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SPECIAL FEATURE

PRESERVING OUR CULTURAL HERITAGE



SOCIAL SCIENCES AND HUMANITIES
**NEANDERTHAL BONES
REVEAL THEIR SECRETS**

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WITH SUSTAINABLE
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EDITORIAL

by the editorial team

IS EUROPE'S CULTURAL HERITAGE FADING AWAY?

There is no denying the huge value that cultural heritage holds for Europe's economy and society. But as time flies, political priorities change and budgetary issues increasingly push governments to reduce their expenditure, there is a real risk of seeing the preservation of this heritage pushed onto the back burner — ultimately resulting in invaluable losses.

Stakeholders have been sounding the alarm for a while, peaking with campaigns like Europa Nostra's '7 Most Endangered' programme which identifies the most threatened monuments and sites in Europe and mobilises public and private organisations to save them before it's too late. Among these sites are the Berlin City Hall,

threatened by the construction of a new underground station, the historic centres of l'Aquila which were damaged by an Earthquake in 2009, and the Roman and pre-roman galleries at Rosia Montana in Romania.

At the same time, current art restoration practices are increasingly showing their limits and new methods are needed to safeguard works of art without the risk of altering or deteriorating them.

Since the ratification of the Lisbon Treaty, the EU has been expected to ensure that the continent's cultural heritage is safeguarded and enhanced. A number of policies and programmes were developed: Some

EUR 3.2 billion and EUR 1.2 billion were invested via the European Regional Development Fund and the European Agricultural Fund for Rural Development, respectively. Around EUR 100 million of research funding was granted under FP7, and an equal budget is foreseen for 2016 and 2017 under the Horizon 2020 programme. As pointed out by the Horizon 2020 Expert Group on Cultural Heritage, 'Not only is [cultural heritage] at the heart of what it means to be European, it is being discovered by both governments and citizens as a means of improving economic performance, people's lives and living environments.'

While New Year celebrations are mostly about hopes for a better future that scientific research personifies to a great extent, they are also an opportunity to reflect on those things that make us who we are and how to preserve them. This is why this first 2016 issue of the *research*EU results magazine* is dedicated to this newly found power of cultural heritage, through the presentation of project results that raise hope of a more in-depth analysis, better conservation and more effective transmission of findings — notably thanks to new information and communication technologies.

This special feature is followed by eight sections providing insights into biology and medicine, social sciences and humanities, energy and transport, the environment, IT and telecommunications, industrial technologies, security and safety, and space, along with a list of upcoming events hosted by or involving EU-funded research projects.

We look forward to receiving your feedback. You can send questions or suggestions to: editorial@cordis.europa.eu



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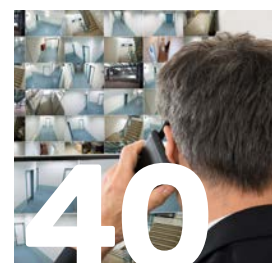
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SPECIAL FEATURE

PRESERVING OUR CULTURAL HERITAGE

NEW DIGITAL TOOLS COULD HELP SPEED UP CULTURAL HERITAGE WORK

Archaeologists will soon have access to new digital tools for reassembly and erosion, while advances in predictive scanning could open up new market opportunities.

The EU-funded PRESIOUS (PREdictive digitization, reStoration and degradatiOn assessment of cultUral heritage objectS) project has developed software tools that could help improve the efficiency of the work of European archaeologists at a time when funding is tight, and shown that computer simulation can play a key role in assisting researchers across a range of disciplines, including the preservation of cultural heritage artefacts. Once the project is completed, these tools will be made freely available for archaeologists to download. The consortium's industry partner has already used some of the advances made.

'We set out to address some of the challenges that archaeologists face in their everyday work,' explains project coordinator Professor Theoharis Theoharis from the Norwegian University of Science and Technology.

'In order to better understand what monuments will look like under certain erosive conditions for example, we built simulation software — within the timescale and resources available — that enables an archaeologist to scan a stone object and estimate erosion patterns under different conditions.'

A second aim was to develop simulation software to help archaeologists piece together fragmented findings, like solving a 3D puzzle. 'During a dig, archaeologists will often

come across thousands of fragments,' says Theoharis. 'Piecing these together involves quadratic complexity, which we computing scientists fully understand.' The second tool developed by the project team automatically proposes possible fits based on the digitised fragments.

The third solution involved developing software capable of filling in gaps in archaeological objects with symmetry. Once fragments have been painstakingly reconstructed, final artefacts are often still missing pieces. The new software tool works by recognising symmetries and geometric patterns in the artefact, and from this information, offers logical suggestions to fill in the gaps, to aid restoration.

'But in order to develop these technologies, we had to address a key bottleneck — the expense and labour intensive nature of digitisation,' says Theoharis. 'We found that it took a trained operator two and a half hours to scan just one fragment. So the fourth thing we did was speed up the digitisation process with our industrial partner.'

This was achieved through the development of predictive scanning, which uses predictions based on 3D object retrieval from repositories of previously digitised objects in order to speed up the scanning process. This technique is useful for applications where cost reductions are imperative and precision scanning is not necessarily the end goal, as is the case for some archaeological applications.

'We did discuss the possibility of commercialising our software, but the academic project partners understood that our end users — archaeologists — work under harsh funding constraints,' says Theoharis. 'So these tools will go live free once the project ends (in January 2016). In addition, we have a great deal of data and research results that we intend to make available online. There were many related cultural heritage issues that we would have liked to tackle, so we hope that by making this information available, the research work will continue.'

Feedback from the archaeological community at various conferences, seminars and demonstrations has been very

positive, and Theoharis is confident that the PRESIOUS tools will directly contribute to the preservation of European cultural heritage.

PRESIOUS

- ★ Coordinated by the Norwegian University of Science and Technology in Norway.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/project/rcn/106904>
- ★ Project website: <http://www.presious.eu/>

NEW SCANNING TECHNOLOGY REPRODUCES ROCK ART IN 3D

To laypeople, prehistoric art is often pictured in the form of cave paintings. But rock art, another form of visual expression found in the open air, is more ubiquitous and often threatened by the whims of the weather. The 3D-PITOTI team has set out to ensure that this heritage continues to be passed on to future generations. Since 2013, it has been developing technologies able to scan, process, reconstruct and visualise rock art in 3D.

Rock art is generally acknowledged by archaeologists as a valuable record of prehistoric and proto-historic thoughts. People represented the things that mattered to them, and rock art is a unique way of figuring out what they had in mind — be it food security, the threat of interpersonal

approaches can we hope to answer these questions.'

The 3D-PITOTI (3D acquisition, processing and presentation of prehistoric European rock-art) project focuses on Valcamonica in the Lombardy region of Italy — a UNESCO World Heritage site home to at least 100 000 rock art images known as 'Pitoti' and perhaps twice as many more hidden across the region. Most scientific and technical experts with extensive knowledge of Valcamonica joined forces to develop the technology to capture, process and visualise in 3D what is reputed as some of the best rock art in the world. Together they hope to enable a wider audience to experience the Pitoti in an interactive and engaging manner.

'Most prior recording was 2D — photos or tracings of 3D forms carved into the rock surfaces,' says project coordinator Dr Sue Cobb from the University of Nottingham. 'The third dimension adds valuable information, for instance with the superimposition of carvings that can allow us to develop relative chronologies.' Team member Craig Alexander noted that while this is not the first time a 3D recording technique has been used in this field, this is the first time it results in digital recordings: 'Over 40 years ago a series of plaster casts was taken in Valcamonica that could be reproduced and exhibited away from the park. However, digital data is weightless and rapidly transferred from place to place — making our 3D

models accessible to anyone with a decent internet connection. A tangible representation of the rock art in a context away from the real valley can also be produced through modern 3D printing technologies.'

A new set of tools

The team's developments resulted in an entirely new pipeline for multi-scale acquisition, processing and visualisation of rock art. A new rock-art scanning system capturing rock art with sub-millimetre accuracy was developed, and new techniques for flight path planning of 'Unmanned aerial vehicles' (UAVs) allow an efficient and effortless capturing of the terrain surrounding individual Pitoti figures on a centimetre to kilometre scale.

For the processing stage, the project developed techniques to accurately register and combine a large number of these 3D scans into a coherent multi-scale 3D model. Advanced segmentation and classification tools support the semi-automatic identification of different types of Pitoti such as people, buildings and animals and, finally, the visualisation and interaction tools allow the exploration of the Pitoti in their natural surrounding on a wide variety of platforms, from tablets and notebooks to head-mounted displays and the Pitoti Scientists' Lab, a unique high-end 3D visualisation facility at Bauhaus-Universität Weimar.

'The software developed in the project is extremely useful, as it allows for

"3D-Pitoti's comprehensive digital processing pipeline for recording, storing, analysing and visualising rock art defines the new standard in rock-art research."

violence or gender roles. As pointed out by Giovanna Bellandi, research assistant at the University of Cambridge, 'Rock art can be seen as a type of ancient language or means of communication. It is not a form of art in the modern sense but is, rather, a form of language through which the people of the past communicated certain ideas.'

Rock art is also very different from one region of Europe to another: 'It is strictly related to the place in which it was made,' points out Bellandi. 'It is necessary to consider the geographical context, the particular type of rock and, probably, the social context. There remain many open questions about rock art, and only by continuing research with different and new



integrating the possibilities of a normal database, organising and storing the data, and also having the Pitoti located in their natural 3D environment and not only on a two-dimensional map,' says Paolo Medici, archaeologist at the Camunian Centre of Prehistoric Studies. 'The database has been created on the basis of the archaeologists' request, so it meets the need for advanced digital rock-art research.'

The benefits of 3D-PITOTI's system are manifold. Whilst state-of-the-art recording of rock art (by tracing on plastic sheets) takes a lot of time and skills and is an analogue technique, the new technology allows archaeologists

to scan in high resolution, at multiple scales and in less time — regardless of the number of engravings. The combination of these reconstructions within a single database also enables researchers to concentrate on the big picture. 'Working with an integrated digital pipeline, large numbers of Pitoti can be compared between each other and to rock art at other locations. This ability to handle large amounts of data also helps us find patterns in the art that might suggest its meaning,' Dr Cobb says. Such a comprehensive digital rock-art library used in combination with Weimar's collaborative 3D visualisation facilities defines the new standard for rock-art research.

Straight to the working field

The consortium hopes to keep developing and testing the project's technologies over the months to come. Graz University of Technology and ArcTron 3D will be working towards the next prototype of the scanner, and several of the archaeologists at the University of Cambridge have already voiced their interest in using the technologies beyond the framework of the project.

Craig Alexander would like to use technologies like image segmentation and classification in the analysis of aerial imagery in order to find new sites such as Neolithic villages in Puglia, while Liliana Janik is hoping to use it as part of her equipment while recording rock art. Frederick Baker, a Pitoti researcher, is interested in filming opportunities: 'I hope the scanner will become the new standard piece of fieldwork equipment. As a film director I will continue to use the scanning technique to create new film in images and a new filmic language,' he concludes.

3D-PITOTI

- ★ Coordinated by the University of Nottingham in the United Kingdom.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/project/rcn/106885>
- ★ Project website: <http://3d-pitoti.eu/>
- ★  <http://bit.ly/1OP1jff>

JOINT STAKEHOLDER EFFORTS SHAPE TOMORROW'S DIGITAL CULTURE

Already underway, the digitalisation of culture requires a common vision from all stakeholders in order to truly take off. The SMARTCULTURE project brought together 13 partners from eight European regions to shape future developments in the sector.

The digitalisation of cultural heritage is one of the main challenges facing European museums and other cultural institutions. Libraries, museums and heritage sites are increasingly experimenting and embracing new technologies able to turn formerly passive audiences into active practitioners of culture.

This process is key not only to protecting art and architecture from the ravages of time, but also to drawing in a new generation of enthusiasts who have been brought up surrounded by tactile devices and the Web 2.0. There is one thing, however, that hinders the development of this new culture consumption pattern: the lack of cross-fertilisation.

Completed in November 2015, SMARTCULTURE was a three-year project involving cooperation between 13 partners and bringing together eight regional research centres

from across Europe. What these partners have in common is their interest in culture, heritage and ICT: Most of the regions involved have a very high population, a very rich cultural heritage with the likes of the Louvre-Lens, Museo Guggenheim and Museo del Prado, as well as dynamic production of contents. Some are European leaders in information & communication and creative & cultural industries, and all have a strong relationship with 'European capitals of culture' (ECOC) whether previous winners or candidates.

'The Digital Cultural Heritage sector necessitates a wide range of competences,' says Anca Draghici, coordinator of the project for French technological hub Euratechnologies. 'Consequently, the cross-fertilisation between ICT enterprises, creative and cultural industries (especially SMEs), research stakeholders, cultural institutions and public

authorities across Europe through mutual learning and mutual mentoring becomes necessary for a wider development of the market.'

Through their 'Coordination and support action' (CSA), SMARTCULTURE partners promoted the creation of engaging digital experiences for people looking to access cultural resources. 'These relationships not only provided an opportunity to open up the hidden social and economic potential of heritage and cultural collections through digital technologies, but also impacted on the quality of life of culturally diverse citizens,' points out Draghici.

Extensive resources to help digital culture thrive

Among the various challenges the digital cultural heritage sector has to face, Draghici mentions three which should be addressed immediately: education and awareness-raising to prevent citizens who currently do not have easy access to culture and technologies from being penalised twice; the harmonisation of European policies in terms of access to content; and the providing of clear answers to all questions related to intellectual property.

To help the sector rise to these challenges, the SMARTCULTURE consortium produced a total of 26 analyses and reports. These include: the inventory of Digital Cultural Heritage stakeholders, infrastructures, initiatives and tools across the eight partner regions; a joint action plan for EU institutions and a business plan; a human potential analysis in the Digital Cultural Heritage field; and a Strategic Research Agenda. The project also provided technical and political recommendations for an international strategy on the digital agenda.

Other key achievements include the organisation of events and mutual mentoring workshops across Europe and beyond, the enhancement of a network of 2 500 professionals, and the design of a set of tools dedicated to quadruple helix stakeholders — Public authorities, Academia, Cultural institutions and Business.

'The insights and examples provided in the SMARTCULTURE documents testify to a great variety and ingenuity in the ways that cultural heritage materials — pre-digital or digital — are put to use to enliven communities while stimulating research and innovation. This is very encouraging and

constitutes a solid base for further developments and for bringing more regions into collaborative projects,' Draghici says.

2015 and beyond

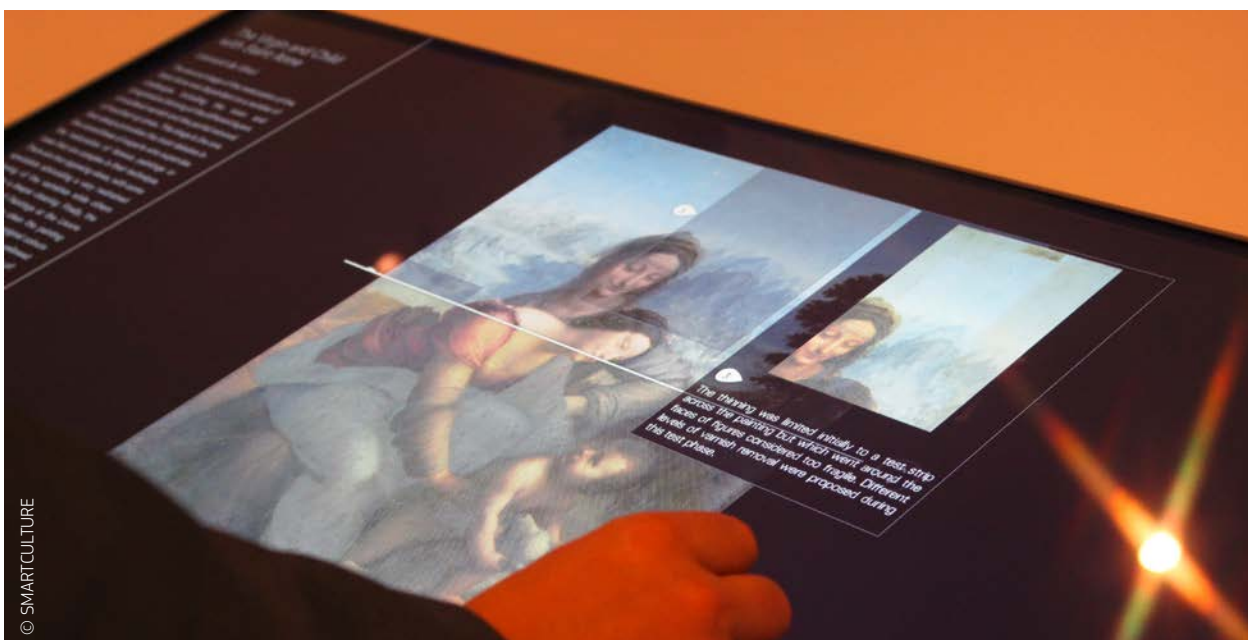
All stakeholders — public administration, private and public companies, academies and the general public — are set to benefit from the project outcomes. The project's reports have been delivered to the European Commission, which will use the data for its future strategies and calls. In addition, the partner regions will pursue SMARTCULTURE dissemination through four main channels: the brochure 'New Technologies and Digital Growth in Cultural and Creative Industries: 8 cases studies', the project website, social media channels and the project's research publications.

The project's end does not however mean that SMARTCULTURE's research efforts are over. 'Academic SMARTCULTURE partners from Birmingham University and the International University of Languages and Media in Milan also envisage a common publication in 2016 through Routledge to bring together the scientific contributions that have emerged from the project and to further explore the innovative concept of the smart culture economy,' Draghici explains. 'It will investigate, through European case studies and contextual cross-cutting research, the current and emergent environment for a smart culture based on the coproduction of interactive digital cultural heritage, a capitalisation on local expertise, and a highlighting of regional heritage and its distinctiveness to wider publics.'

The volume will have a theoretical part divided into two chapters: one dedicated to the concept of Culture 3.0 and one on the innovation capacities of the SMARTCULTURE Quadruple Helix approach. This theoretical part will be followed by regional case studies of best practice in smart culture initiatives, as well as clusters exploring regional dynamics, innovation mechanisms, and their economic and policy implications.

SMARTCULTURE

- ★ Coordinated by Euratechnologies in France.
- ★ Funded under FP7-REGIONS.
- ★ <http://cordis.europa.eu/project/rcn/106233>





ONLINE RESOURCE GIVES NEW LIFE TO ENDANGERED LANGUAGES

EU-funded scientists have established an educational website in order to help preserve endangered languages and better inform the public.



Developed through the EU-funded INNET (Innovative Networking in Infrastructure for Endangered Languages) project, the free, openly accessible website about endangered languages builds on the important work of previous cultural heritage initiatives and features search tools, educational material and interactive maps. Teaching institutions as well as researchers will find the resource practical and easy to use.

‘The project was implemented as an answer to the question of how digital and, specifically, non-written multimedia cultural heritage resources could be effectively maintained and preserved for the future,’ explains project coordinator Dr Dagmar Jung from the University of Cologne, Germany. ‘This challenge has to date not been tackled by the wider scientific and academic community.’

At the same time, the project team wanted to make these valuable resources accessible to the wider public. ‘This meant that the educational component of the project took on a bigger role than we initially expected,’ says Jung. ‘In addition to improving networking on digital resource innovation relating to language and culture, the project aimed to boost education on linguistic diversity and multilingualism at the high school level.’

An international summer school for MA and PhD students focused its

courses on technological issues of language and music archives of lesser-used languages. ‘Participating students came from many European countries, but also from Ethiopia, India, or the US,’ says Jung.

