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SPECIAL FEATURE

SEEDING IDEAS FOR PRESERVING OUR FORESTS



SOCIAL SCIENCES & HUMANITIES
**CREATING A COMMON
EUROPEAN IDENTITY
BY DIGITISING ITS
CULTURAL HERITAGE**

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FOOD & AGRICULTURE
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EDITORIAL

by the editorial team

MANAGEMENT VS. COURSE OF NATURE: WHAT'S THE BEST PATH TO PRESERVE OUR FORESTS FROM CLIMATE CHANGE?

At first sight, Europe seems like a hospitable land for trees of all kinds. Forests cover some 33 % of Europe's territory, and this area has increased by 17 million hectares since 1990. But it doesn't mean the 14 million European forest owners and managers can rest on their laurels: the expansion of urban areas, the growing success of biomass for energy production, wildfires, high demand for wood products, increased land use, and climate change all contribute to putting increasing pressure on these ecosystems.

Whilst the absence of a common forestry policy in Europe prevents the EU from deciding on appropriate counter-measures, the EU does stress the importance of forests for biodiversity, soil

and water protection, carbon sequestration, biofuels or timber production. But the question is, how can forestry make the most of our forests while gearing them up — and using them as a weapon — against climate change?

'Economic needs and the lack of an absolute solution against climate change are forcing scientists to stretch their imagination.'

Deforestation and the results of overly selective breeding programmes might make us think that the best solution to protect forests is to leave them be. However, economic needs and the lack of an absolute solution against climate change are forcing scientists to stretch their imagination.

If we are to create 'super forests' capable of fulfilling all of our needs, we first need to know more about their composition, genetics, evolution, potential for carbon sequestration and capacity to adapt to climate change, and to develop technological solutions to protect or extend them.

This issue of the *research*eu results magazine* is giving the floor to those scientists who are currently trying to fill all of these gaps. Ten of the most recent forest-related and EU-funded projects are presented and shed light on what future forests and future forest management strategies could look like.

This special feature is followed by the usual eight sections providing insights into biology and medicine, social sciences and humanities, energy and transport, environment, IT and telecommunications, industrial technologies, food and agriculture, and physics and mathematics, 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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investing against
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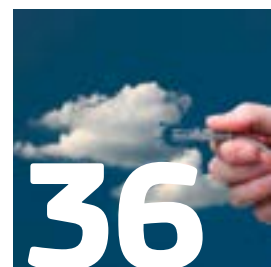
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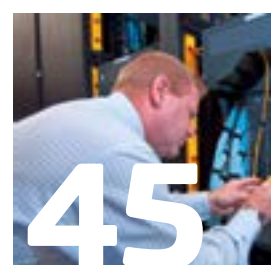
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SPECIAL FEATURE

**SEEDING IDEAS
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INTERVIEW

**FILLING KNOWLEDGE
GAPS TO SUSTAIN FUTURE
FORESTRY**

Sustaining the growing demand for wood products and other forest services is becoming increasingly difficult due to the likes of climate change, pests and diseases affecting European forests. The TREES4FUTURE project brought together 28 research organisations from various disciplines to provide common datasets that will eventually result in more trimmed forestry for the future.

Despite its continued efforts to support sustainable forest management, the forestry sector still has much learning to do when it comes to tree genetics and physical environment, basic wood properties and their impact on end-product quality, as well as know-how to bring studies from individual to forest scale. Whilst the much needed data and expertise do exist, they are currently scattered across various disciplines with no effective means to cross-fertilise them.

Starting in 2011, the EU-funded TREES4FUTURE (Designing Trees for the future) project aimed to bridge these gaps by providing a holistic approach to forestry that integrates

abiotic and biotic environmental aspects through biological responses, biomass production and industrial technology. Five years on, the project has brought each of its 11 work packages to a successful closure.

Among the project outcomes are: a common search interface for genetic data; new standards and methodologies for the assessment of field traits and wood properties; and the creation of three thematic networks on phenotypic plasticity, phenology and societal perception of forestry.

On a purely research level, the close to EUR 7 million project also developed: a suite of statistical tools for genetic



© Gert-Jan Nabuurs

PROF. GERT-JAN NABUURS

evaluation; a molecular marker platform for fingerprinting and traceability of biological material; a site matching tool to match the current or projected climate at a site to any other similar place in Europe; a clearinghouse with 'Geographic information system' (GIS) functionality for research data; improved compatibility of existing modelling tools; and medium to high-throughput phenotyping methods.

Gert-Jan Nabuurs, Professor of European Forest Resources at Wageningen University and vice-coordinator of TREES4FUTURE, agreed to discuss these outcomes ahead of the publication of the project's final report.

• **Why do you think climate change requires a new approach from the wood products and services sector?**

Gert-Jan Nabuurs: There are several reasons the wood products sector requires a new approach. First, the impacts of climate change will alter the state of the forests throughout Europe. In the South, forests will be affected by droughts and fire. In Central Europe, new species will become more dominant, and in Northern Europe the forests will start to grow faster, especially the ones populated by pine.

On the other hand, the wood products sector can help mitigate climate change. Wood products require less energy to produce than the likes of steel and concrete. We foresee a higher demand for the construction sector. Also new demands for new products will arise: these include novel packaging for food or textile, or biorefined products. This will all change the sector dramatically.

• **One of the main project outcomes is a platform for analytical, statistical, genetic and molecular analysis. What are the benefits of using it for stakeholders?**

Tree breeding stands at the basis of all above-mentioned changes. In order to push breeding forward, the platform is

very much needed. Thanks to TREES4FUTURE, access to data is also more secure.

• **What are the other tools that you created? What's their added value?**

For example, we created a set of modelling tools that provides insights into how the sites will change under climate change, or which provenances are best to plant. Furthermore, we created a set of modelling tools to scale up genetic information (which is now scarce and local) to regional predictions of impacts.

• **Why was it important to bring all stakeholders together for this project?**

Eventually, the tree breeders will have to use the information from TREES4FUTURE. The national partners in T4F have a task of further informing national breeders associations. And they will do that.

• **Can you provide a notable example of a knowledge gap that has been filled thanks to TREES4FUTURE?**

Access to provenance trials has been improved. This may sound strange, but it remains a challenge to have good overviews of provenance trials from the past. Furthermore, high throughput phenotyping methods have been further developed and made available. This makes it possible to carry out many measurements and relate these to genetic information. Also, the upscaling of genetic information in modelling tools is now possible. The latter shows that there is much resilience in tree populations, and that climate change impacts are dampened.

• **The project was completed in April. Do you intend to keep maintaining and promoting the tools you developed?**

Yes, the transnational access tools will remain available through the website. Also, the developed tools are open source.

• **What could be, according to you, some examples of selection processes that would be facilitated by the project's outcomes?**

We now know much more about Douglas fir provenances and how they grow here in Europe in comparison to their native sites in the USA. This knowledge may alter the selection of provenances in the future.

"In order to push breeding forward, the platform is very much needed."

TREES4FUTURE

- Coordinated by INRA in France.
- Funded under FP7-INFRASTRUCTURES.
- <http://cordis.europa.eu/project/rcn/100959>
- Project website: <http://www.trees4future.eu/>

ACCURATELY ASSESSING GLOBAL RIVER-FLOODPLAIN FOREST STRATEGIES

A Marie Curie International Outgoing Fellowship (IOF) grant enabled a young European researcher to develop a global perspective on river-floodplain forest restoration strategies and to put forward universal criteria to accurately assess project success.



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Riparian (river-floodplain) forests, which are unique sources of biodiversity, food and raw materials, are under increasing threat from urban, industrial and agricultural development. In order to ensure their survival, a number of restoration projects have been launched across the globe over the past few decades in an attempt to ensure compatibility between self-sustainable and healthy river-floodplain forests with human activity.

'Many restoration projects have sought to deal with a variety of environmental problems that affect riparian forests,' explains ESFFORES (Evaluating Success of Floodplain Forest Restoration) project coordinator Dr Eduardo González, who carried out the project at the University of Denver in the US and the Laboratoire d'Écologie Fonctionnelle et Environnement in Toulouse, France. 'The sheer variety of these approaches, together with a lack of funding for proper monitoring, means that no systematic objective or standard criteria to evaluate their success or failure has ever been put in place. This ultimately jeopardises their impact.'

Measuring success

In order to address this, the ESFFORES project sought to assess the effectiveness of various restoration projects in order to open up discussion on establishing universal criteria for declaring success. Data on environmental management and vegetation variables was recorded at a variety of sites across two semi-arid regions of the western US and southern Europe, with climatic gradients covering different reaches of six large river basins: Middle Rio Grande, Upper and Lower Colorado, Ebro, Duero and Garonne.

'By concentrating our efforts on evaluating results — rather than on defining goals and implementation techniques — we were able to combine traditional evaluations using local and site-specific data with larger spatial evaluations over longer periods of time,' says González. 'The inclusion of very different restoration strategies from around the world, at large spatial and long temporal scales, allowed us to identify some universal indicators responsive to restoration and universal factors leading to success or failure.'

The project found that similar plant diversity metrics can be used to evaluate the success of very different restoration approaches, but that some metrics are more responsive to restoration than others. Furthermore, restoration outcomes in floodplain forest restoration resulting from different strategies can be partially predicted by readily measurable environmental parameters, such as climate.

'Restoration approaches alone cannot restore pre-disturbance conditions, but can greatly influence vegetation successional trajectories,' says González. 'This is important as it gives us room for manoeuvre to modify the ecosystem to satisfy our needs in a sustainable way. An unexpected result was that successful restoration was not necessarily more likely with active revegetation, if natural processes such as flooding are restored.'

A global perspective

The project was made possible by a Marie Curie International Outgoing Fellowship (IOF) grant, which involved González spending two years in a non-European country and one year in Europe. Leading scientists in the field of riparian restoration ecology supervised the project in Europe and the US.

'This framework really suited me as a fundamental aspect of my project was to compare different restoration approaches between world regions,' explains González. 'I was able to meet with some of the most reputed riparian ecologists in North America and learn about their approaches to managing invasions of exotic plants, which is the main motivation of floodplain forest restoration projects in the southwestern US.'

ESFFORES

- Coordinated by CNRS in France.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/news/rcn/125460>

NOVEL FOREST FIRE-FIGHTING TECHNOLOGY ALLOWS ALL END USERS TO CONTRIBUTE

Forest fire-fighting represents a yearly budget of EUR 2.235 million for EU governments and public agencies. This accounts for most European efforts, while the rest of the market is occupied by a myriad of small real estate owners and private companies owning assets they are often not able to protect efficiently. A Spanish SME is developing a Smart Fire Barrier which will allow all these stakeholders to step their game up.

Forest fires have become commonplace. Each year around summertime, Spain, Portugal, France, Greece and Italy combined see around 500000 ha of their forests go up in smoke. This is caused notably by rural depopulation — as activities that were previously keeping forest fires under control are increasingly becoming a thing of the past — and is speeding up climate change. In fact, the local fires our ancestors used to deal with are now increasingly evolving into 'mega-fires'.

The chink in our forests' armour resides in 'Wildland urban interface' (WUI) areas, which are quickly expanding. 'These areas are critical in this process, since they require special attention from the emergency forces and are a typical focus of fire ignition. WUI often lack the required fire prevention countermeasures, due to their cost and their execution requirements in terms of land occupation, vegetation removal and infrastructures,' explains Joaquín Catalá Lloret, CTO of Pyro Fire Extinction in Spain.

Since it was founded in 2011, Pyro Fire Extinction has been contributing to the protection and preservation of forests by designing, engineering and producing innovative solutions for the control and extinction of forest fires. In 2014, the company's know-how granted it a place in the FP7-funded AF3 project to develop technologies that would improve the efficiency of fire-fighting operations. One year later, the company received H2020 funding for the SMART FIRE BARRIER (Innovative Forest Fires Prevention Infrastructure for Residential Areas, Forestry and Critical Infrastructures) project.

SMART FIRE BARRIER revolves around the Pyro Smart Fire Barrier, a completely new prevention tool. Composed of extinguisher Nub-e capsules developed under AF3, the system is able to extinguish incipient fires by itself and can be used in a mobile firebreak to support the action of fire brigades and volunteers.

'Nub-e capsules are easy to transport and to install on the field, and once placed they remain operational for months,' says Catalá. 'The technology is purely based on the temperature elevation generated by the fire, without the use of explosives or electronics. It makes it possible to deliver a safe, robust and easy to use product while reducing the need for maintenance. Once activated, each capsule sprays its content over the vegetation, protecting the defined area and preventing it from burning.' No need to remove vegetation or modify the landscape: the Smart Fire Barrier is modular. It adapts to existing infrastructure and terrain configuration in order to provide a cost-effective solution for small real estate owners.

