build other nanorobots using raw materials found within specially designed bacteria. Such devices could be used for building space colonies or terraforming planets.

This was embodied in the European Strategic Program on Research in Information Technology (ESPRIT) which in the 1980s linked researchers with the big industry players in the IT sector, who proposed what work was needed to compete with the US and Japan.

The 1980s saw the birth of parallel industrial programmes based on the model of ESPRIT: BRITE, which encouraged basic research in industrial technologies across all sectors, and EURAM, backing the research and development of advanced materials.

In the early 1990s support grew for larger 'integrated projects' in the Framework Programmes, which could help Europe's industries innovate and hold their ground against competition from Asia.

It took two years of negotiations for Member States to finally agree that EU research funding should support targeted research in the Fourth Framework Programme, which would help industry to become more competitive.

The focus broadened in the Fifth Framework Programme (FP5) to include measures that would make Europe a better place to innovate, such as a more efficient research infrastructure, and create a cleaner and safer environment.

Arturo García Arroyo, Director for Industrial Technologies at the European Commission's Directorate-General for Research and Innovation during the first five Framework Programmes, stated at the time that 'the key action concept of FP5 embodied all activities, combining the scientific knowledge and technological applications that will help develop and empower our industries to compete with their competitors and help European society develop a sustainable future'.

A NEW INDUSTRIAL FUTURE

During the Sixth Framework Programme (FP6), industry, public authorities and technology users came together as part of the new European Technology Platforms, which were designed to operate across sectors in areas such as manufacturing, construction, nanotechnologies and industrial safety. These forums for discussion and exchange provided a basis for the launch of the JTIs and contractual PPPs in the Seventh Framework Programme (FP7).

The impact of research funding through a consortium of research institutes, universities, small- and medium-sized businesses and large industrial groups is illustrated in the success of the ORION nanomaterials project, funded under FP7.

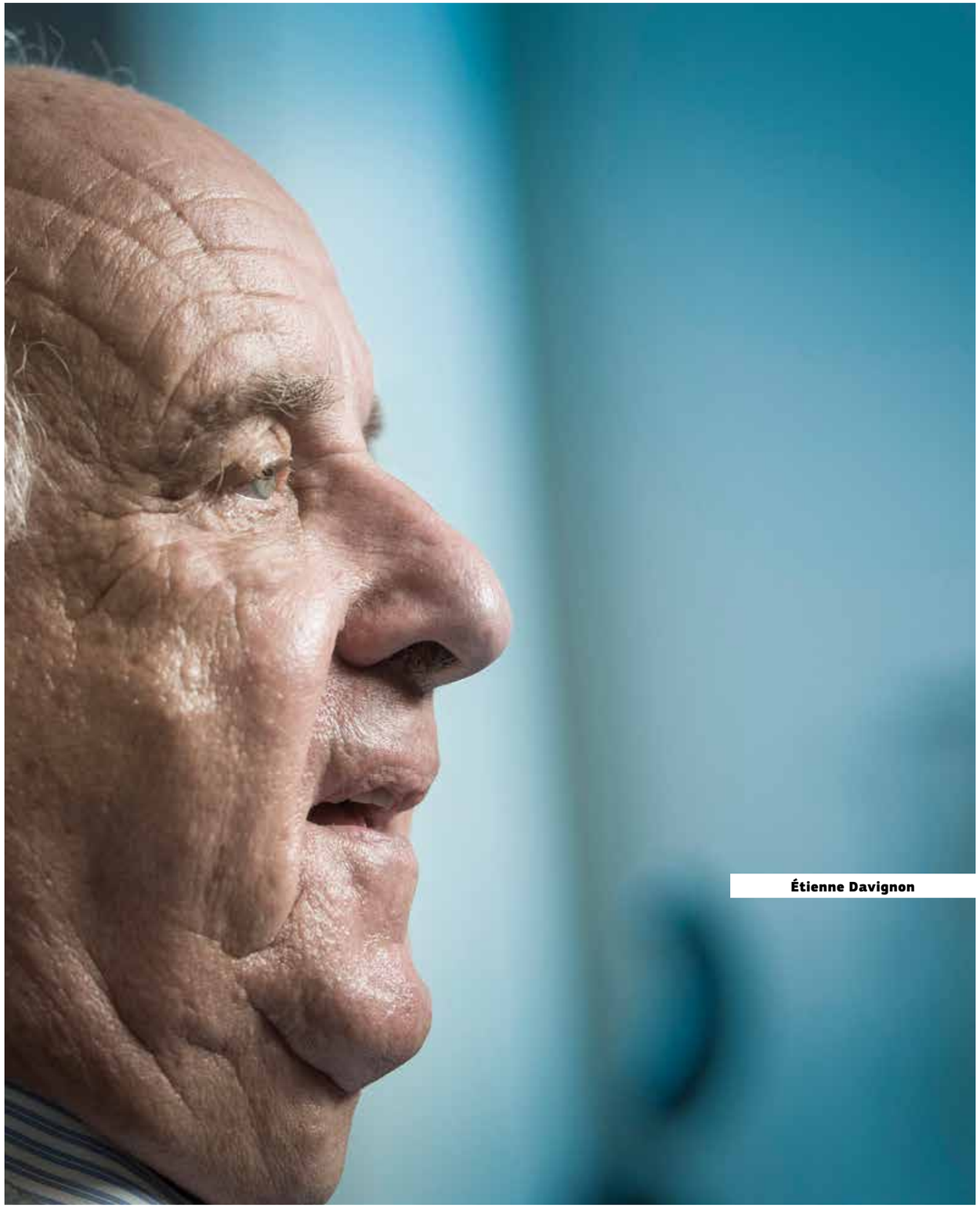
The four-year partnership has generated new technologies that can greatly improve rechargeable batteries, solar panels and light-emitting devices. It has sparked about a dozen patent applications and more than 70 scientific papers. Members of the consortium have also already launched some new products on the market.

The inclusion of emerging but disruptive technologies, such as nanotechnologies, in FP6 completed the full range of research activities that helped Europe to compete and to fashion a new industrial future.

This drive to use research funding to help promote innovation in Europe's industry through large partnerships is being developed further under Horizon 2020 via its industrial leadership pillar, which emphasises the importance of innovation in the quest for competitiveness, economic growth and jobs, and is encouraging thousands of projects that bring benefits to the wider economy. ■

'The timescales of developing some technologies can be very long for a business and difficult to sustain.'

– **Dr Léopold Demiddeleer,** a former executive at Belgian chemicals group Solvay



Étienne Davignon

The SUCCESS

of the Framework Programmes has helped show the vanity of national borders

BY BEN DEIGHTON

'Luckily the pessimists were proved wrong, and what I would like to see is that the pessimists are proved wrong once again.'

– **Étienne Davignon,**
Vice-President of the European Commission 1977-1985

The Framework Programmes have given Europe a leading role in science, showing that more things can be achieved by countries working together than alone, according to Étienne Davignon, European Commissioner for Industrial Affairs and Energy 1981-1985 and a former vice-president of the Commission, who introduced the First Framework Programme in 1984.

When you look back over the last three decades, what were the crucial turning points in the development of the Framework Programmes?

'The crucial points came in the early years. The first is the acceptance by the scientific community of the utility of a European programme, and I think this is important because if you don't have the support of those who are active, then you don't have the legitimacy of your ambition. The second is overcoming the reluctance of Member States to understand why European programmes are useful for them.'

Was there a pivotal moment when Member States conceded that European research had an important role to play?

'The pivotal moment was when ESPRIT (European Strategic Program on Research in Information Technology) was born, because this was an additional budget for an additional project. It was at the end of the time when I was a commissioner. We had a council of research ministers in October and, interestingly, the scientific advisor to Mrs Thatcher (the British Prime Minister at the time) had convinced her that this was a good programme, and the French then came and said, "we are all in favour, but instead of (us agreeing that the EU should give) the EUR 1 billion or the EUR 900 million which were requested, we will only (agree to) give EUR 600 million".

'I surprised the council at that time by saying "I have listened to what has just been said, I withdraw the programme". There was protest to the President of the Commission saying that I had taken a decision which had not been discussed by the Commission itself, that I didn't have the authority to do this. The President said that I had the authority, and in December (after another discussion) we approved the programme at the initial level. So it means that from time to time you can fight for what you believe in.'

What did industry-focused programmes such as ESPRIT, and BRITE-EURAM achieve?

'You have created a system by which industry, universities, and research centres are involved in a number of cooperative projects. The number of states and universities participating has created the network effect which is obvious in science today.'

When you look at Europe today, what part of it has been shaped by the Framework Programmes?

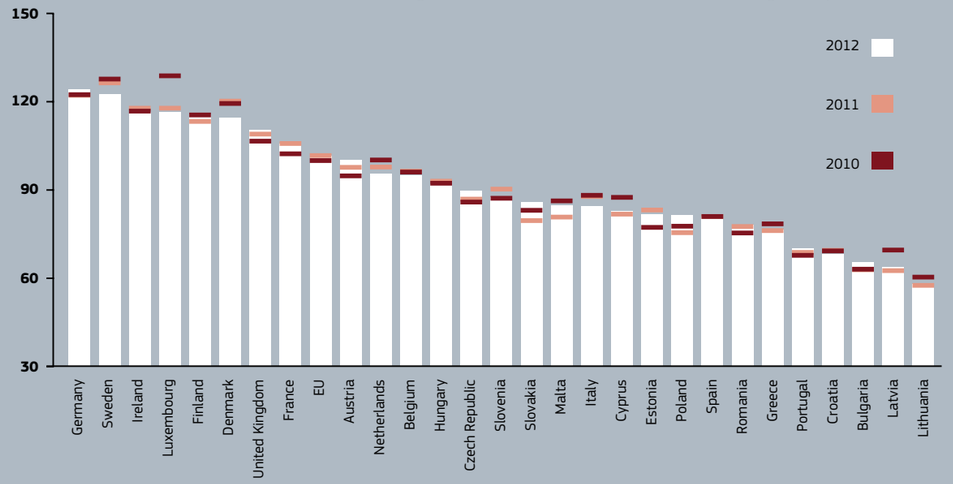
'They (the Framework Programmes) are still a small percentage of the totality of research funding which is being spent, so you can't say that they have been a fundamental shaping factor. But, on the other side, they have clearly demonstrated the vanity of national borders and, in that sense, they have not shaped but simply confirmed that you can do things better together than alone, and I think it was an important statement to re-make. It is also an element which gives credibility to the fact that scientifically Europe is strong. With globalisation there is a lot of feeling that Europe is on the losing side. The Framework Programmes have shown that a lot of important things can be done.'

What is the biggest lesson that you could draw from looking back over the last 30 years?

