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how science expects the unexpected' ■

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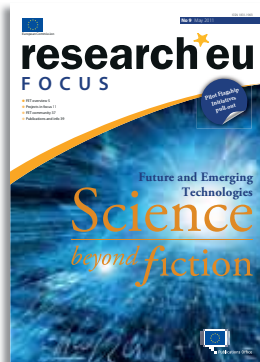
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When it comes to natural disasters, 'knowledge is power'

'Knowledge is power' is a saying often attributed to Sir Francis Bacon, an early exponent of the scientific method. It can also be expressed in Latin as *scientia potentia est*, and science certainly has a lot of potential in helping us predict and prepare against natural disasters.

Scientific knowledge is not a crystal ball, but in some cases science can help us predict specific disasters, as well as forecast their general likelihood and reduce or mitigate their impact. Another relevant saying is 'know your enemy', from Sun Tzu's *The Art of War*, and when it comes to natural disasters, our enemy can be nature itself — so the more we understand the better prepared we can be.

With the 18th Conference of the Parties (COP18) to the United Nations Framework Convention on Climate Change (UNFCCC) coming up in Doha, Qatar, in November, this issue of *research*eu results magazine* focuses on 'Natural disasters and climate change: how science expects the unexpected'.

The UNFCCC entered into force in 1994 and aims to 'stabilise greenhouse gas concentrations at a level that will prevent dangerous human interference with the climate system' as well as prepare for the impacts of climate change.

In the case of climate change, science still has a vital role to play in understanding in ever greater detail how global climate systems work, as well as reducing uncertainties in forecasting the impacts of global warming. The interview in this issue is with David Vaughan of the British Antarctic Survey who is programme coordinator of the Ice2sea project, which focuses on the forecasting of sea-level rises due to melting ice. He explains that increased flooding due to storm surges is one of the main expected outcomes, as even modest rises in sea level can lead to significant increased risk of floods.

The 'environment and society' section then continues with many more examples of research for better understanding, forecasting and preparedness of natural disasters and climate change, starting on page 23 with 'Early warning of potential "desertification"'.

The 'biology and medicine' section starts with an article entitled 'Improved treatment of neurodegenerative disorders', on page 6, while the feature article of the 'energy and transport' section is 'Drinking water from the sea using solar energy' on page 13.

The 'IT and telecommunications' section also enters 'expecting the unexpected' territory with its opening article, 'Search technology that can gauge opinion and predict the future' on page 32, while the 'industrial technologies' section starts with 'Removing hazardous substances from the air', on page 40.

The issue ends, as usual, with a list of events and upcoming conferences.

We look forward to receiving your feedback on this issue and on the *research*eu* publications in general. Send questions or suggestions to: cordis-helpdesk@publications.europa.eu

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Watch this space!

Coming up in issue 17 of *research*eu results magazine* — a special dossier called 'Power up! The future of energy'.

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BIOLOGY AND MEDICINE



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Improved treatment of neurodegenerative disorders

A large network of European scientists has improved current knowledge and treatment options for neurodegenerative disorders. Its findings have great potential for reducing the debilitating effect of these disorders and lessening the socio-economic burden they cause.

Many neurodegenerative disorders are characterised by the deposition of abnormal protein aggregates in various parts of the brain. However, the events that trigger this phenomenon and the role these protein deposits play in disease progression are poorly understood.

Extensive research has linked some of these diseases with genetic mutations. Despite the valuable information obtained regarding the pathological processes, the list of genes associated with neurodegenerative disorders is far from being complete.

To further contribute to the identification of disease-related genes, leading scientists in the field created the EU-funded Apopis¹ project. The ultimate aim was to identify genes involved in the pathology of neurodegenerative disorders, determine their biological functions and better understand their role in disease development.

Substantial progress was achieved towards the delineation of the role of many genes in the pathogenesis of neurodegenerative disorders. Project partners also addressed the lack of treatment options by improving current vaccination strategies for Alzheimer's disease (AD). To overcome the side effects of amyloid-beta immunotherapy, scientists isolated B cells from immunised patients and produced a novel TAP-1 antibody with high affinity for amyloid-beta plaques.

The testing of TAP-1 alongside novel monoclonal antibodies in a mouse model of AD led to a reduction of beta amyloid accumulation in the brains of treated animals. This makes amyloid-beta vaccination a promising therapeutic intervention for the treatment of AD patients.

The Apopis study integrated 39 research groups from across Europe in a common

effort to provide a better understanding of the pathogenic mechanisms involved in neurodegeneration, enhance clinical detection, and improve prevention and treatment of these disorders. The project's results can have a strong socio-economic impact and are expected to improve the quality of life of numerous patients.

The project was coordinated by the VERUM Foundation for Behaviour and Environment in Germany.

1. 'Abnormal proteins in the pathogenesis of neurodegenerative disorders'.

Funded under the FP6 specific programme 'Life sciences, genomics and biotechnology for health'.
<http://cordis.europa.eu/marketplace> > search > offers > 9082

Boosting health-promoting bacteria in foods

EU-funding has helped in the development of a novel encapsulation process for 'good' bacteria. As a result, more of these beneficial bacteria may find their way to people's digestive systems through so-called functional foods, making us all more healthy.

When people hear the word bacteria, most think of infection and antibiotics. The truth is that the human intestinal tract is loaded with bacteria that help keep us healthy. Endogenous gut-dwelling bacteria,

for example, fight harmful bacteria, help digestion and nutrient absorption, and contribute to immune function.

However, a variety of factors can cause an imbalance between beneficial and harmful bacteria, including illness, poor diet, stress and overuse of antibiotics.

Given the growing focus on disease prevention, attempts to add health-promoting bacteria to probiotic (literally 'for life') foods are on the rise. Probiotics are among many functional foods whose purpose is to go beyond nutrition with additives for other specific functions.

Although studies of probiotic therapies have produced mixed results, evidence suggests that some of

them can reduce symptoms of irritable bowel syndrome, Crohn's disease and infectious or antibiotic-associated diarrhoea.

However, achieving such results is not easy. Adding probiotics to food can have an undesirable effect on its texture. Moreover, probiotics can be partially destroyed during manufacturing and storage or even damaged by the acidic stomach environment.

Conscious of these risks, European researchers sought to develop an innovative microencapsulation process to preserve probiotics while making the microcapsules small enough to be added to a wide variety of food with no noticeable effect on its texture.

Funded by the EU, the Flocap¹ project enabled partner scientists to exploit this potentially huge market. Investigators addressed the polymer coating itself and created an innovative flow-focusing technology with a nozzle designed

specifically for probiotics. The processing required conditions sufficiently favourable to ensure high bacterial survival rates, small and uniform capsule size, and feasible scaling-up of production processes.

With increasing public demand for healthy and health-promoting food, the technology is likely to revolutionise the probiotic food sector.

The project was coordinated by the Verein zur Förderung des Technologietransfers an der Hochschule Bremerhaven e.V., based in Germany.

- 1 'Novel flow focusing technology to produce microencapsulated probiotic bacteria for the food sector'.

Funded under the FP6 specific programme 'SME activities'.
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Cell-on-chip technology for toxicity screening

Screening for the toxicity of potential new drugs can be a bottleneck for the pharmaceutical industry. A European consortium addressed this issue by developing chip assays containing nano-drops of cells that could be used to screen various chemicals.

With increased pressure to reduce animal testing in toxicity screening, the development of novel screening methods is of pressing concern. In this context, cell-based assays in culture plates have been proposed as alternatives to toxicity screening. Scientists have proposed to mimic DNA chip experiments by replacing the DNA spots with drops of cell culture. Such a system would provide a link between cell phenotype and chemical toxicity.

Alongside the aforementioned approach, the EU-funded Toxdrop¹ project aimed to develop an innovative 'cell-on-chip' technology

for toxicity screening. The goal was to generate an automated approach for high-throughput toxicity screening, by using a revolutionary format of cellular nano-drops formed on a glass slide.

In order to facilitate toxicity analysis within these cellular nano-drops, two separate approaches were tested, namely fluorescent quantification of proteins and 'Secondary-ion mass spectrometry' (TOF-SIMS). Using various cell lines, scientists managed to detect the three-dimensional (3D) distribution of molecules from both the cell

membrane and the cell nucleus and to perform multiplex phenotypic characterisation. Given the large amount of information to be processed, new software tools were also developed and a shared database was established.

The Toxdrop cell-on-chip assay presents a promising, automated alternative method for high-throughput screening of drugs and chemicals. Its potential for commercialisation is expected to significantly benefit the pharmaceutical sector.

The project was coordinated by the Commissariat à l'Énergie Atomique (CEA), France.

- 1 'Highly parallel cell culture in nano-drops, a new format for high content cell based toxicity screening on cell on chips'.

Funded under the FP6 specific programme 'Research for policy support'.
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BIOLOGY AND MEDICINE

Novel compounds against neurodegeneration

What is the role of adhesion molecules in dysfunctional plasticity and disease? This question has led European researchers to identify new compounds that could soon help treat such medical conditions as inflammation, neurodegeneration and cancer.



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Accumulating evidence suggests that neuronal cell adhesion molecules play a key role in learning and memory processes. They also have a very broad distribution in the nervous system, making them ideal targets for drug development. Their modes of action are mediated by intracellular signalling cascades and regulation of cell-cell and cell-extracellular matrix

adhesion, ultimately affecting neural plasticity.

The key objective of the EU-funded Promemoria¹ project was to study the role of cell recognition processes in normal and dysfunctional plasticity, learning and memory. The goal was to develop compounds with a beneficial effect on diseases involving cognitive impairment.

Consortium partners discovered new genes and proteins, identified novel pathogenic mechanisms and defined new therapeutic strategies for modulating synaptic plasticity that have the potential to improve learning, memory and regeneration. Over 30 patents were granted for compounds with a beneficial effect on learning and memory impairment

in Alzheimer's disease. Some of these were submitted for determination of pharmacokinetics and toxicology, while others were tested in phase I clinical trials.

Interfering with cell adhesion molecules in the nerve system proved a valid approach for modulating cognition and learning impairment. Based on knowledge gathered through the preparation of cell adhesion molecule-related compounds, new biotech enterprises were founded for the development of compounds for the treatment of inflammation, neurodegeneration and cancer.

The project was coordinated by the Protein Laboratory of the Institute of Molecular Pathology at the University of Copenhagen, Denmark.

- 1 'From cell-cell recognition to memory formation. New strategies for the treatment of dysfunctional plasticity, learning and memory'.

Funded under the FP6 specific programme 'Life sciences, genomics and biotechnology for health'.
<http://cordis.europa.eu/marketplace>search>offers>9197>

Immune cell-based vaccines

The ability to transform a patient's blood cells into effector cells that will fight cancer is now a reality. An EU-funded consortium has achieved promising results which indicate that this novel approach could soon become a standard treatment practice.



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Anti-cancer vaccination has long been considered as a promising way of preventing or treating cancer. The idea was conceived after scientists discovered that the immune system of cancer patients is often inoperative or dysfunctional.

In this respect, 'Dendritic cells' (DCs) — as the main regulators of immunity — have received

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special attention. These cells can be 'loaded' with cancer-specific antigens and used as adjuvants to activate a patient's immune system.

The main aim of the Dendritophages¹ project was to prove the immune and clinical effectiveness, reproducibility and feasibility of an anti-cancer DC-based vaccine. Project partners investigated various parameters of the vaccination strategy, including DC differentiation and maturation, tumour antigen selection and loading,

dose delivery, and site and vaccination schedule.

The scientists used the detoxified 'Adenylate cyclase toxoid' (ACT) and the 'Porcine parvovirus-like particles' (PPV-VLPs), known for targeting DCs very efficiently, as antigen delivery vectors. The developed DC culture system was designed to maximise IL-12 secretion and polarise type 1 immune responses that support cytolytic anti-tumour immunity. *In vivo* tracking of the DCs in humans indicated successful accumulation

in the lymph nodes, a process required for effective immune response generation.

Dendritophages successfully demonstrated, for the first time in a clinical setting, the feasibility and safety of a DC-based vaccination approach that induces cytolytic anti-cancer immunity. Standardised 'Good manufacturing practice' (GMP) procedures developed during the project have been implemented in new cell therapy production centres established by the project's five partners.

The project was coordinated by Immuno-Designed Molecules (IDM) s.a., Centre de Recherches Biomedicales des Cordeliers, France.

1 'Therapeutic cancer vaccines'.

Funded under the FP6 specific programme 'Life sciences, genomics and biotechnology for health'.
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Sensing and detecting disease biomarkers

The body's immune system is organised to fight its enemies. EU-funded researchers combined this molecular army with nanotechnology to create a low-cost and portable immunosensor platform with infinite diagnostic possibilities.



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Potential threats to the body's well-being include foreign substances released into the environment, such as bacteria or pollen. Substances formed within the body, such as toxins or even the body's own tissue cells (hence the term autoimmune response), can also trigger an immune response.

Antibodies are formed to fight these enemies, while any substance inducing the formation of antibodies is called an antigen. The latter is typically located on the surface of suspect cells. The antibody binds to its specific antigen in a lock-and-key fashion, immobilising it until other

immune cells can destroy it or take it away.

A series of experimental observations demonstrated that antibodies loaded on to an electro-conductive matrix (one capable of conducting electricity) produced an electrical current when they transiently bound to their antigens.

Funded by the EU under the Elisha¹ project, European scientists sought to establish the nature and origin of the signal transduction mechanism of these nanostructured interfaces. Their advanced understanding of these

mechanisms, together with the creation of appropriate specialised electronics, led to the development of a variety of novel, low-cost and reliable immunosensors for medical diagnostic use.

Elisha developed a fabrication method for the production of an immunosensor capable of detecting the prostate cancer marker, a 'Prostate-specific antigen' (PSA). PSA was detectable at much lower levels than those present in the blood, the conventional biological sample for screening. Similar results were also achieved for a biomarker of trauma, such as that produced by stroke or

heart attack, while another sensor detected a biomarker of micro-haemoglobinuria, a condition in which small amounts of blood pass into the urine.

The Elisha immunosensor systems were fabricated in simple portable devices incorporating rapid signal-processing algorithms. They could easily be used in mobile applications (ambulances) as well as home health care for immediate data processing, as well as the filtering of non-specific binding responses.

Thus, the Elisha method is a template from which innumerable immunosensors could be developed for rapid and reliable detection of antigens present in very low quantities. Its commercialisation potential is exciting and its implementation should greatly enhance medical diagnostics and human health.

The project was coordinated by the University of Leeds in the United Kingdom.

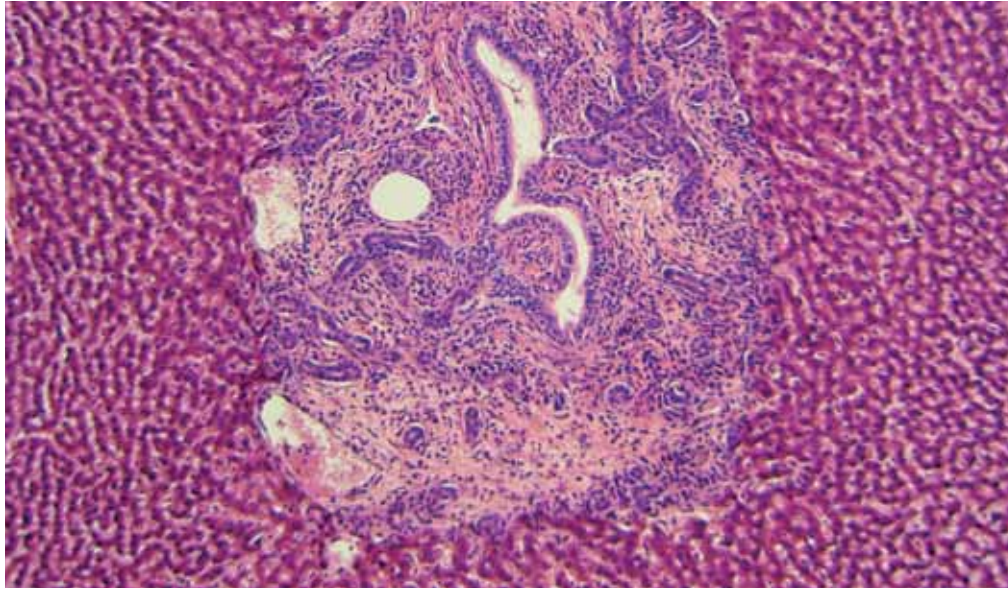
1 'Electronic immuno-interfaces and surface nanobiotechnology: a heterodoxical approach'.

Funded under the FP6 specific programme 'Nanoscience, Nanotechnologies, Materials and New production Technologies' (NMP).
<http://cordis.europa.eu/marketplace> > search > offers > 9101

BIOLOGY AND MEDICINE

Waking up the sleeping anti-tumour potential of p53

Cancer cells present aberrant cell-cycle progression capacities often due to a dysfunction of p53, a protein that acts as a tumour suppressor. A European network has investigated the mechanisms underlying inactivation of wild-type p53 seen in numerous cancers. Their findings raise hope for new clinical practices that could benefit many patients.



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p53 is regarded as a universal tumour suppressor protein that is activated following DNA damage to trigger cell-cycle checkpoints or apoptosis. It is mutated in about 50 % of cancers but remains functional in the rest of the cases, making it a potential solution for preventing tumour development. However, the activity of p53 is often hampered by molecules such as Mdm2 or p73.

To discover how these proteins exert their modulating effect on p53, the EU-funded ACTIVEP53¹ project brought together leading scientists in the field from 19 research centres across Europe. The main idea behind ACTIVEP53 was to use breast cancer as a model for defining the mechanisms of p53 modulator action. This information would then be translated to generate small therapeutic molecules.

Project scientists gained important insight into the interaction of p53, including 'Apoptosis-stimulation of p53 protein 2' (ASSP2) in inducing apoptosis. They delineated the roles of p53-modifying enzymes known to impact its transcriptional activity and also studied the processes leading to p53 activation by small molecules. Correlations between the BRCA1/2 status in breast cancer

and the p53-modifying enzyme 'Ataxia telangiectasia mutated' (ATM) helped to reveal vital information on the clinical implications of these proteins.

Additional senescence markers, other than DNA damage, were identified, which could potentially trigger p53-mediated apoptosis. Furthermore, a positive feedback loop between Lats2 and p53 was found, leading to p53 activation.

The ACTIVEP53 study constitutes a thorough investigation of p53 function and its regulatory mechanisms when dealing with cancer. The information generated has great potential to be translated into clinical practice with obvious benefits for many cancer patients.

The project was coordinated by the Department of Experimental Oncology at the Regina Elena Cancer Institute in Italy.

1 'Manipulating tumour suppression: a key to improve cancer treatment'.

Funded under the FP6 specific programme 'Life sciences, genomics and biotechnology for health'.
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Engineering the human cornea

Currently available synthetic artificial corneas (keratoprotheses) present severe limitations for cornea grafting. European scientists have proposed an alternative in vitro system which is expected to revolutionise cornea transplantation.

Diseases affecting the cornea are on the rise, with over 10 million people being affected worldwide. Current treatment approaches mainly involve transplantation of donor corneas. However, this is hampered by the shortage of donors, the widespread use of corrective surgery — which renders corneas unsuitable for grafting — and the increasing risk of transmissible diseases.