From smart cities to smart landscape

Over the next five years, Pyro Fire Extinction wants its system to disrupt the market by making it possible for everyone to contribute to the fight against forest fires. 'We

understand that we cannot be inhabitants of Smart Cities while being strangers outside them, and thus we propose to connect our cities with their environment, creating the Smart Landscape,' says Catalá.

The first step to living up to this ambition was to conduct a feasibility study under Phase 1 of the SME Instrument.

Thanks to EU funding, the company was able to design an effective market segmentation strategy and a marketing strategy aimed at both specialists and laypeople. 'As a company, Phase 1

has allowed us to reflect on how to successfully address target customer segments over time, in a way that is compatible with the company's growth strategy,' explains Catalá.

'We also conducted market prospection activities with fire fighters, neighbours, public administration managers, etc. in order to study different cases and to understand clearly what the situations in which the introduction of our Smart

"Once activated, each capsule sprays its content over the vegetation, protecting the defined area and preventing it from burning."



SPECIAL FEATURE

Fire Barrier can make a difference are. Furthermore, as a result of having performed the feasibility study, we have now protected our technology by means of a patent application, and we have published several articles in scientific media in order to let others know about our approach and experimental results.'

Next steps

Validation of the technology with end users is also well under way. 'For us, this has been a priority in every stage of PYRO Smart Fire Barrier: we have extensively validated our technology with end-users and independent research institutions, which helps us define the best product, and we have engaged a relevant number of recognised experts for the prescription of Pyro Smart Fire Barrier in the sector,' says Catalá. Most of this process took place under AF3 with support from the public agencies involved in the project. 'AF3 has made it possible for us to achieve technological milestones in a very short period of time, and to have a product tailored to their expectations. However, this project is only based on technology demonstration, and we need to overcome this stage in order to bring our product to the market.'

This is where Phase 2 of SME Instrument funding will be crucial. Catalá and his team expect that this new phase will allow them to convert the technology into a tangible, marketable product, as well as reinforcing their team with business profiles.

'Our main objective under SME Instrument Phase 2 is to perform pilot testing of Smart Fire Barrier with end-user specialists in order to obtain visible success cases. These cases will enable us to show our customers that what we offer will significantly increase their level of safety and even more: they will be granted the reward of contributing to safeguarding their environment. Achieving a suitable product certification from independent institutions is also an objective of Phase 2: it will help us to commercialise the product internationally,' says Catalá enthusiastically.

SMART FIRE BARRIER

- Coordinated by Pyro Fire Extinction in Spain.
- Funded under H2020-SMEINST-1.
- <http://cordis.europa.eu/project/rcn/197573>
- Project website: <http://www.pyro.es/>

TOWARDS BETTER MANAGEMENT OF FOREST GENETIC RESOURCES

An EU-funded project has investigated the impact of changes in 'Forest genetic resources' (FGR) across Europe. The outcome is a panel of guidelines and policy briefs that should help stakeholders and policy makers in adopting FGR management strategies fit to withstand climate change.

The role of forests in the fight against climate change needs no further evidence. But while planting a tree is indeed a solution for removing CO₂ from the atmosphere, grabbing the first seed at hand won't necessarily do the trick. Each tree has its own genetic variations, and this diversity is precisely what allows forests to adapt to a changing climate.

The good news is that European research projects have already compiled valuable information on FGR over recent decades. The bad news is that their present distribution is not well documented, and this lack of information is preventing the development of informed management strategies by forest managers and policy makers.

This is where the FORGER (Towards the Sustainable Management of Forest Genetic Resources in Europe) project comes into play. 'Currently there is little or no FGR management of European forests,' says Dr Koen Kramer of Alterra, who coordinated the project. 'This is regrettable because FGRs are the basis of forest adaptation to environmental changes, brought about by natural processes (evolution) and/or artificial selection.

FGRs are essential to tree breeding and assisted migration, which is why we wanted to better understand their past, present and future.'

Completed in February 2016, FORGER provides guidelines and policy briefs to help stakeholders come up with effective management strategies.

Harvesting seeds and selecting reproductive material

Seed harvesting is the first topic approached by the project, as it stresses that the method employed to harvest seeds significantly affects their genetic quality. 'A genetically-sustainable seed harvest should optimize the genetic diversity in the seeds obtained and minimize genetic differences between seed harvest and the seed stand,' reads the dedicated guidelines document. The level of diversity needs to be balanced, so as to ensure that the forest will be able to cope with climate change while avoiding the sky-high costs associated with harvesting all available seeds.

The dedicated guidelines include research findings along with global and



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species-specific recommendations. Among those is the fact that no fewer than 15 trees should be sampled, provided that seed samples per tree are large and that the species are characterised by random mating. Seed harvest from directly neighbouring trees should also be avoided.

Along with seed harvesting methods comes the question of which 'Forest reproductive material' (FRM) should be favoured to maximise chances of survival in the face of climate change. The project provides further recommendations based on the nature of this change, which varies across regions. It strikes down the prejudice that local provenance is necessarily better, and points to the importance of phenotypic stability.

"Whilst a 'no-management approach' will often result in higher diversity — active management increases the chances of adaptation."

Shaping future policies

Another key contribution of the project, closely related to the ones mentioned above, is a policy brief on the origins of FRM. As data is currently very scattered and EU legislation has failed to result in evaluations, monitoring or guidance, FORGER contributes by examining seven tree species and assessing their movement volume (302 million plants from 2004 to 2014), direction and distance. 'The results generated by FORGER

strongly indicate the need to strengthen the implementation of existing regulations and to harmonise data on transfer of FRM across EU Member States,' Dr Kramer says.

Regarding climate change, the project provides recommendations for policy makers based on field and modelling studies: the team notes the importance of stable performance over various environmental conditions, stresses the role of assisted migration to sustain healthy and productive forests, and makes the case for the establishment of new provenance trials.

Among the most interesting observations is the fact that climate change might outrun genetic adaptations in the monitored species, and that — whilst a 'no-management approach' will often result in higher diversity — active management increases the chances of adaptation.

'FGRs are critical to having forests adapted to future climate. Currently too much emphasis is being put on species change to adapt to future climate. This will strongly disrupt the forest ecosystem and forests management, creating large uncertainties. Much can be attained with changes in provenances while using the same species,' Dr Kramer notes.

In its third and last policy brief, FORGER analyses the impact of *in situ* and *ex situ* conservation of genetic resources. Using databases developed under the EUFGIS and EVOLTREE projects, the team found that few measurements of genetic diversity were available from within the genetic conservation units. It identified conservation gaps — locations where the species examined occur in climatic conditions that are distinct from the climatic conditions found within the genetic conservation units — and concluded that genetic markers available to characterise the genetic diversity of tree species were not associated with their adaptive properties.

The outcomes of the project are already generating interest across Europe. 'The guidelines have been translated to Hungarian, and will be translated to at least German and French, and possibly Italian. Workshops have also been held to disseminate the results in different partner countries,' says Dr Kramer.

FORGER

- Coordinated by Alterra in the Netherlands.
- Funded under FP7-KBBE.
- <http://cordis.europa.eu/project/rcn/102045>

GNSS TECHNOLOGY FOR BETTER BIOMASS MAPPING

The EU-funded COREGAL project combines traditional positioning technology with reflected 'Global navigation satellite system' (GNSS) signals to let land management professionals see through thick tree canopies and better understand what lies on the forest floor.

Not only is Brazil a large country but much of it is covered by the dense Amazon rainforest. Trying to manage such a rugged and isolated area using traditional mapping, surveying and land management tools is simply impossible. Here, a new land management technology is needed — and that technology is called COREGAL (Combined Positioning-Reflectometry Galileo Code Receiver for Forest Management).

The COREGAL project aims to harness the combined power of positioning and reflectometry technology in order to create a low-cost, unmanned aerial platform for biomass mapping of the Brazilian Amazon forests. The innovative platform is the first of its kind — combining GNSS technology with drone, or 'Unmanned aerial vehicle' (UAV), systems.

Traditionally, this sort of work has been completed using a combination of various sensor technologies and sources of information. COREGAL, however, disrupts this approach by bringing a new sensor to the market, one capable of providing additional data to further improve upon existing products. Thus, on the one hand, COREGAL's UAVs are



equipped with a Galileo-enabled GNSS receiver that serves as the main sensor for positioning information and biomass estimation. However, as Galileo signals aren't always able to reach through the thick canopies of Brazil's jungles, the COREGAL platform combines this traditional receiver with reflected GNSS signals (GNSS-R) that are capable of cutting through the dense canopy environment. Combined together, the platform provides the end user with a high-accuracy, lower-cost solution for land management and biomass mapping.

How does the system work?

In the COREGAL system, the GNSS satellite in space serves as the transmitter and the UAV works as the receiver. The transmitted signal from the satellite is reflected off the ground,

acquiring information about the surface's characteristics — including obstacles — along the way. This reflected signal is then received by the UAV's biomass sensor, which extracts the data about the reflected surface (i.e., the ground) from the reflected signals.

“With this information in hand, local governments can mitigate against deforestation and forest degradation activities that could release harmful carbon gasses.”

Specific to its application to biomass mapping, as the signal is reflected back up through the tree canopies, branches and leaves, important biomass data is captured, and subsequently extracted by the UAV receiver.

‘Integrating positioning and reflectometry in a single device within a UAV offers a unique value proposition,’ explains project coordinator Pedro Freire da Silva. ‘Furthermore, GNSS-R signal properties allow for a lower saturation level than traditional radar systems, providing the end user with greater sensitivity to a higher level of biomass density.’

Benefits and next steps

Understanding an area's biomass is essential to being able to assess the economic, conservation and biofuel potential of a given land surface. Furthermore, this biomass data can be used to estimate the amount of carbon stored in a forest — which is important to understanding the potential environmental and climate consequences that any planned land use could have. With this information in hand, local governments can mitigate against deforestation and forest degradation activities that could release harmful carbon gasses.

Currently, test campaigns to validate the COREGAL platform are ongoing. Although the recently conducted first test flight was a success, Silva notes that there have been challenges along the way. For example, during several test campaigns, various interference sources were noted, making it more difficult to receive the Galileo signal, which relies on the E5 radio-frequency band.

That being said, project coordinator remains upbeat: ‘We expect these tests to demonstrate the commercial viability of the COREGAL concept for biomass measurement,’ says Silva. ‘The key advantage of the platform is the substantial cost reduction and increase in biomass mapping accuracy it provides.’ Silva also notes the project is expected to help accelerate the adoption of Galileo-based technology in Brazil, with potential trickledown benefits for related European projects and business ventures.

COREGAL

- Coordinated by DEIMOS Engenharia in Portugal.
- Funded under H2020-GALILEO.
- <http://cordis.europa.eu/news/rcn/125521>
- Project website: <http://www.coregalproject.com/>
-  <http://bit.ly/1tvVZXr>

INNOVATIVE DRONE TECHNOLOGY TO TACKLE DEFORESTATION

A UK start-up is developing a high tech concept that it believes will one day enable it to plant 1 billion trees every year, contributing to efforts to tackle global deforestation and contributing towards greater overall sustainability.



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Deforestation continues to significantly outstrip our best conservation efforts. Illegal logging, land clearance and habitat destruction all contribute towards a net global loss of around 6.6 billion trees each year. But while deforestation is a complex issue with many causes and challenges, there is one concept that can easily be grasped — because tree planting is a labour-intensive and expensive activity, replanting has simply not been able to keep pace with the speed of habitat loss.

Taking this proposition as a starting point, UK-based start-up BioCarbon

Engineering has sought to harness cutting-edge technology to revolutionise the planting process, and thus help to replenish precious habitats and ensure a sustainable supply of forest-based materials. This fits with the EU's objective of moving Europe away from the traditional linear 'take, make and dispose of' model of production and consumption, towards a sustainable circular economy.

The company received an EU grant designed to boost the potential of small businesses for eco-innovation and a sustainable supply of raw materials. This helped to fund a Phase 1 project that focused on establishing a complete supply chain, a sound business model and a commercialisation strategy. The project also involved planning a large-scale pilot for the automated planting solution, to be demonstrated in different ecosystems throughout Europe. The four-month BIOCARBON (Rapid tree-planting through the use of remote sensing and unmanned vehicle planting technologies for large scale reforestation) project was completed at the end of March 2016.

The new planting system consists of a mapping 'Unmanned aerial vehicle' (UAV), a planting UAV and machine learning software. The technique is

fully automated and promises to be a significantly cheaper and faster means of reforestation. The company estimates that 10 seeds can be planted per UAV per minute. Once scaled up, the company aims to plant 1 billion seeds a year.