'That a lot of things we did were considered at the start as hopeless. Luckily the pessimists were proved wrong, and what I would like to see is that the pessimists are proved wrong once again.' ■

MEASURING INNOVATION IN THE EU

The innovation output indicator is a measurement used to estimate the production of ideas and changes that can make our lives better and how likely these are to reach the market and to create jobs. It takes into account the number of patent applications filed, the percentage of people employed in knowledge-intense industries and trade in medium and high-tech products.



Source: Eurostat, OECD, Innovation Union Scoreboard 2014, DG JRC

FUEL, MEDICINES AND BEER: THE MULTIPLE BENEFITS OF THE FIRST-EVER COMPLEX CELL TO HAVE ITS GENOME SEQUENCED

BY REX MERRIFIELD

Sequencing the genome of yeast has enabled researchers to develop new strains that can be used in biofuels or to make vaccines.

Yeast was the very first non-bacterial organism to have all of its genes sequenced, and the collaborative nature of the EU-funded breakthrough laid the foundations for the sequencing of the human genome less than 10 years later.

Unlocking the DNA of Saccharomyces cerevisiae, a species of yeast used in winemaking, baking and brewing, began through the EU's Biotechnology Action Plan (BAP) in 1989. Led by Belgian biologist André Goffeau, a total of 147 researchers from 35 laboratories linked forces to sequence chromosome III, one of the 16 chromosomes found in yeast, with the groundbreaking results published in 1992.

'Without the European funds, I don't think the project would have happened at all. It certainly wouldn't have moved as fast as it did,' said Professor Stephen Oliver, now of Cambridge University, UK, who led the team.

'Sequencing chromosome III … provided the keys to unlock the genetic potential of yeast and other organisms, because we could define what was there and begin to study the function of genes that, previously, we didn't even know existed,' he said.

Mapping the remaining 15 yeast chromosomes was completed with further Framework Programme support for an even wider consortium of researchers in the EU, the US, Japan and Canada, and published in 1996.

Funding from BAP's successors – the BRIDGE and BIOTECH programmes – helped to identify the functions of specific yeast genes. That was crucial in understanding similar genes in humans, and laid the foundations for sequencing the entire human genome, which was completed in 2003.

LOW ALCOHOL

Having a blueprint of the inner workings of yeast has been all-important in identifying and developing new strains for making beers and wines with particular flavours or lower alcohol, or to be used in hotter production regions.

New yeast varieties have also helped in efforts to reduce reliance on fossil fuels, through biofuels such as industrial ethanol and biodiesel from plant matter or waste from wood processing.

In medicine, the yeast genome map has allowed yeast to be used to produce new medications and vaccines, and in understanding diseases such as colon cancer and cystic fibrosis. It has also played an important role in developing treatments such as gene therapy.

'I think the synergy among yeast researchers within Europe was hugely boosted by the chromosome III project and the genome project,' Prof. Oliver said. 'The collaborations outlived the sequencing project itself and have continued through other projects.' ■

'Sequencing chromosome III … provided the keys to unlock the genetic potential of yeast.'

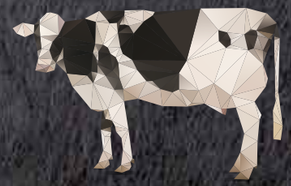
– **Professor Stephen Oliver,** Cambridge University, UK

THE MAD COW DISEASE CRISIS

how Europe's HEALTH RESEARCH came of age

BY GARY FINNEGAN

When a mystery brain disease jumped from cows to humans in 1996, a concerted effort by EU researchers helped to unravel its causes, and change food production for good.



'Very firm scientific relationships have been established that have lasted a very long time and continue to be productive in terms of publications and advancing scientific knowledge.'

– **Professor Bob Will,**
Professor of Clinical Neurology, University of Edinburgh, UK

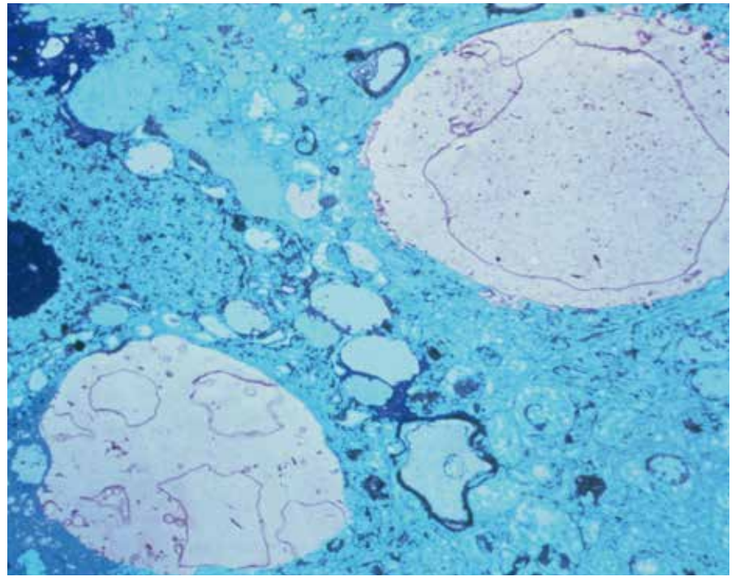
The outbreak was uncharted territory – a unique challenge requiring an unprecedented rapid response. There was no cure to Mad Cow Disease, or bovine spongiform encephalopathy (BSE), no vaccine, and nobody could say with confidence whether there was a risk of a major human outbreak.

Even though the Framework Programmes were seen primarily as a way to strengthen the competitiveness of European industry when they were launched in 1984, health research, along with environment, had been integral from the beginning and became increasingly important as they progressed. In addition, since its inception, EU research policy has addressed issues which are key to society, such as energy and transport.

However, the BSE crisis required something more – a vast effort of real-time coordinated research across Member States.

The alarm was first raised by a collaboration of experts from several countries – supported by

The BSE crisis led to a fundamental change in the rules governing meat traceability and food labelling.



The human form of BSE, known as Creutzfeldt-Jakob disease, causes brain tissue to become spongy, destroying nerve cells and leading to dementia.

the European Commission – who had been conducting enhanced surveillance for the human form of BSE, known as Creutzfeldt-Jakob disease (CJD), since 1993.

In early 1996 they announced a new variant of CJD, and by November that year the European Commission had put forward EUR 50 million to fund research on the disease under the Fourth Framework Programme. In total, around EUR 100 million of European research funds were invested to find answers to this potentially devastating disease between 1996 and 2008.

SCIENTISTS MOBILISED

As the crisis unfolded, scientists across Europe mobilised to deepen their understanding of the disease so they could improve diagnosis and contain the outbreak. National governments shared information and adapted their research priorities to address the problem.

Two BSE diagnostic tests, which were proposed to help decide which animals to cull for BSE control, were developed respectively by an Irish and a Swiss company thanks to EU funding.

The Joint Research Centre (JRC), the EU's in-house science service, was instrumental in validating these two diagnostic tests and reference materials for the disease, helping to ensure that the same high standards of testing were used across Europe.

During the crisis and its aftermath over 200 people died from CJD, while 4.4 million cattle were slaughtered in the UK as part of the eradication programme.

LASTING LEGACY

As a result of the crisis, a European research group on BSE was formed, disease surveillance networks were strengthened, and links were set up between experts from human and veterinary medicine.

'Very firm scientific relationships have been established that have lasted a very long time and continue to be productive in terms of publications and advancing scientific knowledge,' said Professor Bob Will, from the University of Edinburgh, UK, a leading CJD expert.

This research initiative was a crucial part of a broader coordination effort involving European and national authorities in food safety, which resulted in deep changes in the legislation and the practices in this field. It has helped form current regulations which stipulate that meat products must be labelled in such a way that an animal can be traced all the way back to the farm it came from.

Research aimed at monitoring society became increasingly important in successive Framework Programmes. To a large extent, as it showed how research could be put directly to the service of society, the EU's response to the BSE crisis anticipated and pre-empted the focus on societal challenges that now forms the backbone of Horizon 2020. ■

ATLAS OF 'AVOIDABLE DEATH'

The inclusion of societal problems into research funding programmes came through evolution rather than revolution, but there were a number of landmark projects that helped to prove the value of pan-European health research. One example was an ambitious project that looked at how and why people die – and whether these deaths could have been avoided thanks to quicker and more efficient care. By its sheer scale, the project which culminated in the publication of the European Community Atlas of 'Avoidable Death' in 1988 (which has been updated twice, most recently in 1997) was a perfect fit for a European venture. It allowed scientists to look at a much larger, more diverse population and examine genetic factors, lifestyle, and the differences in health systems and their efficiency. Ultimately, it helped improve the performance of health systems in Europe.

Because of the impact it had, the atlas was 'a seminal study', according to Professor Martin McKee, a specialist in European public health at the London School of Hygiene and Tropical Medicine.

The success of projects such as this proved to researchers and politicians that Europe had a unique role to play in health research. It was also an example of science that would go on to have an impact on society.

Professor Luc Soete

Social sciences can unlock the full value of new technologies

BY GARY FINNEGAN

Once seen as the Cinderella of EU research programmes in an era dominated by high-tech industries, social sciences and humanities are now essential to extracting value from research, says Professor Luc Soete, Rector Magnificus of Maastricht University, the Netherlands.

Why were social sciences initially seen as being of lower priority than 'hard' sciences?

'If you look at the historical context and the role of the European Commission, EU research programmes emerged as an extension of industrial policy. Research policy was all about competitiveness; it wasn't connected to university research or education. Almost by definition, social sciences and humanities were not high on the list of priorities at that time.'

What do you see as a major landmark in the evolution of EU support for social sciences and humanities research?

'The Targeted Socio-Economic Research (TSER) programme, under the Fourth Framework Programme, was a big one. With the rise of new technologies and high-tech industries, and the development of new services, there was a need to analyse the economic and social impacts of the changes that were taking place.'

What research questions could social sciences help to answer?

'Looking at the 1990s, there was for instance a big question about whether science and technology would create jobs or would in fact lead to unemployment. Digital technologies were emerging rapidly and ICT was having an impact beyond industry; it was having an impact on society.

'With the rise of new technologies and high-tech industries… there was a need to analyse the economic and social impacts of the changes that were taking place.'

– **Professor Luc Soete,** Rector Magnificus of Maastricht University, the Netherlands

'When the Services Directive (to remove legal and administrative barriers in the services sector) was being crafted, there was also a lot of discussion about diversity in Europe – economic, social, linguistic, cultural – and how this impacts on industry in the EU. Pulling social sciences into the Framework Programmes then became very logical.