Responding to the urgent need to develop new forms of corneal replacements, the EU-funded Cornea Engineering¹ project proposed the *in vitro* development of a human cornea. This would serve for corneal grafting and as an alternative to animal models for cosmetics and pharmaco-toxicity testing.

The innovation of the Cornea Engineering approach relied on the

production of three-dimensional (3D) cell scaffolds resembling the natural 'Extracellular matrix' (ECM). To do so, scientists developed protocols for the use of recombinant human ECM proteins and their processing enzymes in order to support the growth of the different cell types found in the cornea. Implementation of the acquired knowledge led to the development of a hemi-cornea using

human epithelial and stroma cells which would serve as an *in vitro* alternative to animal toxicity testing.

By studying the roles of extracellular enzymes and cell-matrix interactions in corneal structure and repair, partners succeeded in identifying new molecular mechanisms capable of controlling the phenotype of stem cells. These findings

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enabled them to perform clinical trials using stem cell-derived epithelial cells.

The Cornea Engineering project succeeded in unravelling the matrix-cell interactions which are essential for optimal cornea tissue reconstruction, culminating in the development of full-depth *in vitro* corneas. The reconstruction of the human cornea represents a real breakthrough, offering the opportunity for patients with diseased or damaged corneas to have them replaced by tissue-engineered human corneal equivalents.

The project was coordinated by the CNRS Institut de Biologie et Chimie des Protéines (IBCP) in France.

- 1 'Three-dimensional reconstruction of human corneas by tissue engineering'.

Funded under the FP6 specific programme 'Nanoscience, Nanotechnologies, Materials and New production Technologies' (NMP).
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Bio-engineered pancreas

Could a bio-artificial pancreas be the solution to chronic diabetes? Developed within the framework of EU-funded research, a prototype showed encouraging preclinical function when tested on animals, bringing hope to those suffering from the disease.

Almost 80 million people in the world suffer from type I diabetes, an insulin insufficiency disorder that results in increased glucose levels in the blood. Standard treatment involves daily injections of insulin which, nevertheless, fail to reproduce the physiological secretion essential to maintain the glycaemia balance.

Aiming to address this issue, the EU-funded BARP⁺ project focused on the development of a new bio-artificial pancreas prototype suitable for encapsulation of insulin-secreting tissue and for implantation into patients.

As a first step, project partners established a protocol for assembling cells into pancreatic pseudo-islets *in vitro*, within a specially-designed chamber. These insulin-secreting pseudo-islets exhibited functional characteristics superior to those of single cells and were accommodated in a bio-artificial pancreas device.

The islet function in the BARP+ device was tested *in vivo*. Animals with implants maintained physiological blood-glucose levels for up to three days after implantation. However, islets were damaged a few days later, indicating the need



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BIOLOGY AND MEDICINE

for better materials to support encapsulation in the device.

A series of experiments were subsequently performed to create the optimal environment for islet encapsulation. The use of fluorocarbons enhanced islet cell viability by prohibiting cell aggregation. In addition, optimisation of the permeability of the

device membrane and the materials of the frame, as well as the construction of multi-layered membranes resulted in the construction of many prototypes.

The BARP+ device, yet to be tested in a clinical environment, shed light on a promising approach for providing insulin-secreting islets in an

encapsulated supportive environment. Importantly, the immune protection offered to the islets prohibits rejection, which is the most common adverse side effect of islet implantation.

The project was coordinated by the Centre Européen d'Etude du Diabète (CEED), based in France.

- 1 'Development of a bio-artificial pancreas for type I diabetes therapy'.

Funded under the FP6 specific programme 'Nanoscience, Nanotechnologies, Materials and New production Technologies' (NMP).
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A new technique to transform epigenetics research

Collaboration between scientists at Cambridge University and the Babraham Institute has given rise to a new technique that will significantly improve scientists' ability to perform epigenetics research while helping unlock the door to understanding how cells develop and function.



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All body cells may have the same DNA sequence (genome), but it is how this DNA sequence is interpreted that results in the formation of different cell types. Epigenetics, a branch of genetics that studies modifications to the DNA which affect gene activity, involves changes that control how

a DNA sequence is interpreted, specifically how different genes are switched on and off in different cell types, tissues and organs.

One of the most studied epigenetic markers is the addition of a methyl group — a very small chemical modification — to DNA.

The modification, which is called 5-methylcytosine (5mC) since methyl groups are always added to the DNA base cytosine, turns associated genes off.

Scientists from the Babraham Institute and Cambridge University, including a team supported by

EU-FP7-Health projects Blueprint¹ and Epigenesys², have published a study on the role of another DNA chemical modification in mammals. This modification, called 5-hydroxymethyl-cytosine (5hmC), is believed to be important for stem cell development as it helps define how the body develops.

5hmC may be a separate epigenetic mark or possibly be part of the process which removes methyl groups from DNA, allowing genes to be switched on again. The findings have important implications for stem cell research and the development of regenerative medicines.

The Blueprint project was coordinated by the Stichting Katholieke Universiteit in the Netherlands, while Epigenesys was coordinated by the Centre National de la Recherche Scientifique (CNRS), France.

- 1 'A blueprint of haematopoietic epigenomes'.
- 2 'Epigenetics towards systems biology'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Health'.
 Promoted through the Cordis Wire.
<http://cordis.europa.eu/wire> > search > 31750



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Drinking water from the sea using solar energy

One of the main ways to obtain drinking water in hot, dry countries surrounded by sea or ocean is through desalination. EU-funded researchers developed a high-efficiency and low-cost desalination technology which relies solely on solar energy.

'Reverse osmosis' (RO) desalination is one of two traditional desalination methods. In RO, water is forced through a filtration membrane at high pressure. Undesired substances restricted by the size of filtration membrane pores are retained on the pressurised side of the membrane.

The only energy required throughout this entire process is for initial pressurisation of the sea water. However, RO desalination is expensive and particularly energy intensive due to the high throughput.

One way to reduce both cost and energy consumption is to provide the mechanical energy required for RO by using a low-temperature 'Organic rankine cycle' (ORC) system in combination with solar cells.

ORC is a thermodynamic cycle for recovering low-temperature (typically 'waste') heat and converting it to another, more useful

form of energy, such as electrical or mechanical energy. Solar cells can supply heat to the ORC, which then produces mechanical energy to pressurise the water.

Much attention has recently been given to the potential of supercritical fluids used in the ORC when it comes to ensuring optimised thermal efficiency in the conversion of waste heat to electricity. European investigators have delivered an innovative stand-alone solar desalination system based on a low-temperature supercritical ORC, thanks to funding for the RO-Solar-Rankine¹ project.

The system eliminates the need for energy storage and exhibits higher efficiency, translating to higher fresh-water production rates. Investigators also examined environmental and socio-economic impacts of the new system and developed a strategy for market penetration.

Commercial implementation of the RO-Solar-Rankine system should enable regions with warm and dry climates, such as those in the Mediterranean, to exploit their abundant solar energy to produce freshwater from equally abundant salt water.

The project was coordinated by the Agricultural University of Athens, Greece.

1 'Development of an autonomous low-temperature solar rankine cycle system for reverse osmosis desalination'.

ENERGY AND TRANSPORT

Optimising a novel superconducting material

Superconducting materials are widely used in the electrical instrumentation industry. EU-funded researchers have made significant progress in enhancing superconductivity of a novel material which is generating considerable interest from the sector.

The unique property of superconductors, essentially their absence of resistance to current flow (almost ideal conductivity), makes them key to the functioning of a wide variety of existing and future applications.

Conventional superconductors deliver their best properties when cooled to near absolute zero Kelvin with expensive cryogenic liquid (such as liquid nitrogen or helium) cooling. 'High-temperature superconductors' (HTSs), on the other hand, exhibit these properties at relatively high temperatures — very cold but still much less when compared to conventional superconducting materials.

While HTSs eliminate the need for expensive cooling procedures, one considerable drawback has been the brittleness of associated materials. This makes it difficult to manufacture flexible wires, increasing both labour costs and the amount of wasted material.

In this context, Magnesium diboride (MgB_2), a recently discovered superconducting material with the highest-known transition temperature (at which it

becomes superconducting) has generated much enthusiasm. MgB_2 could soon become the preferred superconducting material in numerous medium-range magnetic field applications, such as 'Magnetic resonance imaging' (MRI). European companies already play a dominant role in MRI, and the use of low-cost MgB_2 would substantially enhance European competitiveness in a very competitive global market. In addition, the energy sector, in particular that of liquid hydrogen, could take a great leap forward thanks to the financial, environmental and functional benefits of MgB_2 .

EU researchers initiated the Hipermag¹ project to enhance the performance of MgB_2 and thus increase its commercial potential and market penetration. The results of this project live up to the expectations: the researchers successfully optimised the microstructure of precursor powders, demonstrating enhanced superconducting properties of carbon-doped nanosized precursors and wires (monofilamentary tapes).

They also developed powder-processing techniques leading to the



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development of multifilamentary conductors housed in metallic sheaths. These materials provide the enhanced mechanical stability that MgB_2 lacked until now.

In addition, the researchers improved current-carrying capabilities, employing a variety of microscopic and spectroscopic techniques to determine the preferred orientation of MgB_2 crystallites. Finally, they evaluated the stability of the superconductors in magnetic fields, explaining novel experimental results with theoretical descriptions.

MgB_2 is an intriguing superconducting material with numerous potential uses. Obstacles to its commercial exploitation were

partially overcome via research carried out by the Hipermag consortium.

The project was coordinated by the University Twente, the Netherlands.

1 'Nano- and micro-scale engineering of higher-performance MgB_2 composite superconductors for macro-scale applications'.

Funded under the FP6 specific programme 'Nanoscience, Nanotechnologies, Materials and New production Technologies' (NMP).
<http://cordis.europa.eu/marketplace> > search > offers > 8997

Carbon nanotubes from lab to market

'Carbon nanotubes' (CNTs) are tube-shaped materials made of carbon with a diameter on the scale of nanometres. EU-funded researchers have overcome one of the most important stumbling blocks to their widespread commercial use by demonstrating low-cost mass production of high-quality products.

The carbon in CNTs is in the form of graphite — it was first observed serendipitously in pencil lead. When magnified, CNTs look like rolled-up chicken wire, albeit on the order of the size of atoms and molecules.

CNTs have amazing mechanical strength as well as interesting electrical properties, acting as either metals or semiconductors, depending on geometrical variations. They have captured

the imagination of many for their potential use in a huge variety of novel applications.

However, the most common production process, laser ablation, is quite expensive and not easily scaled up to industrial manufacturing capacity.

European researchers sought to develop inexpensive 'Channel spark ablation' (CSA) technology, which would produce high-quality

'Single-walled CNTs' (SWCNTs) in great quantities, through the Nanospark¹ project.

Scientists first developed the necessary CSA-based machinery for SWCNT production. The energy consumption of CSA manufacturing is typically on the order of 100 times less than conventional laser ablation, enabling a huge decrease in both production cost and the price of the final product.

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In addition, installation costs are often up to five times cheaper.

CNTs were produced using the new Nanospark equipment which has the potential to be commercialised as powders, suspensions and dispersions in thin films (among the prominent media in high demand).

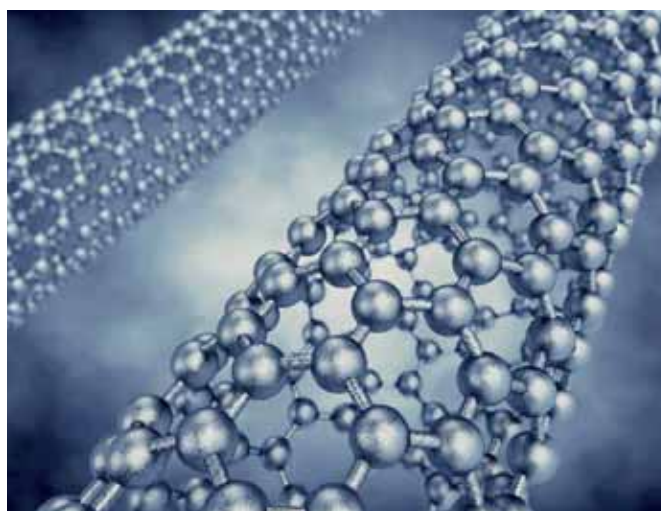
Nanospark's demonstrated production of large quantities of high-quality CNTs with significant cost savings should allow the transfer of numerous CNT-based concepts from lab to market. The immediate goal is an application to solar cells

where a potential 50% cost-saving is expected compared to conventional crystalline cell modules.

The project was coordinated by Labor S.R.L., Italy.

- 1 'Development of a new machinery for nanotubes mass production based on the channel spark ablation technique'.

Funded under the FP6 specific programme 'SME activities'.
<http://cordis.europa.eu/marketplace> >
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Sensing for safety

As the everyday mobility of people becomes more and more important, will road safety rely on increasingly expensive and sophisticated systems? EU-funded researchers are developing a suite of smart solutions that will make our future driving experience safe, but still affordable.

Look at the engine compartment of a modern-day car and it is clear that the days of 'tinkering with your motor' are gone. All vehicle components and subsystems rely

on clever sensors and complex electronic control units to implement their safety and comfort functions. Advanced technologies are widely adopted; from

GPS-enabled, smart phone-compatible navigation and media systems to complex hybrid engines and dynamic fuel-efficiency controls.

But what we all ultimately want is a vehicle that gets us from A to B — in one piece. Safety must come first.

Of course, car-makers apply their best knowledge and capabilities to safety systems, so everything from ABS brakes, electronic skid protection and the soon-to-be-standard eCall emergency communication system all use the latest developments in smart sensor and control systems.

A project funded through the Seventh Framework Programme (FP7) has supported researchers and car-makers in developing next-generation safety-oriented products.

ADOSE¹ focused on the development of new sensors which can be integrated into sophisticated on-board safety systems. The project ran in parallel with other large-scale projects (e.g. Interactive, HAVE-IT) which looked at the development of safety systems rather than sensing devices.

Breakthrough technologies

The ADOSE partners adopted five sensing technologies to build breakthrough prototypes and solutions, with higher performances or lower costs compared to the current state of the art. The sensor prototypes have been integrated into pilot systems which can detect obstacles, measure distances and assess visibility. ➤



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The 'Far infrared' (FIR) imager and a batch-moulding process for FIR optics were developed to lower the cost of key components in car night-vision systems. 'Night vision is only an option for high-end cars at present,' says Ingo Herrmann from Robert Bosch, 'but collision rates could be dramatically reduced if they became a standard safety system. We wanted to make night vision highly attractive and make this technology available for a broader market. We had to develop a sensor which was considerably cheaper to make than existing systems on the market.'

The ADOSE team also developed a 'Multi-functional optical sensor' (MFOS) which measures environmental parameters, such as fog, rain and twilight. This information can complement driving-related data, such as spotting oncoming vehicles, in real time. The MFOS device is based on a low-cost plastic optical light guide coupled to a standard 'Complementary metal-oxide-semiconductor' (CMOS) imager.

The third device is a low-cost '3D range camera' (3DCAM) which can recognise and measure distances to objects travelling at high speed, such as oncoming vehicles. It is suitable for pre-crash warning systems.

Road safety is not just about protecting drivers, of course; pedestrians and cyclists — who typically come off far worse in collisions — will also benefit from ADOSE research. The project has developed a radar system that locates obstacles and unambiguously identifies road users equipped with passive and active transponders (RFID tags). The project has successfully integrated signal processing into the radar system to help remove background 'noise' and mask poor weather conditions.

The last prototype is an innovative 'Silicon retina stereo sensor' (SRS). This system is a low-cost sensor, inspired by biology, for very fast and less power-intensive object detection. The sensor can pinpoint objects moving quickly relative to the sensor (and vehicle) in real time, due to a 'stereo-matching' technique similar to the way our binocular vision allows us to judge distances.

'The SRS technology has been recognised by industry as a very new sensor type,' says Franco Fresolone of the Austrian Institute of Technology. 'The novel method of object sensing, inspired by biological processes, is suitable for various applications, such as roadside traffic-sensing and person-counting. We are already

in early-stage negotiations with a number of engineering firms about using the SRS technology for a variety of road-safety applications.'

Demonstrating value

Some of the ADOSE prototype sensors were tested in November 2011 on two test vehicles at the Centro Sicurezza test track in Orbassano, Italy. As Nereo Pallaro, ADOSE coordinator from the Fiat Research Centre explains: 'A relevant number of life-like test scenarios have been deployed; we tested the ADOSE sensors in the main situations where they show competitive performances with respect to the state of the art'

The tests allowed validation of the installed sensing devices in realistic outdoor conditions, and their adoption in future safety systems is expected. The research which created the MFOS technology also generated a high-dynamic-range CMOS sensor by ST Microelectronics, with micro-lens and colour filters, which can be manufactured at competitive prices. The sensor will go into production as soon as a commercial deal has been signed with a major supplier.

The harmonic radar and passive/active tags system is also generating commercial interest among

organisations outside the consortium, which are now collaborating to refine the technology and build a commercial prototype.

Sensing the future?

'By developing sensing technologies suitable for industrial use we have contributed to Europe's leadership in the area of intelligent safety systems and the expansion of this emerging market,' says Mr Pallaro. 'The technologies are now in various stages of development, further testing or refinement, and we hope to see further improvements in road safety for years to come.'

The ADOSE project received EUR 6.1 million (of the total EUR 10.2 million project budget) in research funding under the EU's Seventh Framework Programme (FP7).

The project was coordinated by the Centro Ricerche Fiat Società Consortile Per Azioni, Italy.

1 'Reliable application specific detection of road users with vehicle on-board sensors'.

Funded under the FP7 specific programme 'Information and communication technologies' (ICT).
<http://cordis.europa.eu/marketplace> > search > offers > 9156

Accelerator research goes pan-European

If facilities such as the European Organisation for Nuclear Research (CERN) and the German Electron Synchrotron (DESY) have achieved great results individually, they could do even more together in a pan-European network. This is the aim of the EU-funded project CARE, which will help produce exponential knowledge in energy physics and similar disciplines.

Science, particularly high-energy physics, has come a long way as a result of the power of particle accelerators. European facilities have been at the forefront of accelerator research, opening doors to many exciting research finds.

The EU-funded project CARE¹ has established a more organised and integrated European network

in the field, bringing notable European infrastructure laboratories and their user communities closer to each other. The project successfully upgraded existing infrastructures, facilitated access to accelerators and enhanced their reliability. Thanks to closer interaction among scientists and experts, it exploited cutting-edge technologies through improved research and development, testing



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of components and generation of novel concepts.

CARE also articulated priorities for the future — such as neutrino (muon) beams and high-energy/high-intensity proton accelerators, as well as an electron linear accelerator and an electron linear collider — contributing to a vision of a pan-European distributed technological platform for accelerator research, supported by

three networking activities and four research activities.

Networking produced comparative studies, prioritised research programmes and developed technical roadmaps for infrastructure evolution, significantly strengthening European knowledge in the field. The joint projects, on the other hand, included work on the development of a superconducting cavity technology and the launch of

a programme to improve photo-injector technology.

Overall, CARE demonstrated that the synergy of all facilities produces outstanding research results far beyond that which one facility alone could have achieved. It helped academic institutions across Europe develop their research capabilities and enabled the accelerator research sector to innovate in numerous ways.

The project was coordinated by the Commissariat à l'Energie Atomique, France.