In addition to cost and speed, the new technique offers a number of other advantages. Mapping technology is used to increase uptake rates and the likelihood of healthy forest development. Given that the planting is carried out by an aerial vehicle, terrain normally inaccessible by land-based approaches can now be reached.

Pods are then fired into the ground by the drone, enabling the planting of a large number of trees in a short period of time. Each pod can be loaded with pre-germinated seeds and a nutritious hydro-gel, giving it all the minerals and moisture it needs to get started.

The technology represents a significant departure from current tree-planting techniques, which include planting by hand and delivering dry seeds by air. Hand-planting is slow and expensive, while spreading dry seeds results in low uptake rates. It also presents an opportunity to help countries meet their environmental obligations. At the

UN Climate Summit in Paris, a commitment was made to restore 350 million hectares of degraded and deforested land by 2030, and it is clear that traditional planting techniques will not be enough.

"The new planting system consists of a mapping 'Unmanned aerial vehicle' (UAV), a planting UAV and machine learning software."

Next steps include scaling up the innovation, continuing to fine-tune the seed-pod dispersal technology, and attracting further interest from potential investors and collaborators in order to bring the concept to market.

BIOCARBON

- Coordinated by Biocarbon Engineering in the United Kingdom.
- Funded under H2020-SMEINST-1.
- <http://cordis.europa.eu/news/rcn/125479>
- Project website: <http://www.biocarbonengineering.com/>
-  <http://bit.ly/21mcvUc>

INTERVIEW

LONGWOOD TELLS THE STORY OF HUMAN INFLUENCE OVER MORAVIAN FORESTS FROM VARIOUS SCIENTIFIC PERSPECTIVES

Knowing the evolution of European forests' composition over the past few centuries or even millennia could prove highly valuable in shaping present management strategies. The LONGWOOD project brought experts and knowledge from various disciplines together to create common databases and prepare guidelines for better woodland management, with a focus on the Moravian Region in Central Europe.

How did humans' management strategies influence Central Europe's vegetation over time? How come we know so little about this process and how can this gap be filled? These questions were at the centre of the LONGWOOD (Long-term woodland dynamics in Central Europe: from estimations to a realistic model) project.

A few months before its completion, Prof. Péter Szabó, coordinator of LONGWOOD, sheds light on the work done so far and discusses its potential for influencing future conservation schemes.

How do you explain that we knew so little about the evolution of forest composition before your project started?

Prof. Péter Szabó: In fact we knew a lot, but I found that the scientific disciplines generating this knowledge did not communicate with each other much. Each discipline has



PROF. PÉTER SZABÓ



its own set of sources and tools and produces specific kinds of results. For example, pollen analysis can reconstruct forest composition in high detail but its geographical scope is limited.

In some respects, cooperation is indeed difficult because the temporal and spatial scales offered by various sources differ. However, in many other respects I saw no reason why the disciplines involved should not work together towards answering what appeared to be common questions. I felt that the moment was right to try to bring different methods together in a region that was large enough to be representative of Central Europe at least and at the same time available for analysis in high resolution.

• **How did you proceed to find past information on Central European forests' composition?**

We planned the research together with colleagues from various disciplines. This was a key stage in the project, because we all knew we could do our own stuff but we had to find a spatio-temporal scale at which we could meaningfully cooperate along with a platform that would hold all the various kinds of data together. For me it was also important to find top-notch experts in each field, because outdated methods in one field would have discredited the whole project.

There are four types of data involved in our research: fossil pollen, archival documents, current vegetation and archaeological data. All these different kinds of data are kept in 'Geographic information systems' (GIS) databases, which

makes them compatible and comparable. Precisely because in our view there was a gap between detailed local studies and somewhat speculative large-scale models, we decided to gather as much data for a larger region (Moravia in the east-

ern Czech Republic, ca. 27 000 km²) as we felt was humanly possible.

Nearing the end of the project, we have thousands of permanent and resurveyed semi-permanent vegetation plots,

dozens of palynological profiles, tens of thousands of historical records on tree species composition and forest management in addition to a complete database of all archaeological findings ever recorded in the area. This gives us a unique opportunity to look at forest development and the role of humans in a complex manner since the end of the latest Ice Age.

• **What have you learned with regards to the evolution of forest composition in Central Europe?**

We are actually in the middle of final analyses and syntheses, but I think first of all we learnt to be suspicious towards received wisdom.

For example, it appears that the most important 20th century process that influenced those forests which are highly valued nowadays for their biodiversity was, at least in our region, the abandonment of traditional management. Nitrogen deposition and other factors also play a role of course, but if you stop managing a forest the way it has been managed for hundreds or maybe thousands of years, that changes practically everything from flowers to butterflies. Our historical data proved that no forest was left unmanaged even in the Middle Ages and also that the ecologically most important factors are not necessarily the best documented. For example, litter raking in forests, which was earlier sidelined as a 'minor use', was practised almost everywhere and could remove as much nutrient from forests as tree cutting.

Another important finding is that it is often impossible to separate human impact from natural processes in ecosystem development. The floristically most valuable oakwood in southern Moravia turned out to have few oaks before people changed its management in the 14th century. Does that make it less 'natural' in the eyes of nature conservation?

On the other hand, not everything is about change. We also found elements of remarkable stability. In a combined palynological, archaeological and palaeoclimatological model we found that open land covered a large part of the lowlands through the entire Holocene period, but again it is impossible to tell exactly to what extent this was caused by people and how much by climate.

• **One main project outcome is a spatio-temporal forest landscape model. What would be typical uses for this model by stakeholders?**

The main sectors that can benefit from our results are nature conservation and forestry. Our results provide an opportunity to follow long-term changes and put current changes, including those triggered by climate change, into a millennial context. On a more concrete level, our databases are intended to be open, so for example if a forestry unit wants to find out about tree species composition in their area in the past few hundred years to develop a better management plan, they will be able to get this information from us.

We are also trying to reassess existing models of tree species' native ranges. Furthermore, we cooperate with nature conservation authorities in several places, where the consequences of the reintroduction of traditional forest management — partly guided by our research — will be monitored by us and also evaluated in the context of overall changes in the 20th century. In an ideal case, our results could contribute to a renewal of Czech forestry policy in terms of desirable tree species composition and the role of traditional forest management, most of which is currently banned outside specially designated areas.

"Our results could contribute to a renewal of Czech forestry policy in terms of desirable tree species composition and the role of traditional forest management."

You also prepared guidelines for more congruous woodland conservation. What are your main recommendations?

I would advise against grand conservation schemes. It is all too easy to rely on a pre-existing classification to fit your local woodland into, but by doing so you run the risk of overlooking what makes your site special. For me, the interesting thing about a forest is not how it is similar to other forests but how it is different from any other forest.

Furthermore, and this is something we are engaged in through our research, overarching conservation schemes and principles tend to turn into dogma and lose their ability to incorporate new knowledge. I would like to see site history much more involved in woodland conservation. Forests are not only natural but also cultural monuments, and as I mentioned above, it is often impossible to say where culture ends and nature begins. I do not see this as a problem but rather something we, especially in Europe, should embrace. Woods are extremely complex, so we

should look at them in a complex manner rather than through a list of desirable species.

Your work focused on the Moravia region. Do you hope that your methodology will help similar initiatives in other regions of Europe?

I do hope so. I would be happy if others found our work inspiring in the sense that the combination of different sources and methods can create synergetic results, more than the simple sum of individual components.

LONGWOOD

- Coordinated by the Institute of Botany of the CAS in the Czech Republic.
- Funded under FP7-IDEAS-ERC.
- <http://cordis.europa.eu/project/rcn/101227>
- Project website: <http://longwood.cz>

MITIGATING FOREST MISMANAGEMENT WITH 3D MAPPING

The EU-funded SLOPE project is using satellite and 'Unmanned aerial vehicle' (UAV) imagery to improve the long-term sustainability of Europe's mountain forests.



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using geospatial information that combines data gathered from traditional in-the-field laser scanning technology with new, state-of-the-art UAV-based aerial surveying systems.

Transformation through technology

'With SLOPE, we intend to transform Europe's forestry industry from one that has traditionally been resource-intensive to one that is knowledge-based and sustainable,' says Senior Research Manager and Project Coordinator Daniele Magliocchetti from GraphiTech, Italy. 'And in doing so, we will help make the European timber industry more competitive at the global level.'

Like many research projects, SLOPE was born out of a perceived problem. Project researchers identified numerous weaknesses in the forest production workflow. For example, the forestry workflow lacks efficient ways for finding the best tree type for a particular demand, correctly placing a cable line to maximise harvesting and minimise setup time, tracking the amount of produced wood, and deciding the best logistic solutions to optimise costs. 'All of these areas are ripe for improvement if the end user has the necessary information readily available,' says Magliocchetti.

35 % of Europe is covered by mountains, many of which are blanketed by dense forests. For the many Europeans who live in these mountainous areas, the forest and the land are often the main sources of income, thus representing an important economic resource. Unfortunately, these same regions are all-too-often victims of mismanagement and deforestation — with significant economic consequences for local communities.

To mitigate against this trend, the SLOPE (Integrated processing and control systems for sustainable forest Production in mountain areas) project aims to improve the long-term management and sustainability of Europe's mountains and forests by providing local communities and forest administrations more precise knowledge about forest ecosystems. It intends to do this by generating detailed, virtual 3D forest models

"The adoption of RFID tags serves as the starting point for the population of the Digital Forest Model — giving each tree marked by foresters a unique digital tracking number."

SLOPE represents a new way of planning forest activities specifically designed for steep and sloped mountain areas, allowing the user to 'see' the forest's true characteristics via a 3D model. To create these models, the project uses UAVs and satellites to produce images, which serve as the source of the spatial information that the system then uses to determine the quality of a particular parcel of land and the position, height and species of each tree. From here, the adoption of 'Radio-frequency identification system' (RFID) tags serves as the starting point for the population of the Digital Forest Model — giving each tree marked by foresters a unique digital tracking number. An enhanced cable carriage system

updates each tree within the database with a harvesting stamp and every log produced from that particular tree, thanks to a sensor-enabled processor head, receives a specific RFID tag and quality grade, allowing it to be tracked along the entire journey to the end customer.

Put this technology together and the SLOPE 'Forest information system' (FIS) is capable of aligning data originated from different sources into a common forest data model visualised in 3D — providing the end user with a complete picture of the forest scenario. 'Using the SLOPE FIS, forest owners and operators can obtain more detailed data about a forest property, which can be used in their planning and inventory phase without the need to conduct direct, in-the-field examinations — saving time and costs,' explains Magliocchetti.

Big benefits

SMEs in particular are set to benefit immensely from the SLOPE system. Prior

to SLOPE, many SMEs were unable to conduct the required surveying of mountain forests due to cost restrictions. 'Because of SLOPE's integration of a variety of innovative, cost-effective methods and tools designed specifically for mountainous forest management, these small and medium-sized companies now have access to unprecedented knowledge, giving them a unique "first mover" advantage in their markets,' says Magliocchetti.

Magliocchetti also believes the system could play a role in increasing employment in less developed mountain areas. Furthermore, the project will help develop stronger relations between local populations and sustainable land use — showing that with SLOPE, one truly can see the forest through the trees.

SLOPE

- Coordinated by Fondazione GraphiTech in Italy.
- Funded under FP7-NMP.
- <http://cordis.europa.eu/news/rcn/125519>
- Project website: <http://www.slopeproject.eu/>

INTERVIEW

BETTER FOREST MANAGEMENT STRATEGIES FOR MAXIMISED MITIGATION POTENTIAL



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Forest managers are often puzzled over the best compromise between carbon sequestration and biomass exploitation for energy production. The FORMIT project will soon be revealing the results of a multiple scenario analysis that should enable decision-makers from all across Europe to make more informed decisions.

FORMIT (FOReSt management strategies to enhance the MITigation potential of European forests) was born from the need to better balance out different forest uses in Europe. It takes into account carbon storage, timber production and biodiversity conservation as well as possible

trade-offs, analyses the likely impact of climate change on European forests, and delivers management options and implementation strategies.

The project, which will come to an end in September 2016, is currently in its final phase. Prof. Dr Frits Mohren, coordinator of FORMIT and Chair in Forest Ecology and Forest Management at Wageningen University, discusses the added value of his research and its potential for shaping future European forest management strategies.

Why was it important to come up with new management strategies for carbon sequestration?

Prof. Dr Frits Mohren: Carbon sequestration is a relatively new objective in forest management. The role that forests play in the global carbon budget has been attracting attention only in recent decades, since the onset of concern about climate change and the need to mitigate this by reducing CO₂ emissions and by increasing CO₂ sequestration in terrestrial ecosystems, notably in forests. Forests store large amounts of carbon, and by adapting forest management this can be further increased, notably in managed forests such as those in Europe.