‘Leading scholars in their field gave lectures on technological implementations as well as linguistic background and methodology. In addition, practical tutorials were held by the same instructors so that an immediate learning effect could take place. The summer school was considered highly successful by the students, some of them keeping in close contact with the INNET project and supplying their own data to the website.’

Other project achievements include establishment of five new regional archives, and annual training events for use of proper and up-to-date standards and tools. Archivists from Argentina, Brazil, Ecuador, Finland, Indonesia, Mexico, Peru, Russia and Sweden as well as partners from Germany, Hungary and the Netherlands were actively involved in these events.

‘Participants at these events were able to present and discuss common issues relevant to the operation of a language archive,’ says Jung. ‘Regional language archives also received additional technical support with the operation of their archive.’

An important predecessor to INNET was the CLARIN project, which established a

distributed network of organisations hosting language resources and related services. This distributed data network has sites all over Europe, typically universities, research institutions, libraries and public archives. The INNET project succeeded in transferring some of the knowledge acquired in CLARIN to a wider network of archives of endangered languages.

The establishment of an expert network will continue to help showcase and disseminate information on endangered cultures and languages. This is a pressing concern; globalisation and fast-paced technological innovation continue to negatively impact many vulnerable cultures and languages, with many of the latter forecast to become extinct in the coming decades.

Digital archives will help to gather and disseminate valuable cultural and language materials for future generations, spark interest among students who might otherwise never be able to access endangered languages, and support the preservation of our shared cultural heritage.

INNET

- ★ Coordinated by the University of Cologne in Germany.
- ★ Funded under FP7-INFRASTRUCTURES.
- ★ <http://cordis.europa.eu/result/rcn/170093>
- ★ Project website: <http://www.innet-project.eu/>

INTERVIEW

GREEN COATING AND CONSOLIDANTS EASE THE RESTORATION OF HISTORICAL OBJECTS

Restoring cultural heritage objects is difficult enough, at the same time having to maintain their authenticity, but it becomes even more of a brainteaser when adding environmental concerns to the mix. New materials developed and tested under the HEROMAT project will help restorers to take on both challenges simultaneously.

HEROMAT (Protection of Cultural Heritage Objects with Multifunctional Advanced Materials) was a multidisciplinary research cooperation project that aimed to develop innovative and environment-friendly materials for the restoration of immovable Cultural Heritage assets in continental Europe. After four years of intensive research and tests conducted on two sites in Serbia and Slovenia, the consortium shortlisted three materials: two consolidants for carbonate and silicate substrates and a photocatalytic material for porous substrates.

The novel materials are applicable for the protection of different inorganic mineral substrates and provide added value in terms of consolidation, self-cleaning, anti-microbial effect and sustainability. Prof. Dr Jonjaua Ranogajec, coordinator of the project for the University of Novi Sad Faculty of Technology, discusses these outcomes and their market potential for different kinds of historical objects located across Europe, but also in modern building engineering.

★ **How do HEROMAT solutions differ from other market offerings? What's their added value?**

Prof. Dr Jonjaua Ranogajec: There are three final HEROMAT solutions: one photocatalytic coating and two consolidants, one for carbonate and the other for silicate-based substrates. Compared to products already available on the market, HEROMAT consolidants differ right from the very beginning of the research planning. Both consolidants were prepared so as to be compatible with his-

torical objects stored under a continental climate. Therefore they have no harmful effects in the long run.

On the other hand, our photocatalytic coating is a totally new product to be placed on the market. It is also compatible with historical materials boasting added value as a self-cleaning coating based on anion clays.

All in all, the application of our newly-developed materials extends the period between two restoration procedures, the lifetime of cultural heritage assets (and other buildings), and therefore decreases investments in cleaning and protecting objects.

★ **The project focused on two specific works of art. What were your main criteria for selecting them?**

Both objects were already chosen at the stage of project planning to serve as case studies for two types of

historical objects. One is a fortress in Bac, Serbia. It is located in an urban environment, dates back to the 14th century and is made of dominant materials such as brick, mortars and renders. The other object is the baroque castle manor in Dornava, Slovenia. There are dominant items made of sculptured stone and concrete placed in the open area of the castle gardens.

Such historic materials are used for the characterisation, design and testing of new materials. Both objects are subjected to the continental climate of central Europe, while some testing of the HEROMAT products is also performed on the Adriatic coast and in the northern Russia region.

★ **Are you happy with the results of your work on these artefacts?**

HEROMAT contributed to effective, long-lasting solutions for the prevention of degradation of cultural assets while keeping their authenticity, functionality and aesthetic appearance and generating socio-economic benefits.

We produced a consolidant for carbonate substrates, a consolidant for silicate substrates, photocatalytic suspension for cultural heritage objects (brick, render, mortar and stone), a methodology for the assessment of adhesion

"HEROMAT's final products could be applied for the restoration and protection of a wide range of immovable cultural heritage in Europe."





SPECIAL FEATURE

characteristics of photocatalytic suspension on porous mineral substrates, and an assessment of the antifungal characteristics of porous mineral substrates. Besides this, we also produced dissemination reports, publications in scientific journals and a project website.

We are highly satisfied with these results. Our new products are environmentally-friendly and highly compatible with historical materials, promising reduced costs for the maintenance of immovable cultural heritage. The monitoring of our case study materials was performed in two cycles, right after application, and 12 months later, and the results are encouraging for future market placement.

★ **What kind of materials did you eventually select and why?**

Materials produced in the HEROMAT project are natural materials meeting the high requirements of historical materials forming the core of the case study objects — brick, clay, mortar, render, stone, concrete. From the beginning, two types of materials were planned: consolidants and photocatalytic coating. They were developed, designed and produced step by step, following several phases of testing and compatibility assessments. All three materials are based on water and therefore are harmless to the environment.

★ **How did you assess this environmental impact?**

The detailed assessment was performed in different life stages of the project. One work package was devoted to studying the environmental footprint of the newly developed protective materials and to evaluating their environmental friendliness. The study was based on use of the 'Life cycle assessment' (LCA) technique. The existing LCA models for protective materials were identified, cradle-to-gate models were developed for each formulation and, finally, a multi-decisional tool for the selection of the best protection materials was designed.

The environmental footprints of the carbonate consolidant and photocatalytic suspension were found to be relatively low, and both products can be considered as environmentally-friendly with regards to energy consumption and greenhouse gas emissions.

★ **What were your other criteria for selecting the best materials?**

Comparing performance characteristics with health and safety data — which, according to our survey, are the two most important criteria for conservators and other stakeholders — a preliminary decision could be made as to which of the available materials were the most suitable for treatment of a given piece of cultural heritage.

Characteristics such as reversibility, minimum intervention and re-treatability are also indicated as important, and additional information about the suitability of the materials should also be sought. Peer recommendations, application techniques, price and availability of the materials were also integrated in decision-support tools and can help conservators and stakeholders make a final decision. By using them, decision makers can compare different materials easily and, based on data shown in the supporting tables, choose the most adequate materials for the treatment of any given item of immovable cultural heritage.

★ **Speaking of which, what kind of historical objects can be restored using your technology?**

In addition to the two case study historical objects located in urban and rural environments with a continental



© Jonjaia Ranogajec

PROF. DR JONJAUA RANOGAJEC

climate, our products were applied on the Petrovaradin Fortress on the Danube in Novi Sad, Serbia and also for consolidation of frescos in St. Vincenta's Church, Istria, Croatia. HEROMAT's final products could be applied for the restoration and protection of a wide range of immovable cultural heritage in Europe, as well as in modern civil engineering where photocatalytic coating can greatly extend the lifetime and aesthetic appearance of colour layers of modern buildings — especially in highly polluted environments like cities with heavy traffic.

★ **What are your commercial plans for your materials, if any?**

The next steps consist in preparations for the launch of three final HEROMAT products on regional and European markets, especially in Italy, Germany and other countries in urgent need of advanced solutions. Moreover, our products are expected to enter the Russian market (one of the HEROMAT partners is NArFU University in Arkhangelsk, Russian Federation). Our products will be marketed to our network of conservators, and special attention will also be given to the placement of photocatalytic coating in the modern building industry.

HEROMAT

- ★ Coordinated by the University of Novi Sad Faculty of Technology in Serbia.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/project/rcn/109416>

APP AIMS TO MAKE CULTURAL HERITAGE INTERESTING AND INTERACTIVE

A new mobile app providing access to cultural heritage information could prove to be a major asset to visitors, museums and historical sites.

The app, called COOLTURA, has been designed for mobile devices through the EU-funded TAG CLOUD (Technologies lead to Adaptability & lifelong enGagement with culture throughout the CLOUD) project (due for completion at the end of January 2016). The app allows users to access and use cultural content from the cloud-based COOLTURA platform.

The project taps into the potential of smartphones and mobile devices. The concept is that mobile features such as geo-location and real time interaction can be used to provide personalised up-to-date and interactive cultural heritage content, in real time.

'The main objective of the TAG CLOUD project has been to enable more active cultural engagement,' explains project coordinator Dr Maria Fernanda Cabrera-Umpierrez from the Technical University of Madrid in Spain. 'This will help to open up learning about cultural heritage.'

The COOLTURA app is currently available for smartphones and tablets and can be integrated with wearable devices (such as the Apple Watch). In the future, says Cabrera-Umpierrez, COOLTURA could be integrated with other devices to engage customers with cultural heritage in different environments, such as at home (e.g. with a Smart TV), on site or during a visit.

Cloud computing is about sharing computing resources rather than having local servers or personal devices handle each individual application. In this sense, 'cloud' is a metaphor for 'the Internet,' where services — such as servers, storage and applications — are delivered to an organisation's computers and devices through the Internet.

This means that high performance computing power to perform tens of trillions of computations per second can be tapped into for consumer-oriented applications.

'TAG CLOUD uses the cloud to provide an adaptive cultural experience according to user interests, likes and habits,' explains Cabrera-Umpierrez. 'Visitors benefit from receiving a personalised cultural experience, and enjoy a more interactive cultural

visit. The innovation will also help cultural institutions attract more visitors, and by getting a better insight into visitor preferences, help them to improve and adapt their exhibitions.'

Indeed, a central aim of the project has been to increase the active participation of the general public in cultural events and experiences, by inviting them to contribute with new content and opinions and to share information, before, during and after a visit. Cultural heritage institutions often use a range of digital technologies in order to attract, engage and retain visitors, but often success is limited. TAG CLOUD opens up the possibility of interactive engagement.

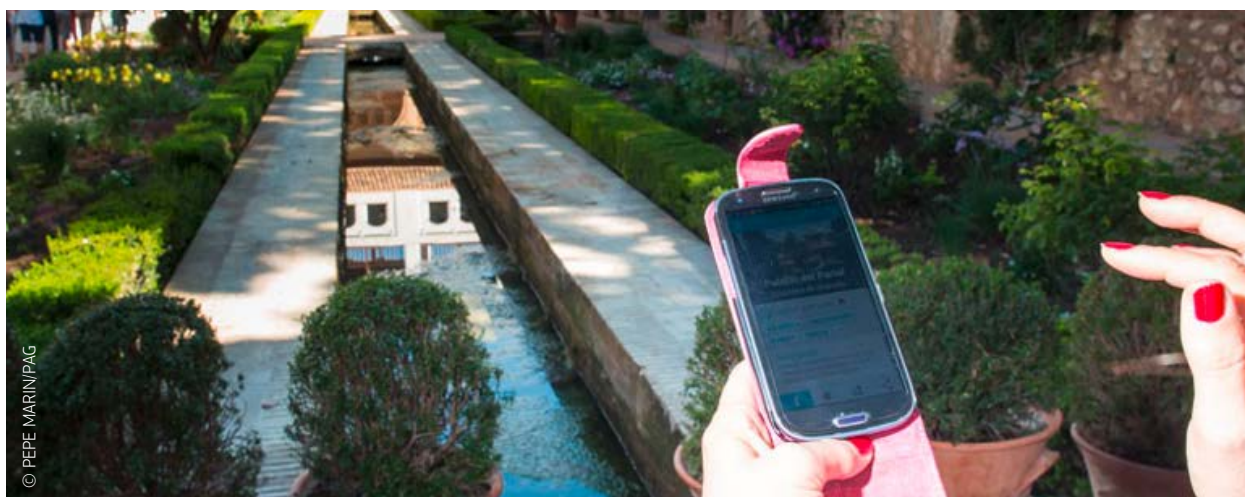
A second app — Stedr — was also developed by the TAG CLOUD team. This app is designed for discovering, creating and sharing digital stories related to places, and for fusing traditional digital storytelling with social media. While COOLTURA is now available for download, Stedr is not yet fully ready for market.

The COOLTURA concept was successfully deployed at three pilot sites: the monument complex of Alhambra and Generalife in Spain; the Barber Institute of Fine Arts in the UK; and the County of Sør Trøndelag in Norway. In order to leave a sustainable legacy, the TAG CLOUD team expects that the concept will be rolled out at other sites, in order to reach a wider audience of end users and cultural institutions.

"TAG CLOUD uses the cloud to provide an adaptive cultural experience according to user interests, likes and habits."

TAG CLOUD

- ★ Coordinated by the Polytechnic University of Madrid in Spain.
- ★ Funded under FP7-ICT.
- ★ Project website: <http://www.tagcloudproject.eu>





SUCCESS FOR CUTTING-EDGE CULTURAL ARTEFACT IMAGING TECHNIQUE

Terahertz imaging technology has the potential to help conservationists and academics better understand the history behind cultural artefacts.

The EU-funded TISCH (Terahertz Imaging and Spectroscopy for Cultural Heritage) project has demonstrated that terahertz imaging and spectroscopy can be a viable, non-destructive and non-invasive tool for aiding the retrieval and analysis of images of obscured features of artwork. Through a Marie Curie Postdoctoral Research Fellowship, Dr Bianca Jackson from the University of Reading in the UK was able to apply this technique to inspect layers of paint, detect structural defects in ceramics and image the physical structure of paintings and manuscripts.

'Institutions that carry out cultural heritage research don't have a lot of extra money for emerging technology, but they do have the hearts and minds of the people — folks love to talk about what is being done with technology to better understand the mysterious Mona Lisa, or whether or not a sarcophagus contains Queen Nefertiti,' says Jackson. 'So one of the best ways to reduce costs and increase the accessibility of terahertz technology is to open up new and interesting areas of applied research.'

In the last 15 years there has been exponential growth in terahertz technology and applied research, along with increasing interest from the pharmaceutical, biomedical, security and aerospace industries. 'In the US, 9/11 and the Columbia disaster led to a large influx of research funding, which has helped to drive this growth,' explains Jackson.

However, the cost of terahertz systems is still much higher than other well-established technologies, which is why further applied research is needed. Furthermore, terahertz spectroscopic imaging has only been used in the field of cultural heritage over the last five years or so, and as a result, its utility in conservation has not been extensively demonstrated.

In order to address this, Jackson examined the walls of several European churches in England, France and Latvia,

where centuries-old paintings were hidden behind many layers of plaster and plain paint. 'We use a time-domain terahertz system, which has a pulse that allowed us to separate out the signals from the top and sub-surface layers,' she explains. 'This

enabled us to find some designs behind some perfectly plain white walls.'

Jackson also scanned a Palaeolithic wall etching of a bird obscured by flow rock and investigated heritage conservation-friendly materials that can be safely applied to works in order to improve the signal to noise quality of the terahertz image. 'Most recently, we started working with the Tate Museum to use terahertz imaging to diagnose flawed areas of ceramic

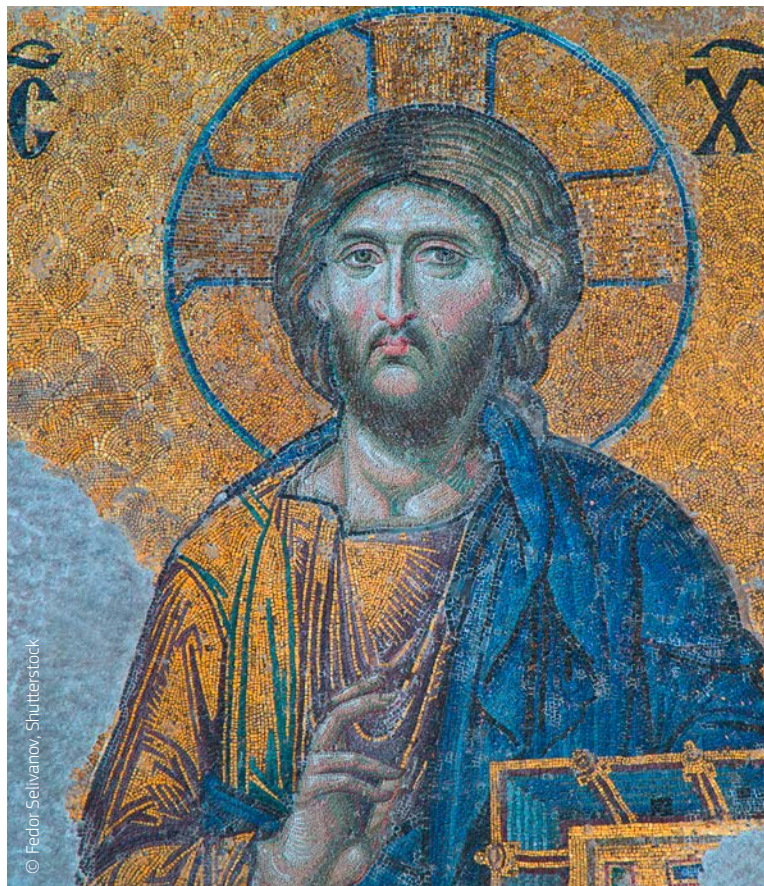
glaze on outdoor sculptures left out in the rain,' she adds. 'While the TISCH project is almost finished, I'm very excited about the implications of our work with the Tate.'

Jackson is confident that the TISCH project represents a positive step forward, with similar cultural heritage projects also now coming on line. 'Horizon 2020 is funding a project called IPERION CH, through which there is a great programme called MOLAB (short for mobile laboratory) that is accepting proposals for research using various advanced diagnostic technologies for cultural heritage,' she says. 'Recently, they added terahertz time-domain spectroscopy and imaging as an option. I've been encouraging interested conservators to apply for MOLAB access, and I've been offering my aid.'

TISCH

- ★ Coordinated by the University of Reading in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/107231>

"Jackson examined the walls of several European churches in England, France and Latvia, where centuries-old paintings were hidden behind many layers of plaster and plain paint."



INTERVIEW

PASSING DOWN TRADITIONAL SPORTS IN A REPLAY

The preservation of traditional sports and games could soon be guaranteed by new, cost-effective motion sensing technologies.

The World Sports Encyclopaedia may be taking an inventory of over 8000 sports in the world, but globalisation and receding cultural differences have put many of them on the verge of disappearing. In Europe alone, a great deal of our 3000 'Traditional sports and games' (TSGs) are either in decline or already lost in spite of their importance for cultural heritage. The question is, how do we keep them alive for the next generations to enjoy?

Launched in 2013, the REPLAY (Reusable low-cost platform for digitizing and preserving traditional participative sports) project answers this question through the tweaking and exploitation of existing motion sensing technologies. From a set of 'Wireless inertial measurement units' (WIMUs) and Kinect devices, the eight-strong consortium has created a unique solution to capture the unique 3D movement signatures of National and Local sporting Heroes (elite and well-known players of TSGs) and allow children to directly compare themselves to them in a funny and engaging manner. Furthermore, the consortium is now able to harness data from video footage and players, store it and use it to help the young master the techniques of elite players.

To test its technology, REPLAY focused on two very representative TSGs: Basque Pelota, which is one of the most popular Basque sports, and Gaelic sports (Gaelic Football and Hurling/Camogie) which are still very popular in Ireland. Maria Teresa Linaza, coordinator of REPLAY, agreed to discuss the outcomes of the project ahead of its end in February 2016.