1 'Coordinated accelerator research in Europe'.

Funded under the FP6 specific programme 'Research infrastructures'.
<http://cordis.europa.eu/marketplace> > search > offers > 9006

Detecting weak signals in cosmic background noise

EU-funded researchers have coordinated their efforts to address some of the most important open questions in astro-particle physics. Detection of dark-matter constituents and Einstein's gravitational waves may not be too far away.



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The Universe is made up of matter, anti-matter, dark matter and all kinds of exotic things that make the picture a bit more complicated than most remember from basic high school physics and chemistry.

Europe is a leading player in the multi-disciplinary field of astro-particle physics, which connects interrelated fields of particle physics, astronomy and cosmology. It maintains four 'Deep underground laboratories' (DULs) and two 'Gravitational wave observatories' (GWOs).

DULs can be found one to two kilometres deep under the Earth's surface. They are designed to minimise interference from cosmic 'noise' and ease the detection of cosmic particles, such as those (of unknown type) that form the dark matter which makes up the majority of the Universe.

GWOs, for their part, are designed to detect the existence of 'Gravitational waves' (GWs), which are ripples in space-time induced by massive accelerating bodies such as black holes. Although predicted by Einstein's Theory

of General Relativity, they have yet to be detected experimentally.

In order to strengthen Europe's knowledge in astro-particle physics, EU researchers initiated the ILIAS¹ project. Its overarching goals were to improve networking, research and international access to facilities.

Amongst the main project achievements are the extensive categorisation — at both types of installations — of sources of background noise as well as the creation of materials and methods

to minimise them. This knowledge should enhance the quality of future experiments as well as aid in selecting new sites and materials for observatories.

The ILIAS consortium also made major progress in the modelling of GWs, yielding the first reliable waveforms for merging black holes and for upper limits on gravitational deformations of isolated neutron stars. Such data should accelerate the development of signal detection algorithms and thus the likelihood of the first-ever detection of GWs.

ILIAS has strengthened the EU research community in astro-particle physics with significant enhancements to infrastructure, joint research activities and international networking. Reduction of noise and enhanced signal detection combined with broad scientific access to knowledge and facilities could make the EU scientific community the first to unravel the nature of dark matter and detect the long-sought but elusive GWs.

The project was coordinated by the Commissariat à l'Energie Atomique, France.

1 'Integrated large infrastructures for astro-particle science'.

Funded under the FP6 specific programme 'Research infrastructures'.
<http://cordis.europa.eu/marketplace> > search > offers > 9055

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Low-cost, eco-friendly insulation

EU-funded researchers have developed novel thermal insulation processing methods. Their work allows for the production of low-cost, environmentally friendly and geometrically varied insulation components.



If the function of thermal insulation is to minimise heat loss, 'Vacuum insulation panels' (VIPs) could very well be the Rolls Royce of insulation materials. Over the past few years, the market has shown more and more interest in VIPs: they promise to be less expensive and more environmentally friendly, while being of lesser volume and demonstrating superior performance compared to conventional insulation materials and methods.

VIPs are already used to insulate shipping containers, exhaust systems and reactors, electronics, pipelines and buildings. However, widespread commercial exploitation and penetration of potential new markets has been hindered by a lack of geometric variety. VIPs are primarily manufactured as flat elements or as cylindrical components shaped by bending.

European researchers initiated the VACI¹ project in order to develop processes and machinery that would allow for manufacturing VIPs in tapered and bent segments as well as to enhance current understanding of segment joining.

In addition, they sought to create methods for maintaining VIPs, enabling on-site repair or replacement of damaged segments. Research focused on cold service equipment and particularly insulated pipe systems.

Numerous investigations of VIPs' thermal and mechanical properties were first performed using finite element modelling. Mechanical and gas-barrier properties of high-barrier films were also assessed. Then, the VACI consortium established manufacturing facilities for cylindrical insulation pipe production as well as facilities for on-site repair of damaged panels. Their efforts have resulted in improved quality monitoring of high-barrier films and VIPs, enhanced production processes and lowered production costs.

The project results should achieve the objective of enhanced commercialisation of VIPs and their penetration of new markets.

The project was coordinated by VA-Q-TEC AG, Germany.

1 'Vacuum insulation'.

Funded under the FP6 specific programme 'SME activities'.
<http://cordis.europa.eu/marketplace> >
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The 'flavours' of the particles of the Universe

EU-funded researchers investigated open questions regarding the fundamental particles making up the universe, with important implications for high-energy physics.

According to the Standard Model, the Universe is made of 12 fundamental matter particles (six quarks and six leptons, the best-known of which is the electron) and four force-carrying particles that interact with them. Physicists have also assigned 'flavours' to each particle.

Whilst most predictions of the Standard Model and all 12 matter

particles have now been observed experimentally, the scientific community has acknowledged a couple of problems.

Looking beyond the Standard Model, one question that remains open is the nature of the symmetry between matter and antimatter. According to the model, for every type of matter particle there

is a corresponding antimatter particle of equal mass and opposite charge (e.g. a positive proton and a negative anti-proton). However, antimatter particles are rarely observed.

In addition, scientists are still trying to understand the nature of the 'dark matter' (DM) that makes up 70 % of the mass of

the Universe and produces visible gravitational effects.

With EU funding for their Flavidas¹ project, European researchers have rolled up their sleeves to address these fundamental open questions of particle physics. Their first area of research concerned the implications of flavour symmetries. The scientists managed to explain a reported deviation from the Standard Model by using the so-called Minimal Flavour Violation hypothesis, explaining how and

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when particles change flavour. The published results provided a good fit to all measures, allowing for robust interpretations.

The second area of research focused on an effective integration of experimental and theoretical work towards the detection of DM. The Flavidas team investigated DM signals and successfully developed a description of direct DM searches and their relevance to 'signatures' of DM (parameters for detection unique to DM).

Overall, Flavidas researchers investigated two of the most important open questions in high-energy particle physics, leading to

important theoretical descriptions and publications. The knowledge gathered should improve understanding of gravity and DM and facilitate an appropriate development of future experimental work.

The project was coordinated by the Scuola Internazionale Superiore Di Studi Avanzati, Italy.

1 'The physics of flavour in visible and dark sectors'.

Funded under the FP7 specific programme People (Marie-Curie actions).
<http://cordis.europa.eu/marketplace> > search > offers > 9002

Manipulating light with 'metamaterials'

A revolutionary new class of materials, metamaterials, is promising to change the face of electronic instrumentation. The establishment of a Virtual Institute (VI) on the topic is putting Europe at the research frontier.

Metamaterials are man-made composites impossible to find in nature. Made up of arrays of very small metallic resonant elements, they enable manipulation of electromagnetic (EM) fields and waves at sub-wavelength scales.

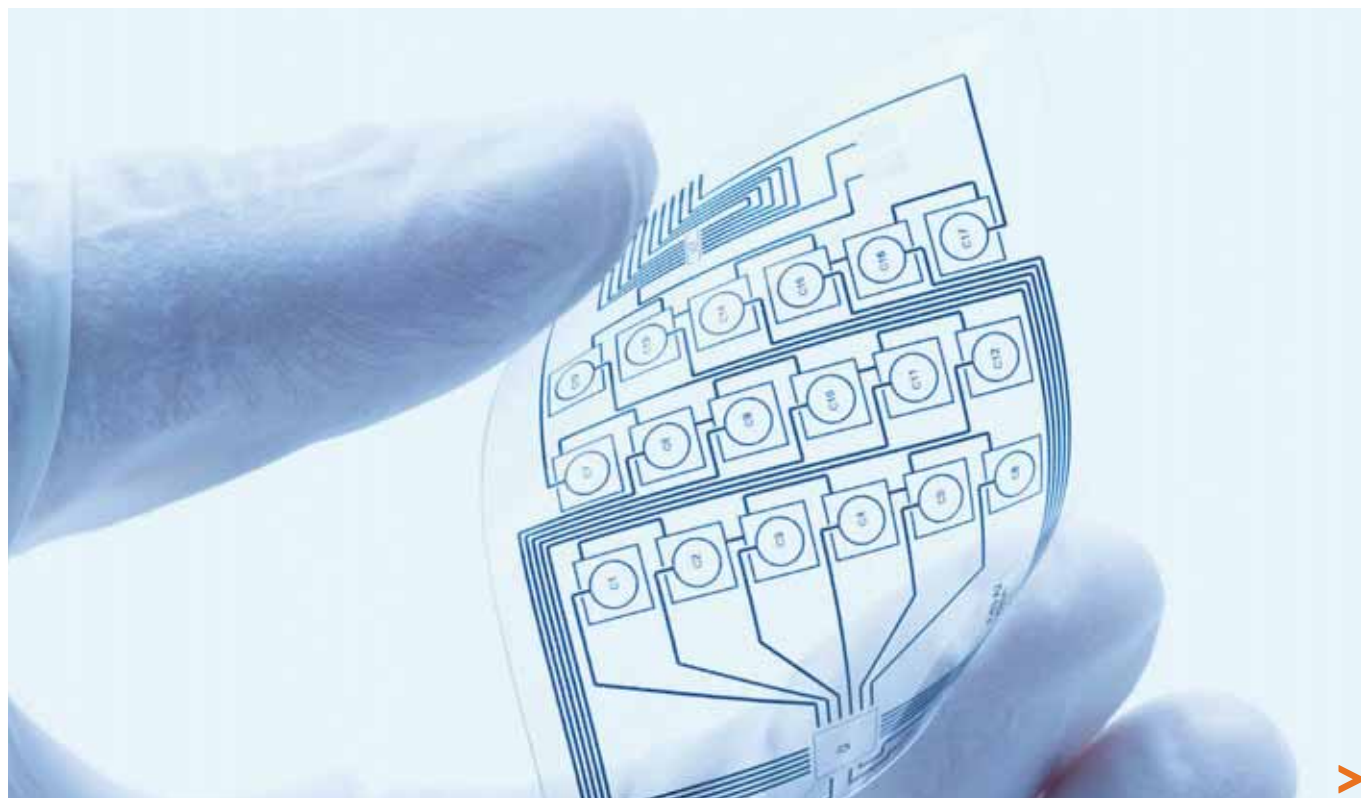
The EM spectrum includes all types of (light) radiation in the form of streams of photons classified according to their wavelengths. It consists of radio waves, microwaves, infra-red light, visible light, ultraviolet light, and gamma rays. In fact, visible

light makes up only a small part of the EM spectrum.

The ability to manipulate EM waves translates in a capacity to manipulate light of all wavelengths, opening the door to a variety of new functionalities

which were previously considered impossible. In fact, one of the most intriguing implications of EM wave manipulation is the ability to make objects invisible.

European researchers seeking to make Europe an internationally



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acclaimed centre for research in this exciting new field of discovery have initiated the Metamorphose¹ project.

The objective was to develop new types of metamaterials and their large-scale assembly processes, leading to enhancements in smart, multifunctional antennae and apertures, high-resolution imaging systems and even 'smart skin'. The latter is packed with micro-circuitry that sticks on the human body in a flexible way,

bending without damaging the components. It is likely to be used initially in biomedicine, enabling measurement of activity in the human heart, muscles or even the brain.

In order to accomplish scientific goals, the consortium established a Virtual Institute (VI) to plan and organise joint research projects and enhance dissemination of knowledge. The VI includes a doctoral programme with web-based learning. In addition, it

houses a job site and organises an annual international conference on metamaterials in microwaves and optics. Publications of news related to the field are constantly updated.

The VI combines expertise from material physics, electromagnetics, optics, radio engineering and electronics. With its establishment, the Metamorphose project promises to place Europe at the forefront of the exciting multidisciplinary field of metamaterials.

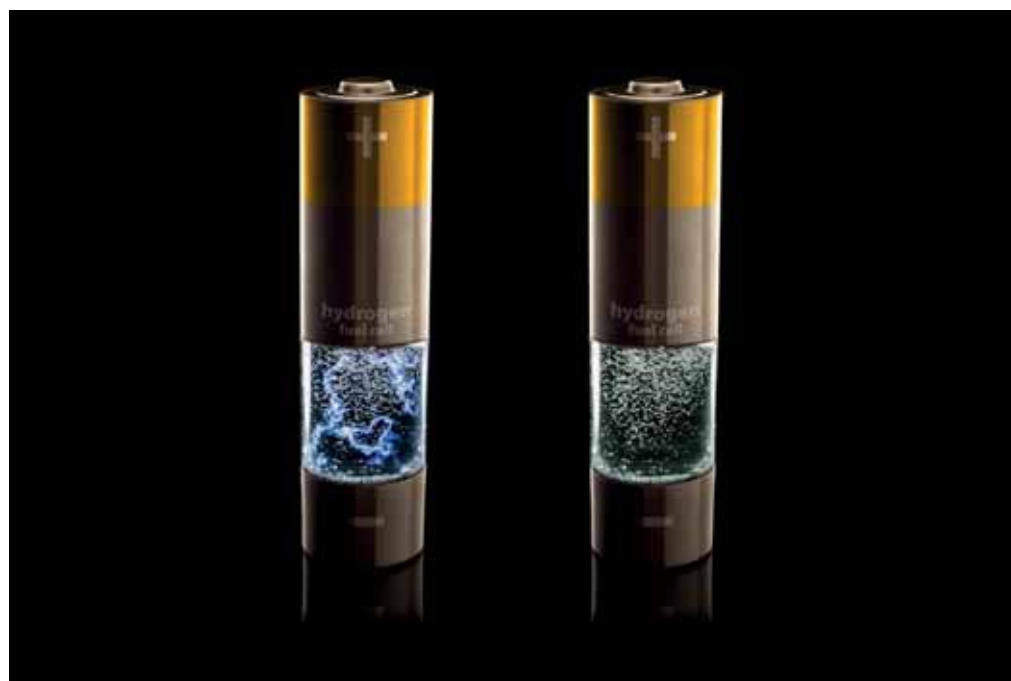
The project was coordinated by the Helsinki University of Technology, Finland.

1 'Metamaterials organised for radio, millimetre wave and photonic superlattice engineering'.

Funded under the FP6 programme 'Sustainable Development, Global Change and Ecosystems'.
<http://cordis.europa.eu/marketplace> > search > offers > 8988

Supercapacitors to provide peak power from fuel cells

Hydrogen-based fuel cells have gained much attention as an energy alternative to fossil fuels. EU-funded scientists have developed an integrated design capable of overcoming one of the main obstacles to their more widespread implementation.



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Fuel cells (FCs) are energy-conversion devices. They convert the energy stored in fuel, such as hydrogen, into mechanical energy (for example, to power a small machine).

Conversion is a one-step process, making FCs much more efficient than typical combustion devices. They have very few moving parts, a unique feature contributing to enhanced reliability, decreased maintenance costs and almost negligible noise. They offer the potential to relieve the current

pressure, instability and rising costs on the fossil fuel market and provide a sustainable and clean form of renewable energy.

One of the major stumbling blocks to more widespread implementation of FCs in small, portable devices is a significantly reduced lifetime in the face of variable loads. Given that most real loads are variable (for example, power peaks when starting), commercial viability is strongly tied to enhancing durability of FC components under such conditions.

European researchers initiated the FEMAG¹ project to develop a novel energy generator. The design integrated an FC with supercapacitors to handle power peaks and thus enable a durable and flexible power supply for small, portable non-automotive devices.

Capacitors, those tiny components ubiquitous on printed circuit boards, are charge-storage devices. Supercapacitors are capable of storing thousands of times more energy than a conventional

capacitor. They are used in conditions of rapid charge-discharge cycles involving high currents of short duration.

The FEMAG system architecture relies on supercapacitors to meet peak power loads, the FC for normal steady-state operating conditions, a back-up battery when power demand exceeds the FC's maximum capability and an intelligent converter that switches from one component to another depending on load conditions.

Scientists developed two prototypes, a low-energy one for installing on a wheelchair and a medium-energy one for 'Automated guided vehicles' (AGVs).

FEMAG technology has a very promising future. The consortium identified 20 potential applications and prepared designs for each one. In the near future, hydrogen-based generators for low-cost, portable applications may be a competitive alternative to today's power generator.

The project was coordinated by AGT SRL, Italy.

1 'Flexible ecological multipurpose advanced generator'.

Funded under the FP6 specific programme 'SME activities'.
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Interview: Reducing uncertainty in forecasting sea-level rises

The melting of continental ice (glaciers, ice caps and ice sheets) is a major source of current sea-level rise, and one that is accelerating more rapidly than predicted.

The Ice2sea¹ programme has seen European and international partners cooperating on studies of the key processes in mountain glacier systems and ice caps (e.g. Svalbard in Norway), and in ice sheets in both polar regions (Greenland and Antarctica), in order to improve our understanding of how these systems will respond to future climate changes.

As the project enters its final year, *Research*eu Results magazine* asked Ice2sea's coordinator, Professor David Vaughan of the British Antarctic Survey, to explain in a little more detail what the project has been investigating.

What brought about the Ice2Sea project?

Ice2sea was needed because the last Intergovernmental Panel on Climate Change (IPCC) report — in 2007 — highlighted that the greatest uncertainties in estimates of future sea-level rises were the contributions of ice sheets and glaciers. It is one of several international projects which aim to reduce those uncertainties, so the next IPCC report — due in September 2013 — contains more precise and accurate forecasts.

Sea-level rise is a consequence of climate change, and climate change is a consequence of CO₂ rise, so to understand uncertainties in sea-level rise we need to identify them in estimates of global CO₂ emissions, regional impacts, impacts on ice sheets, sea-level rise due to melting ice and national-level impacts on Europe — with all uncertainties cascading upwards along this chain of causation. We are working to isolate these uncertainties — then we will know where to prioritise further research.

So what is Ice2sea working on?

Ice2sea is a large research programme — with many actors and partners across the EU and in Iceland, Chile and Norway, as well as links to US-based research groups — coordinating a range of different actions. We have sent researchers to the ice sheets in Greenland and Antarctica to see how they are losing ice, and we used satellite images to measure sea-level rises, changes in the oceans and compared all these data to global and regional climate models. Currently, global sea level is rising by 3mm per year, with probably up to a third of this coming from the Greenland and Antarctica ice sheets.

And what new findings can you reveal?

Ice2sea is taking a lead in understanding how changes in the oceans affect ice sheets — one of the biggest unknowns in future projections. Oceans transport heat towards the ice sheets. If this increases, as changes in the atmospheric climate system feeds into the ocean, it cuts away the edges of the ice cover, with knock-on impacts on the speed of glaciers and their delivery of fresh ice to the edge.

Ice2sea can claim to have built some of the most sophisticated ice-sheet models in existence. We have invited other groups to run models and compare results from these different models — again, with the purpose of trying to reduce uncertainty.

In addition, we have contributed to the first complete inventory of the global glacier population — more than 200 000 glaciers around the world — from just a few square kilometres in size to many hundreds. This has been an international effort; Ice2sea works with other partners where we can't do it all ourselves. ➤

ENVIRONMENT AND SOCIETY



© Ice2sea Project

Professor David Vaughan

Finally, we have worked to understand how changes in sea level affect coastlines — especially in Europe. For this, it is not sufficient to just know how much ice is being lost; we also need to know from where. If ice is lost from Antarctica it has a different effect to ice loss in Greenland.