'There is an incredible opportunity to look at how new digital technologies will change the way we deliver particular services. We would be in a much stronger position if more research had been done on the impact of digital technologies in a fragmented telecoms market.'

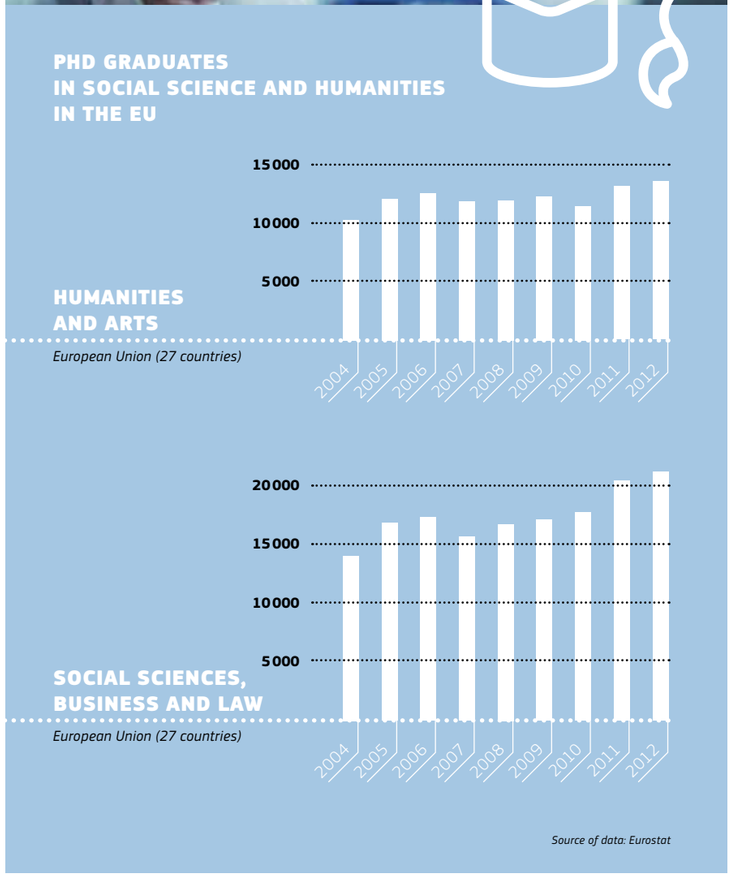
What kind of relationship needs to develop between social sciences and technology development, particularly in terms of EU projects?

'We are now living in a very different world from an industrial point of view (compared to when TSER was launched). Social and hard sciences are more integrated now; behavioural sciences are essential for research policy. When we talk about technology platforms – whether it's ICT or life sciences; nanotech or food – extracting the value from these technologies requires much more understanding of social and behavioural sciences. Social sciences are now viewed as presenting opportunities for the creation of value.'

How important was the launch of the European Research Council (ERC) in 2007 and its commitment to fund social sciences research?

'When the ERC was created it was pretty obvious that it would include all research, including social sciences and humanities. It had a tremendous impact on this area, nurturing quality research by giving prestigious grants to young researchers, and promoting mobility for scientists.

'Of course, the amount of funding available could be more and mobility also creates issues of brain drain which are being addressed, but overall the ERC has made a significant difference.' ■



Teresa Riera Madurell

We wanted to show citizens that science can make Europe a better place to live and work

BY GARY FINNEGAN

European policymakers wanted the EU's latest funding programme, Horizon 2020, to demonstrate how research and innovation make Europe more competitive and – in doing so – more attractive to its inhabitants, according to Teresa Riera Madurell, a former MEP who represented the European Parliament in the negotiations on Horizon 2020.

As 'rapporteur' you were responsible for preparing the report for the European Parliament on Horizon 2020. What was the role of the Parliament in shaping this programme?

'According to the Treaty, the Framework Programme must be adopted by the co-decision procedure, meaning the European Parliament has full legislative powers together with the Council of the EU. I led negotiations within the Parliament. Later, when the parliamentary groups had reached consensus, I had the honour and responsibility of leading the negotiations with the Council.'

What were your priorities during the negotiations to agree the content and budget of Horizon 2020?

'Europe 2020 sets out a vision of the continent as a knowledge-based economy, with a target of 3% research and development intensity to be achieved by the EU by 2020. Horizon 2020 becomes the Union's main contribution to reach this ambitious goal.

'After the long and difficult negotiations, the final agreement, on the EUR 80 billion budget at the service of European research and innovation during the next seven years, was the best deal possible with the Council. To compensate, we negotiated proposals aimed at using the budget in a more efficient way to try to multiply its effects all over Europe and to really reach our objectives of strengthening the EU's position in science, empowering industrial leadership in innovation, and tackling the societal challenges Europe is facing.

'The Parliament also prioritised the reduction of red tape; open access to scientific publications; a clear and ambitious budget for research and innovation in renewable energy sources and energy efficiency; a substantial budget for small- and medium-sized enterprises (SMEs); gender equality; better control of public-private partnerships; a proper role for social sciences and humanities; genuine dialogue between science and society; and strengthening researchers' competences and skills through reinforcing and properly funding the Marie Skłodowska-Curie programme.'

Horizon 2020 will devote 39% of funds to societal challenges. Why is this important?

'Knowledge must be at the heart of innovative answers to the societal challenges which are the greatest concerns of EU citizens. Therefore, Horizon 2020 reflects these major concerns shared by citizens in Europe and elsewhere as the main priorities to be funded.'

Will this help to make EU research more meaningful for European citizens?

'Horizon 2020, as a whole, is designed to contribute to integrating scientific and technological endeavour into European society. Our aim is to help citizens to be aware that research and innovation largely contribute to making Europe a better place to live and work, and that they improve Europe's competitiveness, boosting growth and job creation.'

Why is it important to allocate EUR 400 million for projects under the heading 'science with and for society'?

'Establishing an effective dialogue between science and society is an imperative. Horizon 2020 lays down the foundations for a genuine and fruitful dialogue to emerge. If we want science to be a priority for public investment, we need European citizens to share scientific values and recognise the contribution of science to progress.' ■

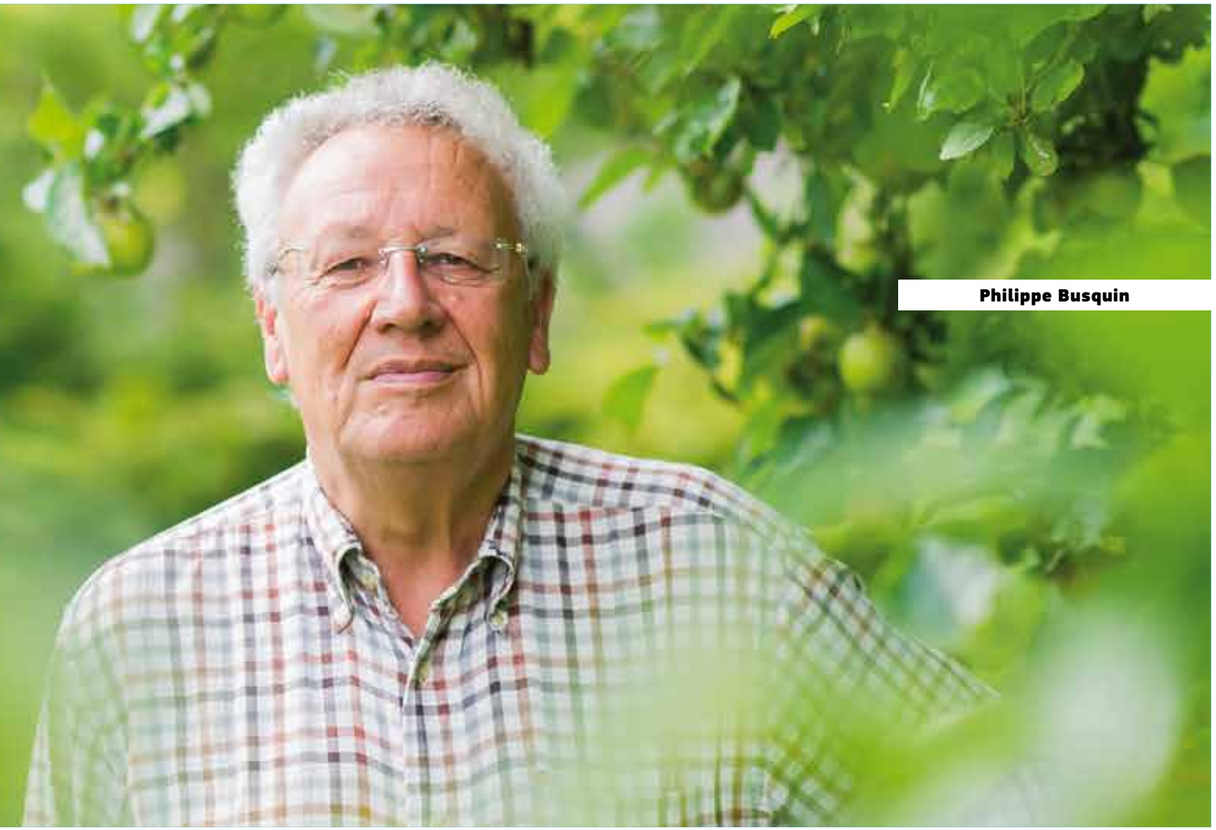
'If we want science to be a priority for public investment, we need European citizens to share scientific values and recognise the contribution of science to progress.'

– **Teresa Riera Madurell,** former MEP

The ‘PERFECT STORM’ to create ERA:

how an idea became a policy priority in just six months

BY GARY FINNEGAN



Philippe Busquin

Former research commissioner Philippe Busquin explains how on taking office in September 1999 he began to champion the idea of a European Research Area (ERA). Thanks to an exceptional set of circumstances, the ERA became part of the EU policy agenda in March 2000, setting the scene for a new level of scientific cooperation across the EU.

Where did the idea for the ERA come from and why didn’t it happen before?

‘It was put forward by Antonio Ruberti (European Commissioner for Research 1993-1995) at the time of President Jacques Delors, but was in fact based on the ideas of one of his predecessors, Ralf Dahrendorf (European Commissioner for Research 1973-1974). So it’s actually an old idea, but one which had never been put into practice. The Framework Programmes were seen as providing additional funding for research alongside the national programmes.

‘Several people had spoken to me about the idea of a European Research Area and straightaway I saw that we needed to transform this idea into a real political project. The Framework Programmes at this time represented 5 % of public funding for research in Europe and needed to be used as leverage.’

The ERA is often seen as a personal achievement for you. What role did you play?