★ **Why did you take an interest in the conservation of traditional sports? Why is it important?**

Maria Teresa Linaza: Traditional Sports and Games are part of Intangible Cultural Heritage, representing a symbol of the cultural diversity of a society and a backbone of the community. They are also an efficient means to convey values of solidarity, diversity, inclusiveness and cultural awareness. They ensure opportunities for social



contact and for the exchange of experiences across generations.

It is therefore imperative that we understand, preserve, protect and promote TSGs just like we protect works of art. New technologies offer great opportunities to do that.

★ **How would you explain the fact that Gaelic and Basque traditional sports are doing so well when other TSGs have completely disappeared?**

There are various reasons for that. First, both lie at the very foundation of their respective cultural traditions. For example, recordings of Basque Pelota can be found at the end of the Roman Empire. Secondly, the popularity of some games crosses state borders, with an international reach which preceded the idea of the nation itself. Basque Pelota is played in Europe (mainly Spain and France), in Latin America and in the United States.

Another key reason is that the equipment necessary for these games is usually cheap. For instance, two main modalities of Basque Pelota analysed within the REPLAY project include very simple equipment: Jai Alai is played in a three-wall court with a hard rubber ball caught and thrown with a curved wicker basket, while handball is played bare-handed on a three-sided court with woollen balls covered with leather.

We believe the strength of these two traditions and their resistance to decline should serve to help other TSGs.

★ **Can you tell us more about the technologies you developed? How can they help preserve TSGs?**

The REPLAY platform revolves around three modules — motion capture, performance comparison, and 3D rendering and visualisation of landscapes and characters — and is applied in three different scenarios.

First, the PLAY&LEARN scenario focuses on children and teenagers having access to a low-cost motion capture set-up (Microsoft Kinect) to try at home, one player at a time, in order to learn and mimic the skills of a National/Local hero.

The second scenario, COACH&TRAIN, is oriented towards the capture of club player skills in order to allow coaches to better instruct their trainees on how to improve their game. The set-up for motion capture is more complex, including multiple Microsoft Kinects and WIMUs, and is located in a controlled environment, such as a sports club. Coaches have access to a database of skills from National/Local heroes and can gather information about how the elites perform a given technique. Apart from giving immediate feedback on the performed movement, the REPLAY platform also records and assesses the progress of a given player, allowing the coach to make better decisions when devising improvement plans for his or her athletes.

Finally, the INTERACT&PRESERVE scenario empowers visitors of a museum or exhibition centre through a visual interface enabling them to 'interact' with the rich content of TSGs and learn more about the related Cultural Heritage. First,



SPECIAL FEATURE

the visitor can access 3D-captured content of National and Local Heroes in order to compete against them in a 3D environment. Then, this 3D interaction is enhanced by legacy videos and content about the TSGs, their history, instruments and modalities. Different stories are authored by museum curators, put in context and published in order to share and engage the visitors of the museum.

★ **How do these technologies differ from similar market offerings?**

As far as we know, until now there has been no market offering other than video that digitally captures skills in 3D or records the unique movement signatures of players. Mainstream sports like football, American football and basketball use very precise motion capture and analysis technologies owned by large companies like Vicon, but the cost of such an approach is very high. On the contrary, REPLAY is looking towards a low-cost capturing, processing and analysis platform based on off-the-shelf technologies combining Microsoft Kinect devices with WIMUs.

★ **You can recover 3D motions even from historical films. How did you make that possible?**

The main skills of 'National Heroes' can be recovered from TSG video legacy recorded with non-calibrated monocular cameras. This reconstruction generates an animated skeleton which represents the movements and poses of the player, along with the trajectory of the ball, all in a 3D environment. Such data can then be used in virtual museums, immersive virtual systems or video games.

To achieve this, a semi-automatic approach has been implemented in which a set of 2D representations of the scene's elements (camera, ball and player) are manually marked in key

frames of the video. Then, an automatic process estimates the calibration parameters of the camera, the 3D positions, poses and body part dimensions of the players, as well as the trajectory of the ball. In-between frames are automatically calculated taking into account constraints related to human kinematics and collisions with the environment.

★ **What types of markets and businesses are you targeting with this project?**

Intangible Cultural Heritage is the natural market for the results of the project. One potential example of application is the preservation of handcrafters' skills by capturing and recognising the gestures performed by some parts of the body (hands, arms and feet) using low-cost standard equipment.

Another potential scenario is rehabilitation, as determining whether the movements of the player are complete and correct can become a big problem. Multiple motion capture modalities should be evaluated and combined, including the already ubiquitous monocular Webcams, depth sensing devices such as Microsoft Kinect and emerging wireless low-cost sensors (mainly inertial sensors). The combination of one or more sensing devices will lead to different uses for the platform (i.e. the use of a low-cost Webcam to practice at home; a Microsoft Kinect device for motion capturing; and multiple Kinects and/or wearable sensors for large-scale installations at nursing homes or even hospitals).

★ **The project ends in February. What are your plans until then and after it finishes?**

In January 2016 the final REPLAY platform will be tested by real users both in the Basque Country and in Ireland. The PLAY&LEARN scenario will be evaluated with children (aged 8 to 16) from Pelota



MARIA TERESA LINAZA

schools from the three Basque provinces and the south of France. For the Gaelic Sports, the three scenarios will be validated: the PLAY&LEARN scenario with children from primary schools in the Dublin area; the COACH&TRAIN scenario with coaches from several Irish clubs and their players; and the INTERACT&PRESERVE scenario with museum curators and visitors at the Croke Park Museum.

The third and final End-User Advisory Board Workshop will take place in Dublin on 28 January during the evaluation of the final REPLAY prototype. Then, a final handbook will analyse and specify the methodologies and most cost-effective hardware solutions to extend the results of the project to other TSGs.

REPLAY

- ★ Coordinated by Vicomtech in Spain.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/project/rcn/106860>
- ★ Project website: <http://www.fp7-replay.eu/>

NANOTECH TOOLS OFFER AFFORDABLE, ACCURATE HISTORICAL PAINT ANALYSIS

A nanotech-based clinical diagnosis kit for analysing ancient layers of paint promises conservation professionals cost reductions and greater accuracy.

Developed through the EU-funded NANOART (Nano Art Research Tool) project, the new testing kit has already been applied to identify binders such as collagen and ovalbumin in ancient paint, not only in model samples painted in the lab but also in real samples collected from works of art.

'Once fully completed, our new tool will be made available to conservation scientists from around the world at an affordable cost (an assay can cost around EUR 0.50 per target), which will facilitate greater knowledge about

historical works of art and help international museums, restoration art studios and laboratories to plan the best conservation and preventive strategies,' explains NANOART project coordinator Dr Jesus de la Fuente from the CSIC/ University of Zaragoza, Spain.

In addition, the sensitivity of the project's new nanotechnology-based methods means that smaller samples are required to be taken from the artwork for analysis. This in itself will help to better preserve our cultural heritage.

In order to characterise ancient paints, experts have often relied on conventional molecular biology methodologies that were developed decades ago. The concept behind the NANOART project was that these techniques could be substituted by more sensitive, inexpensive and faster techniques that take advantage of emerging nanotechnologies.

Furthermore, conventional methods — apart from being expensive — are also only available at a few laboratories, and require specialised personnel and equipment. A key objective of the NANOART project has been to address the cost issue by applying techniques developed for clinical diagnosis. In this way, the project is also highly original as it aims to take the latest developments in clinical medicine and apply them to the conservation and preservation of cultural heritage.

'The innovative nature of the project is also denoted by the fact that there is currently no method or kit available that can be easily used at point-of-care to analyse paints without requiring expensive equipment and extensive training,' says Ana Claro, research fellow from the INA/University of Zaragoza. 'With the NANOART kit, the final user will be able to conduct an

affordable analysis (in some cases at the cost of only a few euros) by simply following the instructions. Within a four-hour period, the results will be available.'

The potential opportunities opened up by the new analytical nanotechnology are huge. For example, developed in parallel with the NANOART kit, a spin-off company called NanoImmunotech has been launched in order to develop devices to detect bacterial infection in meat using the same technology as used in NANOART.

'This opens our technology to other applications far from cultural heritage applications,' says de la Fuente. 'However, we would like to continue further developing novel uses of NANOART technology for other applications in cultural heritage, and our next step will be to look for funding to develop an even more user friendly device.'

NANOART

- ★ Coordinated by the University of Zaragoza in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/107275>

INTERVIEW

NEW TECHNOLOGIES AND TOOLS TO MAP AND PROTECT UNDERWATER TREASURES

Our seas and oceans are home to a tremendous amount of archaeological sites and artefacts. These invaluable witnesses to history are often difficult to locate, and even then experts are still faced with the question of whether to conserve them *in situ* or bring them to the surface. The SASMAP project has developed tools and technologies that will help solve both conundrums.

The value of underwater cultural heritage no longer needs to be proven. According to UNESCO estimates, some 3 million shipwrecks are spread across the world's ocean floors. And that's without counting submerged heritage sites: In Denmark alone, where the 'UNESCO Scientific Colloquium on the Access to Underwater Cultural Heritage' will take place from 8 to 9 June 2016, around 20 000 sites can be found. It therefore comes as no surprise that the National Museum of Denmark, as coordinator of the SASMAP project, set out to help archaeologists to better map and protect these hidden treasures.

The SASMAP concept was born from two main observations. The first one is that the huge potential of underwater cultural heritage is in contrast with how it is undervalued. The Vasa Museum in Sweden, for instance, attracts as many as 1 million visitors per year largely thanks to its huge Swedish warship of 1626 that was recovered in 1961.

The second one, and the most important, is that excavation is not always the most realistic and preferable option. As pointed out on the SASMAP website, 'a single large wooden wreck, such as the Mary Rose in the UK, has to date cost ca. EUR 80 million to raise, conserve and exhibit, whereas the physical *in situ*

preservation of a similar sized wreck in Sweden cost around EUR 0.07 million'. Sometimes bringing such cultural heritage back to the surface can also damage it beyond repair.

Dr David Gregory, coordinator of SASMAP, explains how the project's tools and technologies will help archaeologists in their quest to locate and analyse heritage sites, but also to decide on the best conservation option.

★ What are the main problems related to locating and conserving underwater sites?

Dr David Gregory: I will try and answer this question in two parts. Firstly, the issue of locating, and secondly, matters relating to conservation. Locating sites is generally difficult as sites are underwater and this makes diver-based searches far more labour-intensive and expensive. These operations are often hampered by poor visibility and arduous working conditions. Furthermore, even though one often has the picture of a shipwreck sitting on the seabed, prehistoric remains and landscapes are often buried, and so are more ancient shipwrecks. This has been solved with an increased use of acoustic survey techniques that can very accurately predict, record and model what is lying on the

seabed and within the seabed. A new type of acoustic device that can look into the seabed in 3D has also been developed within the project and is already being taken up by other marine researchers, not just archaeologists but also geologists, etc.

Now in terms of conservation, there are two aspects to consider — one is what is called *in situ* preservation, that is to say locating, documenting, protecting and monitoring sites where they lie on the seabed. This approach is very much the current ethos within maritime archaeology both at a European level and internationally — there are several treaties which argue for this approach. However, sometimes *in situ* preservation is not appropriate as sites are at risk of





being damaged by natural processes. Wherever possible, it would be best to excavate the items, bring them safely to the surface and conserve them for storage and display in e.g. Museums. The SASMAP project looked at both aspects of conservation.

★ **How do the SASMAP tools help overcome these problems?**

The SASMAP project was very holistic in its approach. The idea was to develop various tools to locate sites using desk-based models. This was facilitated on two sites, one in Denmark where submerged prehistoric remains can be found and one in Greece, for submerged classical remains. We established where the sites may be located before sending divers to verify our findings and starting to make an appropriate plan for the management of these sites.

The main question was, if we want to leave a site where it is what are the likely natural threats to it? These could for example be the effects of currents that can relatively quickly wash away covering and protecting sediments, leading to the loss of finds or an entire site. It may be that exposed parts of wrecks or sites are threatened by damaging organisms such as shipworms (see www.wreckprotect.eu — a further FP7 project looking into protection of underwater cultural heritage) that in the right conditions can quickly eat wood. The project partners developed tools that could assess the open seawater environment and burial environment in order to classify whether the site environment was conducive to preservation or not.

These tools included a remote data logging device which could collect water quality parameters such as salinity, temperature, depth, dissolved oxygen and current strength; and three diver-held devices: a data logger measuring various parameters within sediments, another that was developed to take sediment

samples from the seabed for further analysis in lab conditions, and a third one that was used to assess the state of deterioration of wood underwater, *in situ*.

★ **What can be done to protect these sites?**

Even when kept *in situ* the sites often need to be protected. One way this was investigated was the development and use of artificial sea grass, which helps stop underwater currents from removing sediments.

Now if it is decided to excavate artefacts, they are often very fragile and can easily be broken on the way to the surface and during transport back to the laboratory. Methods were developed to consolidate sediments around artefacts (those found in sand are often difficult to excavate safely as the sand simply falls away). This was achieved by using environmentally-friendly polymers that effectively turn the water in the sand into a thick gel which can be easily removed once in the laboratory. Another method entailed what is termed block lifting, that is to say where artefacts encapsulated in thick sediments, such as clay, are lifted as a block and can then be excavated back in the laboratory under safe, controlled conditions.

★ **One of the project's initial goals was to help improve legislation. How?**

In Europe the majority of underwater archaeological investigations and excavations are carried out as a result of sub-sea development. That is to say when a pipeline, wind farm, cable or any other structure is to be placed on the seabed.

We hoped to improve legislation by creating two generic guidelines which explain the process of what is called developer-led archaeology and how the various stakeholders can approach this. Very often project managers working on such projects may not be archaeologists or geologists so we wanted to simply show how this can be done. A second contribution was to provide case studies and examples of how this can be achieved practically by drawing from the results of SASMAP.

The developer-led process falls under the Treaty of Valletta, which concerns the management of cultural heritage. *In situ* preservation is generally the preferred option, but often it can be a case of out of sight, out of mind.

★ **What did you learn from testing your tools and methods in Denmark and Greece?**

The two main sites were in Denmark and Greece but various tools were also

tested in Italy and the Netherlands. The open water data logger was tested in the Netherlands and was superb at assessing the strength of currents over a wreck which was being protected using the artificial sea grass mats developed in the project. Both systems worked very well.

In Denmark the sediment/seabed logger, sediment coring device and wood tester were all tested and proved very successful at assessing the various environments and materials.

The 3D sub bottom profiler, which can look into the seabed, was validated in Denmark, Greece and the Netherlands but was most successfully used outside of the project by Belgian geologists who were very interested in the development of the equipment and used it to help locate the remains of Roman and medieval fish traps.

★ **The project was completed in August. Are you still working on it?**

Yes very much so! As coordinator I am currently finalising the comments from our final review and the finances of the project. Scientifically, we are waiting for final approval of our guidelines by reviewers and the Commission before publishing, and the consortium is working on the publication of numerous popular and scientific articles. We are also looking into the possibility of publishing a more synthetic book on the overall results of the project and management of underwater cultural heritage.

★ **What are the main target markets for your project and when/how can they hope to benefit from its results?**

It is certainly hoped that the underwater cultural heritage community will adopt both the general and holistic approach developed within SASMAP. But also, as the project was focused on supporting SMEs, we hope that our four partner SMEs will benefit from the project.

The market potential reaches far beyond archaeology and can impact marine sciences and ocean exploration in general. Several of the products are already on the market and others are close to that, which is a fantastic achievement.

SASMAP

- ★ Coordinated by the National Museum of Denmark.
- ★ Funded under FP7-ENVIRONMENT.
- ★ <http://cordis.europa.eu/project/rcn/104290>
- ★ Project website: <http://sasmap.eu/>



© David Gregory

DR DAVID GREGORY

BIOLOGY AND MEDICINE

EU-FUNDED STEM CELL BREAKTHROUGH OFFERS HOPE TO LIVER PATIENTS

A stem cell study part-funded by the EU has made a breakthrough that could lead to effective new therapies for patients with liver damage.

Recently published in the Stem Cell Reports journal, the study, to which scientists working on the EU-funded DETECTIVE (Detection of endpoints and biomarkers of repeated dose toxicity using *in vitro* systems) project have contributed, has identified a new, cost-effective technique for growing liver cells from stem cells that could be adapted for mass production.

The process involves growing stem cells on synthetic materials, without the need for animal-based materials. The ability to create stem cells (which possess the ability to self-replicate and differentiate into all cell types in the body) in a cost-effective, humane and safe way could help scientists develop new therapeutic approaches and encourage research targeted at tackling specific diseases.

Developing viable alternatives to animal testing has been a central objective of the DETECTIVE project. Many industries rely on safety assessments of chronically acting toxicants relevant for humans to promote their products to the market. Current methods mainly entail the use of animals, but are time consuming, expensive and ethically questionable.

Through cooperation with other projects within the EU's alternative testing cluster, the project has helped to advance current knowledge and data with regards to existing biomarkers for chronic organ damage, such as liver cirrhosis. From this, the project has developed *in vitro* toxicity models for three target organs, namely the liver, heart and kidney. This research has played a key role in developing the new method for growing stem cells outlined in the Stem Cell Reports journal.

Liver cells have already been used as therapies for patients with liver damage, with some success. However, the conditions used to grow these cells have not been amenable to mass production, which means that at the moment, donor organs are the

only source of cells. Growing liver cells from stem cells could therefore offer a limitless supply for patient therapies, which is why this has become such an intense field of study.

The process outlined in the Stem Cell Reports journal involves growing synthetic versions of naturally occurring molecules called laminins. Laminins are part of the supportive scaffold that surrounds cells and shapes the complex structure of a tissue. The team found that growing stem cells on laminins turned them into organised liver cells more efficiently than previous methods.

Such advances in cell-based therapies, particularly in the liver, represent promising alternatives to whole-organ transplantation. Cell transplantation has several benefits over organ transplantation, including the use of one organ for several patients, and the procedure itself is generally less invasive.

The researchers hope that the breakthrough will one day lead to the large-scale production of high-quality liver cells for use as patient therapies. The next step will be to assess their suitability for human use in appropriate pre-clinical models.

The work of the DETECTIVE project — and all EU-funded projects within the alternative testing cluster — will also have significant exploitation potential within the medical research, pharmaceutical and cosmetics industries. The five-year DETECTIVE project was completed at the end of 2015.

DETECTIVE

- ★ Coordinated by the Clinical University of Cologne in Germany.
- ★ Funded under FP7-HEALTH.
- ★ <http://cordis.europa.eu/news/rcn/124421>
- ★ Project website: <http://www.detect-iv-e.eu/>

MATERNAL OBESITY LINKED WITH OFFSPRING HEALTH

Comprehending how maternal obesity influences offspring health could improve the overall health of the European population. European scientists have identified which early developmental factors determine our health and ageing.

Obesity has become a major health issue in the EU, with over 30% of women of reproductive age being overweight and 20% obese. Babies born to obese mothers are exposed to perturbed insulin levels due to the mothers' insulin resistance.

Additional evidence shows that the placenta in obese mothers expresses higher levels of pro-inflammatory molecules. Combined with pathological glucocorticoid exposure, babies could suffer from greater birth weight and blood pressure.

The EU-funded DORIAN (Developmental origins of healthy and unhealthy ageing: The role of maternal obesity) project has improved our understanding of the basic early developmental mechanisms that impact health in later life.

Epidemiological analysis of existing birth cohorts has so far indicated an

association between maternal 'Body mass index' (BMI) and offspring BMI as well as diabetes development. Interestingly, this relationship was prominent in women and not men. In contrast, men of low birth weight born to obese mothers showed a higher risk of developing cardiovascular disease.