These huge ice sheets are big enough to have a gravitational effect on oceans — so they attract the mass of the water, slightly distorting the surface. The oceans are therefore slightly raised around Greenland and Antarctica — if ice is lost then this 'bump' goes down, as less water is attracted, and it spreads out across the surface of the ocean, leading to a significant additional sea-level rise in neighbouring coastlines.

There are also regional effects and second-order effects to take into account. When ice retreats, the continents rebound upwards, as there is less weight pressing them down into the magma beneath. In Northern Europe we are still seeing some long-term effects of the end of the last Ice Age — Scotland is still rising by 1mm per year! On the other hand, southern England is sinking, like the lower end of a see-saw, and this increases the consequences of sea-level rise for the region, and especially London. This means that local sea-level rises are also of concern.

What are some of the practical implications of all this research?

Small increases in sea level can produce big changes in flood risk. In the Thames estuary the Thames barrier is designed for 1 per 1000 year protection — the probability that a flood will be higher than the barrier can prevent is just once in a millennium. But if the sea level rises 50cm this becomes only once in 100 years. And if there's a rise of as much as a metre the protection drops to potentially being overwhelmed at least once every 10 years.

Our goal is to understand the reality of sea-level rise, and we will provide projections for

each source: Greenland and Antarctica ice sheets, global glaciers and European glaciers. From this we will calculate the base level rise and predict regional rises with detailed national-scale projections.

Improving our knowledge of the North Sea is crucial to understanding the consequences of rising sea levels. This sea is prone to occasional big flood surges — usually in January and February — as storms off the US coast swell across the North Atlantic around Scotland and into the shallower, narrower waters of the North Sea, building in height and intensity as it reaches Denmark, the Netherlands and the United Kingdom.

Flooding in these regions occurs regularly — such as in 1953 when hundreds of people died — and the consequences of climate change, such as higher seas and more extreme weather conditions, could see it happen more frequently. The better we understand, the better we can prepare: 'knowledge is power' in this case!

The reality is that the sea level will continue to rise even if we stop CO₂ emissions now; we need sensible engineering responses. We need to protect the coastline and not build where we have projections of increased flood risk. The Netherlands already builds its defences with the capacity to improve them in the future; for instance, they build dykes much wider than needed so they can be built upon and raised further. There are also economic benefits from better, less uncertain forecasts — by building appropriate sea defences we can save money as well as avoid disaster.

What are some of the difficulties you have encountered?

The biggest difficulties lie in predicting the behaviour of the ice sheets. Normally, numerical models are tested against past changes: global climate models can be compared against 20th century CO₂ and temperature changes, while weather models are tested every day. But for an ice sheet, to test our models we would need centuries or millennia of data.

In addition, there are only two significant ice sheets, Greenland and Antarctica, so we can't take the statistical approach we would with glaciers. So the solution is to build more complex models to be sure we've included all possible physical parameters. This is one reason why the project has been working to test a range of different models. The paucity of available data to test against means we need to include second and third-order factors — you have to put in as much 'physics' as you can!

Another problem was some of the data were old; for example, many of the ice cores from Greenland were taken in the 1970s to 80s. Since then, new snow has been deposited, so we've taken new samples from these sites.

They are very useful for measuring temperature changes in recent decades and the snow-fall accumulation rate. Our partners at the University of Copenhagen did this in Greenland, while the British Antarctica Survey did the same in Antarctica.

Have you already published results from the research so far?

Researchers from the project have published 61 papers already, most recently a paper in the journal *Nature*² in April 2012 showing that warm ocean currents are the dominant cause of recent ice loss from Antarctica. Using NASA's ICESat satellite to map the changing thickness of 54 floating ice shelves around Antarctica, it seems that 20 are being melted by warm ocean currents.

Also, in order to make sure our results could contribute to reducing uncertainties in next year's report from the IPCC, we needed to submit our final reports in July 2012. The contents are now undergoing peer review. We also have an additional 72 research papers in peer review.

What is next for your research?

Ice2sea's next steps are to synthesise the results of all our research — leading to numerical projections and advice to science policy-makers as to where the uncertainties still lie. Now we know in greater detail where ice is being lost, and which glaciers are losing ice fastest, we also know where to focus future work in order to understand specific drivers better. The ocean's influence is another key research area for the future.

I'll be going to Antarctica myself at the end of 2013 — to Pine Island Glacier in West Antarctica. The biggest changes to the ice sheet are being seen in some of the worst places to work — summer temperatures are between -10 and -30°C and it is very windy. I'm definitely not going to Antarctica for a holiday!

The Ice2sea project is coordinated by the Natural Environment Research Council (NERC) of the United Kingdom.

- 1 'Ice2sea — estimating the future contribution of continental ice to sea-level rise'.
- 2 'Antarctic ice sheet loss driven by basal melting of ice shelves', *Nature* 484, 502–505 (26 April 2012): H.D. Pritchard, S.R.M. Ligtenberg, H.A. Fricker, D.G. Vaughan, M.R. van den Broeke, L. Padman

Funded under the FP7 specific programme Cooperation, under the theme 'Environment (including Climate Change)'.
For further information see the project website: <http://www.ice2sea.eu/>



Early warning of potential 'desertification'

Climate change and human activities have contributed to a substantial degradation of Earth's fertile land. Prevention is key to avoiding reaching the point of no return. An EU-funded project has enabled the organisation of the first international conference on the issue — a unique opportunity for scientists to discuss state-of-the-art early-warning systems.



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According to the United Nations Educational Scientific and Cultural Organization (UNESCO), desertification — an irreversible degradation of land affecting its productivity — already affects one quarter of Earth's land surface. Twenty-four billion tonnes of fertile soil have disappeared over the last 20 years.

As a result of the United Nations Convention to Combat

Desertification (UNCCD), the EU has made research and programmes directed at combating desertification a priority. Numerous directives, initiatives and dedicated research projects have been launched.

The Desertstop¹ project provides a link between all these initiatives. Initiated by European scientists willing to share their knowledge and best practices in the field, the

project aims to organise a conference focused on early warning.

The 'First International Conference on Remote Sensing and Geo-information Processing in the Assessment and Monitoring of Land Degradation and Desertification' has allowed renowned experts in the fields of remote sensing and geo-information processing to present recent findings related to desertification

and land degradation. The organisers made a particularly effort to attract young scientists and scientists from countries directly affected by desertification.

The ability to identify early signs of desertification and thus prevent the irreversible loss of fertile land would have a strong impact on developing countries faced with shortages of arable land for crops and grazing. Thanks to its international conference, Desertstop paved the way to significant advances in achieving the EU goals for sustainable development, as well as the UNCCD strategy for combating desertification.

The project was coordinated by the Universität Trier, Germany.

- 1 'Remote sensing and geo-information processing in the assessment and monitoring of land degradation and desertification in support of the UNCCD; state of the art and operational perspectives'.

Funded under the FP6 specific programme 'Sustainable Development, Global Change and Ecosystems'.
<http://cordis.europa.eu/marketplace>
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Global warming transforming Arctic shrubs into forest

Researchers in Finland and the United Kingdom suggest that the warming Arctic climate could turn existing shrubs into trees in the coming years. The finding, presented in the journal Nature Climate Change, reveals that patches of forest can emerge across the tundra, which in turn could speed up the planet's warming.

A recent study funded in part by the Ecochange¹ project — which has received a Marie Curie 'Promoting sciences' grant worth EUR 173 400 under the EU's Seventh Framework Programme (FP7) — implies that the Arctic region could soon see shrubs becoming forests.

Led by Oxford University in the United Kingdom, the

researchers focused their work on a 100 000-km² area known as the north-western Eurasian tundra, which stretches from western Siberia to Finland. Gathered with fieldwork and satellite imaging as well as observations made by indigenous reindeer herders, the data they have released indicates that, since the 1970s, between 8 and 15 % of the area's willow (*Salix*) and alder (*Alnus*) shrubs

have grown into trees reaching more than 8 metres high.

Previous studies that investigated the potential impact of forestation revealed that forest expanding into the Arctic tundra could boost Arctic warming by one to two degrees by the end of this century.

'It's a big surprise that these plants are reacting in this way,' said lead

author Dr Marc Macias-Fauria from the Department of Zoology at Oxford. 'Previously, people had thought that the tundra might be colonised by trees from the boreal forest to the south as the Arctic climate warms, a process that would have taken centuries. But what we've found is that the shrubs that are already there are transforming into trees in just a few decades.'



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According to the researchers, the transformation from shrubs to forest is important because it changes the albedo effect, which refers to the amount of sunlight reflected by the surface of Earth.

The tundra's shrubs are usually covered by a blanket of white, light-reflecting snow during spring and autumn. Trees, however, have the necessary height to deflect the snowfall, presenting a dark, light-absorbing surface. The greater absorption of the Sun's radiation,

along with the micro-climates produced by forested areas, then tends to accelerate global warming.

'Of course, this is just one small part of the vast Arctic tundra and an area that is already warmer than the rest of the Arctic, probably due to the influence of warm air from the Gulf Stream,' said Dr Macias-Fauria. 'However, this area does seem to be a bellwether for the rest of the region; it can show us what is likely to happen

to the rest of the Arctic in the near future if these warming trends continue.'

The researchers said the finding could impact researchers' efforts for modelling present and future low Arctic vegetation responses to climate change. It also stresses the potential for structurally new ecosystems to emerge from within the tundra zone.

The project was coordinated by the Chancellor, Masters and Scholars

of the University of Oxford in the United Kingdom.

- 1 'Creating conditions for persistence of biodiversity in the face of climate change'.

Funded under the FP7 specific programme 'People' (Marie-Curie Actions). Promoted through the Research Information Centre. <http://ec.europa.eu/research/infocentre> > search > 26253



A call to address climate change

Common co-operation initiatives bringing together European and foreign countries struggling against climate change are a source of inspiration for participants willing to embark on relevant projects from proposal submission to project management.

Climate change and environmental challenges are shaping our planet at an alarming rate. Based on the principle that unity is strength, the EU-funded project Econetus¹ sought to ease co-operation between Europe's newest and upcoming members to launch research projects on the issue. Econetus has been the key driver of collaboration initiatives involving both old and new EU Member States, namely Lithuania, Austria, Poland and the United Kingdom, to encourage joint research and development (R&D) projects.

The project has built a database of over 500 partners from across Europe and other countries

to create and enlarge the project network. It conducted over 30 conferences in Europe, the most notable of which was the project's final conference held in Gdansk, Poland.

The project also saw the organisation of knowledge-acquisition workshops dedicated to project management, plus negotiations and contracts to encourage participation of small and medium-sized enterprises (SMEs) in environment-related projects. These events helped disseminate information on the project's database through leaflets, a CD version of the database, and EU national contact points (NCPs).



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Econetus led to the proposal and submission of 10 EU projects focusing on the environment, raising awareness of this important issue and advancing research on climate change. The initiative helped strengthen bonds between researchers and fostered development on the topic, setting the stage for vigorous collaboration in the sector.

Without a doubt, Econetus has bolstered Europe as an important player in empowering countries worldwide to address the challenges of climate change.

The project was coordinated by the Politechnika Slaska, Poland.

- 1 'Support for networks creation in the field of global change and ecosystems - from idea through proposal submission and project managing till completion and successful audit'.

Funded under the FP6 specific programme 'Sustainable Development, Global Change and Ecosystems'. <http://cordis.europa.eu/marketplace> > search > offers > 9181



Scientists sound caution on geo-engineering

Geo-engineering, the deliberate large-scale engineering and manipulation of the planetary environment, is not only for the realm of science fiction but a potentially realistic option to mitigate climate change. In an era where the Earth's climate is influenced by human activity on a global scale, researchers have hinted at the possibility of developing and using specific technologies to countervail the change. But what would be the impact of such an undertaking?

A European effort involving scientists from all over the continent has investigated the impacts that some suggested geo-engineering options would have, and the results may not be quite what was intended. Presented in the journal *Earth System Dynamics*, the research was funded in part by the IMPLICC¹ project, which has received almost EUR 1 million under the Environment theme

of the EU's Seventh Framework Programme (FP7).

Some scientists have formerly argued that using target technologies like injecting sulphur aerosol into the stratosphere to reduce solar irradiation could be more effective and less costly than attempts to reduce greenhouse gas emissions in order to combat climate change. Also,

some say it might become necessary to use geo-engineering technologies to prevent us from abrupt catastrophic changes in climate systems. Others doubt the effectiveness of such options and argue that geo-engineering schemes suffer from unwanted side effects, as well as legal and ethical issues. All the same, there are some researchers, politicians and economists who believe

that using climate engineering in order to reduce the solar radiation reaching our planet could be justified.

To set the discussion on a more solid scientific footing, French, German, Norwegian and British scientists used sophisticated climate models. One consequence of a geo-engineered climate, they observe, was that global and regional rainfall were likely to be reduced significantly.

'Climate engineering cannot be seen as a substitute for a policy pathway of mitigating climate change through the reduction of greenhouse gas emissions,' the authors write in the paper. This suggests that this geo-engineering solution to climate change could lead to significant rainfall reduction in both Europe and North America.

Led by the Max Planck Institute for Meteorology in Germany, the researchers scrutinised how models of Earth in a warm, carbon dioxide (CO₂)-rich world responded to an artificial reduction in the amount of sunlight reaching the planet's surface.

Geo-engineering techniques could be used to reduce the amount of solar radiation reaching Earth's surface by mimicking the effects of large volcanic eruptions, which are known to have global cooling effects. This could be achieved by releasing sulphur dioxide into the atmosphere or by deploying giant mirrors in space, the researchers suggest.

For the purposes of this project, the scientists then focused their efforts on studying the expected impact of the implementation of such geo-engineering schemes. To achieve this, they examined how four Earth models responded to climate engineering under a specific scenario.

Their hypothetical scenario assumed a world with a CO₂ concentration that is four times higher than preindustrial levels, but where the extra heat



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caused by such an increase is balanced by a reduction of radiation we receive from the Sun.

'A quadrupling of CO₂ is at the upper end, but still in the range of what is considered possible at the end of the 21st century,' says Hauke Schmidt from the Max Planck Institute for Meteorology and lead author of the paper.

They observed a reduction in rainfall by 100mm per year, roughly a 15% drop of preindustrial precipitation values in large areas of North America and northern Eurasia. Meanwhile, over central South America, all models show a decrease in rainfall that reaches more than 20% in parts

of the Amazon region. Overall, global rainfall is reduced by about 5% on average in all four models studied.

'The impacts of these changes have yet to be addressed, but the main message is that the climate produced by geo-engineering is different to any earlier climate, even if the global mean temperature of an earlier climate might be reproduced,' note the authors.

However, the researchers are quick to note that the scenario studied is not intended to be realistic for a potential future application of climate engineering. But the experiment allows the team to clearly identify and

compare basic responses of Earth's climate to geo-engineering, laying the groundwork for more detailed future studies.

According to the researchers: 'This study is the first clean comparison of different models following a strict simulation protocol, allowing us to estimate the robustness of the results. In addition, we are using the newest breed of climate models, the ones that will provide results for the Fifth IPCC [Intergovernmental Panel on Climate Change] Report.'

The scientists used climate models developed by the UK Met Office's Hadley Centre, the Institute Pierre Simon Laplace

in France, and the Max Planck Institute in Germany. Norwegian scientists developed the fourth Earth model used.

The project was coordinated by Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V., Germany.

1 'Implications and risks of engineering solar radiation to limit climate change'.

Funded under the FP6 specific programme 'Sustainable Development, Global Change and Ecosystems'. Promoted through the Research Information Centre.
<http://ec.europa.eu/research/infocentre> > search > 26293



Help coral reefs combat stress

Coral reefs have been described as the 'rainforests of the seas', reflecting their rich biodiversity and ecological importance. A European project is helping to protect these irreplaceable natural wonders by providing marine biologists with a clearer understanding of the effects of climate change and pollution.



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A reef's physical structure is the result of a mutually beneficial relationship between the coral and a species of algae called *Symbiodinium*. The algae gain refuge among the calcium carbonate shells of the coral and in return provide large amounts of energy to their animal host. Environmental stress in the form of increased ocean temperatures, acidification or nitrogen levels can cause the coral to expel the algae, resulting in coral bleaching.

The ESCOR¹ project studied the effect of environmental stress on corals at both the molecular and functional levels. This was done using state-of-the-art techniques such as 'Polymerase chain reaction' (PCR) and 'Secondary ion mass spectrometry' (NanoSIMS).

The aim was to determine the level of expression of a number of key genes involved in regulating the relationship between *Symbiodinium* and coral in response to exposure to different climate change scenarios. Researchers also measured the change in uptake and transport of materials following man-made environment modifications such as high levels of dissolved inorganic nitrogen.

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Sampling was conducted at the north-west and south-east ends of the Australian Great Barrier Reef. Initial findings suggested significant molecular regulations in both the algae and coral host in response to increased temperature with alterations to the expression of key genes. The coral's reaction to increased nitrogen levels was examined using NanoSIMS analysis, which provided fresh insights into the role of ammonium in the symbiotic relationship. This also enabled

researchers to quantify the ability of the algae to fix nitrogen, compared to their coral host cells, when exposed to ammonium-enriched seawater.

Valuable new data on the expression of key genes and the metabolic changes occurring in corals during stress conditions was provided by the ESCOR project. This research also provided new insight into the complex mechanisms determining coral sensitivity to environmental changes.

Techniques developed by the consortium can help identify the effects of stressors at the sub-lethal level, the point at which mitigating a response would have the greatest potential for positive outcome. Furthermore, the results will enable scientists and decision-makers to develop more effective conservation and management policies and programmes.

The project was coordinated by Max Planck Gesellschaft Zur

Foerderung Der Wissenschaften E.V., Germany.

- 1 'Environmental stresses in a scleractinian coral-dinoflagellate symbiosis: a genomics approach'.

Funded under the FP6 specific programme 'PEOPLE' (Marie-Curie Actions).
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Alien species play havoc with fish

Researchers in Italy suggest that one of the main limits of spatially explicit forms of marine conservation, such as Marine Protected Areas (MPAs), is that they cannot protect these areas from major threats such as coastal modifications, changes in hydrodynamic and sedimentary regimes, or the spread of exotic species.



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Alien species, in particular the green algae *Caulerpa racemosa*, have invaded the Mediterranean Sea and other MPAs. They significantly impact the feeding habits of demersal species, potentially affecting fish populations as well. A new study, presented in the journal *PLoS ONE* and funded in part by the PERSEUS¹ project, provides new insight into their effects.

With almost EUR 13 million of funding under the Environment theme of the EU's Seventh Framework (FP7), scientists from the Università del Salento in Italy have assessed the coasts along the northern Ionian Sea in south-eastern Italy to evaluate

the occurrence and extent of the interaction between the invasive seaweed and the endemic white sea bream (*Diplodus sargus*). They found that sea bream are eating *C. racemosa*, and in turn accumulating the alkaloid *caulerpin* in many of its tissues.

'Relationships between sub-cellular mechanisms of algal metabolites and indirect effects on marine biodiversity have seldom been investigated,' the authors write in the paper. This study aimed at investigating the effects of such new interactions by measuring toxicological responses at several biochemical and physiological levels on organisms living in invaded and non-invaded

environments. By conjugating organic chemistry, ecotoxicology and ecology, this study attempts to elucidate the potential impact of *C. racemosa* on *D. sargus*, providing new insights into the cellular mechanisms by which biological invasions can affect marine biodiversity and, hence, the effectiveness of protection regimes.