In addition to this, forests may play a role in reducing emissions of CO₂ from fossil fuel use by contributing biomass for energy production. Effectively, this may lead to an intensification of forest use, which in turn may lead to CO₂ emission through forest ecosystem disturbances.

Thus, the aims and objectives of forest management have to be reconsidered, along with its practical operations,

in order to understand its role now and potentially in the future in the regional and global carbon balance.

Currently, the entire European forest area is accumulating biomass, as timber harvest is less than timber increment overall. As a result, the sequestration of carbon in forest ecosystems may amount to some 10% of the total emissions of CO₂ in Europe. As essentially all of these forests are managed, we need to understand what drives this carbon sequestration, how long it may continue, and how it is influenced by forest management.

• **What would you say is the main added value of FORMIT in this regard?**

The added value of FORMIT is the analysis of forest management strategies for the entire forest area in Europe. It distinguishes between geographical regions and forest types with respect to mitigation of emissions. It also takes into account other main forest functions such as timber production and biodiversity conservation, as well as the expected intensification of forest use as part of the developments associated with the increased emphasis on the bio-economy, under which the demand for timber resources is expected to increase significantly.

• **Which European regions did you focus on and why?**

We used the European regions found in Forest Europe reports: northern, west-central, east-central, west-southern and east-southern Europe. These are broad categories, but our basis is the National Forest Inventory data, expanded on the basis of remote sensing (MODIS) data to cover the entire forest area of Europe, which is then aggregated again for the broad regions being considered.

• **What did you learn regarding the mitigation potential of European forests?**

We are currently in the middle of the scenario analysis, hence I cannot give definitive answers at this point. But it is clear that the mitigation potential is large and significant, and that forest management is crucial in achieving this mitigation.

As mentioned above, currently, carbon sequestration in forests accounts for 10% of total emissions. This needs to be sustained and possibly even increased, but the trade-off with other forest functions, notably the expected intensification of use under the bio-economy, is crucial and needs to be understood and quantified. We are making a significant contribution to this with FORMIT.

• **Would you say that a satisfying compromise can be found between carbon storage, timber production and other ecosystem services?**

A compromise will always depend on site conditions, on societal demand for forest products and other ecosystem services. It will be different in different parts of Europe and under different socio-economic conditions.

There are clear synergies between carbon storage and biodiversity conservation; but also in the case where there is intensive forest use, carbon storage can be enhanced. But society cannot have its cake and eat it too. The big advantage of forests is the possibility of sustainable resource supply under close to nature conditions. Timber grows on timber, so the cake is growing back all the time. But still there are trade-offs and compromises which need to be negotiated. Our scenario analysis provides scientifically sound information on possible options and the boundaries of the decision space within which policy makers will need to find compromises.



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PROF. DR FRITS MOHREN

• **How do you hope to convince European regions of relying on your management options and implementation strategies?**

First and foremost by providing sound scientific information on the options and management strategies, and their consequences, that we can identify at this moment. We don't want to be prescriptive, but we aim to provide policy-relevant information in the form of realistic adaptive management strategies. The project will deliver management options and implementation strategies for European forests, focusing on mitigation while safeguarding other forest functions, and accounting for regional differences in environmental and socio-economic conditions. These 'Representative adaptation and mitigation pathways' (RAMPs) as we call them, will integrate and synthesise current understanding, and provide guidance for policymakers and forest practitioners.

• **The project will end in September. What are your plans after that?**

Evidently this is ongoing work. The tools and techniques that we have developed will be further applied by the partners to continue with more detailed national analysis, to also provide nationally-relevant guidance on possible mitigation strategies and adaptive management options for forestry. On the more fundamental side, the FORMIT project entails a number of advanced PhD studies that will be completed after the end of the project, and that will lead to follow-up projects, both methodological as well as more applied.

Also, we are looking into the possibility of establishing, with local and national stakeholders, demonstration projects to show and further document the available management options. Evidently this will depend on further national and international support, but I trust that our results will stir up enough interest to enable us to pursue our research and support forest management in its challenging task of intensifying sustainable forest use, while continuing to contribute significantly to climate mitigation.

FORMIT

- Coordinated by Wageningen University in the Netherlands.
- Funded under FP7-KBBE.
- <http://cordis.europa.eu/project/rcn/104508>

EUROPEAN FOREST TREES SHOW HIGH LEVELS OF BIODIVERSITY WITHIN ONE TREE SPECIES

EU researchers have found that a single tree species may perform many different ecosystem activities, meaning that biodiversity is both between and within species.



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Discovering how forest tree ecosystems function is crucial to both predicting how they might respond to climate change and drawing up forest management plans. It is also key to the EU Forest Action Plan's objective to maintain and enhance biodiversity, carbon absorption, and the health and resilience of forest ecosystems.

One EU-funded project, DIVERFOR (Functional implications of inter- vs. intraspecific trait diversity in European forests), has focussed on European forests which, when compared to forest regions in other areas of the world, are considered to have a relatively low range of different species.

The project found that individual trees in a single tree species can have high

levels of functional biodiversity, meaning they may perform a diverse range of ecosystem activities. These activities include nutrient cycling, climate regulation, timber production, protection against erosion, and recreation.

Measuring tree characteristics

DIVERFOR assessed this diversity by measuring characteristics — or functional traits — such as leaf toughness, which is linked to its resistance to herbivores. It also assessed the branching pattern of a tree which is linked to the way it colonises space and competes with other trees. Other traits measured included the levels of nitrogen in a leaf which is linked to a forest's nutrient cycling rate and a tree's flowering time which is linked to the trees chances of reproducing.

'Our project shows that differences in certain characteristics among individual trees within a species can be as relevant as differences between different tree species in European forests. This is the case in dominant tree species in particular,' says Raquel Benavides, DIVERFOR project researcher.

'DIVERFOR also found that trees can adjust their characteristics according to the environment that surrounds them. This includes adjusting to biotic factors such as the amount of different trees species, and abiotic factors such as light, soil nutrients, water and climate,' Benavides continues.

Both findings are significant since tree communities with higher levels of biodiversity even within a species are expected to be more stable and have a higher resistance to climate change. 'This can be a good reason to preserve patches of forest with a high number of species within areas with fewer species. For example, it is important to maintain an area dominated by pine trees in Finland and pine forest in Spain, as well as areas where pine is mixed with other species,' explains Benavides.

Three different forest types

DIVERFOR carried out research in three different European forests: a boreal forest in Finland, a temperate forest in the Carpathian Mountains in Romania and a Mediterranean forest in Spain. Within these forests, researchers focussed on plots with one dominant tree species, plots with two dominant species, and plots with three or four dominant species. In total, DIVERFOR studied 4000 trees and collected more than 15 000 leaves. One of the biggest challenges the project faced was collecting leaves from trees up to 30 metres tall. This involved hiring climbers, hunters or using telescopic loppers.

The project officially ended in May 2016, but Benavides vows to continue the scientific research into biodiversity within a tree species with a view to increasing understanding of how forest species and ecosystems adapt to current environmental changes.

DIVERFOR

- Coordinated by the Albert Ludwigs University of Freiburg in Germany.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/news/rcn/125499>

"Our project shows that differences in certain characteristics among individual trees within a species can be as relevant as differences between different tree species in European forests."

BIOLOGY AND MEDICINE

NEW TOOLS TO PREVENT THE SPREAD OF HIGH THREAT PATHOGENS IN TRANSPORT HUBS

EU researchers are helping national and regional transportation hubs to better mitigate the risks of the spread of transmissible pathogens.

In 2014 there were 3.3 billion flights around the world, 44% of which were long haul. Furthermore, the number of airline passengers is forecast to double over the course of the next 15 years, meaning the risk of the quick and — at times — uncontrollable spread of naturally or intentionally released person-to-person transmissible pathogens, such as Ebola and anthrax, will be on the rise.

However, although air travel is the main culprit for the global spreading of these pathogens, the risk is not limited to the skies. The high-density mass transport systems found in many European cities also help accelerate the spread of infectious diseases.

Proactive pathogen prevention

PANDHUB (Prevention and Management of High Threat Pathogen Incidents in Transport Hubs), an EU-funded research project, has taken a proactive approach to pathogen prevention. The project has aimed to support transport operators and relevant stakeholders in developing pathogen preparedness and response plans for such transport hubs as airports, major metro interchanges and railway stations.

As a starting point, PANDHUB set out to identify the so-called 'hotspots' that exhibit a higher risk for the transmission of

microbes via breathing, sneezing and touching. The project identified these hotspots by studying the potential routes by which infections are transmitted, passenger flows and the unique characteristics of transportation hubs.

Based on this study, PANDHUB researchers discovered that the transmission of infectious diseases depends on many factors, including the route of transmission, virulence of the microbe and susceptibility of the exposed passenger. The good news is that in normal circumstances, the risk of transmission on public transport is low and requires no special action beyond basic personal hygiene. The bad news, however, is that those locations exhibiting an increased risk tend to be ill-prepared to handle an epidemic.

Validated guidelines and toolboxes

To remedy this gap in preparedness, the project has developed validated pandemic guidelines and mobile, integrated toolboxes that contain modelling components to simulate the spread of diseases and to evaluate the effects of suggested countermeasures. Based on the impact these simulations have, the project is developing tailored rapid response plans to mitigate risks, contain incidents and, ultimately, save lives. In addition, PANDHUB is producing detailed instructions on how to effectively cut off different

routes of transmission, along with guidelines for protecting, cleaning and decontaminating passengers and facilities.

Due to the open borders of the EU and the fact that many transportation systems cross regional and national borders, the risk of a cross-border incident is particularly high in Europe. For this reason, PANDHUB's work pays special attention to cross-border cooperation, including the coordination of data collection and the collation of tools and information. As a result, the project facilitates a swift, coordinated cross-border epidemiological investigation and response.

A team effort

Producing such complex, broad and multi-national guidelines and tools is challenging and thus demands a multidisciplinary approach. As a result, all of PANDHUB's tools are being developed in close collaboration with a Stakeholder

Liaison Group comprised of transport staff, experts, government authorities and end users.

The proposed toolbox is currently undergoing wide testing through field exercises and workshops, with feedback being taken into account for the validation and further development of the tools.

PANDHUB

- Coordinated by VTT Technical Research Centre in Finland.
- Funded under FP7-SECURITY.
- <http://cordis.europa.eu/news/rcn/125279>
- Project website: <http://pandhub-fp7-security.eu/>

A NOVEL DRUG-DELIVERY METHOD

A recent European study has advanced drug delivery for treating lung diseases by developing a novel method based on electrospray technology.

Electrospray is a process whereby a voltage is applied onto a fluid to generate a fine spray. When subjected to an intense electric field, the fluid emitted breaks up into a spray of charged droplets that fly towards a counter electrode.

Electrospray technology finds a variety of applications, including mass spectrometry, tissue engineering and protein microarrays. However, the fundamental parameters underlying electrospray formation are poorly understood, limiting full exploitation of the potential of this phenomenon.

The scope of the EU-funded TAYLORMED (Electrospray-mediated delivery of biological molecules into mammalian cells) project was to utilise electrospray technology to deliver biomolecule-based drugs into cells and tissues. The primary goal was to develop a novel drug-delivery method for treating lung diseases. The consortium comprised industrial and academic members with complementary expertise in biological drug delivery, mechanical and manufacturing engineering as well as microfluidics technologies.

TAYLORMED researchers established methods for visualising sprays and determining the parameters that affect spray quality. They examined a wide range of biological buffers for their capacity to generate electrosprays and to deliver clinically relevant molecules such as DNA, RNA, proteins and small molecules. Novel electrospray emitters were designed and tested for different applications, including the delivery of whole cells for regenerative and cell therapy purposes.

Overall, the TAYLORMED study succeeded in increasing our understanding of the electrospray process

and enabled it to be used in clinically relevant applications. The systems and devices developed served to demonstrate the capacity to deliver a wide range of biological molecules into cells and tissues, opening new roads for drug delivery. Partners are also confident that the technology will be useful in diagnostics work.

TAYLORMED

- Coordinated by the National University of Ireland Maynooth in Ireland.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/182825>

“Novel electrospray emitters were designed and tested for different applications, including the delivery of whole cells for regenerative and cell therapy purposes.”



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NEW DEVICES ADVANCE BREAST CANCER DIAGNOSIS

Researchers in Europe have developed a series of innovative, antibody-like tools, enabling them to study breast cancer and discover new biomarkers.