‘President Romano Prodi, with whom I had a good relationship, had been preparing what would become the Lisbon Strategy, which aimed to make the EU a knowledge-based economy that would be the most competitive in the world by 2010. However, in the eyes of many, the knowledge-based economy was mainly concerned with information technology. I easily convinced Prodi to integrate scientific research into the heart of the project.

‘As soon as I was appointed, we started work. In a few months a document was drafted. On 1 January 2000, Portugal took over the EU Presidency. It so happened that the Portuguese Prime Minister at the time, António Guterres, was both a political ally and a friend. Together with Prodi’s backing for the project, Guterres’ support was decisive.

‘In January 2000 my document was very quickly put on the agenda. Prodi’s support and my network of contacts really helped. In just six months the document was approved and became part of the Lisbon Strategy. It was a real political statement.

‘At the European Council meeting in March 2000 the problem was that the text was so new for many of the delegations, and the bigger countries were asking what it was about. Despite our best efforts, the outcome depended totally on the willingness of the countries involved.’

What was the most difficult part of the negotiations?

‘Member States are always cautious when presented with an initiative coming from the Commission and want to stay in full control. The ERA was an invitation for them to better coordinate their activities and to set up a large market for research, which my successor Janez Potočnik would later call the “fifth freedom”, that of knowledge alongside the freedom of movement for goods, people, services and capital.

‘Well, the idea of coordination always created a lot of reluctance, notably among the larger Member States.

‘At the start of the negotiations we were not at all sure we would win. However, I succeeded in getting the UK research minister Lord Sainsbury’s support and that of his French counterpart, Claude Allègre, and with the backing of certain smaller countries – starting with Portugal and Belgium – we managed to convince everyone to move in this new direction.’

‘Despite our best efforts, the outcome depended totally on the willingness of the countries involved.’

– **Philippe Busquin,**
European Commissioner for Research 1999-2004

How significant is it that the Treaty on the European Union (Treaty of Lisbon) refers to ERA?

‘Up to this point, the objective of research policy, as set out in the Treaties, was to support industrial competitiveness. The Treaty of Lisbon legitimised the objective of coordinating national research efforts and the creation of a single market for research. At the same time, it explicitly allowed fundamental research to become an EU competence. This allowed us to create the European Research Council and give a European dimension to fundamental research.’

Which areas have benefited the most from the creation of the ERA?

‘The benefits are very clear in the case of large research infrastructures. There’s no point creating the same two infrastructures 200 kilometres away from each other in different countries, and large-scale projects of this kind are very costly. The establishment of the European Strategy Forum on Research Infrastructures (ESFRI) has allowed a real European policy to develop in different domains, such as synchrotron radiation sources, high-power lasers, and databases in biology.’

What can be done to make it easier for researchers to move around the European Union?

‘The problem of the social security status of researchers needs to be resolved by creating a specific status – that of a European researcher. A European Charter for Researchers exists, but it isn’t binding and we need to try to go further.’ ■

'In order that we can combine efforts you really need to have simple rules.'

– **Pr Maria da Graça Carvalho,** former MEP

The European Research Area (ERA) is taking shape in the community of researchers who collaborate across Europe, and it's thanks to the Framework Programmes, according to Professor Maria da Graça Carvalho, a former MEP who was instrumental in simplifying the rules of Horizon 2020.

Professor Maria da Graça Carvalho

The Framework Programmes are the most important tool to implement the European Research Area

BY BEN DEIGHTON

What has the role of the Framework Programmes been in helping to build the ERA?

'I see the ERA as a bottom-up process and an evolving process. The Framework Programmes are probably the most powerful tool for building the ERA. We are not starting from scratch though. Every researcher knows the other researchers in their field and they are used to working with each other and exchanging ideas. There is a strong link and this process was initiated by the Framework Programmes.'

What are your experiences of the Framework Programmes and what changes have you seen in that time?

'I participated in the First Framework Programme. I was working at the time as a postdoc at the University of Erlangen-Nuremberg, in Germany, after my PhD at Imperial College, UK. Up until I became a minister in 2003, when I stopped my direct research activities, I always worked on projects financed by the Framework Programmes.

'Moreover, I have vast experience as an evaluator. I was chair of the Marie Curie panel for engineering and physics for six years. And I was a national delegate in many programmes, so I have a lot of experience, as a researcher and as a minister.

'With the passing of time you could see each Framework Programme becoming more and more administratively and financially complicated.'

Why have you focused so squarely on simplification during the preparation of Horizon 2020?

'Bureaucracy and complex rules can be a significant barrier to innovation and to new ideas.

'The Member States have different bureaucracies from the Commission and in order to build the ERA it is important to align the different national research systems. But joining together different bureaucracies can lead to a chaotic system. The EU really needs to simplify and the Member States need to follow this example as most of the Member States have more complex systems than the Commission.'

Have the rules and regulations been simplified enough in Horizon 2020?

'I think that, in terms of simplification, Horizon 2020 is quite balanced and represents a step forward. Now it is important to keep this up during its implementation. I know public administration well, I am a public servant myself, and the tendency of public administrations is to verify, verify, verify. That's a good tendency, but there is the risk that with time things start to become complex again. To avoid this, an assessment of the simplification procedure should be carried out during the mid-term review of Horizon 2020.'

What else needs to be done for the ERA?

'It's very important to make mobility easier, both in terms of the portability of grants and the portability of pension schemes.

'We also need to have more alignment among the Member States. This does not mean that Member States should have the same research agendas, but they should discuss their agendas together and look for ways to build bridges.

'There are many areas where the Member States and the Commission should work together. A good example is rare diseases. Member States should join forces with the Commission on this. Research will advance much more quickly if efforts are combined. This constitutes a concrete example of how the ERA can be strengthened.' ■

WHAT IS ERA?

BY GARY FINNEGAN

ERA IN THE EU TREATY

Article 179 of the Treaty on the European Union (Treaty of Lisbon) states that the ERA can help the EU to strengthen its scientific and technological bases. It describes the ERA as a 'single market' for research and researchers, which should make it possible to share data, compare results, carry out multi-disciplinary studies, transfer and protect new scientific knowledge and gain access to centres of excellence and state-of-the-art equipment. ■

OPEN ACCESS

The free movement of knowledge is a central principle of the ERA. The results of research funded under Horizon 2020 will be freely available to all. This means that scientists, businesses and even the public will be able to read the latest science and apply its findings. EU research funding programmes have an important role to play in making this new way of sharing science the norm. Progress is also being made on encouraging the publication of research data – the information on which research findings are based. ■

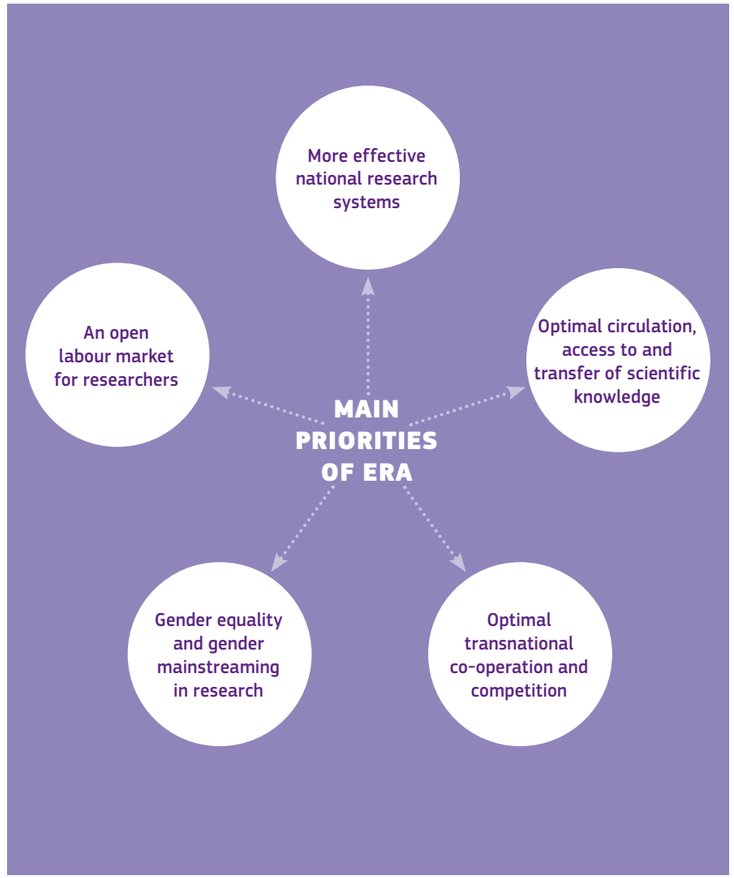
MOBILITY OF RESEARCHERS

The free movement of scientists is a prerequisite for creating a single market for research. EURAXESS (www.euraxess.org) is a pan-European initiative which provides information and support services to researchers to help them take up jobs outside their home countries. The EURAXESS job portal lists thousands of vacancies and fellowships from more than 40 European countries and other parts of the world including China, India and the US. More than 200 EURAXESS Service Centres operate in 40 European countries to help researchers and their families with things like work regulations, taxation and social security.

Other obstacles to mobility exist, which need to be tackled by policymakers – for example, making sure that researchers can move from one EU country to another without losing out on social insurance or pension entitlements. The Commission is supporting the setting up of a single European pension arrangement (RESAVER) to help researchers keep their supplementary pension benefits when moving between different countries. ■

COORDINATION OF NATIONAL RESEARCH

Coordinating more closely national research priorities in different countries can bring benefits because, by pooling resources, funding can be used to tackle major problems which might otherwise be too large for one Member State to address on its own. It also reduces unnecessary duplication, helping to ensure that scarce resources are spent efficiently. Examples include the ERA-NET scheme, which provided targeted support for the coordination of national and regional research programmes, and Joint Programming Initiatives (JPIs), which allow countries to come together to tackle major challenges, such as climate change and healthy ageing. ■



BY REX MERRIFIELD

How the fall of the BERLIN WALL transformed Europe's research landscape

The collapse of communism in the Eastern Bloc in 1989 redrew the map of Europe, and the aftershocks were also felt strongly in the foundations of European research.

'Without the Framework Programmes, we would have never reached this stage.'

– **Professor Anton Anton,**
former Romanian Secretary of State for Research

The fall of the Wall and the other momentous changes in Eastern and Central Europe from 1989 opened up new possibilities for researchers to meet and collaborate with their Western European counterparts and gave them hope of new partnerships.

'After these changes there was an extraordinary opening towards international research,' said Professor Anton Anton, a lecturer in Romania at the time and now professor of hydraulics and environmental protection at the University of Civil Engineering in Bucharest. 'Researchers were very positive.'

New efforts were made at European Community level to encourage cooperation previously impossible because of the Iron Curtain, and 'science diplomacy' was recognised as encouraging European cultural reunification when other paths were still difficult.