Results suggest that maternal obesity has deleterious effects on maternal and offspring behaviour, metabolism and neuroendocrine profiles during adulthood and ageing. The researchers also observed gene environment interactions involving DNA methylation and DNA ageing — many genes were found to be differentially methylated in neonates born to obese versus lean mothers. Moreover, a higher maternal BMI with excessive weight gain during pregnancy resulted in shorter telomere length in the offspring, as observed both at birth and in adult offspring.

Glucocorticoid stress response activation that reduces immune response in the adult offspring was another significant side-effect of obese pregnancy in non-clinical models. DORIAN scientists have identified one therapeutic target



to avoid this stress response — glucocorticoid responsive gene, FKBP51.

Also on a positive note, DORIAN project researchers have recommended the benefits of exercise training in adult offspring of obese mothers as they have a lower predisposition to participate in physical activity.

Press releases ensured that project results were disseminated to end users. Such extensive media attention should result in DORIAN deliverables being translated into increased awareness for health authorities and the public at large.

DORIAN

- ★ Coordinated by the National Council of Research in Italy.
- ★ Funded under FP7-HEALTH.
- ★ <http://cordis.europa.eu/result/rcn/150415>

HOW HYBRID SPECIES EVOLVE

Researchers are using a sparrow hybrid, which recently evolved from a cross between two different sparrow species, to understand the genetics behind speciation.

Hybrid speciation occurs when two related species mate or hybridise, eventually creating a new species that does not reproduce with either parent. The Italian Sparrow (*Passer italiae*), a cross between the House Sparrow (*P. domesticus*) and Spanish Sparrow (*P. hispaniolensis*), is one such example.

The EU-funded ARCHIGENE (The genetic architecture of secondary sexual traits during hybrid speciation) project aimed to determine how traits introduced by hybrid speciation are genetically controlled.

Using the Italian Sparrow as a model, ARCHIGENE wanted to see how genes controlling sexual traits differ between the parent and hybrid species. As the hybrid's appearance is influenced by its genetic background, mixing of genes between the two parent species could affect the hybrid's ability to reproduce.

Since sparrows use plumage colouration to recognise each other and to select mates, researchers studied how the genetic makeup controlling plumage changed during hybrid speciation. They also looked at traits like beak dimension, sexual organs and sperm morphology to determine how hybrids become reproductively isolated to form new species.

They found that the contribution of genes from each parent species had no effect on variation in the hybrid species' beak shape and height. Since sparrow populations with differing beak heights reproduce less

with each other, beak variation may be a way in which speciation occurs.

Ultimately, researchers concluded that traits in hybrid species may be relatively unconstrained by their genetic background, allowing them to rapidly adapt to new environments. This ability to adapt is probably what enables a new hybrid species to survive and evolve in competition with the original parental species.

ARCHIGENE's contribution to the mechanisms behind speciation stands to stimulate further research in the field of evolutionary biology and on the role of hybridisation in evolution.

ARCHIGENE

- ★ Coordinated by the University of Oslo in Norway.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/170157>

“Researchers concluded that traits in hybrid species may be relatively unconstrained by their genetic background, allowing them to rapidly adapt to new environments.”

STEM CELL TRIAL SUCCESS COULD LEAD TO NEW HEART DISEASE THERAPIES

EU-funded researchers have taken steps towards developing and commercialising new stem-cell-based therapies to treat heart attack patients.

The key objective of the EU-funded CARE-MI (Cardio repair European multidisciplinary initiative) project, which was completed in September 2015, was to evaluate the safety and efficacy of AlloCSC-01, a suspension of allogeneic human 'Cardiac stem cells' (CSCs) in patients who have suffered a heart attack. This serious condition occurs when blood stops flowing to a part of the heart, causing damage to the heart muscle.

In this way, the CARE-MI project has developed a new approach to limit tissue damage based on the activation of the heart's natural repair mechanisms in response to damage. The success of the project trials will enable the researchers to perform further analyses on stem cell treatments, with final results expected in the first half of 2017.

The hope is that AlloCSC-01 could become a revolutionary new approach to preventing cardiac disease and the onset of 'Chronic heart failure' (CHF) after a heart attack, boosting patient care and leading to a new market in stem cell therapies. In the US and Europe alone, around 1.5 million heart attacks are treated annually.

Initial recovery after a heart attack is often followed by chronic heart failure. This is partly because current therapies, while initially successful, are unable to regenerate damaged tissue. As chronic heart failure is responsible for an annual mortality rate of 18%, the project team saw a clear need to find treatments capable of tissue regeneration.

Various cell therapies have already been proposed and tested but have proven to be marginally effective. Furthermore, the cost and the complexity of these clinical procedures make these therapies unsuitable for treating the large number of patients that need affordable and readily available products.

The CARE-MI team therefore wanted to drastically improve on these current heart disease treatments. A total of eight

clinical centres of reference in cardiology participated in project trials, led by Prof. Fernández-Avilés from Gregorio Marañón Hospital in Madrid, Spain, and Prof. Stefan Janssens from KU Leuven, Belgium.

The project team built on recent research that found that heart muscles contain pluripotent cells. These cells act like 'Endogenous cardiac stem cells' (eCSCs), which are capable of anatomical and functional regeneration. The project then focused on the clinical development and testing of therapies to activate eCSCs. The ultimate objective has been to make these products biocompatible, affordable, readily available and compliant with regulatory standards.

Significant inroads have been made by the CARE-MI consortium with regard to good manufacturing practice, accredited product development and testing. Allogeneic cell batches (i.e. from different human donors) were used for pre-clinical and stability tests, and results confirmed their robustness and bio-equivalency.

Furthermore, extensive testing also confirmed their anti-inflammatory and hypo-immunogenic properties as well as their capacity to promote healing. Safety and bio-distribution tests were also shown to be highly promising with no major adverse effects. The team also succeeded in optimising dosing, timing and delivery methods.

A new cell production platform is now being constructed, which will enable researchers to move on to a more advanced clinical stage and ultimately bring these therapies to market.

CARE-MI

- ★ Coordinated by CNIC in Spain.
- ★ Funded under FP7-HEALTH.
- ★ <http://cordis.europa.eu/news/rcn/142416>



"A new cell production platform is now being constructed."

NANOPORES ID MOLECULES

DNA sequencing has become far less costly, and the genomes of thousands of pathogens are now available. A more affordable replacement for the lengthy, expensive procedure for detecting potentially fatal genomic variants is also now ready for use.



The EU-funded GENOTYPING NANOPORES (Genotyping using solid-state nanopores and peptide nucleic acid markers — a new tool for single-molecule molecular diagnostics) project has developed a revolutionary, low-cost, single-molecule genotyping method based on nanopore sensing of 'Peptide nucleic acids' (PNAs).

Nanopore analysis involves using a voltage to drive molecules through a nanoscale pore in a membrane between two electrolytes. Changes in the current can be measured as it passes single molecules in the nanopore.

Scientists involved in GENOTYPING NANOPORES previously showed that PNAs were detectable using tiny solid-state nanopores. They have now improved nanopore fabrication, the signal-to-noise ratio of the measurements, and the biomolecular strategies, for efficient PNA invasion of the nanopore.

For high-specificity sensing, the scientists used γ PNA probes for high affinity with DNA. Results show that the ion-current signal corresponding to the passage of a double stranded DNA molecule on which three γ PNA molecules were bound displays

three distinct features. This enables straightforward identification and quantification of the DNA molecules as they translocate through the pore.

Researchers calibrated the distance between any two PNA molecules in base pairs. In real time, they then identified and classified genes in the two HIV subtypes having over 92% similarity. The nanopore classification method gave a rapid and highly accurate discrimination and quantification of the two HIV variants.

Extending the approach in the final phase of the project, the researchers created a more general method for DNA barcoding. Using light-emitting 'molecular beacons' to colour code sequence-specific probes, the fluorophore of the next beacon emits photons on unzipping, which are collected by a sensitive microscope. This procedure is compatible with single-stranded DNA (ssDNA) and ssRNA molecules and has been published in the prestigious journal *Nano Letters*, 15, 745–752, 2015.

The impact on society promises to be tremendous and means opening up multiple possibilities for real-life applications in the biomedical field. Besides early detection of cancer in circulating tumour DNA, these methods can be used to rapidly identify antimicrobial-resistant pathogens and optimise antibiotic administration. Further development of the technology will mean a low-cost, portable, high-throughput device for a broad range of genomic diagnostics.

GENOTYPING NANOPORES

- ★ Coordinated by Technion in Israel.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/152100>
- ★ Project website: http://meller.bm.technion.ac.il/Research_Nanopore_main.html

SUPER RESOLUTION FOR IMAGING PROTEINS

An innovative technology that stains proteins with tiny molecular dyes is allowing researchers to visualise proteins at ultra-fine resolution in living cells.

To see when proteins are made and where they go within a cell, scientists use fluorescent molecules that glow when exposed to ultraviolet light. 'Green fluorescent protein' (GFP), originally isolated from a jellyfish that has glowed green for the past 160 million years, is commonly used for this purpose.

To make a protein glow green, researchers add GFP to the end of the protein molecule in a process known as tagging. Since the tag can interfere with the protein's function, the EU-funded GECCCA (Genetic encoding and click chemistry with copper-chelating azides for super-resolution imaging of proteins) project aimed to develop a new, alternative method to visualise proteins at high resolution under a light microscope.

Organic fluorophores are tiny (up to 100 times smaller than GFP) dye-like

molecules that can 'stain' proteins by emitting coloured light. Since proteins are made from repeating amino acid units, GECCCA developed a way to replace a single amino acid within a protein with the dye.

They did this by changing the protein's genetic sequence to include an artificial amino acid that does not exist in nature. They then added the dye to the artificial amino acid using a nature-inspired chemical reaction that joins small molecules together.

To test their novel method, GECCCA stained two highly abundant filamentous proteins that help maintain a cell's structure (actin and vimentin) with a fluorophore dye. To do this they identified amino acid positions within each protein that could be replaced with an artificial amino acid without affecting the protein's function.

They then tweaked the cell's protein production machinery so that it could recognise the artificial amino acid and, once produced, linked it to the dye.

Lastly, they combined improvements to an imaging system to reveal ultrafine structural detail of individual actin and vimentin filaments in cell compartments. GECCCA's work will make a significant contribution to the visualisation of proteins in living cells.

GECCCA

- ★ Coordinated by the Medical Research Council in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/170160>

SOCIAL SCIENCES AND HUMANITIES

NEANDERTHAL BONES REVEAL THEIR SECRETS

Many fundamental questions about the biology of Neanderthals (*Homo neanderthalensis*), such as how they stood and walked, remain unanswered. An EU-funded project has studied the bone structure of this extinct human species to reveal the truth.

The vertebral column and the thorax hold the key to explaining the development of upright posture and walking in human evolution. Furthermore, the vertebral column protects the spinal cord, which passes through the spinal canal, the size of which can indicate the neurological basis from which throwing abilities and speech evolved. The size of the thorax, however, can provide information about the respiratory capacity and bioenergetics of extinct human species.

The NEANDERSTAN (Neandertal spine and thorax anatomy: 3D reconstruction, ontogeny and phylogeny) project used morphometric and virtual anthropology techniques to study the vertebral column and thorax of Neanderthals. Human vertebral column and thorax morphology are instrumental to the efficient weight transmission and balance of the torso. Together with the unique structure of the human

pelvis and lower limb, they make an upright two-legged gait possible.

NEANDERSTAN analysed the vertebrae and ribs of a large number of Neanderthal adult specimens. The project also virtually reconstructed the vertebral column and thorax of a Neanderthal in order to gain a better understanding of their overall anatomy.

In addition, the vertebrae and ribs of an immature Neanderthal were studied to gain insights into its development. Vertebrae and ribs from the Middle and Lower Pleistocene were studied to assess the evolution of these two anatomical regions in Neanderthals and in modern humans.

For the first time, project results provided a description of fossils that gave an exact idea of the Neanderthal vertebral column and thorax morphology. These were found to be significantly different from those of modern humans.

In another first, the 3D reconstruction of a complete spine and thorax revealed that Neanderthals had a more inward folding vertebral column. This feature, known technically as invagination, is believed to have compensated for the low degree of inward curvature present in the lower back.

Project results will appear in scientific journals and as a chapter in a book titled 'Neanderthal Skeletal Anatomy'. The conclusion was that the vertebral column and thorax of Neanderthals were anatomical regions with distinct morphology from that of modern humans.

NEANDERSTAN

- ★ Coordinated by the National Museum of Natural History in France.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/170215>

ACCURATE HORIZONTAL MERGER POLICY

Researchers have studied horizontal merger control policy to improve accuracy in implementing the consumer welfare standard.

Consumer welfare is the individual benefits derived from the consumption of goods and services. A merger occurring between companies in the same industry is considered a horizontal merger. The EU-backed project HM-PP (Advances in horizontal merger policy and selected public policy topics) delved deeply into the business consolidation that occurs between firms operating in the same space, as competitors offering the same good or service. Horizontal mergers are common in industries with fewer firms, because competition tends to be higher there and the synergies and possible gains in market share are also much greater.

In antitrust applications, some argue that the goal is to maximise consumer surplus, while others argue that producer benefits should also be taken into account.

According to the researchers, current merger control policies typically do not consider firms' strategic reactions to policy. The main model in the study argues that firms are not passive subjects of policy either before or after the merger or merger attempt. In this model, firms take into account merger control policy in their strategic price and non-price decisions, particularly product positioning. In this scenario, firms may react to a merger blockage by increasing product differentiation. Such an increase in differentiation makes price competition less severe, and the resulting merger blockage pricing is not as low as expected. This model implies that merger control policy as currently implemented may have room for improvement. The project explored optimal merger policy in a



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series of theoretically modelled games that become increasingly complicated. This was the first phase of the project.

The second phase focused on empirical research programmes in selected public policy topics. The goal was to address social and economic policies in Europe and globally. Topics touched on include moral hazard in health insurance, formal versus informal care, defence spending and social enterprises.

Researchers successfully completed the EU-funded project and disseminated data online.

HM-PP

- ★ Coordinated by Istanbul Technical University in Turkey.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/170103>

UNDERSTANDING EUROSCEPTIC VOTERS

Studying the successes of Eurosceptic political parties in Central and Eastern Europe (CEE) — from perceptions of European integration to growing Euroscepticism — will help foster a healthier EU.

There are systematic but unexplained attitudinal differences between mass publics in CEE and Western Europe. The EU-funded DEVBCEEC (Determinants of Eurosceptical voting behaviour in CEE countries and party responses) project focused on the premise that the success of the Eurosceptic label in CEE party politics may not be down to anti-EU sentiments alone. It may be a response to mainstream party convergence and the perception of widespread corruption among domestic elites.

"A follow-up and add-on grant has been put together and submitted to an Austrian funding agency with a view to expanding the scope of the survey."

With this in mind, the project conducted a quantitative cross-national study to operationalise and empirically test these

propositions with country-level and individual-level data from the region. The information generated provided an opportunity to observe sufficient variation in the type and strength of protest parties.

Three countries were selected for the administration of a field survey: Hungary, Poland and Slovakia. Project members wrote detailed case studies for each country, providing basic information on general economic development, population demographics, institutional characteristics and development of the national party system. This enabled the identification of factors that potentially influence the behaviour of political parties. Development of a detailed timeline from the first free elections to the present day helped researchers take into account possible effects of specific events on the behaviour of political parties.

Case study findings for each country make up the project's contribution to a Routledge Publishing Consortium book project with the working title 'Prospects in East Central Europe in the 21st Century'. A follow-up and add-on grant has been put together

and submitted to an Austrian funding agency with a view to expanding the scope of the survey.

The project's outcomes hold the promise of contributing to a better understanding of the success of Eurosceptic parties in an expanding EU. The analysis of the survey data on Euroscepticism and the impact of the financial crisis on voter behaviour is ongoing. Since 2013, there have been eight invited conference paper presentations on the subject, three of which took place in 2015. These include the Mid-West Political Science Association in Chicago (two papers) and the Council of European Studies Association Meeting in Paris. The conference papers are being converted into publishable papers, two of which have been recently submitted for review.

DEVBCEEC

- ★ Coordinated by the Paris Lodron University of Salzburg in Austria.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/92007>



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ENERGY AND TRANSPORT

RESEARCH FACILITY NETWORK CATALYSES EUROPE'S BIOMASS POTENTIAL

An EU-funded project has made it easier for SMEs and researchers to access world-class testing facilities to trial next generation biofuel feedstocks.

Completed in September 2015, the four-year BRISK (The European Research Infrastructure for Thermochemical Biomass Conversion) project brought together 26 partners from across Europe — various academic and research institutions — to establish a highly visible network of demonstration rigs.

'Many SMEs and students don't have access to these facilities,' explains project coordinator Professor Andrew Martin from the Royal Institute of Technology (KTH) in Sweden. 'The BRISK project sought to open up these rigs to the whole research community, to overcome fragmentation and enable new feedstocks to be tested.'

More than 200 individuals from 26 European countries were able to carry out experiments on second generation biofuels at these facilities, helping to boost Europe's competitiveness in the global bioeconomy. Indeed, such has been its success that efforts are already in place to find a successor to BRISK.

'Now that the project is over we are already building up a new consortium, and looking to find a Horizon 2020 call that matches our needs,' says Martin. 'Our aim is to broaden our scope further to include more bio-processes and a wider range of feedstocks.'

Advanced biofuels manufactured from biomass have the potential to create thousands of new jobs by stimulating rural development and contributing to Europe's energy security as a sustainable alternative to fossil fuels. Enhancing biomass use will also help Europe to meet its targets of curbing greenhouse gas emissions by 20% by 2020 and 50% by 2050.

In order to capitalise on this, the BRISK project established a searchable online database of partner laboratories throughout Europe. Here, SMEs and researchers could find detailed information about thermal biomass conversion facilities open for experiments. The project concept was that any researcher could apply to access a project partner facility located outside their home country, thus promoting transnational cooperation.

BRISK paid for access costs along with a grant for travel and subsistence. The consortium also developed protocols and databases to facilitate data sharing and benchmarking of experimental rigs, an important legacy that will continue to benefit the European research community.

Through joint research activities, partners created new experimental methodologies including biomass processing techniques

and procedures. Visits to facilities ranged from a few days to three-month placements for PhD students. In all cases, European expertise in biomass was furthered, and knowledge transferred across borders. 'This project was important in

"The project concept was that any researcher could apply to access a project partner facility located outside their home country, thus promoting transnational cooperation."

encouraging research networking, and also provided an opportunity to improve the quality of rigs,' says Martin.

One UK-based researcher for example was able to broaden her PhD research at

ENEA's facilities in Italy by running trials to convert biomass into a synthetic gas (the main application of which is electricity

generation). A researcher from Cordoba University in Spain was able to visit TU Graz in Austria in order to further his research into biofuels (reducing nitrogen oxide during biomass combustion in small-scale biomass boilers).

'We found that it can take time for word to get out, so at the end of this project there was a lot of activity,' says Martin. 'We hope that in any future project, now that our reputation has grown, we will be able to reach out to a wider audience and also attract more researchers from outside the EU.'

BRISK

- ★ Coordinated by the Royal Institute of Technology in Sweden.
- ★ Funded under FP7-INFRASTRUCTURES.
- ★ <http://cordis.europa.eu/news/rcn/124304>
- ★ Project website: <http://briskeu.com/>

TACKLING CHALLENGES FACED BY THE WIND RESOURCE INDUSTRY

Supporting research and education in the emerging wind energy domain is seen as key by the EU. An EU-funded initiative has devised novel methodologies for wind resource assessment to meet the skills gap and other growing industry demands.

Wind energy researchers and training programmes are in short supply in Europe. Recruitment for research and development projects and training for postgraduate and doctoral students have been acknowledged as two effective solutions.