The incidence rate of breast cancer in Europe is about 430 000 cases every year. Tumours with increased levels of the 'Human epidermal growth factor receptor 2' (HER2) are aggressive and associated with high mortality. HER2 is a potent oncoprotein that has become an established target for adjuvant treatment of breast cancer.

Despite the efficacy of anti-HER2 monoclonal antibodies, tumours still progress due to innate or acquired resistance to the treatment. There is an immediate need to develop new, innovative, targeted agents for HER2-positive disease and to identify HER2-related biomarkers for disease prediction, diagnosis and monitoring.

In a bid to address this, the EU-funded IMAGINT (HER Imaging and molecular interaction mapping in breast cancer) project brought together an interdisciplinary team of researchers from across Europe. The scientific plan focused on the therapeutic potential of the antibody-like proteins — 'Designed ankyrin repeat proteins' (DARPs). These are small molecules based on human protein scaffolds that can bind specific targets with high affinity.

IMAGINT developed a series of tools for synthesising and manipulating DARPs to carry specific chemical modifications and generated DARPs against different HER receptors. They went on to study the subcellular HER2 distribution and proposed this as a novel method for screening patient tissues.

Researchers discovered differences between breast cancer and corresponding healthy tissue using imaging cyler microscopy. Furthermore, they detected alterations in associating miRNAs/proteins in response to anti-HER2 therapy. They also identified a number of breast cancer prognostic biomarkers following bioinformatic analysis of gene expression.

One of the IMAGINT imaging assays for identification of HER heterodimers demonstrated clinical applicability and prognostic value. Using this assay, scientists validated a new mechanism of resistance to 'anti-epidermal growth factor receptor' (anti-EGFR) therapy in patients with



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triple-negative breast cancer. Furthermore, they developed a new agent that enables non-invasive whole body imaging of HER2+ tumours, in doing so providing information on disease spread and stages.

The biomarkers identified would help in making tailored treatment decisions and assist in developing new drugs. For instance, early identification of patients at a high risk of metastatic recurrence can help clinicians change their treatment strategy. Collectively, the deliverables of the IMAGINT study enable stratification and monitoring of breast cancer for hopefully better patient outcomes.

IMAGINT

- Coordinated by University College London in the United Kingdom.
- Funded under FP7-HEALTH.
- <http://cordis.europa.eu/result/rcn/91913>
- Project website: <http://www.imagint.eu/>

TWO SHOTS IN ONE: TACKLING HIV AND HEPATITIS C INFECTIONS

Novel vaccines have been created to prevent co-infections of HIV and 'Hepatitis C virus' (HCV), a growing health problem in Europe.

The vaccines, developed by scientists working on the groundbreaking EU-funded project PEACHI (Prevention of Hepatitis C virus (HCV) and HIV-1 co-infections through induction of potent T cell responses using prime-boost viral vector vaccine regimens), combine antiretroviral therapies and vaccines that stimulate targeted immune responses. HCV, which can lead to

chronic liver disease and cancer, is a leading cause of death in HIV co-infected individuals. An estimated 2.3 million people globally are co-infected with HIV and HCV.

PEACHI sought to address this challenge by building upon the success of antiretroviral therapies, which have led to a dramatic improvement in life expectancy for people with HIV infection. While the drugs

do not kill or cure the virus, they can prevent the growth of the virus when taken in combination. When the virus is slowed down, the danger of further HIV complications is reduced.

In order to specifically address co-infections of HCV, the project team sought to combine proven antiretroviral HIV drugs with modified vaccines targeted at HCV. The aim of these



vaccines has been to better focus the immune response of people living with HIV.

Results have been positive. Findings presented at the International Liver Congress 2016 in Barcelona, Spain, suggest that the approach being pioneered by the PEACHI project is indeed effective in boosting the immune system against both HCV and HIV. Furthermore, the co-administration of HCV and HIV components of the boost does not impair specific T-cell responses.

The success of the project means that a combined vaccination against HCV and HIV is now a step closer to commercialisation, and the possibility of vaccinating a single individual against both diseases opens up huge possibilities for rolling back epidemics of disease and co-infection.

Whilst vaccination is the most effective way to prevent many infectious diseases, developing effective vaccines against HIV and HCV has proved extremely challenging. One of the main reasons for this is the enormous variation in HCV and HIV types around the world, which is caused by the extraordinary ability of the viruses to modify their genes.

To begin with, PEACHI scientists focused on vaccine development and the optimisation of clinical trial protocols, together with improving training in good clinical practice. The development of new immunology assays for analysing clinical trial samples may open new avenues for research into immune control of HIV-1 and HCV infections.

Following on from this, the safety and efficacy of vaccines were then tested in healthy individuals without HIV-1 or HCV infections. Single-cell analyses were performed to assess the quality of vaccine-induced T-cell responses.

The PEACHI consortium has also been working on novel vaccine technology to improve the effectiveness of existing vaccines. This approach involves the use of vaccine-encoded antigens (molecules capable of inducing an immune response), which are fused to HCV proteins. The objective is to enhance HCV antigen presentation in the immune cells of HIV patients.

The four-year PEACHI project is due for completion at the end of January 2017.

PEACHI

- Coordinated by the University of Oxford in the United Kingdom.
- Funded under FP7-HEALTH.
- <http://cordis.europa.eu/news/rcn/125361>
- Project website: <http://www.peachi.eu/>

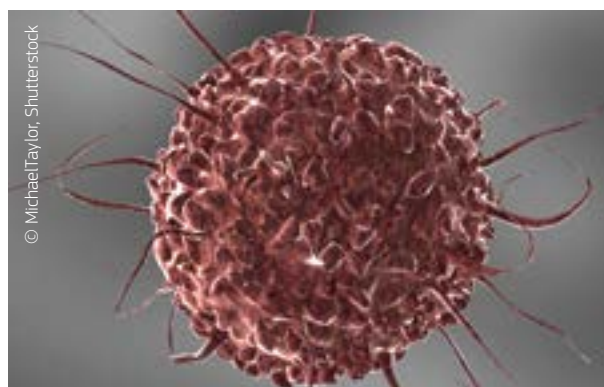
TUMOUR MICROENVIRONMENT PROMOTES CANCER DRUG RESISTANCE

The interaction of cancer cells with their immediate microenvironment is complex but essential for cancer evolution. A European study has investigated how the microenvironment may even be responsible for drug-resistant disease.

Targeting oncogenic kinases such as ABL, BRAF and EGFR now constitutes anti-cancer therapy. However, these drugs are only efficacious against tumours with matching oncogenic mutations until genetically resistant cancer cells emerge. In the case of EGFR, these cells are present even before treatment and have a strong selective advantage during therapy.

Scientists in the EU-funded study IMAGEMELTHERAPYLRI (Single cell level intravital imaging of response, tolerance, and resistance to targeted therapies) set out to investigate the emergence of resistance in BRAF-mutant melanoma treated with BRAF inhibitors. Given the variability in the initial response to BRAF inhibition and the absence of resistant cells before therapy, researchers believe that non-cell autonomous mechanisms involving the tumour microenvironment may drive resistance.

To comprehend how the genetically stable stroma could promote the emergence of BRAF treatment-resistant melanoma, scientists employed intravital imaging techniques and 'Fluorescence resonance energy transfer' (FRET) microscopy. They observed that following an initial period of response to treatment, melanoma-associated fibroblasts exhibited a reactivation of the ERK/MAPK pathway. In turn, this led to matrix protein production and tissue remodelling that provided tolerance to the BRAF inhibitor in melanoma cells. When they abolished ERK pathway reactivation, they obtained a more effective control of BRAF-mutant melanoma.



Study findings indicate that melanoma-associated fibroblasts provide a safe haven for melanoma cells to tolerate BRAF inhibition, facilitating the emergence of genetically resistant cancer cells. The work carried out during the IMAGEMELTHERAPYLRI project highlighted the need to consider how targeted anti-cancer therapies affect the tumour microenvironment. Furthermore, it suggested that co-targeting of the tumour microenvironment might augment cancer therapy and improve its outcome.

IMAGEMELTHERAPYLRI

- Coordinated by the Francis Crick Institute in the United Kingdom.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/182818>

BREAKTHROUGH IN DIAGNOSTIC TOOLS GIVES HOPE TO HEART PATIENTS

EU-funded scientists have made key discoveries and developed more effective ways of diagnosing a heart condition that affects millions of Europeans.



“New real-time automatic fibrillation analysis techniques, novel treatment options and non-invasive diagnostics tools have been developed.”

‘Atrial fibrillation’ (AF) — a condition that causes abnormal heart rhythm — affects up to 2% of the European population and increases the risk of stroke, heart failure and death. Europe’s ageing population means that the prevalence of AF is expected to increase, which will put further pressure on Europe’s stretched health services.

In order to address this, the EU-backed EUTRAF (The European Network for Translational Research in Atrial Fibrillation) project has sought to develop new methods for ensuring earlier diagnoses of AF, thereby making clinical interventions easier and more successful. As well as improving patient care through early diagnostics and treatment, the project, which was officially completed in November 2015, is expected to decrease the cost of current AF management.

The project has also been involved in some groundbreaking trials. One key finding has been that giving daily doses of statins for a few days before and after heart surgery does not prevent the development of AF and can actually increase the risk of developing kidney damage. The results of this trial, part funded by the EUTRAF project, were published in May 2016 in the New England Journal of Medicine (NEJM).

‘Statins have been known to have rapid anti-inflammatory and antioxidant effects for many years,’ says Professor Barbara Casadei, who led the research at the University of Oxford in collaboration with the British Heart Foundation. ‘Although guidelines currently recommend statins at the time of heart surgery to reduce complications, the evidence was not very strong. The results of our large randomised placebo-controlled trial conclusively prove that there are no benefits to taking statins shortly before and after heart surgery to reduce postoperative complications but there is an adverse effect on kidney function.’

This discovery could lead to a change in international guidelines on preventing AF and other complications following heart surgery. The findings do not however challenge the strong evidence showing that long-term treatment with statins reduces heart attack and stroke risk.

The EUTRAF project, which received nearly EUR 12 million in EU funding, began in 2010 by studying the causes, progression and treatment of AF. From this, new biomarkers and novel ion channels and transporters for future therapies were identified. Research on animal models to better understand atrial blood flow regulation and possible

genetic components of AF has also been carried out.

From this initial research, new real-time automatic fibrillation analysis techniques, novel treatment options and non-invasive diagnostics tools have been developed. In addition, the project has pioneered the development of a Clinical Decision Support module mobile app. EUTRAF has been a pioneer of using information technology to support the prediction and prevention of various consequences of AF, such as stroke and thromboembolism.

The project also carried out pre-clinical studies into new ways of measuring fibrosis and atrial fat infiltration, and demonstrated that electrocardiogram-derived atrial complexity parameters could be used to predict the outcome of various therapies with increased accuracy.

EUTRAF

- Coordinated by St George’s Hospital Medical School in the United Kingdom.
- Funded under FP7-HEALTH.
- <http://cordis.europa.eu/news/rcn/125364>
- Project website: <http://www.eutraf.eu/>

SOCIAL SCIENCES AND HUMANITIES

CREATING A COMMON EUROPEAN IDENTITY BY DIGITISING ITS CULTURAL HERITAGE

An EU-funded project is using new technology to rethink and reshape Europe's cultural heritage for the digital age.

When we hear about cultural heritage, we tend to think of art hanging in a museum, watching a play in the theatre or reading a book about ancient history. As such, 'cultural history' (CH) is something from the past that we can visit and view, but not live and interact with.

The RICHES (Renewal, Innovation and Change: Heritage and European Society) project is rethinking this view of CH within the context of today's digital-infused, multimedia-filled world. How can CH-related institutions redefine themselves to meet changing user needs? Can an increasingly diverse society identify with an often singular CH? Is it possible to bring CH closer to its audiences?

To answer these questions and others, the RICHES project drew on the collective expertise of 10 partners from six EU countries and Turkey. Its interdisciplinary team of cultural institutions, public and national administrations, 'Small and medium sized enterprises' (SMEs) and representatives from the humanities and social sciences researched how European CH can evolve to better position itself within the digital age.

A wider audience

The RICHES project set out to investigate the context of change as it applies to CH. Specifically, it looked to design new ways

that CH is performed and preserved and identify how to use digital technology to broadcast CH across audiences and generations.

To put this work into perspective, consider the CH of dance. As a performance-based art, one cannot truly experience a dance recital at a museum or in a book. Traditionally dance is only available to the limited audience who can physically attend a performance. However, the RICHES project is expanding the accessibility of such performance-based CH by using audio-visual technology to record the dance and creating virtual performances that any user located anywhere can watch with just the click of a mouse.