'We realised it would not be easy to become part of the European research community, but there was a lot of enthusiasm, a lot of optimism,' said Dr Jan Krzysztof Frackowiak, of the Polish Academy of Sciences. He was a physicist before becoming Deputy Science Minister of Poland for 14 years from 1991.

Schemes such as PECO/COPERNICUS, launched in 1992 with funding of EUR 55 million, encouraged new ways of working together for Central and Eastern European countries seen as potential future members of the EU.

EASTWARD GROWTH

Along with scientific and technical research fellowships, it also provided for project-by-project participation in parts of the Framework Programmes, with joint activities on the environment, health, information and communication technology, materials, agriculture and food.

'The special actions played a very important role for us in gaining experience of European rules and methods,' Dr Frackowiak said. 'Later on this meant we could gradually take on more important roles.'

Identifying the Central and Eastern European countries as a focus played a large role in the expansion of the Framework Programmes. This eastward growth continued through the 1990s and into the next decade, when 10 Central and Eastern European countries were to join the European Union.

By the Fourth Framework Programme (FP4) in 1994, COPERNICUS was included in a specific programme of International Cooperation (INCO).

SMOOTHER KNEES

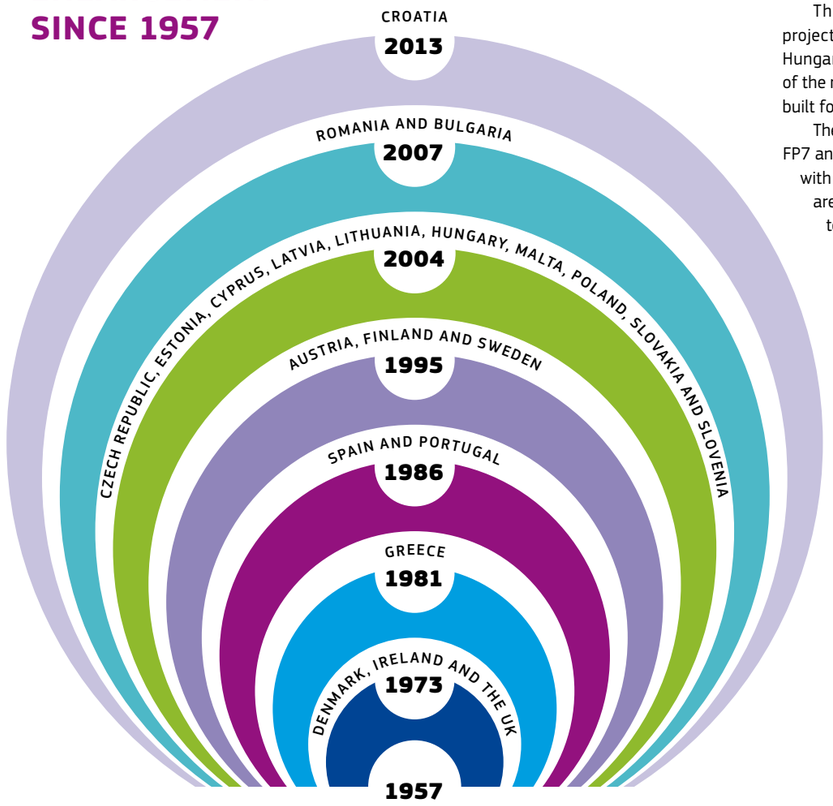
Participation was still on a project-by-project basis, on limited themes, but once the countries were on track for EU membership and became associates of the Framework Programmes, their participation increased. By the Sixth Framework Programme, which began in 2002, Poland for instance was proposing advanced projects as a coordinator and it was to lead more than 180 consortiums in the Seventh Framework Programme (FP7), in the specific programmes of People, Ideas and Cooperation, and the Research Potential (REGPOT).

These have included a selection of prominent projects ranging from information technology, security, and energy efficiency to nanotechnology.

Among the Polish-led advanced nanotechnology projects in FP7 have been the ENSEMBLE study of self-organising electromagnetic structures and SUPERSONIC, looking at depositing layers of lubricating solid nanoparticles to ease the use of wind turbines, aeroplane engines or even artificial knees.

Developing research capacity has benefited greatly from participation in the Framework Programmes, which have kept growing with the EU itself. From EUR 13.1 billion at the start of FP4, when the European Union had just 12 Member States, the funding has swelled to EUR 80 billion for the 28-strong European Union of Horizon 2020.

EU ENLARGEMENT SINCE 1957



SIX FOUNDING MEMBERS:

BELGIUM, GERMANY, FRANCE, ITALY, THE NETHERLANDS, LUXEMBOURG

COMBINED BENEFITS

For new Member States, the benefits of the Framework Programmes have, in many cases, been multiplied by using EU Structural Funds to develop new laboratories and modern facilities for research.

Austria, Finland and Sweden already had very well developed research infrastructure when they joined the European Union in 1995. But Spain has shown the benefits of combining these different forms of European funding to transform its relatively underdeveloped research system in the 1980s to world-class status.

The Extreme Light Infrastructure (ELI) project shows a similar synergy in Romania, Hungary and the Czech Republic, where some of the most intense lasers ever made are being built for research.

The preparatory phase was carried out under FP7 and the three facilities are being developed with support from the Structural Funds. They are expected to be operational by 2018 and to host substantial Framework Programme research in fundamental physics, materials, pharmacology, cancer and X-ray and gamma ray imaging.

'This is one of the main benefits for us,' said Prof. Anton, who is also a former Romanian government minister and Secretary of State for Research. 'Without the Framework Programmes, we would have never reached this stage.' ■

Professor Enric Banda

The success of Spain: research has flourished since it joined the EU

BY REX MERRIFIELD

Since it joined the EU, Spain's research has expanded sharply in capacity and in outlook, according to Professor Enric Banda, former Spanish Secretary of State for Universities and Research.

How have the Framework Programmes encouraged participation in research and innovation in Spain?

'When we joined the European Community in 1986 our research and development system was not very strong, so it was extremely useful for us to join. When countries join there is a peak in enthusiasm and this was clearly the case for the scientific community in Spain. Through encouragement by the Framework Programmes people were very pleased to work with other Europeans, so from the research and innovation point of view it was a very good opportunity. Since then, the Framework Programmes have really encouraged research and innovation in Spain in an extraordinary way.'

Can you elaborate on what you mean by extraordinary?

'The Framework Programmes gave us a new injection of morale, of money, of enthusiasm and of knowledge, in terms of working together with European colleagues. Of course many of our researchers were already well connected in Europe, but the Framework Programmes meant we could join new networks and take part in new projects.'

What would you see as the major benefits and successes resulting from Spain's participation in the Framework Programmes?

'The impact of the Framework Programmes has been enormous, particularly in integration and networking. Integration of new Member States does not only mean funding research and attending meetings; it is also about joining communities, working together and being part of a greater system. Networks with colleagues in other EU countries provide the means for collaboration and internationalisation, and science is international, after all. It has also increased access to knowledge, and resources to bring more skills and talent to Spain.'

'I was principal investigator for projects involving geothermal energy that wouldn't have happened without the Framework Programmes.'

– **Professor Enric Banda,** former Spanish Secretary of State for Universities and Research

Can you give any concrete examples?

'This was the case in many disciplines, including for my own field, earth sciences, which was not even at the core of the European programmes. I was principal investigator for projects involving geothermal energy that wouldn't have happened without the Framework Programmes. And the fact that we had the opportunity to join European projects meant that active researchers, working at the laboratory bench, had much more mobility. They could participate in scientific meetings, with new possibilities for working together.'

How has that changed during the financial crisis?

'The impact of the crisis has been dramatic. It has meant a very big reduction in the science budget in Spain and this has major implications. We are able to attract fewer researchers than before, some of those who came to Spain have left again and some of our own scientists have been leaving to take jobs abroad. And it has affected the basic sciences a lot. This has meant more Spanish researchers now turn to the Framework Programmes and the ERC (European Research Council) grants for support. In that sense, the Framework Programmes can help. But we cannot assume that Brussels or elsewhere will be the solution, we have to have a solid, national science budget. Particularly in a knowledge society, you need talent and innovation and those need resources.' ■

Crossing continents to protect LIVELIHOODS IN EUROPE and beyond

BY REX MERRIFIELD

'With the movement of people in the world these days and with the movements of diseases, there are no borders.'

– **Dr Aldo Tagliabue,**
researcher from ALTA, Italy

The Framework Programmes have helped finance research collaborations with developing countries in Africa to focus on agriculture and infectious diseases.

The EU has been collaborating thematically with non-member countries since the 1980s.

Research collaboration spanning Europe and the Mediterranean region has generated crucial understanding of the changing Mediterranean ecosystem, helping to protect communities which rely on fishing and tourism.

It's the kind of progress that was only made possible by a European drive to develop research collaboration focused on specific regions of the world.

The European Union has been collaborating thematically with non-member countries since the early 1980s. In addition to collaboration in health, environment and agriculture through the specific programme Science and Technology for Development, in 1984 the EU started bilateral international scientific cooperation actions with countries in Latin America, in Asia and in the Mediterranean region.

The EU followed this up in 1993 with the largest of its research projects at this time, the Mediterranean Targeted Project initiative, under the Marine Science and Technology programme (MAST).

'For the first time, researchers from different disciplines accustomed to working on specific sites in the east and west Mediterranean basin linked their studies,' said Dr Elisabeth Lipiatou, who now heads the European Neighbourhood, Africa and the Gulf unit at the European Commission's Directorate-General for Research and Innovation.

The results of observations and modelling were the subject of a vast multidisciplinary debate bringing together around 200 scientists from 70 institutions in 14 European countries, plus Morocco and Tunisia. Important findings included evidence of climate change in the deep waters of the eastern Mediterranean, and new understanding of how this ecosystem works. These led to new opportunities for climate modelling and coastal management.

'This had important implications for many people throughout the region,' Dr Lipiatou said.

Collaborative research initiatives such as AVICENNE, which was launched in 1992 to explore the potential for collaboration across the Mediterranean, accompanied the evolution of EU-Mediterranean cooperation in science and technology in the early 1990s.

Euro-Mediterranean collaboration marks the most developed example of inter-regional cooperation in science and technology.

Other Euro-Mediterranean projects have included topics such as the impact of climate change, the effect of lead pollution from vehicle emissions on sea life, and the consequences of excess fertilizers and effluent for the marine environment.

'Over and above the important scientific outcomes, the Framework Programmes have helped to create a community of scientists and a regional conscience for the Mediterranean region in science, technology and innovation,' Dr Lipiatou said.