The team identified 11 major food items in the stomachs of the sea bream, with *C. racemosa* being the most important in terms of frequency of occurrence and relative significance in fish. The researchers also observed a negative interaction between invasive species and native ones,

specifically in terms of how the availability or quality of nutrients, food and physical resources are changed.

'*Caulerpa racemosa* has become a major food item in the diet of this important fish species,' they wrote. 'Here, we confirm the frequent occurrence of invasive alga in stomach contents of the fish with the concomitant accumulation in fish tissues of the caulerpin. The switch from a diet composed of animal and plant items to a diet based mostly on the invasive alga could influence organoleptic properties and nutrition quality of this economically important fish resource. The nutritional value, taste and flavour of the fish fillet, in fact, depend both on the amount of fat and fatty acid composition and on the muscle amino acids which, in turn, are all strongly influenced by the fish's dietary history.'

The project was coordinated by the Hellenic Centre for Marine Research, Greece.

- 1 'Policy-oriented marine environmental research in the southern European seas'.

Funded under the FP7 specific programme 'Environment'. Promoted through the Research Information Centre.
<http://ec.europa.eu/research/infocentre> > search > 26213

ENVIRONMENT AND SOCIETY



Shaking the foundations of earthquake hazard prediction

EU-funded research on earthquakes of low seismicity is being incorporated into models that are more appropriate for Europe. To date, hazard assessment has been based on data gathered from strong earthquakes that have taken place in other regions of the world.

One of the key steps in hazard assessment in the face of earthquakes is to use a ground motion prediction equation (GMPE). This forms the basis for an estimation of the level of shaking according to seismological data, such as earthquake magnitude and distance of a site from the source.

Up to now, data has been used from strong ground motion records which are inappropriate for use in regions of low to moderate seismicity, such as western central Europe. Moreover, data is normally from models in other continents like Asia and the Americas. Aiming to close this gap, a unified seismic hazard assessment specific to the Euro-Mediterranean region is currently under development by the

Seventh Framework Programme's (FP7) project SHARE¹.

Thanks to SHARE, high-quality data is now available from regions where small earthquakes prevail. Aiming to make use of this information, the EU-funded Seismolos² project set out to understand the non-linear behaviour of some parameters. For example, scaling laws that predict earthquake stress may not be applicable to lower-level earthquakes. The new data can then be applied in models of hazard assessment such as those suggested under the SHARE initiative.

Project scientists used data from a French metropolitan area and the French West Indies to provide input for future stochastic ground

motion models. Another objective was to produce a homogeneous moment catalogue as well as regional attenuation functions.

In addition, strong ground motion data from Japan and the United States were analysed to allow for a better characterisation of rock-site effects when seismic waves are modified by local geological conditions. More specifically, this data allows for high-frequency attenuation or weakening.

The research will help us understand the source of significant uncertainties in ground motion modelling. The Seismolos project successfully collected sets of parameters that can be used to model ground motion using the stochastic simulation method.

Critical information on engineering requirements, for example, can be extrapolated from resulting models.

The project was coordinated by the Université Joseph Fourier Grenoble 1, France.

- 1 'Seismic hazard harmonization in Europe'.
- 2 'Ground-motion modelling for seismic hazard assessment in regions with moderate to low seismic activity'.

Funded under the FP7 specific programme 'Environment'
<http://cordis.europa.eu/marketplace>
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Climate conundrum

With climate change increasingly affecting the eastern corner of the Mediterranean, resources like water, energy and agriculture on the island of Cyprus are under threat. It is hoped that a recent evaluation of climate change in the region will help mitigate its effects.

The Eastern Mediterranean island of Cyprus is a beautiful place to live but has to rely on limited resources which are threatened by climate change. The EU-funded project CCECON¹ examined the

expected economic effects of climate change on the island for the coming decades. Supported by different government authorities and institutions in the country, the project shed some light on the

potential consequences of climate change on energy use, agriculture and human health.

According to the project researchers, the costs of climate change-related water scarcity in Cyprus should range from EUR 6 to 31 million in the period 2010-2013. CCECON also demonstrates that climate change will diminish agricultural water availability, warning that annual national crop production over the next decade could decrease by 41-43 %. However, the research states that there are still several options available for the agriculture sector to adapt to climate change.

With respect to energy use, the project found that electricity consumption in Cyprus may rise by 2.9 % by 2030, leading to over EUR 200 million in losses for the period of 2008-2030. It may also lead to 85-95 MW of extra

electricity load in 2030, implying more funding will be needed for additional power reserve capacity.

Lastly, CCECON has prepared a report on the expected health effects of climate change in Cyprus. The latter is expected to help the country's policy-makers to mitigate the phenomenon. If novel measures are taken to protect agriculture, along with plans to pre-empt future electricity needs, then the project could prove very useful for the country's future.

The project was coordinated by the University of Cyprus, Cyprus.



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1 'Assessment of economic impacts of climate change in Cyprus'.

Funded under the FP7 specific programme 'People' (Marie-Curie Actions).
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All for the Amazon

Sensitive ecosystems in the Amazon must be protected, and Europe is playing its part in this great endeavour by supporting research aiming to model climate change more efficiently. If successful, these efforts should allow a preemption of ecological disasters.

Research on the rain forest reveals that the western side of the Amazon produces three times more above-ground biomass than its eastern counterpart, probably due to the distribution of trees, climatic conditions or geological variations. The EU-funded project Intrabasis¹ investigated this phenomenon. It looked at spatial patterns to understand how forest diversity and carbon-cycle processes interact, as well as to define the way in which ecosystems become vulnerable to climate change.

Intrabasis has developed a data model on vegetation dynamics that simulates biodiversity and heterogeneity in rain forests. The model, dubbed tropical forest simulator

(TFS), estimated future tree growth in permanent forest plots and grouped plants using a smarter approach compared to previous studies, based on novel computer algorithms.

After rigorous testing at both canopy level and tree level, the team found that the model responded well to climate change and availability of soil water, simulating natural conditions very effectively. The model was meant to simulate up to six years into the future, demonstrating plausible above-ground biomass estimations and growth rates.

In addition, it helped simulate carbon use efficiency (CUE), gross



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primary productivity (GPP) and net primary productivity (NPP) in 69 plots, providing important criteria for assessing the rain forests. The model was further refined by exploiting regeneration and mortality dynamics, as well as by linking it to other modelling strategies. The results of this new modelling approach are set to support protection of the Amazon rain forests while helping develop recommendations for a more sustainable use of the Amazon basin.

The project was coordinated by the University of Leeds, United Kingdom.

1 'Development and application of an individual-trait-based simulator of Amazon forest dynamics'.

Funded under the FP7 specific programme 'People' (Marie-Curie Actions).
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ENVIRONMENT AND SOCIETY



Modelling land surface and atmosphere interactions

Strategies for mitigating climate change require an in-depth understanding of feedback loops found in processes affecting the Earth's atmosphere and surface. EU-funded researchers developed computer simulations that helped scientists reach a better understanding of how these two components interact with each other.



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State-of-the-art terrestrial biosphere models require a greater understanding of land surface processes than previously available. The EU-funded JULIA¹ project helped close the gap

between observational science and large-scale modelling of biosphere processes at a level of detail suitable for an Earth system model.

Two of the most important areas to be addressed were plant-soil interactions and conductance from tree canopies. Both fields have a significant influence on land-surface fluxes, ecosystem productivity and long-term carbon sequestration.

Researchers' investigations included determining the role of the nitrogen cycle within the climate system and its impact on the natural carbon cycle. Moreover,

they assessed the impact of man-made nitrogen on terrestrial greenhouse gas fluxes. The studies showed that greater effort is needed to mitigate climate change since the carbon sequestration capacity of the terrestrial biosphere had previously been overestimated. Furthermore, nitrogen management is important for controlling the effects of human activities on the climate system.

Scientists have used flux measurements, plant characteristics and the outcomes of ecosystem-monitoring studies to create sophisticated terrestrial computer models of the biosphere. This work resulted in a series of publications on the nitrogen cycle, the modelling of plant soil interaction and the effect of drought on tree canopies. The results were incorporated into a model system that is part of the international Global Carbon Project and provides data for the Intergovernmental Panel on

Climate Change (IPCC) and its Fifth Assessment Report (AR5).

The JULIA project successfully developed a tool to better measure interactions between the terrestrial biosphere and the climate system for use in Earth system models, thereby enabling more accurate predictions to be made when looking into future climate conditions.

The project was coordinated by Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V., Germany.

- 1 'Joining eco-physiological understanding and global ecosystem modelling for improved simulation of land surface interactions with the atmosphere'.

Funded under the FP7 specific programme 'People' (Marie-Curie Actions)
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Saving the Sava river basin

When a river passes through several countries, gaps can appear in essential information such as environmental data. A European research project has undertaken a major study of the Sava river basin, the catchment area for four Balkan countries.

The River Sava is the Danube's largest tributary. It receives discharge from no less than four Balkan countries: Bosnia and Herzegovina, Croatia, Serbia and Slovenia. Moreover, it connects three capital cities: Belgrade, Ljubljana and Zagreb. As such, it is an essential element of the socio-economic framework of the Balkans, in particular providing many recreational resources from unique wetlands and rich forests.

For about two decades, information regarding the use of land and water resources in the Balkans was inadequate. Managing this valuable resource and capitalising on its assets require strong institutional and legal control of resources along with close monitoring.

The SARIB¹ project's main objective was to develop and validate tools to help ensure a sustainable use of catchment resources. For that, they used a combination of chemical analyses and biological impact assessments to evaluate the extent of pollution and its impact on life in the river.

Geographical distribution of the pollution was monitored using a 'Geographic information system' (GIS). Data on environmental parameters such as pollutants, bioaccumulation and fish health was also collected and combined with model approaches to develop assessment tools.

SARIB project achievements include a prediction model for the



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behaviour of hazardous toxins. The model was integrated with a socio-economic system to be able to analyse different scenarios, remediation measures and best practice methods. Importantly, tools to identify, mitigate or distribute critical loads according to ecological vulnerability potential and predictions for optimal economic exploitation of catchment resources were also developed.

The SARIB researchers have instigated a strong, interdisciplinary, synergistic collaboration between researchers, scientists and other stakeholders involved in the management of this important river system's resources. Overall, this

strong network and the newly developed modelling tools should make a positive contribution to the well-being of the wildlife and residents of the Sava river basin.

The project was coordinated by the Ministry of Education, Science, Culture and Sport, Slovenia.

- 1 'Sava river basin: sustainable use, management and protection of resources'.

Funded under the FP6 specific programme 'International Scientific Cooperation Activities'.
<http://cordis.europa.eu/marketplace> >
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Menacing monsoons

Studying the long rainy seasons of Indochina can help climatologists understand the accompanying and often threatening phenomena, hopefully leading to findings that could bring relief to the country's inhabitants.

With ominous climate changes affecting some parts of the world more than others, the monsoon rains in South-east Asia are wreaking havoc on the livelihood of communities in the region. Aiming to find solutions to this recurring issue, the EU-funded project ASIAN Monsoon¹ studied the variability of the monsoon by looking at stable isotopes in stalagmites found within the caves of Laos.

ASIAN Monsoon aimed to outline the area's vulnerability to climate change and map out past

climatological changes in the region. The team investigated over 20 caves across the country and conducted uranium dating that estimated the age of most stalagmites at less than 10 000 years, i.e. during the Holocene era. While some had even appeared around 20 000 years ago during the last glacial period, the Holocene stalagmites bear the most impact on monsoon information.

Using oxygen and carbon isotopes from the stalagmites and comparing them to other data has helped piece together revelatory

climate characteristics over a long period of time. The samples were also compared with those from Chinese caves which, among other sources of information, allowed the project team to reconstruct past precipitation in the region more accurately.

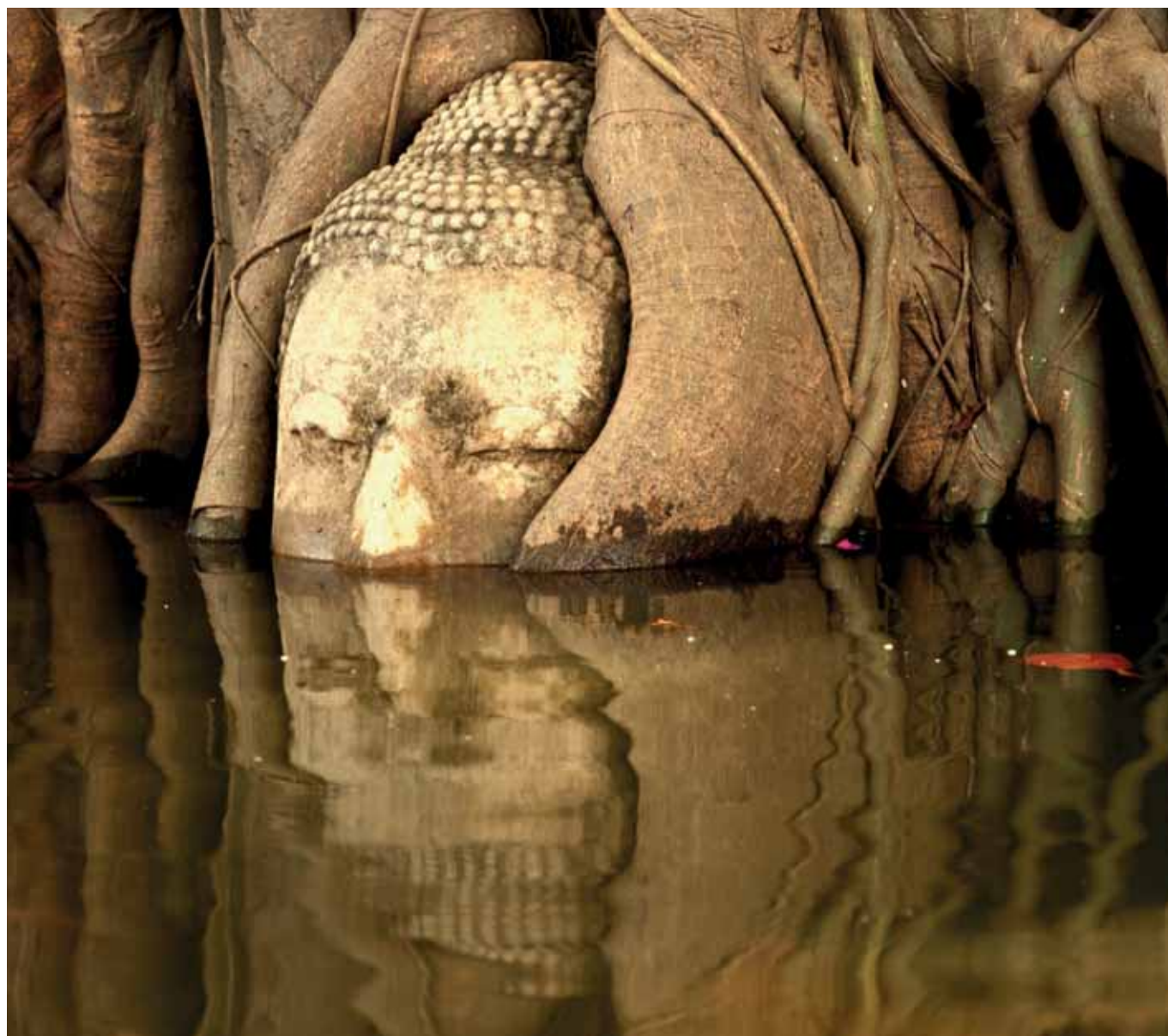
The results can help scientists to enhance our understanding of factors that affect the monsoon changes and perhaps improve the capability to predict trends and disasters. The more knowledge researchers have, the better their chances of helping the peoples of

Indochina circumvent the menace of monsoon rains.

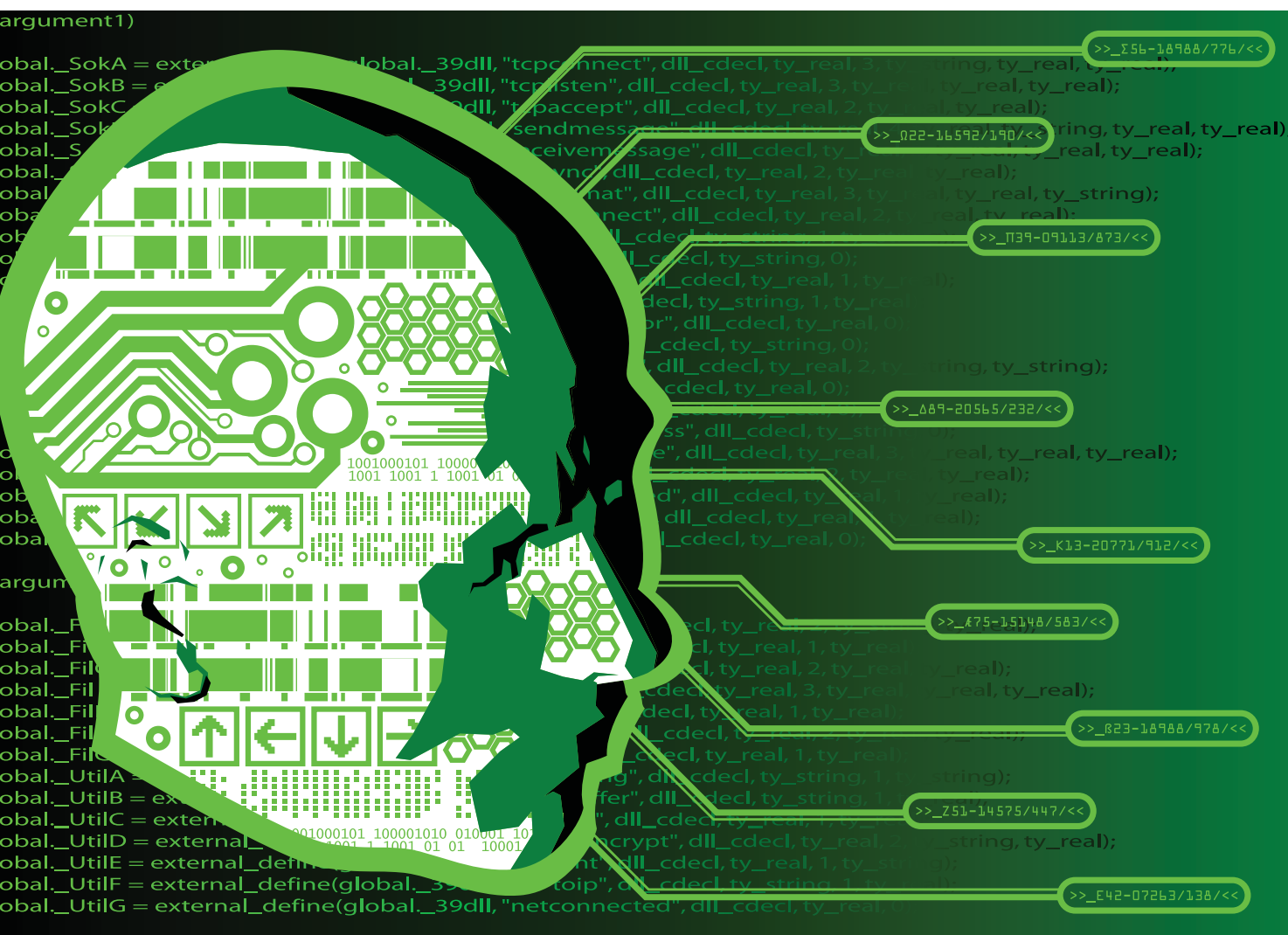
The project was coordinated by the Chancellor, Masters and Scholars of the University of Oxford, United Kingdom.