At the conclusion of its research, the project provided relevant stakeholders with evidence-based policy recommendations, foresight studies, toolkits and best practice guidelines for establishing cooperative initiatives — all of which are available to interested users via an intuitive website.

Uniting past, present and future

According to project coordinators, the RICHES project is expected to have a widespread impact. For example, the project's results clearly demonstrate how digital technology challenges the so-called democratic deficit that exists between a creator/

performer and an end user, thus encouraging more users to engage deeper and directly with their CH. Likewise, the project shows how technology can stimulate innovative interactions with cultural audiences and users and lead to novel learning opportunities for teaching CH in schools.

But of all its results, perhaps the most important is the use of digital CH to foster a common European identity made accessible across Europe's many diverse communities. As the digital format promoted by the project's research makes CH available to a wider audience, it helps bridge physical divides to connect communities by building understanding, creating cohesion, fostering cultural exchanges and stressing similarities.

In other words, the RICHES project has not only created new ways to engage with and experience CH but also positioned digital resources as a means of uniting the past with the present, and the present with the future.

RICHES

- Coordinated by Coventry University in the United Kingdom.
- Funded under FP7-SSH.
- <http://cordis.europa.eu/news/rcn/125219>
- Project website: <http://resources.riches-project.eu/>

THE SCIENCE OF LINGUISTICS

A novel concept of treating linguistics as the object of the history of science can help reveal linguists' self-perception as scientists and shed new light on its historical and philosophical implications.

Linguistics is known as the scientific study of language. An EU-funded project LINGUISTICSSCIENCE (Linguistics as a science — a historical philosophical study) explored the scientific analysis of natural languages, taking a multidisciplinary approach, combining strategies of perspectives from the history and philosophy of science.

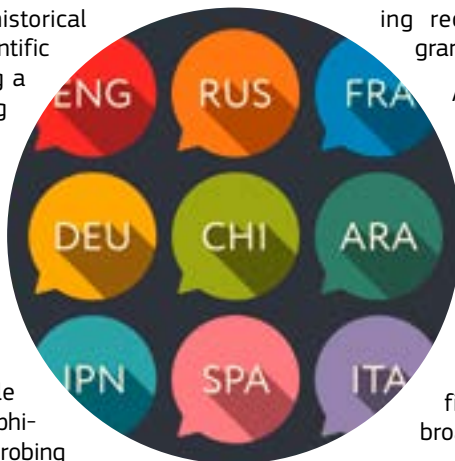
One of the two angles used by the project included an argument for recounting the history of linguistics over the past 200 years from a scientific perspective. By doing so, it can contribute to learning about its various developments. The second angle claims that the methodology of the philosophy of science can be useful for probing linguistic theories as well as their scientific and social aspects.

The study involved the various schools of linguistics. A review of the literature of the philosophy of science centred on the rift between the hard sciences and the

humanities. Studying reciprocal constructions and the various theories related to them, such as verbal encoding reciprocity and the directionality of grammaticalisation, was also included.

Advancements were made in the study and several publications have subsequently resulted. Furthermore, two additional topics were added to the study, which included Dative Constructions and negation. Both topics intersect with linguistics and philosophy.

Results will be useful not only in the field of linguistics but also in other fields, and may be of importance to the broader study of the history of science.



LINGUISTICSSCIENCE

- Coordinated by the Hebrew University of Jerusalem in Israel.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/182842>

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STUDY REVEALS THAT A LARGER SOCIAL CIRCLE INCREASES PAIN TOLERANCE

Research funded by the EU has discovered that individuals with more friends have a higher pain tolerance.



Researchers from the University of Oxford, working under the EU-funded RELNET (Psychology of Relationships, Networks and Community Cohesion) project, believe that the link between the number of friends and the ability to tolerate pain is due to a system in the brain that involves endorphins, pain-killing chemicals that also trigger a sense of wellbeing.

Writing in the journal 'Scientific Reports', the team led by Professor Robin Dunbar and Katerina Johnson, a doctoral student,

aimed to explore the theory that the brain's endorphin system may have evolved to not only handle our response to physical discomfort and pain but also influence our experience of pleasure from social interactions.

In particular, she was interested in the 'brain opioid theory of social attachment', where social interactions trigger positive emotions when endorphins bind to opioid receptors in the brain, giving us a 'feel-good factor' when seeing close friends. 'Social behaviour and being attached to other individuals is really important for our survival — whether that is staying close to our parents, or our offspring, or collaborating with others to find food or to help defend ourselves,' commented Johnson.

Conducting the experiment

To test the theory, the research team examined both the social networks and the pain thresholds of 101 adults aged between 18 and 34. Each participant completed a questionnaire that was designed to quiz them on friends they contacted once a week and those

they only communicated with once a month. The personality of each participant was also probed, looking at traits such as 'agreeableness'. They also had to provide details on their levels of physical fitness and general levels of stress.

As greater endorphin activity in the brain is linked to higher pain tolerance, each participant was also asked to squat with their back against a wall and their knees at right-angles to their body, which is a simple yet uncomfortable exercise, for as long as they were able to. This provided the project team with an indirect method of gauging endorphin activity in the brain.

"Participants who reported higher levels of fitness were able to endure the pain test for longer but generally had smaller friendship groups."

Expected & unexpected results

The researchers found that equally for both men and women, larger social networks were linked to greater pain tolerance. Most surprisingly, it was the number of friends contacted only monthly, rather than weekly, that appeared to be the most important factor. The results, when controlling for stress, fitness and agreeableness, showed that an increase from seven to 12 friends in this second layer of personal contacts is predicted to boost pain tolerance from one minute to four minutes on average. However, the project team did state that it was not clear whether the link was due to greater social activity boosting the release of endorphins that subsequently dampens pain, or whether individuals with a more active endorphin system experience greater rewards from social activity and hence surround themselves with more friends.

There were also some other interesting results from the study. Participants who reported higher levels of fitness were able to endure the pain test for longer but generally had smaller friendship groups. This could merely be a question of time — those who exercise more have less time for socialising. However, another possibility is that those who experience higher endorphin levels from exercising do not need to seek a similar feeling from interacting with friends.

Additionally, those who reported higher stress levels were also found to have fewer friends, although there was little correlation with pain tolerance. However, it is unclear if stress hinders people from forming meaningful friendships, or whether having more friends allows individuals to better cope with the pressures of modern life. 'These results are also interesting because recent research suggests that the endorphin system may be

disrupted in psychological disorders such as depression. This may be part of the reason why depressed people often suffer from a lack of pleasure and become socially withdrawn,' commented Johnson.

Although the research results seem to support previous evidence that endorphin activity in the brain might be linked to social interactions, further research will be needed to ascertain what causes the differences between individuals, with genetic variations that impact the level of endorphin receptors in the brain being a possible avenue for future enquiry.

RELNET

- Coordinated by the University of Oxford in the United Kingdom.
- Funded under FP7-IDEAS-ERC.
- <http://cordis.europa.eu/news/rcn/125260>

INNOVATIVE TRUST MODEL TO HELP JOURNALISTS VERIFY SOCIAL MEDIA CONTENT

Using the November 2015 Paris terror attacks as an example, the EU-funded REVEAL project has demonstrated novel solutions for assisting journalists in assessing the accuracy of eyewitness social media content during breaking news incidents.

With a large majority of individuals now actively using platforms such as Facebook or Twitter every day, social media has increasingly become an important source for journalists. In a breaking news event, journalists are now able to pick up first-hand eyewitness reports that also often contain photos and/or video footage. However, whilst there is a lot of genuine information available, it is all too easy for a journalist to accidentally risk their reputation by publishing satire, propaganda or copy-cat content instead of genuine content during a crisis or emergency news situation.

The REVEAL (REVEALing hidden concepts in Social Media) project has been focusing on developing methods that will allow journalists to quickly and accurately distinguish useful information on social media from 'the noise' — useless or misleading information. They point out that often social media acts as an 'echo chamber', spreading rumours that often turn out to be false. This is not much of a problem for long-term news stories, as with time it becomes clear as to what really happened. However, in breaking news situations, it can be much more difficult to quickly distinguish fact from fiction.

Trust model for verifying content

Presenting at the Third Workshop of Social News on the Web in Montreal, Canada, in April 2016, REVEAL project researchers outlined their novel 'trust model' for partially automating the process of filtering useful information on social media by using trusted sources, helping journalists when they need to react quickly to a developing situation. The model allows journalists to maintain a list of their sources,



linking new content to authors. When tracking a news story on social media, content items are associated with authors and can be filtered using predefined lists. For each new content item, it becomes clear immediately whether it is in some way related to a source: if it has been posted by that source, mentions that source or is attributed to it.

The model additionally aims to help journalists quickly pick up new eyewitness content. This does not mean trending content from established news organisations or agencies, as the content is no longer breaking. Instead, this would be

content that contains eyewitness images or video that is less than five minutes old since publication and is likely to still be unverified.

Paris as an example

To showcase the model and its capabilities, the REVEAL team used the terror attacks that hit Paris on 13 November 2015 as a case study. Crawling through social media platforms, they

“To showcase the model and its capabilities, the REVEAL team used the terror attacks that hit Paris on 13 November 2015 as a case study.”

used natural language processing techniques to identify named entities (such as ‘BBC’ and ‘Le Monde’) in English and French and mentioned URLs. The data was then imported into the trust model, which already con-

tained a sample list of trusted and untrusted sources. By doing this, all content written by, mentioning or attributed to a specific source could be retrieved.

The team then picked five pictures posted during the night of the Paris attacks, with three of them being genuine. They then identified URLs for copies of the posted image that might have been shared instead of the original image URL. They then queried their database in 10-minute intervals during the first hour after each image was published to see how often it was shared (overall and by trusted/untrusted sources). In a second experiment, they sorted URLs by the number of mentions, and every five minutes compared the currently top ranking URLs that were being shared on social media and filtered the old ones out. By doing this, they tried to detect new eyewitness content to investigate before it went viral.

Analysing the results

When analysing eyewitness content, the team found that untrusted sources generally share images earlier than trusted sources. They also found that trusted sources are an indication that an image is authentic. Trusted sources that are related to user-generated content make it more likely to be genuine. This is typically the case 30 minutes after a photo has been published. Consequently, if a journalist is prepared to wait, it can point them in the right direction for conventional means of verification, such as factual cross-checking or contacting the source directly through social media channels.

The team also found that for the discovery of newsworthy eyewitness content, it helps to filter old content. Using this method, the five images tested showed up in the top 6% of all content crawled through during a time-window of five minutes. This means a journalist does not have to check potentially thousands of social media URLs but can focus on the top URLs.

Although preliminary, these results look promising. The trust model pioneered by REVEAL could help journalists to become both faster and more efficient when sourcing content on breaking stories and publish content with more confidence that material sourced from social media is authentic.

REVEAL

- Coordinated by Intrasoft International in Luxembourg.
- Funded under FP7-ICT.
- <http://cordis.europa.eu/news/rcn/125339>
- Project website: <http://revealproject.eu/>

HOW IMMIGRANTS MANAGE BICULTURALISM

Immigrants usually find themselves torn between the norms, social pressures, behaviours and identities (cultural belongings) of both their ethnic heritage culture and the host majority culture. Research into how immigrants feel and what they think about this can be used to improve their adjustment, design adequate international policymaking and foster interethnic community relations.

Researchers in the EU-backed project BICULTURALISM (Biculturalism: Social correlates and individual differences) studied first- and second-generation immigrants to advance knowledge in the field. The study sought to answer questions related to how they manage their cultures cognitively and emotionally, what their social networks are like, and how all this affects their integration and adjustment.

First, the team conducted a social network study in Barcelona of 222 immigrants (from Ecuador, Morocco,

Pakistan and Romania). This provided detailed information about their habitual social networks (composition, density and clustering). They looked at key social and individual factors involved in the development and management of biculturalism/multiculturalism. An additional focus was on how the immigrants’ personal social networks and cultural self-identification(s) jointly predicted psychological and socio-cultural adjustment.

Following this, BICULTURALISM examined variations in how bicultural individuals deal with the daily challenges of negotiating between multiple and often conflicting cultural identities and value systems — a construction known as ‘Bicultural identity integration’ (BII). The mixed-methods research design comprised a qualitative study of 100 self-identified bicultural individuals and a large psychometric study. This

“The mixed-methods research design comprised a qualitative study of 100 self-identified bicultural individuals and a large psychometric study.”



second, quantitative component relied on the validation of the 'Bicultural identity integration scale' (BIIS-2) with an ethnically diverse sample of 1 000 biculturals. Results from this project phase are presented in a study submitted to the journal 'Psychological Assessment'.