GLOBAL CHALLENGES

With the Fourth Framework Programme in 1994, the Science and Technology for Development and International Scientific Cooperation schemes were integrated into the specific programme 'International Cooperation'. While the emphasis has evolved with geopolitical changes and European priorities, international cooperation has been a feature of the Framework Programmes ever since.

As well as specific international cooperation activities, all parts of the Framework Programmes have been open to teams from non-EU countries since 2002.

The fields of cooperation can vary according to the different groups of countries: developing countries, those in the neighbourhood, such as the Mediterranean countries, and Eastern European states, emerging economies, and industrialised countries such as the US and Japan.

However, cooperation is always based on the principles of mutual benefit and common interest.

Industrial countries, for instance, have been involved in research projects in genome sequencing and climate change. In working with developing countries in Africa, the Framework Programmes have given strong support to research on agriculture and infectious diseases, with particular backing for actions to find new treatments and vaccines for HIV/AIDS, tuberculosis and malaria, such as the European Malaria Vaccine Initiative (EMVI).

'With the movement of people in the world these days and with the movements of diseases, there are no borders,' said Dr Aldo Tagliabue, a researcher who has been working on immunology, biotechnology and vaccines over a number of decades. His company, ALTA, based in Italy, manages Framework Programme projects with partners ranging from Europe to South Africa, China, the US and Brazil.

'Certainly in human health, you have to take that into account and you have to work like that too,' he said.

International cooperation remains a special feature of the strategic approach embraced in Horizon 2020, providing for bilateral as well as regional and multilateral cooperation with partners such as the southern Mediterranean countries, where the research and innovation partnership has gained new momentum despite upheavals in the region in recent years. ■

Professor Manfred Horvat

International cooperation in research is more important now than ever

BY REX MERRIFIELD

Europe needs to cooperate with increasingly innovative countries such as China and Brazil if it is to become more competitive, according to Professor Manfred Horvat, an adviser to the EU who has been involved in international cooperation since the early 1990s.

How important is the international cooperation aspect of research and technological development to the European Union?

'I think it has always been an important asset of the Framework Programmes and nowadays even more so, since science and technology and innovation has become ever more global. The Framework Programme is the largest competitive collaborative programme worldwide, and the only one that is totally open to collaboration with countries all over the world.

'Europe has to play a leading role in all the aspects of globalisation, and research and innovation are important elements of that process.'

How did international cooperation become such an integral part of the Framework Programmes?

'International cooperation started in the First and Second Framework Programmes as development aid. Later it became a broader activity, with a very big role in the integration of countries that subsequently became new Member States.

'Towards the end of the 1990s and in the following years, the integration of researchers and research institutions from the Western Balkan countries in the Framework Programme was a first step for them, just a short time after they had been at war.

'In the new millennium, the Framework Programmes played a key role in strengthening the links to the newly emerging BRIC countries (Brazil, Russia, India and China), while also being instrumental in strengthening cooperation with the US.'

How is international cooperation in the Framework Programmes helping to improve EU competitiveness?

'It is even more important than before. There are many aspects where we have to be aware of the new landscape of knowledge production and innovation in the world. An example is China, which is progressing so fast in many aspects. For example, it is in a strong position in information and communication technology and even in industrial processes it has been very innovative. The same is also probably true for countries like Brazil.

'Europe has to play a leading role in all the aspects of globalisation, and research and innovation are important elements of that process.'

– **Professor Manfred Horvat,** independent expert for European and international research and technology cooperation

'Research and innovation cooperation with developing countries, such as in Africa, will in the long run ensure a strong position of the EU in these countries in scientific, economic and social terms.

'The new emphasis on innovation opens new opportunities but will need also in-depth dialogues and clear agreements with partner countries to define the rules of the game, especially on issues such as intellectual property rights.'

How do you see the development of international cooperation in future Framework Programmes?

'The new strategic approach for EU international cooperation requires an appropriate supporting framework. First, the implementation of the approach calls for a master plan for integrating the international dimension across the Framework Programme with consistent plans also for the programme's specific elements. Secondly, defining a coordination and monitoring function in the Commission should ensure overall coherence when facilitating the strategy development with partner countries and regions.

'Finally, we need to use more strategic intelligence, more in-depth knowledge and insight as well as foresight into what is going on all over the world, to identify the trends and emerging areas that are interesting for European collaboration.' ■

OVER 60 COUNTRIES FIGHTING DISEASE IN AFRICA

BY REX MERRIFIELD

The combined effort of the European Commission, EU Member States, developing countries, donors and industry has resulted in a programme of clinical trials against HIV/AIDS, tuberculosis and malaria in Africa which has funded hundreds of research projects in the last 10 years.

The European & Developing Countries Clinical Trials Partnership (EDCTP) is working to combat these three diseases, which taken together kill more than 3.4 million people across the world every year, as well as other infectious diseases such as Leishmaniasis and sleeping sickness.

Together with other large-scale initiatives such as the Bill and Melinda Gates Foundation, the programme is working on new vaccines, treatments and approaches to help ease the burden of disease, with a particular focus on sub-Saharan Africa.

'I think it has produced high-quality research, while at the same time strengthening research capacity in Africa,' said Professor Peter Piot from the London School of Hygiene and Tropical Medicine, UK, and a former executive director of the UNAIDS programme. 'But of course it is only one tiny piece of the Framework Programmes.'

While the EDCTP is a public-private partnership involving the European Union and European and African participating states, the EU has made the study of developing-world diseases a priority for the Framework Programmes since the 1980s.

Collaboration with researchers and institutions from outside the European Union has been a crucial part of this, particularly in developing links with countries where these diseases have the biggest impact.

'If we really want to make an impact eventually in fighting these diseases, the people in these countries have to be involved in every step of the process, and that includes in the research itself,' said Dr Cornelius Schmaltz, deputy head of the European Commission's Fighting Infectious Diseases and Global Epidemics unit at the Directorate-General for Research and Innovation.

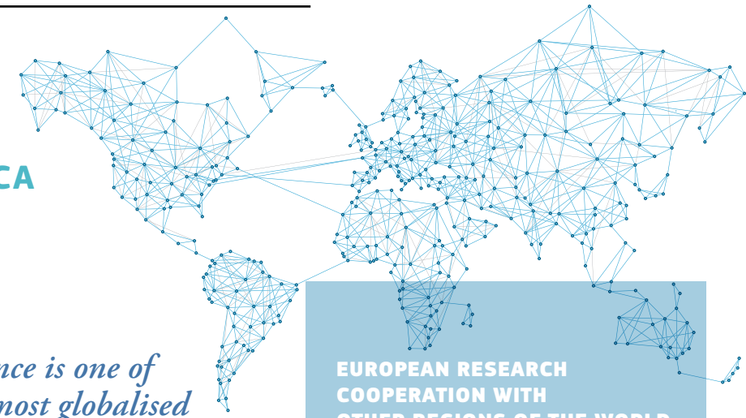
Successive Framework Programmes have evolved ways to encourage participation from international partners in the affected regions, including grants with lighter administrative loads, staff exchanges through the Marie Skłodowska-Curie actions, and collaboration schemes.

Prof. Piot sees being open to international cooperation in research as crucial to future European success.

'Science is one of the most globalised activities on earth at the moment,' he said. 'So think global, of Europe as part of a global research enterprise. After all, frankly, the only real hope for our future is in innovation and science and entrepreneurship.' ■

'Science is one of the most globalised activities on earth at the moment.'

– **Professor Peter Piot** from the London School of Hygiene and Tropical Medicine, UK



EUROPEAN RESEARCH COOPERATION WITH OTHER REGIONS OF THE WORLD

Africa

Number of participants	Participant EU contribution
819	EUR 126.9 million

Asia

Number of participants	Participant EU contribution
954	EUR 110.5 million

Caribbean

Number of participants	Participant EU contribution
26	EUR 3.3 million

Eastern Europe and Central Asia

Number of participants	Participant EU contribution
1 075	EUR 119.6 million

Latin America

Number of participants	Participant EU contribution
723	EUR 94.8 million

Mediterranean Partner countries

Number of participants	Participant EU contribution
3 659	EUR 1 108.1 million

Other

Number of participants	Participant EU contribution
1 255	EUR 131.9 million

Pacific

Number of participants	Participant EU contribution
10	EUR 1.3 million

Western Balkan countries

Number of participants	Participant EU contribution
556	EUR 84.6 million

(All data cover the period of the Seventh Framework Programme 2007-2013)

The researchers who **CROSSED BORDERS** for science

BY JON CARTWRIGHT

Marie Skłodowska-Curie actions have been designed to promote excellence in research by giving grants to scientists who needed to move country to further their careers.

In recent decades researchers have travelled abroad in greater and greater numbers, and it's helped a generation of scientists learn from each other.

'In terms of research it is quite important that you are exposed to different ways of working, different people and different cultures, because in the end research is highly collaborative and interdisciplinary,' said Spanish neuroscientist Dr Xoana Troncoso.

'If you stay in the same place throughout your career you are going to miss things that you didn't even know existed.'

Dr Troncoso first travelled from Galicia in Spain to the UK to complete her PhD studies, and then went to the United States where she took two postdoctoral research positions, one in Phoenix, Arizona, and one at the California Institute of Technology.

In 2012, she received a Marie Curie award to come back to Europe to study how the human brain uses vision to interpret motion at France's national science centre CNRS. Her research forms part of the EU's Future Emerging Technologies project BrainScaleS, which is trying to understand how the brain processes information and the implications for bio-inspired computing.

The 37-year-old hopes that the fact that she is now managing a Marie Curie grant will put her in a good position to secure one of Europe's highly sought-after permanent research posts.

EARLY HELP

The EU has been helping researchers like Dr Troncoso since the early days of the Framework Programmes. Along with the First Framework Programme in 1984 came the launch of a programme called Stimulation, which – while promoting basic research – was designed to encourage the networking and mobility of researchers.

For example, it offered funding to those who wanted to collaborate on projects, or grants to young researchers who wanted to broaden their outlook by attending conferences abroad.

'If you stay in the same place throughout your career you are going to miss things that you didn't even know existed.'

– **Dr Xoana Troncoso,**
neuroscientist, CNRS

Stimulation was renamed Science in the Second Framework Programme. While budgets increased, so too did the focus on the career-fostering aspects, explained Manuela Soares, Director of the Transport programme at the EU's Directorate-General for Research and Innovation. 'In the Science Programme the emphasis was on accepting project proposals from scientists, the bottom-up approach,' she said. 'But the emphasis changed with each programme.'

Stimulation and Science paved the way for what is widely considered the EU's greatest contribution towards individual careers: the Marie Curie actions of the Sixth Framework Programme in 2002.