To address the issue, the EU-funded WAUDIT (Wind resource assessment audit and standardization) project set out to design training and education schemes. Overall, the aim was to develop novel methodologies in order to contribute to more reliable wind energy assessment procedures.

Work began with the mapping of current wind assessment methods via an EU-wide survey. This led to a report that contains feedback from 72 wind analysts representing 48 different organisations. Results showed that many methodologies exist, but most lack appropriate assessment. The document proposed success factors for wind resource assessment. It also identified key research priorities.

To study the complementarities of various numerical and experimental methodologies, validation and demonstration test cases were carried out. This resulted in a guidance report on quality-check methods in order to standardise model evaluation procedures.

A wind energy training programme was established for 23 'Early-stage researchers' (ESRs) from 13 European institutions engaged in the development of wind resource assessment techniques. This



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was achieved with the coordination efforts of the European Wind Energy Academy and the support of 30 universities, research centres and industrial partners from eight Member States. General and specialised courses were run through a series of three summer and autumn schools. A PhD seminar for ESRs was also held annually at the Academy. The programme further developed 15 PhD theses and contributed to more than 100 journal, conference and technical report publications.

WAUDIT's training-through-research scheme succeeded in delivering standardised quality-check procedures for assessment models and methodologies and reducing fragmentation in Europe. It will also help meet EU targets for reducing uncertainties in wind

"The document proposed success factors for wind resource assessment. It also identified key research priorities."

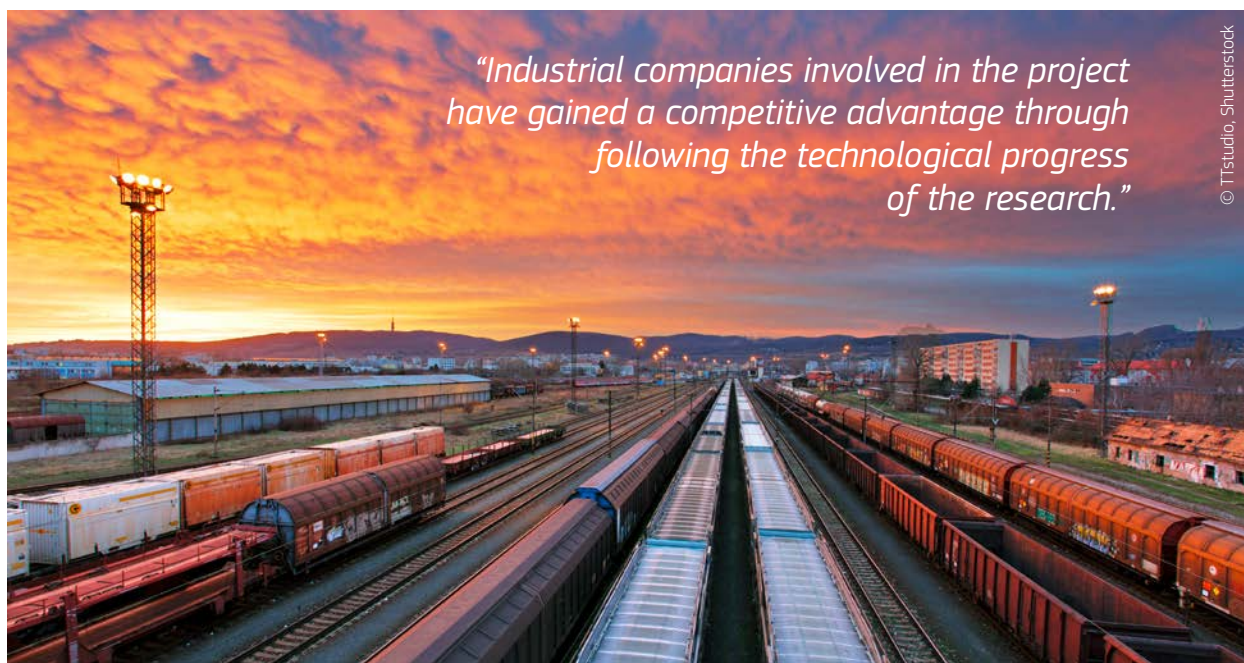
resource evaluation and forecasting to below 3% by 2030.

WAUDIT

- ★ Coordinated by the CENER-CIEMAT Foundation in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/170143>
- ★ Project website: <http://www.waudit-itn.eu/>

NEW AXLE MONITORING TOOLS A BOOST FOR THE RAIL FREIGHT SECTOR

The reliability, cost-effectiveness and safety of rolling stock and rail infrastructure have been strengthened thanks to EU-funded researchers.



"Industrial companies involved in the project have gained a competitive advantage through following the technological progress of the research."

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The three-year MAXBE (Interoperable Monitoring, Diagnosis and Maintenance Strategies for Axle Bearings) project, which was completed in October 2015, sought to reduce the economic impact of axle bearing damage on rail operators by introducing new technology to achieve optimised ongoing monitoring and maintenance. This will help to reduce the need for expensive inspections and at the same time improve safety, making rail freight transportation more economically attractive. This in turn will help take lorries off the road and have a positive impact on Europe's environment.

The axle bearing monitoring system developed by the project consortium can be adopted by any type of rail network, which increases the potential exploitation of the technology. It is expected that the system will be of direct interest to operators and infrastructure companies, not only in Europe but also worldwide.

Furthermore, industrial companies involved in the project have gained a competitive advantage through following the technological progress of the research. This could lead to further innovations to make European rail even more competitive. In turn, participating universities and research institutes have enhanced their ability to train Europe's next generation of railway engineers in cutting-edge technology.

The MAXBE project taps into rising European and indeed global demand for safe, environment-friendly transport. In order to tackle these challenges, the railway sector must assume a larger share of transport demand over the coming decades. For its part, the European Commission is working to create a single European railway area in order to achieve a more competitive and resource-efficient European transport system.

However, despite public support for significant investment in infrastructure and high-grade technology, the share of overall transport use via rail remains relatively low — 6%

for passenger transport and 10% for freight. Furthermore, a key challenge in achieving a truly integrated European rail network has been the fact that there has been a consistent lack of standardisation in this field.

For example, there is no unified EU-wide documentation on guidelines for maintaining rolling stock with regards to axle bearings. The MAXBE project has addressed this by putting forward guidelines and protocols for implementing — across Europe — diagnostic systems for axle bearing conditioning. The long-term objective of the project has been to enable Europe's rail network to play a wider role in the global transport market, both by addressing urgent short-term technical issues such as maintenance and inspection, and by building on a long-term vision of how to offer an attractive alternative to other forms of transport.

The MAXBE consortium brought together 17 partners from industry and academia. The team included rail operators, axle bearing manufacturers and experts in the field of monitoring, maintenance and rolling stock. Manufacturers were supported by academics from various disciplines, including metallurgy, materials science and mechanical, civil, electrical, electronic and IT engineering. This breadth of expertise was crucial, not only for the project's ability to enhance and optimise axle bearing diagnosis and maintenance, but also to ensure that the tools developed have real market potential.

MAXBE

- ★ Coordinated by the University of Porto in Portugal.
- ★ Funded under FP7-TRANSPORT.
- ★ <http://cordis.europa.eu/news/rcn/124422>
- ★ Project website: <http://paginas.fe.up.pt/~maxbe/>

REDUCING POLLUTANTS FROM SHIP EXHAUSTS



Engine exhaust from ships is one of the most pervasive pollutants in the world today. An EU initiative has built a device that can remove gases and particles from diesel exhaust.

Ships use a type of low-cost diesel that is high in sulphur and other pollutants. In 2010, the International Maritime Organisation put into place

strict regulations on ship emissions to limit this major source of air pollution.

The EU-funded DEECON (Innovative after-treatment system for marine diesel engine emission control) project set out to build a modular exhaust scrubbing unit to remove pollutants from diesel exhaust.

Work started with a full analysis of ship engines to determine system requirements. The device's sub-units, namely the 'Electrostatic seawater scrubber' (ESWS), a plasma reactor, a catalytic reactor and a washwater treatment unit, were developed and tested primarily on gaseous pollutants.

Trials show that the ESWS can remove up to 93% of particulate matter and reduce sulphur dioxide by about 70%. Similarly, the plasma reactor prototype that uses microwaves as an energy source could scrub up to 90% of gaseous pollutants and reduce nitric oxide by nearly 100%.

Following testing, all sub-units were assembled to form the prototype DEECON exhaust scrubbing system. A demonstration at Gdynia Maritime University in Poland was then conducted to treat the exhaust of a marine diesel engine. Results show that the system uses up much less power and water than existing systems.

Thanks to DEECON, commercial fleets will ultimately be retrofitted with an innovative solution that sufficiently removes all gaseous pollutants from their exhausts. This will pave the way for eco-friendly ships that lessen air pollution and do much less harm to coastal communities and marine life.

DEECON

- ★ Coordinated by Brunel University in the United Kingdom.
- ★ Funded under FP7-TRANSPORT.
- ★ <http://cordis.europa.eu/result/rcn/147280>
- ★ Project website: <http://www.vtssrl.com/deecon.php>

DEVELOPING SORGHUM CROP AS A SOURCE FOR BIOFUELS

Sweet sorghum has many advantages over other crops when it comes to producing sugar for biofuel. An EU initiative has developed new hybrids, crop models and sustainability analyses to assist exploitation in numerous settings.

Sorghum is a multipurpose crop producing food and feed as well as fuel from sugars in the stem. The bottleneck to date has been the lack of sorghum varieties available for production of ethanol. The EU-funded SWEETFUEL (Sweet sorghum: An alternative energy crop) project set out to pool resources to breed strains of sweet sorghum that would maximise its productivity.

SWEETFUEL carried out a major breeding effort in target environments and production systems. Improved sorghum hybrids specially adapted to temperate climates, drought-prone environments and poor soils were bred and tested.

Project members identified, characterised and assessed sweet sorghum traits in order to better understand relationships between traits for sugar accumulation, plant phenology and drought tolerance. Field and laboratory tests

identified the main limitations and traits associated with the yield. Factors such as water consumption, nutrient uptake, harvest time and energy consumption were

Following a series of environmental, economic and technological assessments and analyses, a full sustainability assessment was delivered that identified the most sustainable sweet and biomass sorghum pathways. It also highlighted the potential environmental, economic and social benefits of cultivating sweet and biomass sorghum in contrast to the use of fossil fuels.

SWEETFUEL disseminated activities and outcomes and actively promoted exchange among stakeholders. Five regional workshops were held in Brazil, Europe, India, Mexico and South Africa. It also boasts numerous publications in scientific and trade journals as well as presentations at national and international conferences and other events.

Knowledge gained was used to publish a handbook providing interested parties with a current overview of key facts and figures on energy sorghum. SWEETFUEL helped optimise sweet sorghum yields in various climates by improving its genetics and agricultural practices.

"A full sustainability assessment was delivered that identified the most sustainable sweet and biomass sorghum pathways."

assessed. Based on this, the team proposed cultivation and harvest methods and developed a crop model for sorghum.

SWEETFUEL

- ★ Coordinated by CIRAD in France.
- ★ Funded under FP7-KBBE.
- ★ <http://cordis.europa.eu/result/rcn/85882>
- ★ Project website: <http://www.sweetfuel-project.eu/>

ENVIRONMENT AND SOCIETY

GREENING CONCRETE WITH SUSTAINABLE RAW MATERIALS

Concrete products manufactured from secondary raw materials could help the building sector improve its environmental performance and cut waste.

The new concrete products developed through the EU-funded SUS-CON (SUStainable, innovative and energy-efficient CONcrete, based on the integration of all-waste materials) project have been designed to meet the competitive and cost-efficient needs of the construction industry while at the same time reducing the sector's impact on the environment.

'We have developed completely new concepts and technologies in order to integrate secondary raw materials in the production of concrete,' explains project coordinator Alessandro Largo from CETMA in Italy. 'This will lead to the manufacture of more sustainable and energy-efficient concrete for both ready-mixed and pre-cast applications.'

The project is also promoting awareness of the benefits of new greener products in order to overcome both technical and non-technical barriers in an industry as traditional as construction.

For the moment, the main exploitable results concern several novel types of aggregates and binders made completely from secondary raw materials (such as plastic waste, electrical and electronic equipment waste, polyurethane foam and municipal solid waste). Other results include the combination of these novel products in an energy-efficient lightweight concrete made entirely of secondary materials along with a decision

support tool to help manage and share EU waste stream data.

'The lightweight, eco-friendly, cost-efficient and all-waste concrete products we've developed are applicable for both ready-mixed products (floor screed and floor screed underlay) and pre-cast applications (blocks and panels),' says Largo. 'These pre-cast and ready-mixed prototypes have been produced by various European construction companies within the project, and their compatibility with existing production processes has been demonstrated in real-life trials.'

The SUS-CON concrete solutions were then installed in real buildings located at three different European sites (Spain, Turkey and Romania). Improvements in the energy efficiency of buildings constructed with SUS-CON concrete were monitored. The prototypes were also evaluated in terms of their mechanical, thermal and acoustic insulation properties and fire resistance.

An exploitation plan has now been developed in order to drive forward concepts that are deemed to have commercial potential. 'This plan contains a full list of exploitable results, a description of each result, an explanation and a short exploitation plan,' explains Largo. 'In order to bring these products closer to the market, we will first develop promising systems at the pilot scale.'

Ultimately, the project's results will contribute towards reducing the embodied energy and CO₂ footprint of concrete through the replacement of traditional binders with novel binders made from secondary materials. The new concrete concepts developed by combining these new novel aggregates and binders will offer improved thermal insulation properties, and enable architects and builders to incorporate higher performance standards in both design and construction.

'The construction industry is one of the largest consumers of energy and raw materials and one of the highest contributors to the emission of greenhouse gases,' says Largo. 'In order to become more sustainable, the sector needs to limit its environmental impact and in particular must reduce the use of both raw materials and energy. We believe that developing new novel technologies that integrate secondary materials in the production cycle of lightweight concrete is an all-inclusive solution that can improve both sustainability and cost efficiency.'

SUS-CON

- ★ Coordinated by CETMA in Italy.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/result/rcn/173491>
- ★ Project website: <http://www.sus-con.eu/>
- ★ <http://bit.ly/1Nkux1x>

NOVEL RECYCLING METHODS FOR HELICOPTER PARTS

Recycling strategies used in the manufacturing of high-performance helicopter structures have economic and environmental drawbacks. An EU initiative has looked into a promising technique for recycling.

Thermoplastic composite materials' (TPCs) are potentially highly recyclable when compared to more popular methods that use thermosets. What is more, they promise unlimited storage life, robustness and chemical resistibility, resulting in lower manufacturing costs, reduced weight and positive environmental impact.

The EU-funded DISACOP (Disassembly of eco-designed helicopter demonstrators) project aimed to explore the potential of recycling helicopter parts through the fusion bonding of TPCs.

Existing methods do not allow for recycling, repairing and reusing manufactured parts. By contrast, DISACOP's innovative recycling strategy assembles components and disassembles integral parts of structures via fusion bonding techniques. Single elements can be detached from the main structure and reused on a repaired component. Bolts and rivets that assemble current aerospace structures are no longer needed, saving on both costs and weight. Excess waste is avoided by separating damaged components from intact components of a TPC structure. In addition, the local heating procedure uses up minimal energy and the joining and separation of TPCs do not give off any toxic substances.

Work began with the mapping of various heating methods for the fusion bonding of TPCs. Initial tests were carried out

to demonstrate the debonding procedure, leading to the most suitable method for the disassembly of TPC structures. This method's heating mechanism was then fully studied.



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Tests on available coupons and sub-components were performed to understand the effects of the procedure on real joints. The technology was further developed based on requirements beginning at coupon level. Project partners then applied the developed component separation scenario on demonstrators. They were able to identify a method to locally apply heat and to debond the assemblies.

DISACOP demonstrated the relative advantages of TPCs over their established alternatives. The recyclability and reusability of manufactured parts by disassembly is now a reality. Aerospace manufacturers and suppliers as well as society stand to benefit from the economic and environmental gains.

DISACOP

- ★ Coordinated by TUM in Germany.
- ★ Funded under FP7-JTI.
- ★ <http://cordis.europa.eu/result/rcn/170170>

SECRETS OF ALGAL BLOOMS REVEALED

Every year aquaculture and fisheries around the world suffer significant economic losses from 'Harmful algal blooms' (HABs) causing shellfish toxicity and the deaths of large numbers of fish.

Microscopic planktonic algae are found throughout the world's oceans, providing food for filter-feeding bivalve shellfish and the larvae of commercially important crustaceans and fish. The growth of planktonic algae is usually beneficial to aquaculture and wild fisheries, but

under certain circumstances algal blooms can have a negative impact.

The EU-funded MOHAB (Multi-disciplinary modelling approaches to understand harmful algal blooms dynamics) project investigated the factors influencing HAB populations and behaviour. A two-fold approach based on field observations and computer modelling was used to understand HAB population dynamics.

Case studies were carried out on two key algal species (*Alexandrium fundyense* and *Alexandrium minutum*) from different ecosystems. These field observations were integrated into a

variety of simulation models for the two ecosystems.

Researchers studied the effect of parasites on the development of spring algal blooms of *A. fundyense*. Results showed the importance of parasites in understanding the end of *A. fundyense* blooms. Laboratory experiments were conducted to determine important parameters for modelling the relationship between *A. fundyense* and its parasite *Amoebophrya*.

Coupling physical effects with biological behaviour models provided valuable tools for understanding the complexity of HAB events and forecasting their

"MOHAB results highlighted the importance of biological factors affecting the natural population dynamics of HAB species."

initiation, intensity, duration and decline. However, biological models have remained basic due to a lack of data regarding the life history and behaviour patterns of HAB species.

Project partners remedied this situation by developing advanced computer models to determine the main mechanisms and drivers behind the end of blooms. This information was used to develop indicators to help with decision making in environmental management.

MOHAB results highlighted the importance of biological factors affecting the natural population dynamics of HAB species. An understanding of these dynamics is needed before implementing any mitigation and/or management actions, and calls for an integrated strategy that includes both



observation and modelling. The project therefore provided greater understanding of the parasite-host relationship and key biological processes involved in the decline of HABs.

MOHAB

- ★ Coordinated by Ifremer in France.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/92285>

INSECT HORMONE LEADS TO NEW PESTICIDES

New environment-friendly pesticides can now be developed thanks to the work of an EU-funded initiative that investigated 'juvenile hormone' (JH) in insects.

JH plays a crucial role in insects and crustaceans, and its synthetic analogues have been used since the 1970s to control insect pests and carriers of disease. However, this molecular action was only discovered recently. It revealed that the effects of JH and its insecticidal mimics are mediated by the 'methoprene-tolerant' (MET) protein, which was believed to be a JH receptor.

The JHRECEPTOR (Structure and function of the insect Juvenile hormone receptor) project aimed to prove that MET is a true JH receptor. To achieve this, researchers studied the structure of the hormone binding part of MET and demonstrated that this binding is critical for insect development. They also investigated the transcriptional activation by MET in response to JH and the function of proteins that interact with MET.

Successful identification of the JH receptor was critical to understanding how insect development and reproduction are regulated and how insecticides mimicking JH exert their effects. This was reflected in the fact that the results of JHRECEPTOR have received >200 citations to date in the seven peer reviewed papers published within the project. The project has clearly inspired further research in the field of insect endocrinology.