Training and dissemination activities included organising a small-group conference in 2014 entitled 'Culture and Psychology: Insights from the

European Context' and publishing the 'Oxford handbook of multi-cultural identity: Basic and applied psychological perspectives'. A proposal for a special issue to showcase work done at the conference has been submitted to the 'Journal of Cross-Cultural Psychology'.

Project findings can help improve interethnic relations through improved policy targeting social cohesion and integration. Additionally, future research

can build on the knowledge generated regarding individuals' abilities to negotiate and integrate multiple cultural belongings.

BICULTURALISM

- Coordinated by Pompeu Fabra University in Spain.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/170427>

HOW CAN WE COMBAT AGEISM?

Ageism is the stereotyping of and discrimination against a person or groups of individuals on the basis of their age. EU-funded research has delved into the cultural, socioeconomic and political context behind age discrimination to grasp the dynamics of the problem.

The project ELDERLY STEREOTYPES (Nice but incompetent? The elderly stereotype in Europe) adopted a multilevel perspective in investigating the contextual and personal underpinnings of age-related attitudes and older people's ageing experiences.

Work included analysing representative data from the European Social Survey (ESS) module 'Age Attitudes and Experiences of Ageism' (56 752 individuals from 29 countries). The team carried out five different studies that show how the societal context combines with individual-level variables in explaining ageist attitudes and ageing experiences.

A combination of socioeconomic factors and the employment rate of the elderly in society influences the way older people are perceived. Noteworthy findings point to more positive perceptions of the elderly in more modern countries that also have a higher employment rate of older people. Older people's ill-health is greater in countries where income is distributed unevenly. Also, a major factor in how others view the elderly has to do with the latter group's health and their own perceptions of their age.

In a second phase, researchers conducted a series of experimental and survey studies to better understand how

malleable age stereotypes are. Findings in this line of inquiry highlight cultural differences in ageism. Furthermore, the stereotype that the elderly are nice but incompetent starts early. It is found in children as young as six years of age and remains there until adolescence. On the upside, the structured and theory-guided imAGES intervention programme can be used to change this ambivalent age stereotype. The results of an experimental study on the role of environmental cues support the idea that perceptions about older people are malleable.

Europe as a world region shows the greatest increase in the percentage of elderly people relative to its workforce. This research project advanced knowledge on the causes of ageism, which can be used to inform policy and design interventions ensuring fewer older people miss out on opportunities.

ELDERLY STEREOTYPES

- Coordinated by CESIS in Portugal.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/151273>



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ENERGY AND TRANSPORT

VARIABLE-SPEED PUMPED STORAGE HYDRO PLANTS OFFER A NEW ERA OF SMARTER ENERGY MANAGEMENT

The EU-funded ESTORAGE project has presented a range of options for increasing energy storage capacity across Europe, whilst also building flexibility into grids to better integrate renewables.

The project recently made some of its first results public, identifying an impressive 2 291 GWh of energy storage capacity realisable through 'Pumped storage hydro plants' (PSPs) across existing development-ready sites. This is more than seven times the currently installed PSP capacity across Europe.

The sites are located across the EU-15, along with Norway and Switzerland. Southern Norway alone was found to have 54% of the study's total feasible pumped storage capacity with 1 242 GWh. The Alps were found to have 13% or 303 GWh across Austria, Italy, France and Switzerland, with 9 GWh in the German Alps. 5% of the total potential capacity in the study area was found in the Pyrenees in France and Spain with 118 GWh.

Generating electricity by transferring water between reservoirs at different elevations is posited as being the most cost-effective and flexible means for GWh-scale storage of electricity. PSPs are ideally suited to respond to frequent changes between electricity shortages and surpluses by generating or absorbing excess as required; with modern systems able to start the pumps or turbines from standstill in just 30 seconds.

Potential locations for new PSPs were identified in the study via a 'Geographic information system' (GIS) model which utilised high-level non-country/region specific selection and only looked at existing water body pairs, due to the cost advantage of connecting existing water bodies rather than building new reservoirs. These locations were further scrutinised by national experts against specific country/regional criteria, resulting in a list of potential sites ranked with their total theoretical and realisable storage potential.

Addressing the challenge of integrating renewables

Whilst renewables, such as wind and solar, represent a growing share of the world's power output, their unpredictability weakens overall grid stability. The challenge for integrating renewables into the grid is their intermittent nature coupled with the problem of storing surplus which can be used during periods of peak demand.

However, whilst PSPs can allow more cost-effective load balancing flexibility than traditional plants such as nuclear or coal powered, conventional PSPs are also limited by only being able to regulate power in generation mode. The project ESTORAGE (Solution for cost-effective

integration of renewable intermittent generation by demonstrating the feasibility of flexible large-scale energy storage with innovative market and grid control approach) is looking at the technical and economic feasibility of upgrading an existing fixed-speed PSP to variable-speed technology, bringing flexibility to the pumping mode as well.

Here, speed is varied through a frequency converter with a change in the discharge/power. With fixed speed, there is only one operating point for a given head and so in effect they have limited operational flexibility, with pumps either at full power or switched off. Variable-speed technology, already several years in use, particularly in Japan, caters well for the fast growth in renewable sources of power, compensating for fluctuations.

The path to smarter European energy management

The EU electricity grid will have to undergo unprecedented changes in capacity to meet increasing demand; and in the ability to integrate renewables to meet climate change targets. Indeed, the EU's 'Strategic Energy Technology Plan' (SET) outlines the vision of wind power contributing up to 20%, and solar

power up to 15% of the EU's total electricity supply by 2020.

The ESTORAGE approach to retrofitting PSPs avoids the costs associated with constructing new PSPs along with the eight to 10 years' development time required. This advantage is especially significant due to the project's ambition to develop solutions that could upgrade 75% of European pumped hydro storage to variable speed. It has been estimated that up

to 10 GW of additional regulation capability can be achieved through significant upgrade and this with no environmental impact.

The project, due to finish next year, is also looking at supplementary systems such as upgrading IT infrastructure for a real-time flexible system management across national systems. Additionally, the project will establish a viable business model that enables EU-wide deployment by

investigating current gaps and barriers to flexible energy technologies in the market and regulatory regimes.

ESTORAGE

- Coordinated by Alstom Hydro in France.
- Funded under FP7-ENERGY.
- <http://cordis.europa.eu/news/rcn/125319>
- Project website: <http://www.estorage-project.eu/>
-  <http://bit.ly/1rgm6l>

IMPROVED FREIGHT CARRIAGES AND TRACKS

An EU consortium has aided the upgrade of Europe's rail network via novel, lightweight freight carriages and new track infrastructure. Work involved cataloguing, assessing and testing candidate innovations, in addition to documenting new track designs.

Europe's economy depends on an efficient rail freight system. However, in recent years, the use of other transport methods has overtaken rail. As a result, rail needs to evolve to regain its former dominance.

The EU-funded project SUSTRAIL (The sustainable freight railway: Designing the freight vehicle — track system for

higher delivered tonnage with improved availability at reduced cost) aimed to initiate a new rail era by designing novel freight vehicles that utilise lightweight materials. Secondly, the group planned to develop new track infrastructure,

involving optimised track geometry plus ground stabilisation and innovative monitoring techniques. The developments should improve rail freight efficiency and reliability while reducing maintenance frequency and costs.

Work towards the end of the project's third year focused on identifying and assessing the proposed innovations. Initially, researchers benchmarked the technical and economic state of the current system. The team also prepared new track design specifications that match requirements and address the performance of future vehicles. The resulting description supports key decisions regarding future systems.

The consortium reviewed four key train technology sectors. Candidate solutions were assessed and compared with reference to potential implementation in the SUSTRAIL prototype.

Team members also investigated a sustainable track design, intended to yield a low-maintenance track concept. They defined a set of critical parameters to help determine the track modifications necessary for new freight vehicles and increased freight traffic. Following a failure mode and effects analysis, a set of track innovations was selected.

The final phase involved demonstrating the innovations previously identified. Researchers designed, built and tested a prototype vehicle on a special track, along with upgraded infrastructure. Testing also examined economic costs and benefits. The prototype successfully met the

requirements identified at the start of the project. The outcomes were then made available for implementation as part of a sustainable and efficient rail freight network.

Researchers later conducted substantial dissemination work, particularly to the European Commission, other EU projects and interested stakeholders.

SUSTRAIL yielded innovative concepts for rail freight vehicles and tracks. The developments should improve rail efficiency and lower costs.

SUSTRAIL

- Coordinated by the Train Consortium in Italy.
- Funded under FP7-TRANSPORT.
- <http://cordis.europa.eu/result/rcn/165132>
- Project website: <http://www.sustrail.eu/>
-  <http://bit.ly/1VoryM7>

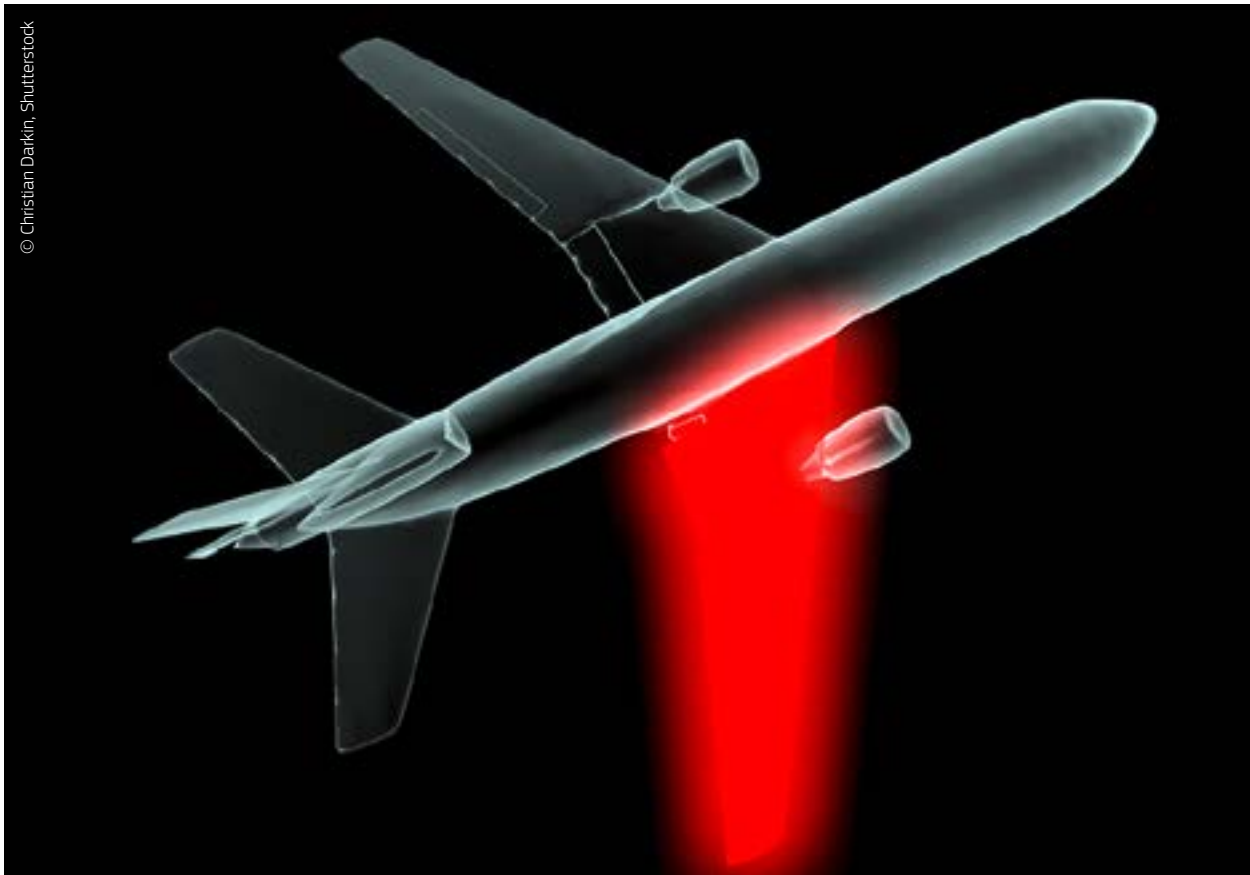
"The mixed-methods research design comprised a qualitative study of 100 self-identified bicultural individuals and a large psychometric study."



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SELF-SHAPING WINGS TO REDEFINE AVIATION IN THE FUTURE

Increasing the aerodynamics of an aeroplane by developing wings that change their shape could one day lead to faster, more fuel-efficient aircraft.