Named after the Polish scientist who overcame tremendous societal odds to pioneer research into radioactivity – and to win Nobel Prizes in both physics and chemistry for her discoveries – the Marie Curie actions were designed to promote excellence in research by giving grants to scientists who needed to move country to further their careers.

Now called the Marie Skłodowska-Curie actions (MSCA) within Horizon 2020, the programme allows researchers at any stage of their career – irrespective of their age or nationality or field of work – to gain experience in laboratories, universities, and non-academic settings provided that they are internationally mobile.

Mobility is a crucial requirement for scientists given the hugely collaborative nature of science itself. Working in a research institution in another country can enrich a researcher's career although it is not always easy in a continent of such varying languages and cultures. Still, along with its predecessor, the MSCA programme has helped so far some 80 000 researchers overcome these barriers. During the Seventh Framework Programme alone it funded 10 000 PhDs.

'It came gradually, but today Marie Skłodowska-Curie is seen as a benchmark of excellence,' said Soares.

OTHER SUPPORT

The MSCA programme may be the chief initiative that has helped researchers' careers, but it is not alone. Collaborative research projects and grants from the European Research Council, for example, have also made an important contribution.

In addition, the EU has adopted a European Charter for Researchers and a Code of Conduct for the Recruitment of Researchers, both of which outline certain principles concerning the respective roles and responsibilities of researchers and their employers.

Dr Troncoso believes the facilities are in place for researchers to help them adapt to each new country, however she fears that there is still too much uncertainty for researchers on whether they can secure one of a dwindling number of fixed positions after having travelled around Europe or further afield.

'At some point you need to settle down,' she said. 'That's something that science needs to figure out.' ■

MARIE SKŁODOWSKA-CURIE ACTIONS 2014-2020

€ 6.2
billion budget

65 000
researchers to be supported

140+
different nationalities

38%
of researchers are female

INTERNATIONAL APPEAL

The vast majority of non-EU researchers are now interested in taking their careers to Europe, according to the MORE2 study (which surveyed some 4 000 individual non-EU researchers) funded by the European Commission.

The study found that nine-tenths of researchers who had never previously worked in the EU were interested in doing so, and 72% of researchers who had previously worked in the EU would have liked to stay on.

http://www.more-2.eu

Professor José Mariano Gago

The most urgent priority for science policy in Europe should be to increase investment in research

BY JON CARTWRIGHT

Public funding for research is dangerously low in many countries and collective action needs to be taken, according to Professor José Mariano Gago, a physicist and former Portuguese Minister for Science, Technology and Higher Education.

What was it about Europe that allowed you to be successful in your career?

'My entire scientific career was developed at CERN (the European Organization for Nuclear Research) together with the Portuguese Laboratory of Instrumentation and Experimental Particle Physics (LIP), which I created later. CERN, an intergovernmental particle physics laboratory, is certainly the most outstanding example of collaborative scientific success in Europe. In its field of research there is no brain drain of scientists to countries outside of Europe; on the contrary, CERN draws in scientists from all over the world who bring their talent, their resources, and their technical and industrial expertise.'

It was in the Second Framework Programme that the European Commission introduced a human resources component to help researchers' careers. You had a hand in that, didn't you?

'That's a curious story. In 1986, having become the president of the Portuguese National Science and Technology Board, I attended the Council of Research Ministers where I suggested that human resources needed to be made a new priority. At that time, the approval of the Framework Programme by research ministerial delegations had to be taken at unanimity. Near the end of the discussions, my suggestion for making human resources a new priority in the Framework Programme was adopted and the Portuguese delegation indicated that it was key to achieving a unanimous vote on the whole programme.

'This bold and unusual position helped the EU to progress. Portugal's initiative and vote were due to, on the one hand, a commitment to high-level training, particularly abroad, of researchers over a long period. On the other hand, we were convinced that a more European and less nationalistic approach to the doctoral and postdoctoral training of researchers was essential for Europe, and that it would also provide the best external environment for the fast development of Portugal's science and technology.

'I am now convinced that the EU programmes for human resources for science and technology have been extremely important for research in Europe, although they are still unacceptably limited in their dimension.'

Why are they limited?

'The intensity of research and development has been stale for many years, because public funding levels for research are much too low. The EU is not a federal state. When we speak of public funding for research we are therefore speaking mainly of national funding, which in many countries across Europe has diminished or remained dangerously limited. Using our collective efforts to overcome this problem must be a priority.

'Overall, qualified human resources for science and technology are today the most precious asset for the EU and for each of its nations. Preserving, expanding and improving such an asset, nationally as well as internationally, should, in my view, be recognised as the most urgent issue for science and technology policies in Europe.'

In your role as Portugal's Minister for Science and Technology, you promoted scientific education and culture. Do you think this will ultimately improve the European research environment?

'Yes, absolutely. One of the projects in Portugal in which I have been involved is Ciência Viva, which is a national movement to help develop opportunities for scientists and non-scientists to interact. It has empowered science teachers across the country while promoting experimental science education and close ties between schools, science centres, and research laboratories.' ■

'The intensity of research and development has been stale for many years, because public funding levels for research are much too low.'

– **Professor José Mariano Gago,**
former Portuguese Minister for Science, Technology and Higher Education

The fight for EQUALITY is still with us

BY JON CARTWRIGHT

'It isn't enough to promote it intellectually: successful women need to be visible role models.'

– **Dr Claudie Haigneré,**
President, Universciences

Dr Claudie Haigneré

Even though women have been well represented in Europe's laboratories since the start of the Framework Programmes, the number of female professors remains stubbornly low, therefore we need to promote stories of successful women, says Dr Claudie Haigneré, a former astronaut and the president of Universcience, a French centre that teaches young people the value of scientific and technological discoveries.

Based on your experience, how do you think we could attract equal numbers of boys and girls to scientific studies? Is it a question of image or upbringing or education, for example?

'The truth is that there are too many countries where parity is not achieved; and yes women are still reluctant to progress into certain sectors of science and technology – like computer science, physics, maths, or engineering. In France, at present, 27.8% of students in these fields are women; yet we know that for instance girls perform as well as boys in mathematics. Girls censor themselves; they lack confidence. Education and family have an important role in this, because they teach girls not to expect things. I would say that education should be at the heart of a change of attitudes. Education in school, the formal way, and also the informal education you find in science centres and museums, where there is maybe more freedom to be creative. At Universcience, we take very seriously our responsibility to provide citizens with a democratic space – where everyone is equal – to engage with science.'

There is the problem not only of women leaving research, but of those who stay in research not being promoted to the best jobs. Why is that, and what can we do to address it?

'There is a lack of confidence, but I would say also there can be a tendency in selection committees – even by women in those committees – to discriminate against women. So the fight for equality must be undertaken everywhere.'

You have been involved in several initiatives to promote gender equality in research, such as the L'Oréal-UNESCO Award for Women in Science. How important have those awards been?

'Reports have clearly shown that the success stories of women in science are not visible enough, yet we know that women who are successful can act as multipliers to promote equality in science. Young ambassadors are particularly important, because the younger generation are inspired by the generation that is closest to them.

'Awards such as the L'Oréal-UNESCO are important, because the winners can serve as role models and inspire others in the future. Women must be fully committed to inspiring younger women and, beyond being mere examples of success, they must communicate their passion for their work.'

What's the risk if we do nothing?

'Integrating the gender dimension into basic and applied research encourages excellence in science, engineering, research and policy. Today this is done through strategies, programmes and projects, but it needs to be promoted at all stages of the research cycle.

'If women scientists are not visible, and if their successful careers are not in public view, they cannot serve as role models to attract young women into scientific professions and convince them to build research careers. It's vital that this waste of talent is addressed if we are to boost European competitiveness and innovation.' ■

Under Horizon 2020 EUR 13 billion has been allocated to frontier research through the European Research Council (ERC).

Europe's support for frontier research takes scientists deep into the Atlantic Ocean

BY JON CARTWRIGHT

Thousands of metres below the Atlantic Ocean live strange types of coral that no human has ever set eyes on. Or at least that was true until last year, when a group of researchers began investigating the uncharted abyss with a remotely-operated vehicle.

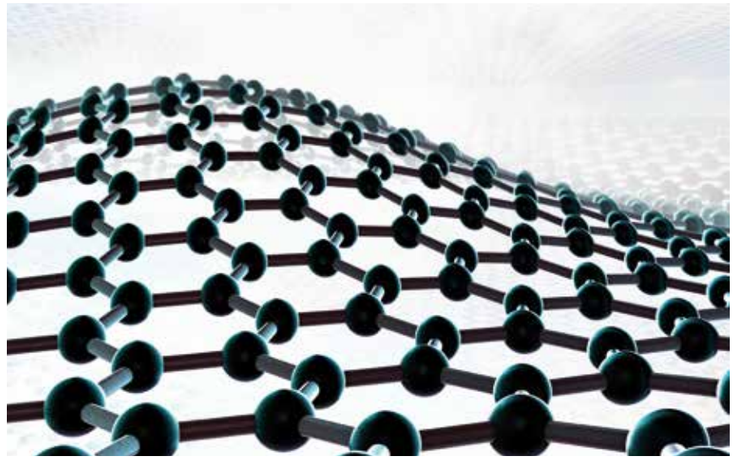
It's the kind of speculative research that is only possible thanks to a EUR 2 million grant from the European Research Council (ERC), which funded the specialist equipment required and a team of scientists to use it.

'We were able to charter a ship, get access to a state-of-the-art underwater vehicle and equip the lab with a new laser for making age-determinations,' said geochemist Dr Laura Robinson at the University of Bristol, UK.

The research could help our understanding of the impact of the climate on fragile ecosystems. For example, it could shed light on the extent to which dissolved carbon dioxide stifles the growth of deep-sea corals, which host numerous species of fish and invertebrates.

Robinson's is just one of many projects that have been made possible by the ERC – a body that aims to foster frontier research. Unlike other EU funding mechanisms, the ERC allows researchers to come up with their own ideas for projects, rather than be led by pre-defined goals.

The ERC, which operates as an executive agency of the European Commission, is run by a scientific council, a group of 22 independent academics, who establish the ERC strategy, monitor the quality of operations and oversee



Making graphene can be as simple as peeling sellotape off a block of charcoal, however the one-atom-thick carbon is giving engineers a radical new tool that is incredibly strong, highly conductive, and bendable.

the implementation of the programme at the scientific level.

However, the EU was backing frontier research before the formation of the ERC, even if it was not doing so explicitly and on the same scale. The Stimulation programme, which was part of the First Framework Programme in 1984, allowed researchers to come up with their own ideas for research projects and balanced the rest of the Framework Programme's emphasis on applied research. The same was true of the Science programme, which continued from Stimulation in 1987 until 1991.