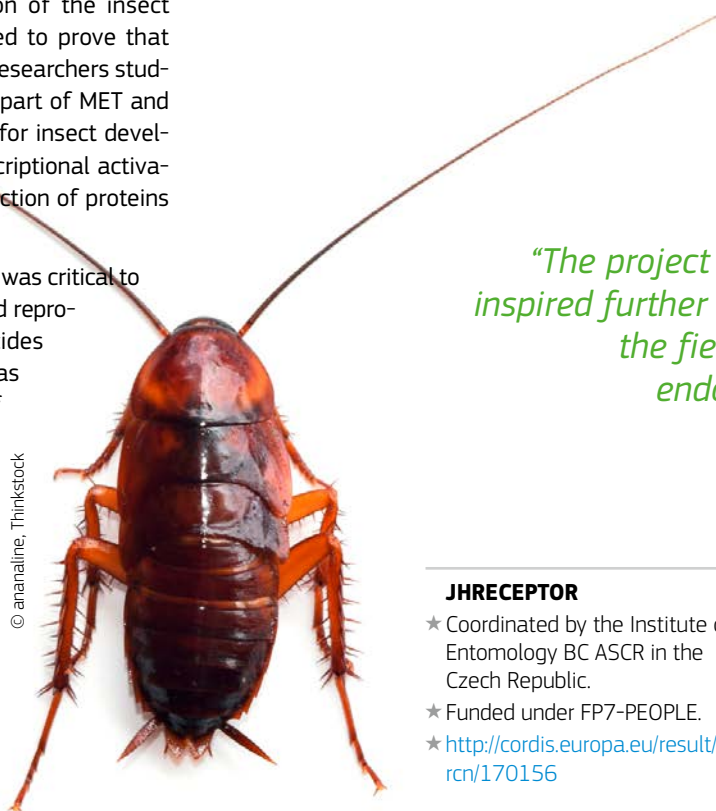
JHRECEPTOR developed powerful new research techniques including an *in vitro* JH binding assay and a cell-based system for testing potential new JH agonists and antagonists. New collaborations within the Czech Republic, South

Korea and the United States were established to investigate these mechanisms.

Project outcomes will contribute to the design of environment-friendly insecticides that do not harm beneficial insect species. In the future, these compounds could be adopted by the chemical industry, replacing the relatively non-selective JH mimics that are in use today.

"The project has clearly inspired further research in the field of insect endocrinology."

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JHRECEPTOR

- ★ Coordinated by the Institute of Entomology BC ASCR in the Czech Republic.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/170156>

EU PROJECT OPENS UP POTENTIAL FOR ENERGY-EFFICIENT WINDOWS

New insulated window concepts that enable manufacturers to achieve energy savings of up to 15 % and weight reductions of up to 50 % have been developed.

The new energy-efficient window concepts were developed through the EU-funded HARWIN (Harvesting solar energy with multifunctional glass-polymer windows) project.

'The benefits of these lightweight glazing and frame materials in terms of energy and cost savings — in particular for the refurbishment of old buildings — have been clearly demonstrated,' says HARWIN project coordinator Prof. Monika Willert-Porada from the University of Bayreuth, Germany. 'The next step is to put forward a proposal to commercialise the new, thin glass pane-based glazing.'

The project began by examining the effectiveness of various innovative materials with low embodied energy (i.e. the energy consumed by all of the processes associated with production). The mechanical performance of these materials was then improved through the use of advanced strengthening methods for both glazing and frame construction.

'The end result is thin glass laminated panes, reinforced with new polymer-glass composite materials that are

comparable or even superior to existing triple glazing, at 50 % less weight,' says Willert-Porada. 'The new, extremely stiff, thermally-insulated frame, based on polymer foam core-glass fibre reinforced polymer skin materials, offers additional embodied energy savings due to further weight reductions when compared to PVC or aluminium frames.'

Following the extensive examination of HARWIN windows' optical and thermal properties, a database of new materials was also set up. This database can be used by SMEs as a cost analysis tool to validate the cost-saving potential of these materials. 'This database can also be used to assess the recyclability of materials,' adds Willert-Porada. 'A HARWIN window module for building performance simulation has also been implemented into existing sophisticated building performance software.'

Only about 15 % of Europe's windows contain energy-saving glass, while nearly 40 % of energy consumption in the EU goes to heating, cooling and lighting buildings. This energy demand accounts for a significant amount of carbon dioxide emissions.

The new materials for advanced, multi-purpose windows pioneered by HARWIN will enable manufacturers to tap growing demand for energy-efficient refurbishment and new build projects, and

help Europe reduce the energy consumption of its building stock.

HARWIN's window concepts also open up possibilities in developing new functionalities. Coatings can be applied to the thin glass laminated panes to further improve their energy efficiency, and new active luminescent glass (which emits light but not heat) can be applied to reduce lighting energy demand. The team was able to demonstrate the improved functionality of this laminate glazing with the help of coatings.

The new materials are also capable of regulating humidity, decreasing thermal conduction and ensuring acoustic insulation. 'The challenge — which this project succeeded in meeting — has been to combine these functional characteristics into the new window pane with sufficient transparency,' says Willert-Porada.

The HARWIN project was completed in August 2015.

HARWIN

- ★ Coordinated by the University of Bayreuth in Germany.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/result/rcn/165061>
- ★ Project website: <http://www.harwin-fp7.eu/>



HOW BIRD COMMUNITIES EVOLVE AND SPREAD

Islands, with their distinct boundaries, act as natural laboratories for the study of evolution, biogeography and ecology. The Indo-Pacific region has the largest concentration of islands and archipelagos on the planet, making it the ideal place for testing these ideas.

The EU-funded BIRDEVOBIOGEO (Passerine bird evolution and biogeography) project focused on a large group of passerine (perching) birds known as the Corvoidea, which comprises the crow family. The Corvoidea originated in the mid-Tertiary in Australia, before spreading across the Indo-Pacific archipelagos onwards to other continents.

At present, molecular data exists for about 85 % of Corvoidea species, thereby enabling evolutionary and biogeographical theories to be tested using evolutionary and ecological statistical tools. These theories concern the history of this group and the reasons behind their success, and offer hope in answering questions regarding diversity, evolution, community assembly and biogeography.

Using passerine bird species from the tropical regions of Africa and Asia, BIRDEVOBIOGEO showed that the build-up of continental passerine communities is continuously influenced by random extinction of entire clades. A clade is a group that shares inherited features from a common ancestor.

Data based on the morphology of more than 5 000 passerine bird species revealed that different groups tend to occupy the same morphological space. Morphological space acted as a proxy for what the birds ate and the habitat they lived in.

It was also revealed that passerine birds occupy a wide range of niches and potentially interact, but this has little to do with the relative order of colonisation. Other significant results indicated that seasonal migration has facilitated diversification through the divergence of migratory subpopulations that have become sedentary.

BIRDEVOBIOGEO generated valuable new data on how communities of birds form and which spatial and temporal factors affect the build-up of both continental and island bird communities.

BIRDEVOBIOGEO

- ★ Coordinated by the Imperial College of Science, Technology and Medicine in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/170217>



TOOLBOX TO GUIDE ONLINE DEVELOPERS AROUND THE CLOUD

A toolbox to help online developers identify the best cloud technology for their applications has been made available thanks to EU funding.

The final version of the toolbox, which has been developed through the EU-funded MODACLOUDS (Model-Driven Approach for design and execution of applications on multiple Clouds) project, includes three different demonstrator tools showcasing the project's innovations and technologies. Start-ups can use these demonstrators to review possible cloud solutions as they seek to develop new online technologies.

The solution has been designed to enable online developers working on a range of applications, including data storage, to harness the full potential of the cloud. The toolbox will also hopefully boost Europe's high-tech sector by favouring the emergence of European cloud technology and avoiding vendor lock-in problems (where developers are compelled to use the technology of just one operator).

The cloud computing concept is about sharing computing resources rather than having local servers or personal devices handle each individual application. In this sense, 'cloud' is a metaphor for 'the internet', where services — such as servers, storage and applications — are delivered to an organisation's computers and devices through the internet.

This shared IT infrastructure contains pools of systems that are linked together, with specialised connections spreading data-processing chores across them. This means that high-performance computing power for performing tens of trillions of computations per second can be tapped into for consumer-oriented applications, such as financial transactions and data storage, or for powering immersive multi-user online computer games.


However, cloud business models and technologies are still characterised by critical early stage issues, which pose specific challenges and require advanced software engineering methods. The MODACLOUDS toolbox will enable online developers to navigate around these issues.

The project began by taking into account key business considerations, end user needs and current technological constraints in order to develop an effective toolbox. The main goal throughout has been to provide start-up developers with proven methods, an effective decision support system and an open source environment for high-level design, prototyping and deployment of multi-cloud applications.

For example, new risk analysis and quality prediction tools will enable developers to specify appropriate cloud models, monitor applications on these models and then finally optimise the service based on feedback. New techniques for synchronising operations among multiple clouds have also been developed.

Another key outcome of the project has been the establishment of the MultiClouds Alliance, which aims to further promote and evolve cloud technologies and business-driven online solutions. The alliance is open to any organisation wishing to participate, as members or associates, in the promotion and development of future cloud technologies. The alliance will also ensure that the results of the MODACLOUDS project have a long-lasting legacy. The three-year MODACLOUDS project was completed in September 2015.

MODACLOUDS

- ★ Coordinated by the Polytechnic University of Milan in Italy.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/news/rcn/124343>
- ★ Project website:
<http://www.modaclouds.eu/>
- ★  <http://bit.ly/1QiOJa5>

INTERVIEW

RETROFITTING THE EASY WAY THANKS TO NEW SET OF ICT TOOLS

Energy-efficient retrofitting may be a market with much potential, but the current lack of tools for comparing available technologies and putting customers in touch with specialised SMEs is hampering its growth. The NEWBEE project has come up with innovative solutions to these two problems.

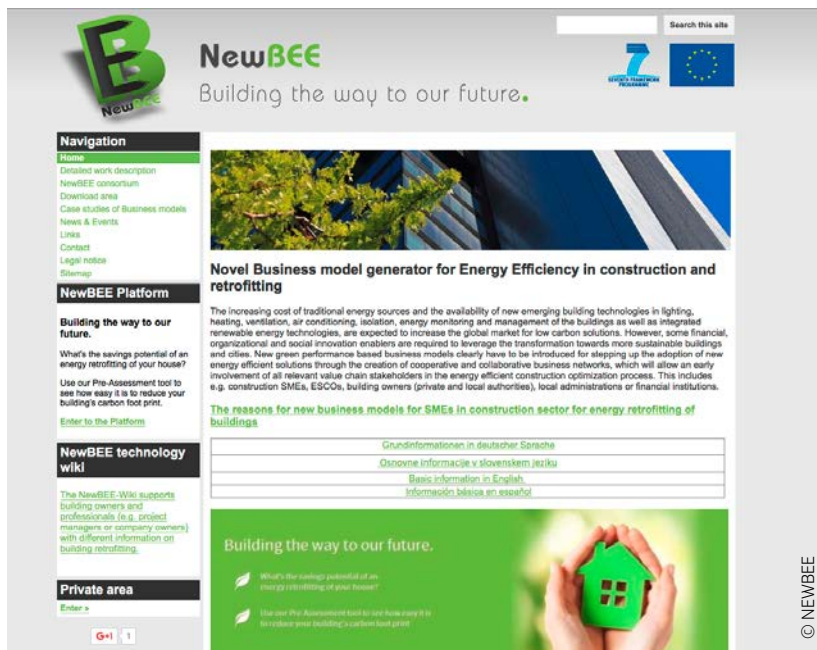
Completed at the end of September, the EU-funded NEWBEE (Novel Business model generator for Energy Efficiency in construction and retrofitting) project proposes new performance-based business models which they hope can speed up the adoption of energy-efficient solutions in buildings. Laura Garcia Zambrano, Scientific Researcher at Tecnalia and coordinator of the project, explains how the project's new ICT tool will ease each step in retrofitting initiatives, from comparing technologies to launching calls for tenders and awarding contracts.

★ **The implementation of a business model for the whole value chain is your main objective. Why do you think that's necessary?**

Laura Garcia Zambrano: New energy performance-based business models can increase the adoption of efficient solutions through cooperation between construction companies and SMEs specialised in retrofitting, 'Energy service companies' (ESCOs),

"We first need to attract building owners with services of quality and make them free of charge."

public and private building owners, local administrations and financial institutions. In the construction sector, the successful implementation of these models depends on the entire value chain. In this context, the main innovative aspect of NEWBEE is the integration of all actors thanks to suitable methodologies for the new energy efficiency paradigm, supported by a set of web-based ICT tools. This will enable SMEs to compete with large contractors.



★ **Can you tell us more about the software solution you developed?**

Our technology is for both sides of the market: building owners (who are demanding retrofitting services) and SMEs (who are offering the retrofitting services).

The NEWBEE platform includes: a knowledge repository that provides building owners with information about the different retrofitting technologies and SMEs with competitive knowledge; a pre-assessment and a financial tool which helps building owners to evaluate the different technologies available in light of the specific problem they are facing and their financial constraints; a 'marketplace tool' enabling building owners to identify and launch calls for proposals and SMEs to find retrofitting opportunities; an energy performance assessment tool for SMEs offering a detailed assessment of the technologies and their cost for a particular problem; and a business model assessment tool that supports SMEs in improving their business strategy by allowing them to search for ideas and good business concepts and guiding them step by step.

★ **What kind of methods did you use to classify and evaluate existing technologies in a clear and coherent manner?**

Technologies have been classified according to various factors, ranging from their applications to elements such as energy required, materials, physical principles applied and performance.

Classifying these technologies was a challenge, as SMEs need the system to work in a relatively non-scientific manner while answering the day-to-day challenges they face. Thus, the technologies are initially classified following the trades or assembly section of buildings (e.g. roof, façade). This is based on the German classification DIN276, which covers elements that are principally used for the structure and management of construction projects.

Technologies were also evaluated by the SMEs involved in the NEWBEE project thanks to discussions and semi-structured personal interviews. The proposed scheme for evaluating the technology classification was composed of two sets of factors: The first set involved the structural and

physical aspect of the technology, and the second set provided SMEs with information on the techno-economic feasibility of the selected technologies.

★ **What would be a typical use case for NEWBEE's solutions?**

A typical use case for NEWBEE would be that of a building owner or community of neighbours requesting a retrofitting service covering every single stage of the process. This process starts with raising owner awareness about the benefits of energy-efficient retrofitting and available technologies to solve their problem. Once the building owner has all the necessary information, he/she can go deeper into the analysis of his/her own building and estimate the costs and possible financing options.

After that the owner formally asks for proposals (offers) through the marketplace and identifies a construction company with a good reputation. That's when SMEs come into play. They will study the proposal, create a team to offer a holistic solution and respond to the owner's request. The SMEs will use the professional tools intended for them (the energy performance assessment tool) in order to make a more precise estimation of the energy performance of the building before and after the proposed retrofitting solutions. Also, they will use the business model assessment tool

to look for ideas for a good business model to propose to their partners.

★ **So SMEs were your main targets. How do you plan to attract them?**

Well, the strategy for attracting SMEs is quite simple. We first need to attract building owners with services of quality and make them free of charge. Some of the most powerful services developed in NEWBEE are intended for building owners (retrofitting knowledge repository, pre-assessment and financial tool) and we are confident that this will engage them to use the marketplace tool. If we succeed in this first step, it will then be easy enough to attract SMEs. The quality and quantity of owners requesting retrofitting offers will be our best commercial claim.

★ **How can stakeholders access your platform and what are the conditions?**

The platform is currently in the pre-commercial stage and therefore is not yet accessible for the market in general. However, several commercial options are being discussed and considered: We will have to take into account the fact that the platform offers services adapted to the climate and the financial options of each country and region, and therefore that the tool has to be adapted

(populated, parameterised) for each country/region.

As we have already explained, the services intended for building owners will be free of charge, but for SMEs different commercial and price policies can be considered. The first one is a one-time fee (pay-per-use) system where the SME is charged every time its staff use the platform. This is the preferred option for those clients who want to explore NEWBEE premium options such as the marketplace.

But there are other options: a yearly subscription, a fee applied when a business opportunity is accepted (pay-per-success), and a license for third parties who want to install, localise and run the platform in a specific country (it could be a one-time licence or one-year licence). Unlike the previous options where the NEWBEE partner running the platform charges a fee, this option sees software owners sell a license to a third party who will then run the platform in a certain country.

NEWBEE

- ★ Coordinated by Tecnalia in Spain.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/result/rcn/173493>
- ★ Project website: <http://www.newbee.eu>

3D ASSISTANCE FOR THE VISUALLY IMPAIRED

A new digital tool has been developed to help the visually impaired see better, improving their mobility and quality of life. This tool is customisable to the user's eye disease symptoms.

The EU-backed project DIGIGLASSES (Development of 3D digital glasses for enhancing mobility of visually impaired people to open strategic product lines for participant SMEs) developed 3D glasses that give users stereoscopic vision, allowing them to judge distances in their environment. Consortium partners outlined the functional system specifications for the digiglasses. They then developed the hardware and software necessary for creating the desired functions, while allowing for optimisation and fine-tuning where needed. Researchers then designed the optical part of the system, which lets the user see the image in front of them at the proper distance.

Consortium members prepared the manufacturing processes and contacted manufacturers before creating the prototypes. The 3D glasses produced are affordable, stylish and functional. A video animation showing the concept of the project was disseminated through YouTube and Facebook, and is also available on the project website.

DIGIGLASSES successfully completed its tasks and demonstrated the complete DIGIGLASSES system: hardware and software containing the 'Head-mounted display' (HMD)



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system, HMD camera, optics system, image processing DSP (hardware and embedded software), and PC-based configuration software.

The second and third main results of the project are also marketable innovations on their own. For example, the HMD system and the configuration software that contain the knowledge of the applicable image modification processes can be sold as separate technology.

DIGIGLASSES will help people with poor vision get jobs more easily and work in a wide range of environments. This invention is highly suited to the global demographic trend.

As a newly developed high-tech product, it can serve the visually impaired worldwide on an everyday basis and improve overall quality of life.

DIGIGLASSES

- ★ Coordinated by Ateknea Solutions in Hungary.
- ★ Funded under FP7-SME.
- ★ <http://cordis.europa.eu/result/rcn/151166>
- ★ Project website: <http://digiglasses.eu/>
- ★  <http://bit.ly/1OX11lj>

HELPING BUSINESSES BUILD SOFTWARE

An EU team has extended an earlier project, yielding a mashup system enabling companies to rapidly develop software applications. Offering new tools and interfaces, plus community interaction, the demonstrator was successfully applied to risk analysis.

Most SMEs lack the resources and skills to develop fully-realised software products. A previous EU project (RAISME, 2010-2012) worked to help SMEs create innovative software applications, via collaborative use of 'mashup' technology and cloud computing. A recent EU-funded project AAPD (Applications and analytics platform demonstration) has built on RAISME's results. AAPD was intended to provide a configurable platform for rapid development of software.

The project offered a system of advanced, interactive interfaces and visualisation tools, allowing interaction among the community of users and developers. The intent was to foster more adventurous software development, while at the same time lowering the risk and improving performance. The four-member project ran for 18 months to the end of 2014.

Initial work involved demonstrating the RAISME platform in the context of risk management. The AAPD demonstrator was designed to handle large datasets, such as those involved in risk or insurance analysis. In this domain, the demonstrator was shown to be useful to business, via a new extendable cloud platform supporting the types of analysis planned. The demonstration involved specialised visualisation techniques.