1 'The impact of climate change on the South-east Asian monsoon'.

Funded under the FP7 specific programme 'People' (Marie-Curie Actions)
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IT AND TELECOMMUNICATIONS



Search technology that can gauge opinion and predict the future

Inspired by a system for categorising books proposed by an Indian librarian more than 50 years ago, a team of EU-funded researchers have developed a new kind of internet search that takes into account factors such as opinion, bias, context, time and location. The new technology, which could soon be in use commercially, can display trends in public opinion about a topic, company or person over time — and can even be used to predict the future.

'Do a search for the word "climate" on Google or another search engine and basically you will get back a list of results featuring that word: there is no categorisation, no specific order, and no context. Current search engines do not take into account the dimensions of diversity: factors such as when the information was published, if there is a bias toward one opinion or another inherent in the content and structure, who published it and when,' explains Fausto Giunchiglia, a professor of computer science at the University of Trento in Italy.

But can search technology be made to identify and embrace diversity? Can a search

engine tell you, for example, how public opinion about climate change has changed over the last decade? Or how hot the weather will be a century from now, by aggregating current and past estimates from different sources?

It seems that it can, thanks to a pioneering combination of modern science and a decades-old classification method, brought together by European researchers in the LivingKnowledge¹ project. Supported by EUR 4.8 million in funding from the European Commission, the LivingKnowledge team, coordinated by Prof. Giunchiglia, adopted a multi-disciplinary approach to developing

new search technology, drawing on fields as diverse as computer science, social science, semiotics and library science.

Indeed, the so-called father of library science, Sirkali Ramamrita Ranganathan, an Indian librarian, served as a source of inspiration for the researchers. In the 1920s and 30s, Ranganathan developed the first major analytical-synthetic, or faceted, classification system. Using this approach, objects — books, in the case of Ranganathan; web and database content, in the case of the LivingKnowledge team — are assigned multiple characteristics and attributes (facets), enabling the classification to be ordered in multiple ways, rather

IT AND TELECOMMUNICATIONS

than in a single, predetermined, taxonomic order. Using the system, an article about the effects on agriculture of climate change, written in Norway in 1990, might be classified as 'Geography; Climate; Climate change; Agriculture; Research; Norway; 1990.'

In order to understand the classification system better, and implement it in search-engine technology, the LivingKnowledge researchers turned to the Indian Statistical Institute, a project partner, which uses faceted classification on a daily basis.

'Using their knowledge we were able to turn Ranganathan's pseudo-algorithm into a computer algorithm and the computer scientists were able to use it to mine data from the web, extract its meaning and context, assign facets to it, and use these to structure the information based on the dimensions of diversity,' Prof. Giunchiglia says.

Researchers at the University of Pavia in Italy, another partner, drew on their expertise in extracting meaning from web content — not just from text and multimedia content, but also from the way the information is structured and laid out — in order to infer bias and opinions, adding another facet to the data.

'We are able to identify the bias of authors on a certain subject and whether their opinions are positive or negative,' the LivingKnowledge coordinator says. 'Facts are facts, but any information about an event, or on any subject, is often surrounded by opinions and bias.'

From libraries to space travel

The technology was implemented in a test bed, now available as open source software, and used for trials based around two intriguing application scenarios.

Working with Austrian social research institute SORA, the team used the LivingKnowledge

system to identify social trends and monitor public opinion in both quantitative and qualitative terms. Used for media content analysis, the system could help a company understand the impact of a new advertising campaign, showing how it has affected brand recognition over time and which social groups have been most receptive. Alternatively, a government might use the system to gauge public opinion about a new policy, or a politician could use it to respond in the most publicly acceptable way to a rival candidate's claims.

Together with Barcelona Media, a non-profit research foundation supported by Yahoo!, and the Netherlands-based Internet Memory Foundation, the LivingKnowledge team looked not only at current and past trends, but extrapolated them and drew on forecasts extracted from existing data to try to predict the future. Their Future Predictor application is able to make searches based on questions such as 'What will oil prices be in 2050?' or 'How much will global temperatures rise over the next 100 years?', and find relevant information and forecasts from today's web. For example, a search for the year 2034 turns up 'space travel' as the most relevant topic indexed in today's news.

'More immediately, this application scenario provides functionality for detecting trends even before these trends become apparent in daily events — based on integrated search and navigation capabilities for finding diverse, multidimensional information depending on content, bias and time,' Prof. Giunchiglia explains.

Several of the project partners have plans to implement the technology commercially, and the project coordinator intends to set up a non-profit foundation to build on the LivingKnowledge results at a time when demand for this sort of technology is only likely to increase.

As Prof. Giunchiglia points out, Google fundamentally changed the world by providing everyone with access to much of the world's information, but it did it for people: currently, only humans can understand the meaning of all that data, so much so that information overload is a common problem. As we move into a 'big data' age in which information about everything and anything is available at the touch of a button, the meaning of that information needs to be understandable not just by humans but also by machines, so quantity must come combined with quality. The LivingKnowledge approach addresses that problem.

'When we started the project, no one was talking about big data. Now everyone is and there is increasing interest in this sort of technology,' Prof. Giunchiglia says. 'The future will be all about big data — we can't say whether it will be good or bad, but it will certainly be different.'

Armed with the project's Future Predictor, Prof. Giunchiglia is well equipped to make that prediction.

LivingKnowledge was coordinated by the Università degli Studi di Trento, Italy.

1 'LivingKnowledge facts, opinions and bias in time'.

Funded under the FP7 specific programme 'Information and Communication Technologies' (ICT).
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Robotic assistance for the elderly

A team of EU-funded researchers has developed a robotic companion and intelligent home environment that could help elderly people live richer and more independent lives and reduce the burden on health-care services.

People are living much longer into old age, and the need for care and medical assistance for elderly populations is growing rapidly. Ideally, elderly people should be able to live happily and independently at home, but medical complications and conditions, such

as depression and dementia, can make this extremely difficult.

'Without support, assistance and cognitive stimulation, sufferers from elderly dementia and depression can deteriorate rapidly; in these circumstances their carers,

for instance their spouses or children, face a more demanding task; the elderly and their carers both face an increased risk of social exclusion,' explains Professor Atta Badii of the University of Reading, UK.

To address these challenges, European researchers are developing intelligent home-help systems and robot assistants which support elderly people to live well and look after themselves. Happier,

healthier and more active elderly populations can ease the burden of care on family, friends and health authorities.

A robot companion

Prof. Badii is the coordinator of the FP7 project, Companionable¹ which has created a robotic companion called 'Hector'. Hector can move around a house on its own and respond to commands such as 'follow me' or 'go to the kitchen'. He can help users socialise ➤

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and provide cognitive stimulation in their daily lives. Users interact with Hector directly through voice commands and a large touch screen.

Hector functions autonomously, or as part of a larger-scale intelligent-home system designed to support independent living for elderly people. By controlling smart systems around the house, Hector is able to open and close curtains and windows, turn lights on and off, or regulate the central heating.

Here, Hector bridges the gap between new smart environments that are sometimes difficult to use and elderly people who may not be experienced or able to interact with such systems with ease. As a companion, he acts as an

intermediary and makes these systems accessible through more natural interactions.

'Hector can, for example, help his human companion get ready to leave the house,' says Prof. Badii. 'He approaches his owner and reminds him not to forget to take certain items such as a purse. He can also detect any open windows or doors, or appliances that have been left on, and remind his human companion to deal with these issues before leaving the house.'

The multi-talented Hector also helps his companion to socialise through an easy-to-use video-telephone interface — he can automatically connect the user to family, professional carers or

trusted associates. If he or other smart systems detect abnormal or alarming situations, for example if the user has a fall, Hector will dial up a 'Remote response centre' which will then handle the emergency.

Smart home integration

Hector's integration into smart home systems and remote-care and control centres can be adapted to new environments relatively easily, Prof. Badii explains. 'We can extend Hector's capabilities in a modular fashion, making him a "plug-and-perform" companion robot. He can be effective in a large variety of home settings to support assisted independent living.'

The care support offered by Companionable includes monitoring vital physiological signs and more subtle factors such as moods, as well as diary management, video telephony and reminders to ensure users take the right medicine on time.

The project has installed Companionable systems in a number of demonstration homes, which are used to test and improve the wide spectrum of functionalities developed by the project partners through long-term studies with real elderly care recipients. The high reliability and low maintenance costs that these studies

have demonstrated open the way for the commercialisation of the smart technologies developed by the CompanionAble project.

The project team comprises 19 specialist partners who are currently presenting the results of the project, and the integration of Hector with smart-home facilities, at a wide range of dedicated sites and public events. Final trials and demonstrations are under way in Belgium, Spain, France and the Netherlands.

The four-year Companionable integrated project received EUR 7.8 million (of a total of EUR 10.72 million project budget) in research funding under the EU Seventh Framework Programme (FP7) 'Information and communication technologies' (ICT) theme. The project was coordinated by the University of Reading in the United Kingdom.

- 1 'Integrated cognitive assistive and domestic companion robotic systems for ability and security'

Funded under the FP7 specific programme 'Information and Communication Technologies' (ICT).
<http://cordis.europa.eu/marketplace> > search > offers > 8915

ICT is new weapon in the war on drug-resistant diseases

Every year hundreds of thousands of people die because of infections that have become resistant to treatment. A new data-mining, clinical monitoring and decision-support system, developed by EU-funded researchers, offers a powerful new weapon in the war on resistance to antibiotics.

According to the World Health Organisation, around 440 000 new cases of multidrug-resistant tuberculosis emerge annually, causing at least 150 000 deaths, while hospital-acquired infections caused by highly resistant bacteria such as 'Methicillin-resistant *staphylococcus aureus*' (MRSA) have become increasingly widespread. Many other infectious diseases have also stopped responding to treatment, putting

patients' lives at risk, reducing the efficacy of care and increasing the threat of epidemics.

'Clinically, antimicrobial resistance is a huge challenge. Pharmaceutical companies simply can't come up with new antibiotics fast enough to counter the resistance of bacteria to existing antibiotics and medications,' explains Dr Dirk Colaert, Chief Medical Officer at Agfa HealthCare in



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Belgium. 'By definition, it's a war that can't be won by antibiotics alone.'

When bacteria are first exposed to a new antibiotic they are usually quickly killed off. But over time the bacteria will evolve and adapt to resist the treatment, a problem made worse by factors such as the incorrect prescription of antibiotics, their misuse or the failure of a patient to fully complete a course of medication. Continually developing new antibiotics can therefore only go so far towards treating diseases effectively.

Smarter use of antibiotics

'On top of new antibiotics, we need new tools to apply antibiotics more smartly,' Dr Colaert says.

That is the reasoning behind the Debugit¹ project, coordinated by Dr Colaert and supported by EUR 6.4 million in research funding from the European Commission.

The idea is simple: monitor antimicrobial resistance using data from different hospitals, identify trends showing which types of bacteria are becoming resistant to certain types of antibiotics and then use that knowledge to implement courses of treatment with more effective drugs.

'If you monitor bacterial resistance and can see which bacteria is becoming more resistant you can switch drugs. When bacteria starts to show resistance to the new drug, say after a couple of years, you can switch again, even going back to the antibiotic that was used before, as the bacteria's

resistance to it will have been reduced,' Dr Colaert explains.

Although the concept sounds simple, implementing it is a big challenge. Some hospitals have infectious disease specialists who monitor patient data and conduct antibiograms for antimicrobial resistance. Antibiograms are lab tests in which isolated bacteria samples are exposed to different antibiotics to determine resistance levels. But often the data is incomplete or stored in formats, systems and structures that make sharing, mining and analysing it difficult.

'The main challenge is the poor quality of clinical data. In an ideal world you have nicely coded and structured data, but in reality you have to deal with free text and incomplete data,' the Debugit coordinator says.

A semantic interoperability solution

Dr Colaert and his team overcame that challenge by using ICT technology and a semantic interoperability framework to extract heterogeneous clinical and 'antibiogram' data from 'Hospital information systems' (HIS) and use it to determine trends in antimicrobial resistance.

The Debugit system maps HIS data to a common domain ontology concerning microbes and infection control, aggregates this information from different sites and harmonises it with a common ontology to create a global but virtual clinical data repository. The data is then analysed by applying statistical and data-mining

techniques and can be output via HIS systems or even through a standalone web application.

'The system could be used to aggregate and analyse data from many hospitals to determine antimicrobial resistance in a region, country or worldwide. However, in practice, hospitals are reluctant to make their data available in this way. It's not a privacy issue, but rather the fact that hospitals do not want to disclose information that can show how good or bad they are performing,' Dr Colaert explains. 'Nonetheless, in Debugit we showed that this can be done, and we believe it should be done given the huge benefits to patients, society and health-care systems in being able to use antibiotics more smartly.'

Besides saving patient lives and improving care through a more effective and efficient use of antibiotics, the system, if implemented widely, could dramatically reduce hospital and health-care system costs as less money would be wasted on ineffective treatments and patient recovery would be accelerated.

Several hospitals involved in the project are carrying out validation trials, including the University Hospital of Geneva which plans to permanently incorporate the Debugit platform into its hospital information system.

With the click of a button, doctors will be able to search for information about a bacterial infection, see its resistance levels to different antibiotics and receive

decision-support about the best drugs to prescribe for any individual patient.

'Other factors can also be incorporated into the decision-support mechanism, such as contraindications and side effects. In fact, our proof of concept demonstrator shows step by step that the more clinical data you provide, the more accurate and effective the system becomes,' Dr Colaert says.

Agfa HealthCare is considering incorporating the platform into its proprietary HIS, called ORBIS, to provide an antimicrobial-resistance monitoring solution and as the basis for other potential applications.

'The underlying technology and semantic interoperability framework is capable of doing much more than monitoring bacterial resistance. For example, we are also looking at the potential of using it to help pharmaceutical companies find patients for clinical trials,' Dr Colaert explains.

The project was coordinated by Agfa HealthCare, based in Belgium.

1 'Detecting and eliminating bacteria using information technologies'

Funded under the FP7 specific programme 'Information and Communication Technologies' (ICT).
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Big data at your service

The increasing use of ICT for business, leisure and public services is leading to the accumulation of mountains of structured and in many cases unstructured data. But this so-called 'big data' should be seen as an opportunity not a problem. EU research and efforts to promote open data are helping to make sense and good use of this resource.

'Open data' is the idea that certain data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other control mechanisms. Inspired by the open

source (non-proprietary software) and open access (academic publishing) movements, open data is broadly taken to mean the liberal movement, use, reuse or electronic distribution of data.

An important part of this 'big data' movement is the use for the wider benefit of society of the non-personal information that citizens share with their governments and public services.

Open government data is a tremendous resource that has yet to be fully tapped. 'Government collects a vast quantity of high-quality data as part of its ordinary working activities. If this data is made open, it can have huge potential benefits,' notes the Open Government Data (OGD) website, run by the Open Government Working Group.



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According to Rufus Pollock of the Open Knowledge Foundation, opening up the data enables companies, individuals and the non-profit sector to build useful 'apps' and services, and it promotes democracy, government participation, transparency and accountability. 'Why not open up the data that's already there and is already being collected?' he says.

But there are numerous challenges — legal, technical, social and market related — that need to be faced before the many benefits of open (government) data can be effectively transferred to citizens.

This way forward...

According to reports from the recent Future Internet Assembly (FIA) in Aalborg, Denmark, 'Trends like "big data" and the "internet of things" (IoT), including "people as sensors", are showing how citizens/entrepreneurs/innovators can develop new services and apps for the benefit of smart cities.' FIA presenter Reinhard Scholl of the International Telecommunication Union (ITU) said that good examples include New York City's Open Data initiative, Amsterdam's Smart City programme, Catalonia's Open Data Gencat, and the European Commission's Open Cities challenge.

Best practices from the USA, according to Mr Scholl, include MIT's 'Track Trash' experiment which used sensors to monitor where rubbish ends up. And Oakland's data-driven 'crime spotting' service, he said, is helping the city improve security.

'Public-sector information' (PSI) is the single largest source of information in Europe, according to the European Commission's DG Connect, and includes digital maps, meteorological, legal, traffic, financial, economic and other data. Most of this raw data could be reused or integrated into new products and services for everyday use, such as car navigation systems, weather forecasts, financial and insurance services.

'Reuse of public-sector information means using it in new ways by adding value to it, combining information from different sources, making mash-ups and new

applications, both for commercial and non-commercial purposes. Public-sector information has great economic potential,' explains the Commission on its dedicated PSI web page.

EU research, adapting to change

The research landscape has also moved to accommodate the rapid changes taking place in data collection, processing and handling. For example, projects funded under the FP7 'Technologies for information management' activities, as part of the 'Content and knowledge' theme, have targeted a range of research domains encompassing online content, interactive and social media; reasoning and information exploitation; and knowledge discover and management.

One initiative, the EU-funded Weknowit¹ project, has developed a platform that converts vast user-generated content from a problem of information overload into a new, 'collective intelligence' with a range of applications, from handling emergencies to enhanced city tourism. The project has filed for several patents and a handful of products and results are destined for public or commercial release.

'Using a wide variety of tools, the Weknowit platform transforms large-scale and poorly structured information into meaningful topics, entities, points of interest, social connections and events,' says project coordinator Yiannis Kompatsiaris of the Informatics and Telematics Institute (CERTH-ITI), Multimedia Knowledge Lab in Greece. To do this, the partners developed a middleware application that can be deployed on servers to process incoming data and route it effectively.

They also developed several tools within the project case studies, including an emergency-response scenario and a consumer social group scenario, and partners created a dozen more tools for specific tasks. Meanwhile, partners CERTH-ITI, Yahoo! and Koblenz University are further collaborating on real-time aspects of social media information extraction as well as looking at applications in the news sector and large events, such as film festivals.

Open data for science, too

Better use of structured data also benefits scientific research more directly, thanks to advances in cloud and grid computing, or supercomputing. European investment in e-infrastructure, which harnesses the 'unused' capacity of computers distributed all over the world, means researchers can process and analyse larger data sets than ever before, revealing possible answers to some of science's biggest questions, from quantum physics to climate-change modelling.

For example, biologists studying a specific problem could create a 'Virtual research environment' (VRE) for collaborating across the grid, processing information from one source in Estonia and analysing it with data-mining software tools from another in, say, Portugal.

Going one step further, an EU-funded project called D4Science-II² has created an interoperable framework for e-infrastructures which is like an ecosystem in which data, computing and software resources belonging to different e-infrastructures can be shared regardless of location, technology, format, language, protocol or workflow. Their ecosystem has supported VREs in fields such as high-energy physics, biodiversity, fisheries and aquaculture resources. It has helped open up new areas of research between them and is being extended to new domains.

For instance, D4Science-II supported the Aquamaps marine species mapping study. Aquamaps helps scientists to cross-reference marine biodiversity with records of fish catches to get a clearer picture of where fish stocks are most at risk. This is a huge data- and number-crunching exercise made possible thanks to European funding for e-infrastructure and its open data policy and research initiatives.