LOGIC CIRCUIT

The European Joint Optical Bistability (EJOB) project was one of the projects under these programmes. In 1986, scientists taking part in the EJOB project demonstrated the prototype of a basic logic circuit that processed light instead of electric current. This result kick-started the field of optical logic, which some researchers believe could still offer a means to build more powerful, light-based computers.

Professor Des Smith, a physicist who participated in the EJOB project and who now helps run the company Edinburgh Biosciences in the UK, believes frontier research is just as important as applied research.

He gives the example of the first computer revolution, which would not have been possible without the discovery of semiconductors in solid-state physics. 'The lesson is, you mustn't ignore basic research,' he said. 'You'll always need that to take the next step.'

However, it was not until the introduction in 2000 of the Lisbon Strategy, which emphasised the need for a knowledge-based European economy, that plans for a large-scale, pan-European frontier research funding body really began to take shape.

Since it was formed in 2007 with the Seventh Framework Programme (FP7), the ERC has backed some 4 500 projects out of more than 43 000 applications.

The ERC is remarkable for the scale of its funding. Under FP7, its budget was EUR 7.5 billion. That sum has been increased by approximately three quarters to EUR 13 billion under Horizon 2020, making it equal in nominal terms to the entire budget of the Fourth Framework Programme.

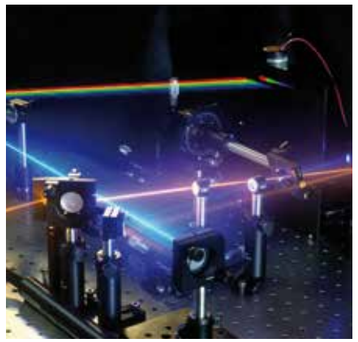
For the first time since the end of the 1970s, the ERC offers grants that do not have transnational cooperation as an assessment criterion, and because of the investigator-driven nature of its funding, it has helped promising young researchers to sidestep the career hierarchies that often prevent them getting funding for novel projects in their own institutions.

Of course, not knowing where research will take you can lead to some creative proposals. Today, if you take a look through the ERC-funded frontier research projects that is just the case: there is everything from exploring the types of singularity posed by the Nobel Prize-winning mathematician John Nash, to understanding the neurobiological processes that lead us to acquire knowledge, to the impact of family break-up on society, and the fall of Communism in Eastern Europe.

There are also frontier research projects currently taking place that have been funded by other parts of Horizon 2020. For example, in the long-running Future and Emerging Technologies programme, the Graphene Flagship has been tasked with taking the one-atom-thick material from the realm of academic laboratories into European society in the space of 10 years, thereby generating economic growth, new jobs and new opportunities for Europeans both as investors and employees. ■

'You mustn't ignore basic research. You'll always need that to take the next step.'

– **Professor Des Smith,**
Director, Edinburgh Biosciences, UK

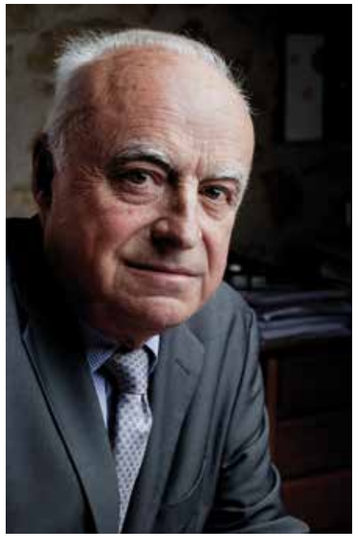


Optical logic circuits – where light replaces electric current – could enable the construction of powerful light-based computers.

Professor Pierre Papon

Frontier Research breakthroughs may not bear fruit until decades later

BY JON CARTWRIGHT



With the formation of the European Research Council (ERC) in 2007, the EU has given a substantial boost to frontier research. Now we just need to allow it time to produce results, says Professor Pierre Papon, a former director-general of the French National Center for Scientific Research (CNRS).

Surely all science is conducted with an open mind. What is it, then, that defines frontier research?

'Frontier research is science that is related to understanding the laws of nature, without any direct concern about practical applications. Think about the discovery of the double-helix structure of DNA by Francis Crick and James Watson at Cambridge University, UK, in 1953. Watson and Crick wanted to understand DNA structure; at that time they did not consider any practical applications of their discovery, which instead came several decades later.'

Have the EU and its predecessors always been interested in backing frontier research?

'No. The Treaty of Rome, which established the European Economic Community (EEC) in 1957, didn't allow for the support of either frontier research or mission-oriented research. It wasn't until the 1970s, when governments considered that the technological competitiveness of European industry was a matter of concern, that the EEC launched scientific programmes to support technology development.

'The Framework Programmes have been mission-oriented, although some of them have involved what could be considered frontier research. For example, in the 1990s, when I was in charge of the French Research Institute for Exploitation of the Sea (IFREMER), the Institute was involved in the MAST (Marine Science and Technology) programme which supported research on the interactions between the ocean and the atmosphere. Also don't forget about the Marie Curie fellowships which were quite extensive. But the turning point for frontier research was the creation of the ERC in 2007.'

'Today we might point to studies of quantum physics, which are leading to the development of new types of computers and new types of information transfer.'

– **Professor Pierre Papon,**
physicist, former director-general of the French National Center for Scientific Research (CNRS) and of IFREMER

What prompted the establishment of an EU institution like the ERC to fund frontier research?

'There were several concerns. First was the health and wellbeing of European science compared with that of the US and Japan, and European scientists had been putting pressure on their governments so that Europe would support frontier research. Second, the mechanism for creating research projects was getting more and more complicated as in general they involved many partners and thus required cumbersome coordination.

'Finally, you need to bring fresh blood into science by giving young scientists money and a chance to succeed. So that was another idea behind the creation of the ERC: to give chances to scientists in Europe and to bet on new ideas.'

What is your favourite example of a recent frontier research success?

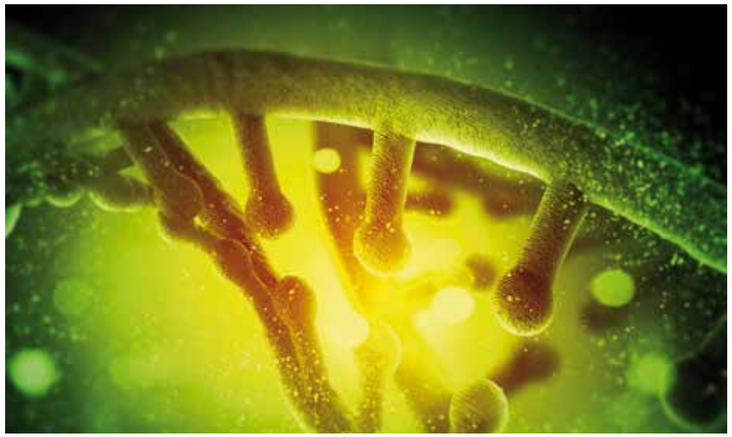
'I mentioned the discovery of the structure of DNA. But with frontier research we must consider that often one only understands 20 or 30 years later that a discovery was a breakthrough. At the time, in 1953, there were very few articles in the press about the discovery. There are other examples: the discovery of nuclear fission, which opened the road to reactors for the generation of electricity; or the application of microwaves to study matter under radiation, which led to the phenomenon of nuclear magnetic resonance which is now a staple of medical imaging.

'Today, we might point to studies of quantum information, which may lead to the development of new types of computers and new methods for information transfer. Frontier research is a long-term investment and you have to always be patient.' ■

HOW DIABETES RESEARCH CHANGED THE WAY WE VIEW EXERCISE

BY JON CARTWRIGHT

The project began with a straightforward goal: to understand the chemical basis of lifestyle-related diabetes. But the results raised the possibility of a solution to a very different medical problem: helping physically disabled people get the benefits of exercise.



The DNA of people with Type 2 diabetes is chemically marked with molecules that inhibit the ability of their muscles to metabolise sugar and fat.

The project – which was backed by a European Research Council (ERC) grant in 2008 – is a great example of the importance of fontier research according to its leader Professor Juleen Zierath, a physiologist at the Karolinska Institute in Stockholm. 'I could hardly have imagined that our research would take us in this direction,' she said.

Since 1986, Prof. Zierath has been investigating how lifestyle-related diabetes, known as Type 2 diabetes, develops. Her group had discovered that the DNA of people with the disease is chemically 'marked' with more methyl groups – a hydrocarbon – than normal.

That's important because these methyl groups inhibit the ability of the muscles to metabolise sugar and fat. With fewer methyl groups in place, the muscle finds exercise easier.

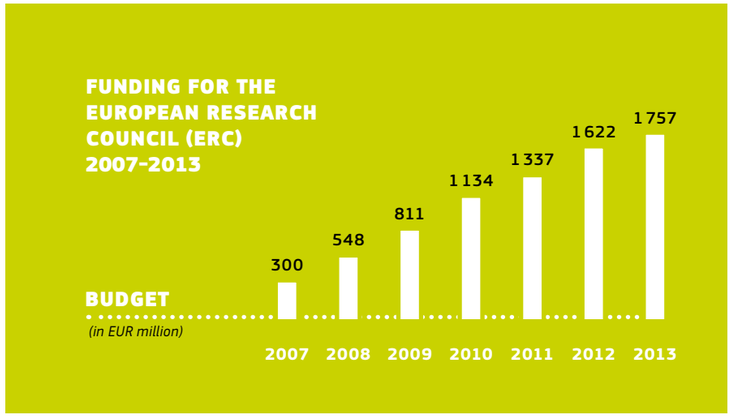
Her team had also discovered that these markers disappear when obese people – who are at greater risk of Type 2 diabetes – undergo weight-loss surgery. Using her ERC grant, Prof. Zierath then went on to prove that exercise, which is known to reduce susceptibility to Type 2 diabetes, had the same effect on the number of methyl group markers.

But the study did not end there. The research team artificially contracted rodent muscle cells in culture in the lab by stimulating them with caffeine, and found that the same loss of methyl groups occurred. This suggested that artificial stimulation could give people the benefits of exercise, even if a physical disability – for example, being confined to a wheelchair – prevented them from exercising normally.

Such therapy is probably a long way off, but the prospect has at least been raised – and that would not have come about without the ERC grant, said Prof. Zierath. 'Five years of sustained funding at a high level allowed us a lot of breathing room, a lot of freedom, and an opportunity to relax and test different ideas,' she added. ■

'Five years of sustained funding at a high level allowed us a lot of breathing room, a lot of freedom, and an opportunity to relax and test different ideas.'

– **Professor Juleen Zierath,**
Karolinska Institute,
Stockholm, Sweden



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KI-02-14-992-EN-N

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