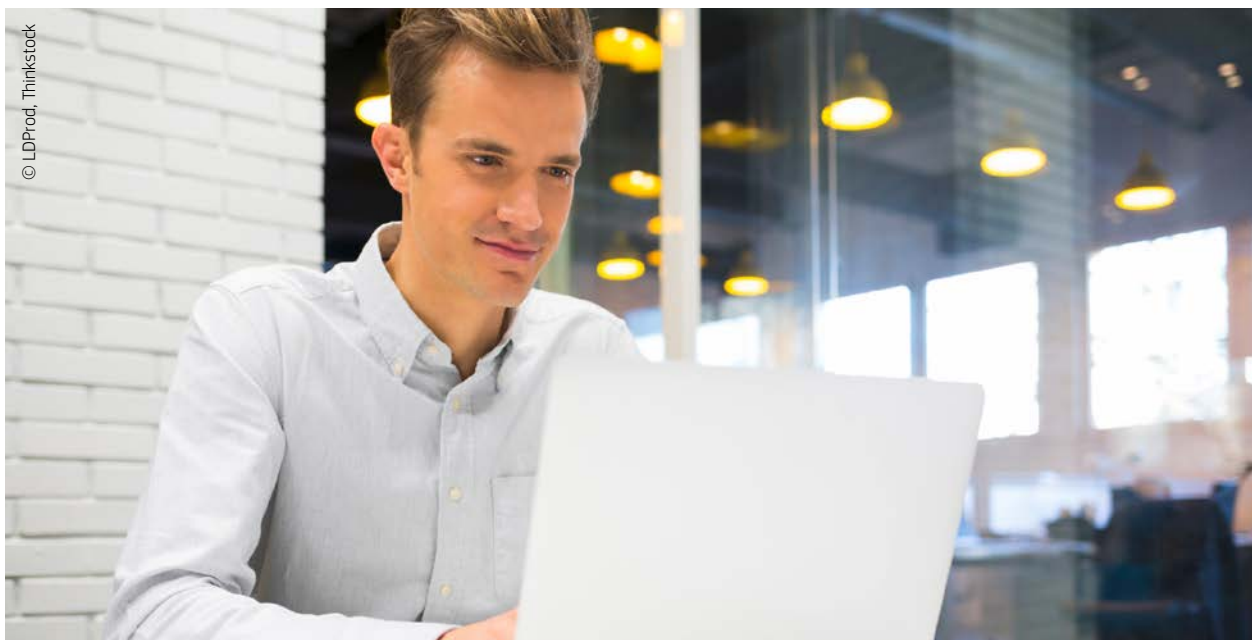
Technical outcomes included the ability to continuously monitor platform usage, and to assess customer experience in real time. The project also demonstrated the customisable integration of customer tools.

AAPD has developed a system providing support for rapid development of software for business needs. The achievements are expected to generate considerable revenues.

AAPD

- ★ Coordinated by Dependable Real Time Systems in the United Kingdom.
- ★ Funded under FP7-SME.
- ★ <http://cordis.europa.eu/result/rcn/170164>
- ★ Project website: <http://www.aapd.eu/>

"The demonstrator was shown to be useful to business, via a new extendable cloud platform supporting the types of analysis planned."



INDUSTRIAL TECHNOLOGIES

NEW COMPOSITE MATERIAL TECHNIQUES PROMISE EFFICIENT MANUFACTURING

EU-funded researchers have developed a highly productive and environmentally sound way of manufacturing powder gel coats for new composite moulds.

Composites have emerged in recent years as a valuable class of engineering materials. They offer many attributes not attainable with other materials — they are lightweight, yet offer stiffness — and as a result can be found in a range of high-tech applications such as satellites and high-performance aircraft. Gel coats are used to provide a high-quality finish to the visible surface of fibre-reinforced composite materials, which are then used in the manufacture of complex moulded parts.

This latest manufacturing breakthrough, achieved through the EU-funded ECOGEL CRONOS (High productivity manufacturing process of composite parts based on zero emissions fast curing coatings and heated moulds) project, will therefore be of interest to mass production vehicle manufacturers, where even slight increases in efficiency and reductions in cost can lead to significant savings. The transport industry is also facing increasingly stringent environmental regulations which aim to increase the power-to-weight ratio of cars, reduce overall weight and thereby reduce vehicle emissions. Composites have been identified as a key enabling technology that meets weight, cost and production rate requirements.

The high-tech aerospace sector, an industry that is characterised by high costs and low productivity, also stands to benefit. New manufacturing technologies that can achieve

advanced aerospace materials at lower cost — and with less impact on the environment — will help ensure that Europe's aerospace industry has a strong future.

Different manufacturing techniques were developed within the ECOGEL CRONOS project and combined with suitable additives in order to obtain highly reactive, stable and cost-effective powder gel coat formulations. The new process has been demonstrated to reduce both gel coat manufacturing times and production emissions.

Project trials were carried out for composite parts used in tractors and car doors, and modelling tasks were employed to determine electrical conductivity thresholds. In a test run, a fully-finished powder gel coat was delivered 80% quicker compared to conventional liquid gel coats.

The three-year project, which is scheduled for completion at the end of August 2016, is now focusing on developing new composite moulds for carbon fibre laminate. While traditional composites used in the automotive industry have typically used high-cost aerospace-derived technology for a technique known as 'Sheet moulding compound' (SMC), the ECOGEL CRONOS project is concentrating on 'Resin transfer moulding' (RTM) to provide greater efficiency in terms of cost and production, with the same performance and quality.

“A fully-finished powder gel coat was delivered 80% quicker compared to conventional liquid gel coats.”

The new RTM process, which involves reusable electrically-conductive, temperature-controlled skins, allows release agents, gel coats and fibres to be applied to the composite skin whilst another one is being injected. In this way, it is possible to increase production for a relatively small additional investment. A pilot plant mould has been built and tests are currently being run.

Successful results could open the door to composite materials being used in other sectors, such as consumer, infrastructure

and sporting goods industries. The transition to other mass-production sectors has to date been slow, in part because of the cost of manufacturing these materials. However, the advances achieved through the ECOGEL CRONOS project could help address this challenge.

ECOGEL CRONOS

- ★ Coordinated by AIMPLAS in Spain.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/news/rcn/124381>
- ★ Project website:
<http://www.ecogelcronos.eu>
- ★  <http://bit.ly/1QiTb8K>

IMPROVING REFRIGERATION TECHNOLOGY

Refrigeration technology stakeholders worked together to research and develop new technologies for more efficient energy usage and food storage.

The energy required for food refrigeration accounts for 8% of electric power and 2.5% of carbon dioxide emissions worldwide. The efficiency of food refrigeration has a safety, economic and environmental impact that affects not only consumers, but also the refrigeration industry as a whole. The EU-funded FRISBEE (Food refrigeration innovations for safety, consumer benefit, environmental impact and energy optimization along cold chain in Europe) project strove to improve refrigeration and the cold chain overall, working with a total of 26 partners across 12 EU Member States.

Researchers studied the entire cold chain, including packaging, handling, storage, transporting, and retail and household refrigerators. Specifically, the project aimed to enhance food quality, consumer confidence and the competitiveness of European industries, in addition to reducing energy consumption for environmental sustainability. The project team developed new refrigeration models that took account of energy consumption, food quality degradation, high-tech innovations and disruptive technologies.

To achieve its aims, FRISBEE compiled new databases of technologies and food product temperatures. It developed quality, energy and environmental assessment tools to develop and evaluate novel and emerging refrigeration technologies for the European food industry. Work also involved assessing the current cold chain and consumer expectations within Europe, as well as conducting a survey on the needs of refrigeration operators.

New technologies developed include the design for a domestic magnetic refrigerator and the characterisation of 'Phase change materials' (PCMs) used in food packaging. Nanoencapsulation of PCMs was explored, confirming its positive impact on energy reduction.

A study was also conducted on the use of nanoparticles in refrigeration at low temperatures, looking at its potential benefits and technical and safety implications. Other advances include a simulation tool to predict ice formation during superchilling, a model for ice crystals, tests on real cold chains and new software to study refrigeration.

The results of this research were disseminated through the project website, journal publications and newsletters. With a better overview of European refrigeration

“Researchers studied the entire cold chain, including packaging, handling, storage, transporting, and retail and household refrigerators.”

needs and the emergence of new technologies, the results will support the entire European food industry, economy and environment as well as consumers worldwide.

FRISBEE

- ★ Coordinated by Irstea in France.
- ★ Funded under FP7-KBBE.
- ★ <http://cordis.europa.eu/result/rcn/158489>

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NEXT-GENERATION ROBOTS AUTOMATE LARGE-SCALE INDUSTRIAL PROCESSES

Robotic or automated systems have their limitations when it comes to large-scale product life cycles. An EU initiative has designed a flexible and reconfigurable robotic system to accelerate maintenance and repair processes in large-scale products.

Automation in the aeronautics and construction industries has been hindered by the need to move sizeable and heavy structures as well as the risk of damaging automation equipment. These major issues have motivated inquiry into automated processes that will be flexible and cost effective.

The EU-funded CABLEBOT (Parallel cable robotics for improving maintenance and logistics of large-scale products) project was uniquely designed to meet these needs. Researchers worked on developing a new generation of modular and reconfigurable robotic devices that are capable of performing different maintenance steps during the life-cycle stages of large-scale structures.

To achieve automation and flexibility in large-scale maintenance, team members used novel software tools to design parallel cable robots. These robotic solutions meet the needs of products that have differing dimensions and features.

Simulations were carried out to verify the robotic device's operation in environments with large-scale structures. Software tools and methods were designed to simulate the different requirements of each life-cycle stage. Project partners also developed control algorithms and strategies to operate the cable robots based on industrial requirements.

Lastly, two industrial use cases tested the software tools and cable robots developed, and demonstrated the efficiency of the control algorithms and strategies. They also validated the feasibility of employing cable robots in aircraft maintenance and in handling and assembling construction beams.

CABLEBOT proved the value of parallel cable robots as a cost-effective and flexible alternative to conventional industrial robots in automating large-scale processes, particularly for the aerospace and construction industries. As a result, the



service life of products will be extended while reducing their overall life-cycle costs.

Last June, Euronews visited the facilities of TECNALIA in Montpellier where the prototype COGIRO is installed. COGIRO is Europe's biggest cable-driven parallel robot and was developed by CNRS-LIRMM and TECNALIA.

CABLEBOT

- ★ Coordinated by TecNALIA in Spain.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/result/rcn/147125>
- ★ Project website: <http://www.cablebot.eu/>

NEW MOBILE WELDING DEVICE CREATED

A group of EU researchers and companies has created a new welding machine that can be used for intricate aluminium welding in ship building.

Aluminium is rapidly becoming the metal of choice for ship building worldwide. 'Friction stir welding' (FSW) is used to join aluminium and aluminium alloys, but there are no FSW machines flexible enough for final assembly in a shipyard.

The EU-funded MOBI-WELD (Low force mobile friction stir welding system for

on-site marine fabrication) project aimed to create a fully mobile prototype FSW device that could be used for ship building with aluminium alloys.

The project started by surveying shipyards and builders to determine what end-users required in a mobile FSW device. From the data collected, MOBI-WELD developed specifications for the welding machine.

Researchers tested different welding tools for two different types of aluminium panel. Information from these trials provided the specifications for a welding head.

The prototype incorporated several sensors to help automate the process, along with a crawler system with vacuum cups.

This system allows the device to travel across the panels as it welds.

The prototype device performed well in testing, but it still needs to be thoroughly validated before commercial development can begin. Once that happens, the MOBI-WELD device will be set to revolutionise ship building.

MOBI-WELD

- ★ Coordinated by Abis in Poland.
- ★ Funded under FP7-SME.
- ★ <http://cordis.europa.eu/result/rcn/170166>
- ★ Project website: <http://www.mobiweld.eu/>
- ★ <http://bit.ly/1SSaL1a>

"The project started by surveying shipyards and builders to determine what end-users required in a mobile FSW device."

ROBOTS BOOSTING COMPETITIVE ADVANTAGE OF EUROPEAN TIMBER INDUSTRY

Timber industry production lines require manual tasks, such as wood patching, which hinder productivity. An EU initiative has developed robotic technology to increase throughput and competitiveness while reducing labour costs.

To keep up with strong Chinese and Indian competition in the manufacturing of wood panels, the industry must leave behind certain manual production processes. This means embracing automation on the timber sawmill shop floor.

In line with this objective, the EU-funded HOL-I-WOOD PR (Holonomic integration of cognition, communication and control for a wood patching robot) project aimed to design a robot and an accompanying scanner that fully automate the removal and repair process for wood panels.

The robot instantly identifies and repairs all defects in real time thanks to data it receives from a high-resolution optical scanner. This scanner inspects large boards and panels and immediately detects all faults. The robot repairs each panel based on the information stored or retrieved. The wood products are then ready for inspection. This efficient, manageable and user-friendly robotic technology can repair up to 450 wood panels an hour, roughly the equivalent of 50 human operators.

Project partners specified system requirements and all internal and external interfaces and environments. They defined the technical requirements, component architecture and integration framework. Investigation of effectiveness, determination of optimal equipment control and definition of constraints then followed.

The team redesigned a robot eye to optimise image analysis and real-time imaging in smart cams, and integrated multi-sensory scanning technology to perform analyses.

Project members developed the robot and related components such as the user interface, dialogue system and



real-time control and communication network. The technology was successfully demonstrated at a gluelam factory.

By introducing a highly automated and integrated robotic technology to mills and factories, HOL-I-WOOD PR has helped optimise production. Wood processing companies in Europe will be able to maintain their competitiveness and fend off their biggest competitors.

HOL-I-WOOD PR

- ★ Coordinated by MiCROTEC in Italy.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/result/rcn/170159>
- ★ Project website:
<http://www.holiwoodpr.wordpress.com/>
- ★ <http://bit.ly/1OW4WAw>

INORGANIC POLYMERS BRING INSULATION TO THE NEXT LEVEL

A new generation of inorganic, insulating and incombustible building materials has been tested at pilot scale and shown commercial promise.

The EU-funded LEEMA (Low Embodied Energy Advanced (Novel) Insulation Materials and Insulating Masonry Components for Energy Efficient Buildings) project, due for final completion at the end of December

2015, has developed and tested novel inorganic polymer materials suitable for insulating both new and retrofitted buildings. The objective has been to offer a sustainable, cost-effective and healthier alternative to traditional insulation materials, which are sometimes highly combustible, can easily shrink and can contain volatile compounds that contaminate the indoor building environment.

The products created by the LEEMA team are known as '3I' in that they are inorganic, insulating and incombustible. Following successful demonstrations, the next step will be to bring them to market.

'The two key components developed within the LEEMA project are the "3I loose filling materials" (3I LFM) — new lightweight expanded granular materials that can replace traditional bulk insulation — and 3I Binders, designed to replace cementitious binders or even clay,' explains project coordinator Christos Dedeloudis from S&B Industrial Minerals, Greece. 'To date, test results demonstrate that these products have great potential.'

For example, 3I LFMs for cavity wall insulation have been shown to have 40% lower density than traditional materials, with preliminary estimations

"Pilot-scale extrusion trials have demonstrated that the new inorganic binders could potentially replace cement or clay for the production of prefabricated elements or bricks."

suggesting that the material can be competitively priced (compared to expanded perlite, a non-renewable resource). Two more grades of LFMs have been developed — the first for 3I fibre boards and the second for 3I bricks and 'Expanded perlite boards' (EPBs).

'Both of these grades show between 10 and 20% lower density and thermal conductivity compared to traditional expanded perlite,' says Dedeloudis. 'Also, all 3I LFMs have between 40 and 60% less embodied energy per functional unit compared to expanded perlite.' Embodied energy is the sum of all energy required to produce a good — including sourcing and manufacture — and is an effective way of determining the total amount of potential energy that can be saved.

3I binders have also been developed and tested, and have shown compressive strength compatible with conventional binders (such as cement). 'Pilot-scale extrusion trials have demonstrated that the new inorganic binders could potentially replace cement or clay for the production of prefabricated elements or bricks,' says Dedeloudis. Other new products include 3I fibre boards and 3I foamed blocks for use as insulating masonry elements. All products are inert

and non-toxic, and designed to ensure a cleaner indoor environment.

Another key element of the LEEMA project has been its focus on sustainable production. The team has used raw materials from industrial mineral waste streams, together with other industrial wastes and by-products, throughout the project. By adding appropriate mineral by-products that easily react with alkali solutions, inert stable structures can be formed.

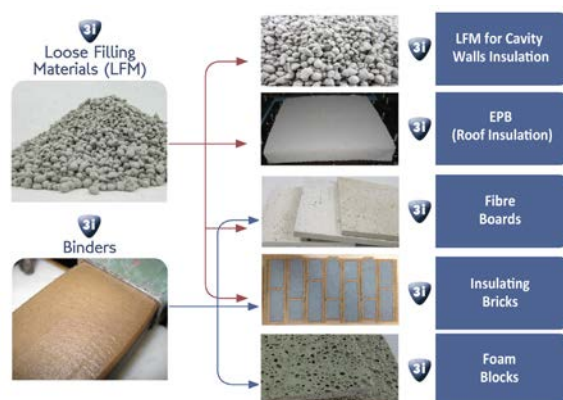
This non-energy intensive manufacturing process will decrease embodied energy and cost at component level compared to current solutions.

LEEMA's activities are in line with the EU Directive on the 'Energy Performance of Buildings'. The success of the project will pave the way for an increased number of buildings that not only fulfil current minimum energy performance requirements, but are also more energy efficient.

LEEMA

- ★ Coordinated by S&B Minerals in Greece.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/result/rcn/151478>
- ★ Project website: <http://www.leema.eu>
- ★ <http://bit.ly/1ITyMyS>

© LEEMA



NOVEL ROTOR RETAINING SLEEVES FOR AIR CONDITIONING SYSTEMS IN AIRCRAFTS

'Air conditioning systems' (ACSs) used in aircraft applications need to provide sustainable energy benefits and better performance. An EU initiative aimed to improve ACSs to meet these requirements.

Electrically driven ACSs for aircraft applications require a high-speed motocompressor based on permanent magnet rotor technology. One solution is to develop their retaining sleeve via a direct filament winding process, a manufacturing method that provides the greatest control over fibre placement and uniformity of structure.

With EU-funding, the E-SLEEVE (Direct filament wound rotor carbon resin sleeves by bulk curing and layer-by-layer electron beam polymerisation) project set out to develop a direct filament winding method on the rotor so that the filament has enough tensile strength to apply a preload on

the magnets. To do so, it had to find an optimal resin/fibre combination that can withstand operational conditions such as temperature and humidity and still be suitable for filament winding.

Project partners designed, set up and demonstrated two different processes for the filament winding of carbon sleeves. The sleeves were integrated into the electric rotor of high-speed motocompressors for aircraft ACSs. With filament winding, fibre

filaments are wetted with a resin and then wound around a rotating mandrel at various angles to meet mechanical requirements. The structure is then cured and the mandrel removed. Sleeves are mainly used to retain magnets on high speed rotors and are increasingly used in a variety of applications to improve speed and energy efficiency.

The processes were validated by manufacturing the required nine sleeves directly on the rotor sub-assembly using two alternative processes. Both processes needed to demonstrate the required radial pressure and reliability to guarantee safe retainment of the rotor magnets at high revolution speed and operational conditions.

E-SLEEVE developed carbon sleeves made of filament winding and directly wound on an electric motor rotor. It helped improve the design of rotors and sleeves. The new sleeves are expected to see a boost in performance, gains in logistics and possibly lower manufacturing costs.

E-SLEEVE

- ★ Coordinated by Next Technology Tecnotessile in Italy.
- ★ Funded under FP7-JTI.
- ★ <http://cordis.europa.eu/result/rcn/170178>

"Project partners designed, set up and demonstrated two different processes for the filament winding of carbon sleeves."

SECURITY & SAFETY

QUALITY SURVEILLANCE VIDEO

An EU team has provided new capability for transmission of high-quality remotely sensed video. Superior compression techniques overcame previous limitations, improving performance from low-power drones and offering new low-light applications.

Certain kinds of remote sensing systems, including unmanned aerial vehicles and ground-based sensors, are often used in both military and civilian surveillance. While such systems offer excellent capability and convenience, they suffer performance limitations concerning transmission of high-quality video.