'Co-operation across e-infrastructures opens up entirely new possibilities and areas of research. We can analyse scientific data against economic statistics, for example, to get an entirely new perspective that was not available before,' says Donatella Castelli, a D4Science-II partner at the

Institute of Information Science and Technology (Alessandro Faedo) of Italy's National Research Council.

Open-access publishing

While public organisations are opening up their data to researchers, it might seem ironic that the results of such research might end up inaccessible in expensive journals. In an effort to promote more open-access publishing online — especially for publicly funded research — the European Commission has made open-access publishing mandatory for around 20% of FP7 projects.

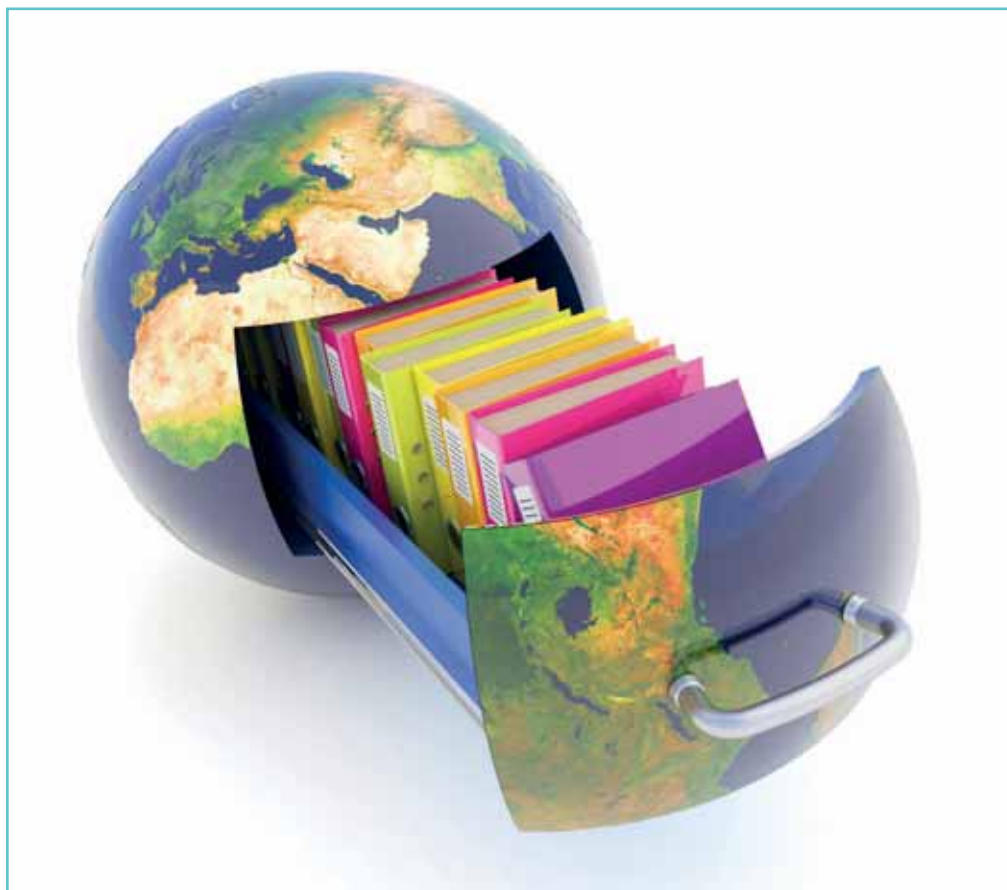
In addition, when projects publish results in a range of traditional journals, as well as some in open-access publications, knowledge is fragmented and it is less easy to measure the output of a project. The EU-supported project Openaire³ set out to change that with the vision of making everything accessible for everyone.

The Openaire team recognised early on that better technology is only half the battle to overcoming research and data fragmentation: 'A significant part of the project focuses on promoting open access in the FP7 community,' says Natalia Manola, the project's manager, 'advocating open-access publishing so projects can fully contribute to Europe's knowledge infrastructure.'

With the help of projects like Openaire and its follow-up Openaireplus, open-access publishing can boost Europe's economy and innovation levels, according to Ms Manola. If you are an employee of a small firm or a teacher, subscriptions to high-end scientific journals can be prohibitive, which means valuable research is locked away in silos. 'With open access, anybody [can] use it how they want — it is the best way to make the most of publicly funded research,' she concludes.

Related to this, the nuclear research organisation CERN has spearheaded an EU-funded project, called SOAP⁴, in search of sustainable business models to promote scholarly publishing. The team documented over 4000 journals and, following some analysis, the SOAP

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team found that some 8 % of the worldwide production of scientific papers, or about 120 000 articles per year out of the estimated industry figure of 1.5 million, is currently published as open access. They concluded that a 'hybrid open access' model (partially subscription-based) is the most viable option especially for scientific and research publishing.

'By enhancing viable open-access models, European researchers — and indeed the world — will gain from the exchange of knowledge and have access to vast material,' according to a CORDIS report, 'Open access to mountains of research', on SOAP.

Data-speak

While opening up publicly-owned data, combining data sets and open-access publishing of results all have their advantages for science, monetising structured data commercially is a more complex challenge. Some newly launched EU projects are looking into it.

The EU-funded project CODE⁵ is an SME-led initiative focusing on the digital content and languages side of the big data equation. 'Linked open data' (LOD) shows enormous

potential as the next big evolutionary step of the internet, according to the CODE team. But this potential remains largely untapped due to missing usage and monetisation strategies.

CODE, which only began work this year, is developing a robust ecosystem for commercialising LOD based on a value-creation-chain among traditional (e.g. data provider and consumer) and non-traditional (e.g. data analyst) roles in data market places. Early results look promising.

Recognising that we live our lives more and more online, partners in the EU-backed project Limosine⁶ are meanwhile looking to leverage language and semantic search technology to improve this online experience.

'Information is accumulated on a wide range of human activities, from science and facts, to personal content, opinions and trends,' notes the project team. Limosine's multilingual web opinion-mining system means the internet can move away from current document-centric search towards greater semantic aggregation. In other words, getting refined search results faster

through smarter tools which better understand and even predict what you are looking for.

For example, if you search 'dog's breakfast' using today's search standards you get results about British idiom or Canadian theatre, when a non-native English speaker may have been looking more literally for a healthy alternative to feed their pet instead of cereal! Semantic search tools may be able to contextualise the query based on your previous searches or other gathered evidence.

Meanwhile, projects like LIVE+GOV⁷ bring together 'Reality sensing, mining and augmentation for mobile citizen-government dialogue'. The project is developing an 'm-government' solution that allows citizens to express their needs to government through mobile-sensing technologies already in smart phones, alongside established mobile e-participation formats.

Oiling the European economy

Eventually, public data, generated by all administrations in Europe, should become automatically reusable and will stimulate innovation

and entrepreneurship, which in turn feeds into new applications and services, both fixed and mobile.

'Just as oil was likened to black gold, data takes on a new importance and value in the digital age,' commented Neelie Kroes, Vice-President of the European Commission responsible for the Digital Agenda, at the launch of the EU's Open Data Strategy last December. This open-data package informs the new PSI Directive which is now before the European Council and Parliament.

Public-sector information already generates some EUR 32 billion of economic activity each year. The new package stands to more than double that to around EUR 70 billion which, according to Ms Kroes, is a 'badly needed boost to our economy'. She applauded the UK, Denmark and France on their open data initiatives and said that the new strategy will 'radically shake up' how EU institutions and most public authorities in Europe share data.

Ms Kroes called on governments not to wait for this package to become law: 'You can give your data away now and generate revenue and jobs, and even save money from the better information and decisions that will flow.' She encouraged the private sector to open their data to generate new services. 'Data is gold... Let's start mining it!' she urged.

- 1 'Emerging, collective intelligence for personal, organisational and social use'.
- 2 'Data infrastructures ecosystem for science'.
- 3 'Open access infrastructure for research in Europe'.
- 4 'Study of open-access publishing'.
- 5 'Commercially empowered linked open data ecosystems in research'.
- 6 'Linguistically motivated semantic aggregation engines'.
- 7 'Reality sensing, mining and augmentation for mobile citizen-government dialogue'.

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Cutting the costs of secure, evolving software

Software-based systems are increasingly security-critical and are often used for much longer than their intended lifespan. Enabling software to evolve to meet new requirements, usage models and threats while remaining secure is a huge and costly challenge, but one that EU-funded researchers are addressing with a radical new approach to software development, verification and deployment.

Have you just downloaded a new app on your smart phone? Did you notice the tick-box that said 'Update automatically'? There are many reasons to update the software, from adding new features to fixing security bugs that could make you a victim of hackers. But sometimes newly downloaded features introduce new security vulnerabilities. That, in essence, is the problem of traditional approaches to software development and deployment — a trade-off between security and flexibility.

'You have secure software, for example. You ship it to the customer and then you need to update it, perhaps to add features to stay ahead of the competition. If you need to start from scratch every time and verify all code — even if only a small part of it has changed — you face considerable time and financial costs,' explains Fabio Massacci, a professor of computer science at the University of Trento in Italy.

Prof. Massacci, who coordinated the SecureChange¹ project — which addressed precisely this problem — points to web browsers as common examples of regularly updated software with strict security requirements.

An analysis conducted by the SecureChange team, spanning five years and six major version updates of the open source Firefox browser, found that only around one-third of the software code changed from one version to the next. In addition, a significant number of vulnerabilities were inherited by each new version from its predecessor, a phenomenon common to other browsers like Chrome and IE. The need for quick updates means there is less time to do testing and verification. But is it possible to test only the new parts and maintain the security and integrity of the entire system?

Supported by EUR 5.1 million in research funding from the European Commission, the SecureChange researchers have developed the methodology, techniques and tools to make the entire software lifecycle — from requirements engineering, through design, development, testing and verification, to deployment and updating — more efficient, more flexible, more secure and far less costly in terms of time and money.

Change — a first-class citizen

'Our main idea was to consider change itself as a first-class citizen, using evolution rules for the software to make sure that each change respects the desired security properties. In this way, you automatically know that any modification satisfies your desired properties,' Prof. Massacci says.

Their approach focused on the so-called 'delta' — the difference between the old and the new release of the software. A range of innovative tools enable developers and test engineers to work in a synchronised way and automatically identify only those pieces of code that need to be tested along with those verified properties that are preserved from one version to the next.

'Test engineers can quickly and easily identify which tests are needed, what is new and what is obsolete, thereby avoiding the need to re-test millions of lines of code that have not changed, and enabling them to focus their efforts on what is really new and hence potentially more risky,' Prof. Massacci explains.

When it comes to development, the SecureChange team's approach to engineering processes focused on orchestrating changes to the software in a granular fashion, rather than integrating directly, so modifications to one element



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of the software do not necessarily impact other elements.

Significantly, this approach scales from small software programmes to large-scale critical systems with millions of elements. That potential was highlighted by the SecureChange researchers in a series of prototype implementations built around real-world case studies and involving several industrial partners.

With Thales in France, the team looked at how their tools and approach could improve and speed up the incorporation of new features to an air-traffic management system that required changes in organisational and operational processes.

With Telefónica in Spain, the researchers implemented prototype technology on security-critical features of home networks, enabling the network to dynamically configure and reconfigure itself in

a secure way to allow for the incorporation of new devices, such as a friend bringing over a smart phone.

With French digital security company Gemalto, the researchers implemented the system with smart cards and tokens, such as those used to pay for public transport and other services, enabling the software to be securely updated.

'Take a Visa or MasterCard, for example: it would be convenient if you could also use that as a smart card to use the railway, but at the moment that is impossible because it would take too long and be too expensive for a third party, such as the railway company, to go through the process of verifying any changes they make to the software on the card. We have shown that with our approach such features are possible to implement easily and quickly, and we have proven

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it not just in theory but also, for the first time, in practical applications,' Prof. Massacci says.

Commercial plans and spin-offs

The SecureChange industrial partners are exploiting some of the project results internally, the coordinator says. A tool called EvoTest, developed by French partner SmartTesting, is now in commercial production, for example, while other tools have been made available as open source software. The project also contributed to the foundation of a spin-off company,

QE LaB Business Services, from the University of Innsbruck and the Centre for Academic Spin-Offs Tyrol, Austria.

Meanwhile, open source community development on some of the technology is going to continue for a component called EMF-IncQuery, which has been proposed to the Eclipse Foundation.

The biggest upshot of the SecureChange approach, if adopted widely by the software development community, would be a dramatic reduction in the time-to-market of new software

and software versions, and a considerable reduction in the cost of software testing and verification.

Currently, software testing accounts for around half of software pre-release costs and as much as 70 % of post-release expenses, while almost 6 in 10 software development projects do not achieve their desired functionality and more than 8 in 10 are not completed on time.

'Not only would the risk of errors and security vulnerabilities be reduced, but companies would be able to release software much

quicker, enabling them to rapidly seize market opportunities,' Prof. Massacci notes.

The project was coordinated by the University of Trento in Italy.

1 'Security engineering for lifelong evolvable systems'

Funded under the FP7 specific programme 'Information and Communication Technologies' (ICT).
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New software for the genetic road to sustainable health

Exploiting genetics effectively to help uncover the complexities of diseases could in turn lead to better treatments, potentially bringing relief to millions of people around the globe.



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Progress in genome research is increasing rapidly, with much hope that it may unravel many complex human illnesses and develop new therapies or drugs to overcome them. This requires a deeper understanding of advanced bioinformatics, particularly metabolic processes and disease-relevant signalling pathways related to drug target validation.

The EU-funded project EMI-CD¹ worked on developing software

and methods that would advance research in this area. It closely analysed new experiment measurements of biological processes to create effective biological networks using probabilistic learning methods.

After intensive simulation and modelling exercises, the project evaluated network hypotheses and was able to improve the design and verification of genetic research experiments. Through its strategy,

the project built new software, methodology and tools that can handle new techniques for discovering gene function and unveiling disease processes.

Building on these strengths, EMI-CD successfully upgraded systems biology research, developing specific strategies that are now being exploited in disease applications across the EU. The key advantage of these strategies lies in combining information from

various databases with the latest research data and different computer modelling approaches.

Other important advantages include model analysis methodology which supports bottom-up and top-down approaches, as well as multiple pathway resources that handle powerful computational modelling. More comprehensive databases for modelling involving transcriptomes, proteomics, reactome pathways and other important processes related to genome research have also been incorporated in the new methodology.

These advances will help the science of bioinformatics move forward rapidly and are expected to contribute to better health care in unprecedented ways.

The project was coordinated by the Max-Planck-Institute for Molecular Genetics, based in Germany.

1 'Security engineering for lifelong evolvable systems'

Funded under the FP6 specific programme 'Life sciences, genomics and biotechnology for health'.
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INDUSTRIAL TECHNOLOGIES



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Removing hazardous substances from the air

'Volatile organic compounds' (VOCs) are carbon-based compounds, many of which are human health hazards. An EU-funded project has helped coordinate research efforts to apply nanotechnology to the capture and sequestration of these compounds.

VOCs evaporate into the air at room temperature and pressure. The evaporation process produces tiny air-borne molecules of often questionable safety to those who either inhale them, come into contact with them via adsorption to the skin, or drink them in contaminated water supplies.

While the use of VOCs has been restricted in recent years, there are still thousands of products present in everyday life that contain VOCs. Their removal from waste air streams, whether at factories that use VOCs or at waste-water

treatment plants which remove VOCs, is commonly accomplished with separation membranes.

The application of nanotechnology, or technology on the scale of atoms or molecules, to membrane filtration of VOCs in waste air streams offers great potential for enhanced operation.

Nanoparticles have the unique feature of very high surface areas compared to their volumes. This surface area is extremely useful as a work

surface for chemical reactions and adsorption of other molecules.

However, integration of nanotechnology with membrane-separation technology for more efficient and greener removal of VOCs from waste air streams is an emerging field that has yet to reach maturity.

The ANVOC¹ project therefore aimed to coordinate efforts in research with those in industry and in policy-making bodies.

INDUSTRIAL TECHNOLOGIES

The main goal of the project was to organise a symposium to bring together stakeholders from all areas to disseminate knowledge to end-users and to motivate co-operation among research and development (R&D) bodies.

ANVOC scientists met all goals, bringing together international experts in nanotechnology, membrane technology and air-pollution control.

The symposium presented R&D results, identified the types of membranes used in recovery of VOCs, and demonstrated the use of

membranes in gas separation. In addition, valuable possibilities for future research collaboration were identified.

ANVOC project outcomes should have important impact on the future of R&D related to the integration of nanotechnology with membrane-filtration technology for VOC recovery from waste air streams. Eventual commercialisation of innovations will enhance both consumer and worker health while protecting the environment.

The project was coordinated by the Marmara Research Centre, Energy Systems and

Environmental Research Institute (ESERI), Turkey.

- 1 'Application of nanotechnologies for separation and recovery of volatile organic compounds from waste air streams'.

Funded under the FP6 specific programme 'Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices' (NMP).
<http://cordis.europa.eu/marketplace> > search > offers > 9135

Using bacteria to mine precious metals

Black shale ores are rich in valuable precious metals such as copper, nickel, silver, gold and platinum. EU-funded researchers used biotechnology to successfully mine metals from these difficult sites with minimal environmental impact.



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The high content of organic matter and carbonates in black shale ore deposits makes recovery of precious metals technically difficult. Furthermore, conventional techniques have come under scrutiny due to environmental considerations.

'Bio-hydro-metallurgy' is a branch of biotechnology involving the use of microbes ('bio') in an aqueous environment ('hydro') to recover or treat metals ('metallurgy').

Microbes are introduced to the shale, speeding chemical

transformations that result in dissolution of metals and subsequent selective recovery (bioleaching). The rest of the material is transformed into inert waste.

Although commercial application of bio-hydro-metallurgy for copper extraction began in the 1950s, and was extended to gold in the 1980s, the true potential for biotechnology in metallurgy has remained untapped.

The goal of the Bioshale¹ project was therefore to define innovative biotechnological processes

for the effective and eco-friendly recovery of numerous precious metals from black shale deposits.

Three extensive metal-rich European black shale deposits were selected for case studies: an unexploited site in Finland, a site currently being mined in Poland, and an old site in Germany no longer mined.

Researchers first evaluated the nature of the geological resources at the sites in order to select appropriate bacteria and processing methods. Simultaneously, they developed

bioleaching technologies and investigated novel micro-organisms of interest.

Given the project umbrella goal of sustainable mining, scientists developed a software tool used to conduct a global environmental impact study of conditions before, during and after mining activities.

The Bioshale consortium successfully demonstrated the ability to use bio-hydro-metallurgy to bioleach precious metals from black shale ore deposits rich in organic matter.

Bioshale project results should enable Europe to tap into the wealth of valuable metals present in its black shale ore deposits without damaging the environment.

Bioshale was coordinated by the Bureau de Recherches Géologiques et Minières, France.

- 1 'Search for a sustainable way of exploiting black shale ores using biotechnologies'.

Funded under the FP6 specific programme 'Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices' (NMP).
<http://cordis.europa.eu/marketplace> > search > offers > 9071

INDUSTRIAL TECHNOLOGIES

Low production costs for high-precision parts

European machining and manufacturing companies are facing increasing difficulties in maintaining their competitive edge. New technology that drastically reduces production time, developed by an EU-funded project, should translate into lower costs and higher productivity.



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Demand for high-precision stainless steel parts, with ever-superior performance parameters, cannot be met with current machining technologies. In addition, an inability to cut production and thus final product costs has resulted in an increase in the high-precision machining market share of low-labour-cost countries.

European researchers sought to develop novel technology for the flexible production of high-precision stainless steel parts by integrating two processes in one machine. Via funding for the TAF¹ project, scientists set out to reduce non-productive times and thus to greatly enhance productivity.

'Hard turning' is a cutting and shaping process that relies on the

use of a single-point cutting tool, typically a lathe, to cut and shape 'hard' materials like stainless steel. 'Super-finishing' is the very fine honing or polishing of a metal surface using abrasive stones.

TAF scientists developed a combined process designed to reduce production time and inhalation of hazardous oil mists used for lubrication. They tested the technology at two plants, one already using the hard-turning technology and one employing both hard turning and super-finishing but using two different machines.

In the first case, the TAF process reduced production time and tool costs by approximately 80 %. In addition, it reliably produced better surface quality than the method previously used by the factory.

In the second instance, combining hard turning and super-finishing in one step resulted in an approximate 75 % reduction in production

time while tool costs were comparable.

The TAF project's aims were thus successfully reached, demonstrating tremendous reductions in production time that should directly relate to decreased costs. Implementation of the TAF system has the potential to stimulate the EU precision machining industry, enabling it to recover a significant portion of the market share lost in recent years to low-labour-cost countries.

The project was coordinated by B.V. Gereedschapswerktuigen-industrie Hembrug, based in the Netherlands.

- 1 'Turn and finish - development of a combined hard-turning and superfinishing technology'.

Funded under the FP6 specific programme 'SME activities'.
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Enhancing the competitive edge of the EU textile industry

EU-funded researchers have developed a novel probe for on-line monitoring and control of textile dye-bath parameters. Commercialisation should enhance competitiveness of the European textile industry by decreasing costs while increasing production rates.

The European textile industry has faced difficulties in recent years due to legislation aimed at reducing the environmental impact of textile processing. At the same time, intense competition from developing countries has led to an increase in imports from low-cost-labour countries controlled by fewer environmental regulations.

European investigators sought to enhance the quality of EU textiles while reducing environmental impact, thus restoring the competitive edge. They set out to develop a dye monitoring-and-control tool via funding of the EDY¹ project.

Scientists developed a 'Variable optical-path spectrometer' (VOPS) providing reliable on-line and real-time data regarding dye-bath elemental composition and colours, pH, conductivity and temperature. Together with an adaptive control loop, the system was capable of modifying control based on continuous real-time feedback.

Previous monitoring systems generally provided information about dye-bath parameters analysed after the process had been completed. Such systems did not facilitate real-time changes for optimal process conditions.



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Being economical, the EDY system enabled improved textile product quality with less waste of materials and time. The end result was higher production rates with lower environmental and financial costs.

Overall, EDY has the potential to significantly enhance the competitiveness of the European textile industry, which has suffered recently due to strict environmental legislation and cheap labour in other countries. In particular, small and medium-sized enterprises in the textile sector

should benefit greatly from the EDY system's reduced costs and ready compliance with regulations.

The project was coordinated by Iris DP S.R.L., based in Italy.

- 1 'Development of a clean and efficient automatic dyeing control system'.

Funded under the FP6 specific programme 'SME activities'.
<http://cordis.europa.eu/marketplace> >
search > offers > 9121

Decision support for composites design and manufacture

The market for composite materials — those made of two or more other materials — is steadily growing. An EU project has developed a web-based modelling platform to assist companies in making the best design and manufacturing decisions.



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Composites enable designers to build on the individual strengths of each component, leading to a final product with superior technical

specifications which often include low weight and high strength. Applications of composites are found not only in conventional sectors such as automotive, aerospace and civil engineering, but also in emerging and commodity sectors.

Indeed, the many possible combinations of materials, and their various processing requirements, results in a diverse range of possible products; so varied, in fact, that engineers and manufacturers would benefit from advanced technological support for their design and optimisation tasks.

The aim of the ECOMP¹ project was to develop a web-based platform facilitating decision-making for optimal process, equipment and materials selection with maximum cost reduction.

Scientists used object-oriented programming, a relatively recent programming technique used by languages such as Java. In Java, individual entities (objects) are defined with specific rules for controlling their associated data and interactions with other objects. Thus, in this software application, the relevant objects included materials, properties and processes.

They combined this with an 'Agent-based model' (ABM), a relatively new computational modelling structure that evaluates the effects of multiple components (agents) on the system as a whole. An ABM was used to model effects of various objects on cost, in order to evaluate costs of alternative routes and to inform the user of issues unrelated to economics that might affect his or her decision.

ECOMP has therefore delivered the first web-based software tool for modelling cost and selecting materials, processes and equipment in the early phases of composite design. Commercialisation of ECOMP has the potential to increase the competitive position of small and medium-sized enterprises involved in composites manufacturing. It should also increase the quality and variety of available products while reducing their costs, which is an added benefit to end-users.

ECOMP was coordinated by the Centre de Recerca i Investigació de Catalunya (CRIC) in Spain.

- 1 'Agent-based engineering in a cost estimation model for composites'.

Funded under the FP6 specific programme 'SME activities'.
<http://cordis.europa.eu/marketplace> >
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Better moulds for plastic and metal parts

EU funding enabled European researchers to develop novel technology enhancing the entire manufacturing pipeline for 'moulded' plastic and metal parts. Commercialisation should help significantly offset the effects of competition from countries with lower manufacturing costs.

Metallic and plastic components are ubiquitous. They are commonly produced using moulds, much as one bakes a cake in a special tin to create a car or a heart shape. Among the processes relying on moulds are 'High-pressure die casting' (HPDC), injection moulding and blow moulding.

More than 2 000 small and medium-sized enterprises in the EU are involved in the mould-making sector, even though they face intense competition from manufacturers in less expensive countries.

Given the huge volume and variety of parts produced, improving the parameters of the production

process would have significant and far-reaching impact.

The Foinmoulds¹ project aimed to improve the production process by employing a new mould concept that uses metal-foam inserts (cellular materials) to enhance heat dissipation and potentially reduce mould weight. Together, these two factors could reduce mould distortions resulting in higher-quality products, less scrap and less maintenance.

Investigators decreased mould manufacturing time and costs significantly. Analysis of mould performance demonstrated enhanced thermal behaviour in moulds containing foams in

their cooling channels, leading to improvements in all three metal and plastic moulding processes. The Foinmoulds consortium also created a complete database of the properties of various foams to assist in the design of future moulds.

Foinmoulds thus contributed valuable new technology, relevant to thousands of companies involved in making moulds, using them to manufacture plastic and metal components, as well as end-users of the components produced.

Commercialisation of concepts has the potential to substantially enhance the EU's competitive position which has been adversely



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affected by imports from 'low-cost' countries.

The project was coordinated by Erku Praezisionsteile GmbH, based in Austria.

- 1 'Increase of the productivity and efficiency of injection processes through the use of metallic foam concepts in the production of moulds'.

Funded under the FP6 specific programme 'SME activities'.
<http://cordis.europa.eu/marketplace> >
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INDUSTRIAL TECHNOLOGIES

Metal forging with less heat input

Reducing the heat required to shape metal pieces has many advantages. An EU project has developed a production process significantly extending the current applications of semi-hot forging.

Many people might think of a blacksmith's workshop when the word forge is mentioned. In fact, the work of the blacksmith, namely heating and forming metal into useful shapes, is still important today — this process is called forging.

Hot forging requires heating the metal to very high temperatures and thus a large energy input. In addition, the high temperatures lead to poor surface quality and waste of material, as well as the formation of an oxide 'scale'.

In an effort to reduce environmental impact and cost while improving accuracy and the quality of the final product, manufacturing has turned to semi-hot or warm forging.

Semi-hot forging has been used successfully to produce symmetric pieces around a given axis (rotational symmetric). European researchers proposed to extend this technology to pieces lacking rotational symmetry, using funding for the Desproch¹ project.

Scientists evaluated requirements and adapted selected forging geometries to the semi-hot process using 'Computer-aided design' (CAD). Forming process sequences were evaluated by material flow simulation using 'Finite-element analysis' (FEA) in which very tiny 'pieces' (finite elements) of material are evaluated individually and in terms of interrelationships.

Having developed and produced the necessary forging tools, along

with designing the layout of the process chain, the production line was tested and evaluated. Quality assurance specifications were developed for this purpose and for use in manufacturing in general.

The Desproch consortium successfully established a production line for semi-hot forging of long parts with rotational asymmetry. The team thus extended the range of parts to which this economical and environmentally friendly process can be applied to produce high-quality parts in less time with less waste.

The project was coordinated by the Institut für Integrierte Produktion Hannover gemeinnützige GmbH (IPH), based in Germany.



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1 'Design of a semi-hot process chain'.

Funded under the FP6 specific programme 'SME activities'.
<http://cordis.europa.eu/marketplace> >
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Bread gets ahead

Bread-makers can now optimise their equipment, upgrade their facilities and improve production processes, thanks to new web-based software.

Bread is the stuff of life and has been an important staple around the world for millennia. Now this important food has come of age

as knowledge on bread-making processes and related equipment is disseminated via the web. With this in mind, the EU-funded

project E-Breadmaking¹ is helping take this sector on-line.

The project aimed to exploit intelligent web-based software, such as the rule-based system and fuzzy logic, to optimise equipment configurations and improve the production chain. It used intelligent reasoning features to design e-commerce applications to help clients select ideal bread-making processes and equipment customisation. Users input production levels, bread format, atmospheric conditions, layout restrictions and room dimensions into a virtual configuration to determine their suitability.

Overall, the system helps centralise knowledge about bread-making processes and equipment, identifying market requirements, too. It promotes business-to-business e-commerce effectively and provides a virtual-reality environment for the client to assess

equipment suitability before ordering.

The technology is expected to reduce the number of specialists and resources needed to design and procure the correct bread-making equipment. It will promote more specialised products in the industry and improve competitiveness in the sector. Across Europe, SMEs in particular stand to benefit from such a web-based platform.

The project was coordinated by Industrias Torrents, S.A., based in Spain.

1 'E-Commerce of bread-making equipment based on an expert system, distributed agents and virtual reality'.

Funded under the FP6 specific programme 'SME activities'.
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Aerospace SMEs gain more EU support

In the footsteps of earlier European Union initiatives, a project has helped the aerospace sector's businesses acquire new technology and submit proposals to join EU-funded projects more effectively.



The aerospace industry is one of the pillars of the European economy, contributing significantly to exports and manufacturing. In the EU's Fifth Framework Programme (FP5), Union-funded initiatives known as Scratch projects have supported the sector's thousands of small and medium-sized enterprises (SMEs).

Representing a partnership of 20 associations and firms from across the EU, the EU-funded project Scratch Phase IV¹ helped SMEs to acquire technology, in addition to raising research and development awareness. It assisted the sector's SMEs across the EU and Associated States in jointly preparing technology acquisition proposals.

Moreover, Scratch Phase IV helped them structure their corporate research plans, and assessed their own needs, in addition to supporting funding mechanisms and enriching databases to encourage partnerships. This ultimately led to

the submission to the EU of several research and development projects for evaluation.

Looking to the future, the project evaluated SME requirements in light of the then upcoming FP7, ensuring the sector's sustainability over the long term. The combination of these actions has undoubtedly helped ascertain the viability of the aeronautic sector in Europe, preparing for new co-operation initiatives and bringing the EU's newest members into the aerospace arena.

The project was coordinated by Euro Inter Toulouse SARL, in France.

1 'Support for SMEs collaborative aeronautical technical research'.

Funded under the FP6 specific programme 'Aeronautics and space'.
<http://cordis.europa.eu/marketplace> >
 search > offers > 9254

Advancing rapid prototyping technology

European researchers investigated the potential of a novel system for producing prototypes at greater speed and flexibility. The new technology is expected to greatly impact product prototyping and market release.

'Rapid prototyping' (RP) refers to the group of techniques that facilitate the development of a product using 'Computer-aided design' (CAD) and 3D technology. Various prototyping machines exist that allow construction of parts and prototypes for rapid product dissemination to the market. However, special skills are needed for the high-end RP techniques, and the machines are expensive and not easily adjustable to an office environment.

To address these issues, the EU-funded Flexrap¹ project aimed to develop a high-quality rapid-prototyping system with more flexibility and functionality than 'stereo-lithography' (SLA) systems.

Project partners worked on various parameters of prototyping machines, including development of the support material so that it could be easily removed in an office environment while providing sufficient strength. The type of model material used (hard or soft) was also investigated, giving special emphasis to resin formulations which had to comply with the proprietary ink-jet technology.

A major breakthrough was the development of a flexible formulation with a high elongation at break and good elasticity, which was successfully introduced on to the market by project partners. In addition, an experimental printer was built and the applicability of

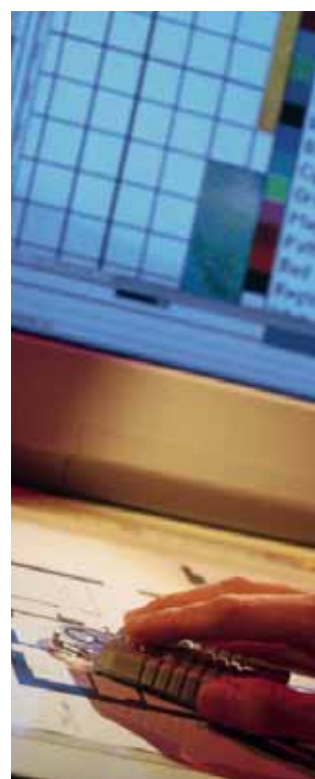
the new prototype machine was investigated.

Successful applications of the Flexrap technology were identified in the foundry, toy and footwear industries.

The project was coordinated by Objet Geometries Ltd., based in Israel.

1 'Development of an innovative, modular rapid prototyping system for rigid and flexible models'.

Funded under the FP6 specific programme 'SME activities'.
<http://cordis.europa.eu/marketplace> >
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EVENTS

Macrotheme conference on technology and science

A conference on technology and science will take place on 15 and 16 October 2012 in Paris, France.

Although it is difficult to quantify the direct social and economic benefits of scientific research, the rapid emergence and growth of new products and industries due to breakthroughs in fields such as magnetic resonance imaging, superconductivity, lasers, antibiotics and transistor action supports the idea that they do exist.

The event will address topics related to technology and science (physics, chemistry, biology, medicine, pharmaceutical), particularly the implications for investors in technology and scientific start-ups.

For further information, please visit:

http://www.macrotheme.com/international_conferences/paris_-_technology_and_science

Greener by design annual conference: 'biofuels for aviation — overcoming the barriers'

The Royal Aeronautical Society will organise a conference on 'biofuels for aviation' on 16 October 2012 in London, the United Kingdom.

Emissions of carbon dioxide need to be reduced in order to allay global climate concerns. This pressure, along with increasingly scarce fossil fuels, will result in numerous challenges for the aviation industry.

Over the past few years, advances have been made in demonstrating processes that can convert biomass to kerosene. The challenge is now to meet sustainability standards and generate sufficient quantities of such fuel at a price that remains affordable for consumers.

The conference will bring together expert speakers from industry, government and other sectors who will review these challenges and the current state of progress.

For further information, please visit:

<http://www.aerosociety.com/Events/Event-List/383/Greener-by-Design-Annual-Conference-Biofuels-for-Aviation-Overcoming-the-Barriers>

European initiatives in the maritime environment — future capabilities, technologies and civil-military synergies

The Cyprus Presidency of the Council of the European Union will organise an event entitled 'European initiatives in the maritime environment — future capabilities, technologies and civil-military synergies' on 18 and 19 October 2012 in Nikosia, Cyprus.

As a crucial resource for the European economy, the maritime environment needs to be dealt with effectively and in a sustainable manner. The conference will help promote European initiatives in the maritime environment while ensuring a continuation of current efforts to integrate maritime surveillance and broader maritime issues.

Discussions will focus on the need for a European approach and the identification of civil-military synergies. The agenda will also include topical research and technology issues and how the naval industry can support European capabilities.

For further information, please visit:

<http://www.cy2012.eu/index.php/en/political-calendar/areas/foreign-affairs/european-defence-agency-seminar-with-title-european-initiatives-in-the-maritime-environment---future>

Conference on human bio-monitoring — linking environment to health

A conference on human bio-monitoring will take place from 22 to 24 October 2012 in Larnaca, Cyprus.

'Human bio-monitoring' (HBM) is a scientific technique for assessing human exposures to environmental agents and their effects, based on sampling and analysis of an individual's tissues and fluids. Coordination of on-going bio-monitoring activities in Europe will help achieve the objectives of the EU 'Environment and Health Action Plan', which allows for data comparability between countries, better information integration and the exchange of experience among teams and countries.

The event will look into the possible ways to integrate HBM into environmental and health monitoring infrastructure. The agenda will also include possible use of human bio-monitoring in supporting and evaluating policy decisions, as well as in investigating the correlation between environmental exposure and health.

For further information, please visit:

<http://www.cy2012.eu/index.php/en/political-calendar/areas/employment-social-policy-health-consumer-affairs/conference-on-human-biomonitoring-hbm---linking>

First international conference on urban sustainability and resilience

The First International Conference on Urban Sustainability and Resilience, organised by the University College London, will take place on 5 and 6 November 2012 in London, the United Kingdom.

The continuing trend towards urbanisation has demonstrated the connection between human societies, technology and natural environment. The decisions made today by engineers, policy makers, designers and planners often have impacts for generations to come. These decisions must be backed by sound science and knowledge of social mechanisms.

The conference will bring together world experts from across a wide range of engineering, science and social science disciplines to discuss some of society's most urgent issues.

For further information, please visit:
<http://www.usar-conference-2012.org/>

'Marie Skłodowska-Curie actions' in Horizon 2020

A conference on Marie Skłodowska-Curie actions in Horizon 2020 will take place on 5 and 6 November 2012 in Nicosia, Cyprus.

This event, organised under the auspices of the Cyprus Presidency of the Council of the EU, will aim to expose researchers to the potential of Marie Skłodowska-Curie Actions while highlighting their contribution towards the Europe 2020 objectives.

The conference will provide a combination of speakers, high-level stakeholders and experts, as well as Marie Curie Fellows. It will aim to help young researchers in networking with multidisciplinary peers, presenting their work, and attending a series of workshops and seminars that will run across the event.

For further information, please visit:
<http://www.marie-curie2012.eu/index.php?id=2>

Boarding Time: Completing the European Research Area in the context of the Innovation Union

A conference titled 'Boarding Time' on completing the European Research Area in the context of the Innovation Union will be held on 14 November 2012 in Nicosia, Cyprus.

The objective of the conference is to bring together European Research Area(ERA) stakeholders — such as research organisations, universities, private enterprises and public authorities — to contribute to the debate on the policy measures and actions which must be implemented with a view to completing ERA by 2014.

During the conference, key specific and cross-cutting issues of ERA policy will be explored, including, *inter alia*, the effectiveness of national research systems, an open labour market for researchers, investing in research infrastructures, gender issues, knowledge transfer and open access issues, cross border cooperation and competition of research actors, and international cooperation and the monitoring mechanism.

For further information, please visit:
http://www.research.org.cy/EL/european_research_area.shtm

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