Backed by EU funding, the CS-ORION (Compressed sensing for remote imaging in aerial and terrestrial surveillance) project aimed to make improvements. Current remote sensing equipment can only provide low-quality streaming video. The aim was to develop compression techniques to improve all stages, from capture to reconstruction, thus enabling higher-quality remotely sensed video. The four-member consortium ran for four years, starting in September 2010.

The team designed a technique for compressing video to surpass the limitations of MPEG and MJPEG methods. Results could be integrated into lightweight devices having limited resources.

Enquiries yielded a method for classifying video from compressed features. The method was applicable to decision systems having low power and limited resources. An additional outcome was an active range imaging system able to achieve high-quality depth map reconstruction from fewer frames.

The group explored high dynamic range imaging, yielding a method requiring fewer low dynamic range images. A framework of compressive sensing was utilised to provide accurate localisation based on signal strength measurements, which also reduced the amount of information transmitted.

Other innovations, involving central processing unit implementation of the compressive video sensing module or novel hyperspectral imaging architecture, also led to improved compression and performance. Lastly, the team developed a method of enhancing images captured under low-light conditions, based on a mathematical framework of sparse representations.

The CS-ORION project achieved performance gains for compression and streaming of remotely sensed video. Looking ahead, the developments promise improvements in surveillance capability.

CS-ORION

- ★ Coordinated by Hellas in Greece.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/92215>
- ★ Project website:
<http://www.cs-orion.eu/>

VICTIM-OFFENDER DIALOGUE AS TRANSFORMATIVE FOR VICTIMS OF CRIME

Victims play a significant role in an innovative approach to responding to crime that aims to raise awareness for a safer society.

When victims of crime participate in a restorative intervention, they are taking an active role in the aftermath of a crime. In seeking empowerment and serving their own needs, they are at the same time trying to build a safer society.

VICTIMS AND RJ (Victims and their justice motives in a restorative intervention) is an EU-funded project that looked at the reasons victims of crime are participating in a 'restorative justice' (RJ) intervention. In such a practice, the victim and the offender of a particular crime are invited to communicate with each other. That is, provided

they agree and the offender is willing to take responsibility for the crime.

With the aid of a mediator, they take part in a dialogue. Victim-offender mediation and conferencing are restorative practices used globally in response to property crime and crime against a person. They can be crimes committed by a young or adult offender. These interventions take place in addition to or instead of conventional criminal justice proceedings and decision making.

Research has shown that RJ surpasses criminal justice proceedings when it comes to meeting victim needs for expression and closure, especially in the case of a serious crime. Although confrontation of this sort is hard on the victim, the willingness is still there. The project delved into the intricacies at work and the motives involved. Respondents were recruited from Belgium and the United Kingdom, which use different judicial regimes, and they were interviewed at the start and at the end of the restorative intervention.

Differences in motives for participation between Belgian and English

respondents were minimal. One of the most important findings was that victims appreciated the opportunity to communicate with their offender. By doing so, they were able to obtain better perceptions of justice for themselves as well as for the offender and society.

Research findings have been disseminated to RJ practitioners in workshops in Belgium and the United Kingdom as well as to academic audiences through conferences and meetings. As a result of this study, insight regarding why RJ matters to crime victims can be better understood. RJ allows them to transform suffering into something constructive for themselves and others.

“Research has shown that RJ surpasses criminal justice proceedings when it comes to meeting victim needs for expression and closure, especially in the case of a serious crime.”

VICTIMS AND RJ

- ★ Coordinated by the University of Sheffield in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/170229>



MAKING RAILWAYS A SAFER PLACE

Railways and railway stations can be subject to vandalism and suicides. Improved measures could help avoid mishaps and tragedies, while strengthening security and punctuality.



From vandalising trespassers to disturbing suicide attempts, railway infrastructure is often targeted by individuals who want to make a statement or who are unhappy with their lives. This can cause a major service disruption for thousands of travellers and result in significant delays. The EU-funded project RESTRAIL (Reduction of suicides and trespasses on railway property) aimed to reduce the occurrence of trespasses and suicides on

railway property. These factors have been assessed as the most ideal prevention and mitigation measures.

To achieve its aims, the project outlined best practices and research data from around the globe, analysing factors that influence these acts and investigating consequences. It studied current countermeasures to develop new ways of coping with occurrences, with the aim of producing a set of recommendations and guidelines on the topic.

Bringing together experts from the rail industry as well as the police, emergency services, academia and media, the project created a web-based toolkit to support authorities in reducing suicides and trespasses. The project team collected and analysed valuable data on railway suicides and trespassing accidents, in addition to having identified measures to reduce these incidents.

Among its key achievements, the project team developed tools and methods based on the most effective soft measures (e.g. media efforts) and hard measures (technical solutions). From education campaigns to high-tech deterrents, the railway sector can help discourage the phenomena in question and streamline its operations.

By providing decision makers in the rail sector with the tools to mitigate suicides and trespasses, the RESTRAIL project will help improve the safety, security and reliability of rail transport.

“The project team collected and analysed valuable data on railway suicides and trespassing accidents, in addition to having identified measures to reduce these incidents.”

RESTRAIL

- ★ Coordinated by UIC in France.
- ★ Funded under FP7-TRANSPORT.
- ★ <http://cordis.europa.eu/result/rcn/92526>
- ★ Project website: <http://www.restrail.eu/>

KEEPING OUR ELECTRICITY SUPPLY SAFE

These days, extreme weather phenomena and terrorist attacks that debilitate electricity supply infrastructures are a reality. Researchers have recently created new tools to protect the EU against such attacks.

Security and infrastructure are important topics in the EU. The Member States are working proactively against occurrences on their territories, particularly since electric grids are now connected across borders and countries. The EU-funded project SESAME (Securing the European electricity supply against malicious and accidental threats) worked on an advanced solution to protect against such scenarios.

More specifically, the project developed a decision support system to protect power transmission, as well as distribution and generation systems. It created a software system

“The project developed a decision support system to protect power transmission, as well as distribution and generation systems.”

that detects vulnerabilities and threats, while proposing protective measures and effective cost-benefit analyses for countermeasures. The project team also addressed market mechanisms that hinder protection. These include the lack of incentives for building a secured infrastructure and inefficient regulatory and policy frameworks concerning infrastructure security.

Already, the project team has analysed sample blackouts to identify their causes and rank the threats. It designed a system for detecting structural vulnerability and an incident-response system to simulate the blackout after triggering events and restoration of the lost load. In addition, the team surveyed households in all EU Member States and businesses in 266 regions and nine economic sectors to assess the economic impacts of power interruptions. This revealed that the European networks are facing new risks such as rapid market liberalisation and growing market interconnections.

One major project achievement was developing a risk management framework to strengthen the decision support system, effectively ranking threats and countermeasures. The system includes a risk assessment tool used to identify vulnerabilities in grids and plants. The system is designed to protect critical infrastructures against cascading effects caused by sabotage or terrorism. It also features a system for planning automatic restoration and intelligent reconfiguration in case of failure. This is in addition to a tool that assesses the potential impact of a failure.

The SESAME system will benefit not only single-nation grids but also multi-national grids. It will keep the electricity supply that we depend on safer and more secure than ever.



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SESAME

- ★ Coordinated by the Politecnico di Torino in Italy.
- ★ Funded under FP7-SECURITY.
- ★ <http://cordis.europa.eu/result/rcn/148988>
- ★ Project website:
<http://www.sesame-project.eu/>

SPACE

IMPROVED EPHEMERIDES OF NATURAL SATELLITES

Measuring the position of natural satellites is essential to ensuring a spacecraft has enough propulsion to reach its target. EU-funded scientists have calculated precise ephemerides for planetary moons by taking physics into account.

Ephemeride is the scientific term used for a mathematical calculation primarily used to determine the position of Solar System objects, in particular natural satellites. Space scientists use ephemerides to locate where a planet, satellite or comet will be at specific points in the future. They need this information to plan manoeuvres known as 'fly-bys' during which a spacecraft tracks the target from an appropriate distance.

The EU-funded project ESPACE (European satellite partnership for computing ephemerides) brought together seven

universities and research centres to find new ways to develop precise ephemerides. At the heart of their efforts were observations collected from space missions covering

gravity, each object's orientation and tidal effects — some of them had never been used before.

These observations were combined with data from ground-based observatories, including photographic plates from long-focus instruments to improve the constraints on the motion of solar system objects. Some observatories, particularly in the US, keep a large number of photographic plates that have never been analysed using modern computing techniques.

Plates from the United States Naval Observatory (USNO) and other institutes were digitised with a new generation scanning machine. Going back in time provided the time span needed to identify tiny deviations in natural satellites' motion. It was by using this piece of information that ESPACE researchers could calculate more accurately the location of the moons of Mars, Saturn and Uranus.

All the data scanned and analysed has been made available through the ESPACE natural satellites database. Digitised astrometric data together with satellite data have already been used to improve orbit models of spacecraft. This will be valuable for prospective planetary missions such as ExoMars.

More important, ESPACE has created Europe's first network of space scientists working on ephemerides. The project is expected to impact on the coming decades and for the benefit of future planetary space missions.

ESPACE

- ★ Coordinated by Paris Observatory in France.
- ★ Funded under FP7-SPACE.
- ★ <http://cordis.europa.eu/result/rcn/90408>
- ★ Project website: <http://espace.oma.be/>

FORECASTING SPACE WEATHER

With more than 1 000 satellites in orbit around Earth, figuring out how to predict solar storms has been high on the research agenda. A new European system has responded to the challenge and now provides frequent and reliable web-based forecasts so that satellite operators can take action to protect their satellites from damaging solar eruptive activity.

Invaluable in a myriad of applications, satellites are also vulnerable. Quite plausibly, an unusual output from the Sun could wipe out tens of billions of euros worth of equipment.

The EU-funded project SPACECAST (Protecting space assets from high energy particles by developing European dynamic modelling and forecasting capabilities) has delivered a real-time system that assesses space radiation risks, helping to protect satellites used for navigation, telecommunications and other services.

For the first time, it is possible to forecast radiation levels for a whole range of different orbits. These range from the geostationary orbit to the slot region, including medium Earth orbit.

The new system can detect and forecast high-energy particle radiation in the Earth's outer radiation belt. Using the project's two unique forecasting models, the system provides a risk index for satellite operators.

One of its key features is that radiation levels are computed from the physics of wave-particle interactions. Observations had long shown that special types of very-low-frequency electromagnetic waves can increase or decrease space radiation levels. These variations are now incorporated into the forecasting models. Based on these, scientists demonstrated that chorus waves can accelerate electrons to very high energies and acceleration occurs at the geostationary orbit.

In addition to detecting high-energy particles, the system is providing real-time updates of medium-energy electrons. These can statically charge a satellite, potentially damaging components such as solar panels. Previously, providing such updates had proven difficult. Finnish partners achieved this by adapting current research models to run in real time, while also considering the solar wind electrical interactions with Earth's magnetosphere.

During the Sun's 11-year activity cycle, the number of moderate to large magnetic storms varies from about 15 to 60 per year. Solar maximum activity peaked in 2014, while in 2015 the number of magnetic storms started to wane. The hourly-updated new forecasting system will help protect the satellites from these storms.

"Scientists demonstrated that chorus waves can accelerate electrons to very high energies and acceleration occurs at the geostationary orbit."

SPACECAST

- ★ Coordinated by the Natural Environment Research Council in the United Kingdom.
- ★ Funded under FP7-SPACE.
- ★ <http://cordis.europa.eu/result/rcn/90392>
- ★ Project website: <http://www.fp7-spacecast.eu/>

SMALL ENGINE TO SET SMALL SATELLITES FREE

Scientists all over the world are beginning to use satellites the size of a shoe box to explore space on the cheap. Recently, an EU-funded team unveiled a new type of thruster that could revolutionise how these small satellites are used.

Scientists working on the L-μPPT (Innovative liquid micro pulsed plasma thruster system for nanosatellites) project developed a prototype mini thruster to extend the capabilities of the new breed of small satellites — CubeSats. Incorporating a propulsion system will increase the diversity of missions undertaken by these nanosatellites.

CubeSats have dimensions of 10 cubic cm and therefore impose extremely demanding mass budgets. Attempting to incorporate a propulsion system into such nanosatellites is a highly ambitious goal. However, the benefits of on-board propulsion for changing orbit or even propelling them to far-flung destinations, something that currently requires larger spacecraft, outweigh the increased system complexity and cost by far.

Due to their reliability and low weight, a 'Pulsed plasma thruster' (PPT) was considered the most suitable option for nanosatellites. A PPT operates on a train of pulses. Each pulse is a plasma discharge that forms across the propellant, typically Teflon. The spark erodes the metal from the



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SPACE

electrodes, and electromagnetic fields accelerate the eroded mass out of nozzles, producing thrust.

The L- μ PPT team replaced blocks of Teflon with a non-toxic liquid propellant, allowing the amount of fuel introduced to be tightly controlled. The physical mechanisms that occur within a PPT were analysed on a test bed to determine the efficiency with which the energy stored in the capacitor is converted to energy to accelerate plasma.

Understanding this issue was key to the design of a functional prototype weighing 0.33 kg and measuring 33 mm in height. The first prototype was fabricated using mature and inexpensive technologies adopted from printed circuit boards. L- μ PPT scientists conducted multiple vacuum

chamber tests to verify the targeted impulse of at least 100 newtons per second and three-axis attitude control.

The L- μ PPT system is one of the first propulsion systems to provide full axis control on nanosatellites. Having an active propulsion system in orbit will open up new possibilities for CubeSat missions, like rendezvous and docking. The experience gained in using the new liquid μ -PPT on CubeSats could then be scaled for larger missions, providing a low-cost and low-mass solution for future endeavours.

L- μ PPT

★ Coordinated by JMP Ingenieros SL in Spain.

★ Funded under FP7-SPACE.

★ <http://cordis.europa.eu/result/rcn/90926>

MULTI-GBIT/S NETWORK TECHNOLOGY FOR SPACE

Technology able to support multi-Gbit/s communication networks has been developed to transfer data from instruments to the mass memory and then to the downlink telemetry unit, but this has been restricted to United States missions. The good news for Europe is that an EU-funded project has remedied the situation.

Space Fibre has been developed for use with high data rate payloads, like synthetic aperture radars and hyperspectral optical imagers producing data at rates of several Gbit/s. This high-speed serial data link complements the capabilities of the widely used networking standard Space Wire. It provides bandwidth that is more than 10 times wider.

The project VHISSI (Very high speed serial interfaces) aimed to leverage research on Space Fibre to provide a complete solution for the on-board networks of Earth observation missions. To

achieve this goal, the European micro-electronics research community joined their efforts with large prime contractors and small and medium-sized enterprises.

VHISSI's seven project partners were successful in developing an experimental chip implementing the Space Fibre serial communications protocol. It has been designed to integrate fault detection, isolation and recovery capabilities into the hardware. In addition, quality of service mechanisms allow the bandwidth of on-board communication networks to be specified.

The VHISSI device provides a Space Fibre interface able to operate at the speeds of spaceflight-qualified field-programmable gate arrays while sustaining data transfer of two Gbit/s. Together with a router device to interconnect instruments, it is able to support the multiplexing of packets containing instrument data, control or status information.

A series of prototypes of the VHISSI chip was manufactured by a European foundry. Extensive testing has been carried out to cover all modes of operation. The results obtained at different temperatures and with different supply voltages have demonstrated its robustness. The interfaces of the chip performed at the speed they were expected to operate, suggesting that it fulfils the design goals.

To date, the Space Fibre technology has relied on United States-based providers for radiation-tolerant devices that could not, however, be used on European space missions. The VHISSI project has provided Europe with technology needed for spacecraft on-board data links and communications networks that will enable it to compete on the world market.

VHISSI

★ Coordinated by the University of Dundee in the United Kingdom.

★ Funded under FP7-SPACE.

★ <http://cordis.europa.eu/result/rcn/170122>



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EVENTS

MARCH
03

London, UNITED KINGDOM

EVENT

THE EU-FUNDED VRUITS PROJECT

The EU-funded VRUITS project will hold its final event in London on 3 March 2016.

The VRUITS (Improving Safety and Mobility of Vulnerable Road Users through its Applications) project will be hosting its final project event in London where project coordinators, researchers and contributors will discuss and assess the project's success.

Starting in April 2013, the VRUITS project has been developing evidence-based recommended practices on how vulnerable road users can be integrated in Intelligent Transport Systems (ITS). It has also been assessing the overall societal impacts of ITS on how they can contribute to improving the safety and mobility of vulnerable road users.

For further information, please visit:
<http://bit.ly/1Wr59gu>

MARCH
08

Hamburg, GERMANY

CONFERENCE

PLEEC FINAL CONFERENCE

The final conference for the PLEEC project will take place at the HafenCity University in Hamburg, Germany, on 8 March 2016.

It will be organised within the framework of the International Conference on Sustainable Built Environment (SBE 16), a first-class scientific event focused on sustainable development and new concepts of sustainability in the building sector.

PLEEC, which began in April 2013, has been developing a general model for energy efficiency and sustainable city planning.

For further information, please visit:
<http://bit.ly/1nvGVFY>

MARCH
08-10

Girona, SPAIN

EVENT

DROPSA MEETING AND STAKEHOLDER EVENT

The EU-funded DROPSA project will host its next meeting and stakeholder event in Girona, Spain, from 8 to 10 March 2016.

The meeting will gather project coordinators, consortium members and other relevant stakeholders together to assess the project's progress and the next stages of its development.

The DROPSA project, scheduled to run from January 2014 to February 2018, is in the process of developing effective, innovative and practical approaches to protect major European fruit crops from pests and pathogens.

For further information, please visit:
<http://bit.ly/1n7MdXD>

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EVENTS

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Stockholm, SWEDEN

CONFERENCE

UNDISCIPLINED ENVIRONMENTS: INTERNATIONAL CONFERENCE OF THE EUROPEAN NETWORK OF POLITICAL ECOLOGY (ENTICE)

The EU-funded ENTITLE project will be hosting an international conference in Stockholm on the theme of 'Undisciplined Environments', Sweden, from 20 to 23 March 2016.

This international event organised by the European Network of Political Ecology (ENTICE), in association with the Centre for Social Studies at the University of Coimbra, will discuss the possibilities for the development of an interdisciplinary political ecology.

The conference will offer three plenary sessions, each featuring a dialogue between two keynote speakers from different geographical and disciplinary environments: 'Decolonial political ecology', 'post-capitalist ecologies' and 'enclosures vs. communing'.

In addition to the three plenary sessions, the conference will host a number of parallel panel sessions, as well as non-academic interventions.

For further information, please visit: <http://bit.ly/1Wr33xh>



Introducing the New CORDIS Results Packs

CORDIS is pleased to announce the launch of the Results Pack series, a collection of articles bound together in a single web page that focuses exclusively on one specific topic of interest. Each

collaboration to stimulate new research initiatives and/or pave the way for the commercialisation of new products within the sector.

Each Results Pack on the CORDIS website has its own dedicated space. Results Pack will be revised and extended on a regular basis, to make sure that the information keeps up with the latest outcomes in the field.

If you're interested in finding out more, we invite you to go to the CORDIS website at cordis.europa.eu, where you will be able to explore our very first Results Pack edition, published in December 2015, focusing on the development of new materials to further increase buildings' energy efficiency and contribute to the EU's long-term climate change ambitions.

If you like what you see, we invite you to get in contact with the CORDIS editorial team (editorial@cordis.europa.eu) to enquire as to whether your project could be featured in an upcoming Results Pack.

edition will contain one introductory editorial, followed by a series of research articles and interviews exploring in-depth the results of EU-funded projects relevant to the overarching theme.

The CORDIS Results Pack aims to ensure that all interested parties are kept up-to-date on recent results within their specialised field, and to provide a succinct snapshot of exciting new products, trends and scientific advances within the sector that can be further built upon and utilised. The Results Pack series also aims to foster and encourage closer

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