The idea of building lighter, more efficient and more aerodynamic aircraft is crucial for saving on energy costs and lowering the aviation industry's carbon footprint. The EU-funded FUTUREWINGS (Wings of the future) project worked towards an aeroplane that could change its shape during flight — e.g. through self-shaping wings — in order to increase flight efficiency. It tested the viability of such a radical concept, focusing on developing a thin-walled beam whose shape could be controlled through piezo-electric actuators.

To achieve this, the project team conducted research into how piezo-electric technology can manipulate the shape of beams and other structural elements involved in aerospace engineering. It built a novel electronic control system required to activate sets of macro fibre composite components and established the numerical procedure for simulating hybrid structures.

A key project achievement involved the design and testing of torsion specimens and bending specimens made up of hybrid composite active material. The project team also verified the numerical analysis and the design of the Future-Wing concept.

FUTUREWINGS then compared the aero-elasticity of the aircraft model designed with that of conventional aircraft and conducted flight simulations to validate the aeromechanical behaviour of the futuristic aircraft concept.

In effect, the project furthered the use of smart material that transforms aircraft wings and tails into 'living tissue', facilitating aircraft control by changing the shape of its surfaces and aerodynamics. The research results have been disseminated through workshops and publications, while the project partners have made plans to continue collaboration beyond the project's end. Although still at an early stage of development, so-called

"A key project achievement involved the design and testing of torsion specimens and bending specimens made up of hybrid composite active material."

'self-shaping structures' could play an important part in the aviation and engineering of the future.

FUTUREWINGS

- Coordinated by the University of Pisa in Italy.
- Funded under FP7-TRANSPORT.
- <http://cordis.europa.eu/result/rcn/182845>
- Project website: <http://www.futurewings.eu/>

NOW ON CORDIS



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Energy-efficient process industries Furthering Europe's ambitious environmental targets

Over **450 000** enterprises and around **6.8 million** jobs are dependent on Europe's process industries, which include chemicals, engineering, minerals and ore, non-ferrous metals, steel and water. Consequently, the process industries, which generate more than **EUR 1.6 billion** in annual turnover and represent **20 %** of the EU's total industrial production, are absolutely vital to Europe's economy and long-term industrial competitiveness.

However, these vital industries have had to face the key challenge of reducing their high dependency on resources. Although energy efficiency in industry across the EU has gradually improved (by an average of 1.8 % per year up until 2009), there is still much work that could and should be done to encourage the uptake of cleaner technologies, more efficient methods and better industrial procedures to reduce the industrial processing sector's environmental impact.

Achieving a better environmental footprint for the process industries is now even more pressing due to the EU's target to cut its emissions to at least 40 % of 1990 levels as a part of its comprehensive 2030 climate and energy framework. On Friday 22 April 2016, the EU also formally signed the Paris Agreement on Climate Change (COP21) that was agreed in December last year, formally committing the Union to fully embracing the transition to a low-carbon economy and society.

On 15 June 2016, CORDIS released a new Results Pack to showcase some of the EU-funded projects that have taken up the challenge of developing the novel methods and key enabling technologies that will serve to increase energy efficiency in industrial processes.

Please see the following link for more information:

http://cordis.europa.eu/article/id/400040-energy-efficient-process-industries-furthering-europes-ambitious-environmental-targets_en.html

About CORDIS ResultsPacks

CORDIS ResultsPacks are a new set of products grouping EU-funded project results per topic and target audience. The aim is to disseminate information about new studies, scientific findings and technologies to the relevant target audience, in order to facilitate their exploitation across Europe.

BIOGAS FROM SLAUGHTERHOUSE WASTE

Slaughterhouse waste can now be used to produce biogas thanks to an EU-funded initiative, thereby avoiding the need for incineration and landfill.



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Large amounts of solid wastes with a high lipid and protein content are produced by slaughterhouses. This gives the waste greater potential for methane production than other feedstocks, such as energy crops or municipal water. However, lipid-rich waste can inhibit the growth of microorganisms, reducing efficiency and creating problems in anaerobic digestion.

The ADAW (Saponification pre-treatment and biosensors based control system for slaughterhouse waste anaerobic digestion improvement) project set out to improve biogas production technology and treat lipid-rich waste from the slaughtering industry.

Project partners used thermo-chemical pre-treatment to improve biogas yields through a hot hydrolysis reaction

between a fatty acid from non-soluble slaughterhouse waste and an alkali. The result was smaller, simpler molecules with improved contact between the substrate and microorganisms that enhanced anaerobic biodegradability.

Ultrasonic-dispersion was then used to break down complex organic molecules and aid their digestion by bacteria during anaerobic digestion. Online sensors were developed to detect alkalinity and volatile fatty acids, thereby resulting in better control of the anaerobic digestion process for stable automated biogas process control.

ADAW was targeted at two main groups of end-users. The first was small- and medium-sized slaughterhouse operators who will benefit by integrating a small-scale biogas plant into their operations without the need for major investment. The second group included commercial biogas operators who will now be able to use slaughterhouse waste as a potential source of energy.

The technology developed by ADAW will mean that certain types of organic wastes with high protein and lipid content will be correctly managed and exploited through the use of anaerobic digestion processes. Furthermore, biogas plant operators will be able to feed their system with slaughterhouse waste. Until now, it has not been possible to carry out this treatment through anaerobic digestion.

ADAW

- Coordinated by Biogas Fuel Cell in Spain.
- Funded under FP7-SME.
- <http://cordis.europa.eu/result/rcn/182824>

NOVEL MATERIALS FOR SOLAR FUEL TECHNOLOGY

Researchers have identified cheap, non-toxic materials that could potentially form the basis of an efficient system to produce solar fuel.

The creation of syngas (consisting primarily of 'hydrogen' (H_2) and carbon monoxide) from water and sunlight is the first step in the production of solar fuel, an alternative to fossil fuels. Researchers are searching for better catalysts and light-absorbing materials for this reaction in order to assemble a viable photosynthetic device on a useable scale. Catalysts made from abundant earth metals, rather than precious metals, and cheap materials that absorb light efficiently from the entire solar spectrum would be ideal.

The EU-funded CO2SF (Solar fuel chemistry: Design and development of novel Earth-abundant metal complexes for the photocatalytic reduction of carbon dioxide) project investigated two metal-free light-absorbing materials in combination with a water-soluble nickel catalyst used with an H_2 -producing enzyme.

The first material was carbon nitride, a non-toxic and cost-effective carbon-based material made by condensing melamine. It proved to be very stable, remaining active for much longer than other known photosensitiser systems, which photobleach or degrade over extended periods of irradiation. The second material was carbon quantum dots, which can be synthesised from citric acid, a common, cheap and non-toxic starting material. It was active as a light absorber, and measurable H_2 production occurred even under visible light irradiation.

Using hydrogenase enzymes as part of the catalyst was also novel, with researchers gaining significant insights into their action and mechanism. Four high-impact scientific publications have resulted from this investigation, and several spin-off projects continue to make use of the project's findings.

This work has thus helped pave the way for the development of solar fuel technology. Ultimately, the capture, conversion and storage of solar energy in this way will help scientists develop carbon-neutral energy sources.

CO2SF

- Coordinated by the University of Cambridge in the United Kingdom.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/182822>

"Four high-impact scientific publications have resulted from this investigation, and several spin-off projects continue to make use of the project's findings."

ENVIRONMENT AND SOCIETY

EU-FUNDED PROJECT EVIDENCES THE VALUE OF 'GREEN MINING'

The I²MINE project has demonstrated an integrated and green mining approach which helps meet consumer demand for mineral-dependent products, whilst boosting competitiveness and improving sustainability.

Many everyday consumer products depend on minerals extracted from the ground, and with 30 million jobs in the EU depending on their supply, much European prosperity rests on this. Additionally, with ever increasing demand for these products, the mining industry now finds that it has to go deeper into the ground to maintain the necessary supply of raw materials. Deep mining of the future will require new innovations, and whilst this presents a challenge, it also creates an opportunity to develop new technologies and processes.

A deep-mining approach balancing safety, efficiency & sustainability

Mining is sometimes perceived as being a dirty, highly unsustainable industry of

the past. Against this backdrop, the I²MINE (Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future) project bringing together European scientists and engineers was established. According to the Project Manager, Dr Horst Hejny, 'The overall objective of the project was the development of innovative technologies and methods for sustainable mining at greater depths.'

Looking at the entire mining cycle, the project sought to demonstrate the concept of an integrated deep mine (at depths greater than 1 500 m) which is 'invisible, safe and with zero impact'. 'We have been addressing the sustainability of mining operations by increasing energy efficiency, reducing waste and starting the approach of an "invisible" mine that operates underground to the extent possible. Ideally, only the final product will come out of the ground,' Dr Hejny elaborated.

A central focus of the project was on intelligent 'selective exploitation', for example by developing new sensor techniques for material recognition and boundary layer detection and sorting. Another area of innovation

was in the field of extraction. 'We developed a new cutting head for continuously cutting hard rock of more than 250 MPa compressive strengths. This new device would allow for continuous operation where nowadays only drilling and blasting would be feasible,' Dr Hejny commented.

Combined with improved mass flow management, efficiency was further increased with the development of an ore pre-sorting device which could operate directly at, or very close to, the face. 'This is a significant step to improve sustainability of mining operations through keeping waste rock directly underground and using it for backfill,' as Dr Hejny stated. The underground operation also extended to the treatment of emissions, to the degree possible, further reducing the environmental impact.

Another component of the project was to maximise the use of autonomous machinery, for example by using underground collision avoidance transportation systems. However, the project found that this was not possible in all operations and so also factored in increased worker safety. The project included the development of a spraying robot that

"Looking at the entire mining cycle, the project sought to demonstrate the concept of an integrated deep mine (at depths greater than 1 500 m) which is 'invisible, safe and with zero impact'."

created concrete liners, resulting in increased safety and efficiency. As Dr Hejny summarised: 'These devices are a step forward in the direction of both automation and autonomy in mining.'

Securing Europe's supply of raw materials and contributing to the green economy

As to what difference I²MINE or complementary projects such as SMIFU (Smart Mine of the Future) make to the lives of European citizens, Dr Hejny responded by saying: 'The public will benefit by a higher security of raw materials provision and thus maintaining our living

standards.' Securing supply will enable Europe to more effectively plan for the future, reducing dependency on imports, as well as increasing the competitiveness of the extraction industry and its allied technologies.

The objectives of the I²MINE project also contribute to the wider drive for a green economy; an increasing priority within the EU as it features within the Europe 2020 Strategy, the Seventh Environment Action Programme and Horizon 2020 to name but a few. With the eco-innovation market valued at around EUR 1 trillion per annum, and expected to triple by 2030, this represents a major opportunity.

As the I²MINE project demonstrated a balance of technological, social, environmental and economic requirements, Dr Hejny concluded: 'The most important next step is to implement the results of I²MINE into practice, and this has already started.'

I²MINE

- Coordinated by LKAB in Sweden.
- Funded under FP7-NMP.
- <http://cordis.europa.eu/news/rcn/125261>
- Project website: <http://www.i2mine.eu/>
-  <http://bit.ly/1UaqZV6>

NEW INSTRUMENT EXPLORES ROLE OF ORGANIC AEROSOLS

Scientists are only now beginning to understand the behaviour and influence of aerosols on atmospheric processes, such as gas-aerosol partitioning, chemical reactions and water uptake. An EU-funded initiative has developed a new instrument that will give a clearer picture of these processes at the single particle level.



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Organic aerosols play a major role in the chemistry and physics of the atmosphere, as their physical and chemical properties are of profound importance. They come from both natural and man-made sources and serve as cloud condensation or ice nuclei and sites of interfacial chemistry. They also scatter and absorb incident radiation.

Despite their ubiquity and importance in the environment, little is known about organic aerosols. Therefore, the BBOT (Characterizing the phase transitions of single organic aerosols in an optical trap) project was established to develop a new instrument for understanding aerosol behaviour, at the level of a single particle (600 – 5 000 nm in size), and its influence on various atmospheric processes.

Project partners constructed an instrument that can be cooled down to 228 K (-50 °C) to mimic temperatures in the troposphere and stratosphere. It was used to explore aerosol phase transformations of a single aerosol particle and combined an optical trap comprising two 'Counter-propagating Bessel beams' (CPBBs), 'relative humidity' (RH) and temperature control. Proof of concept tests were conducted, and involved freezing several supercooled test substances: water and long-chained hydrocarbons.

Researchers conducted the first reported study of the freezing process of levitated single submicrometre-sized droplets in air using optical trapping techniques, including supercooled water droplets at 228 K. Project partners also explored the behaviour of organic (sucrose) aerosol droplets and the conditions that lead to glass formation of these aerosols at room temperature.

In addition, explorations into the freezing of long-chain aliphatic hydrocarbons and the response of ultra-viscous organic aerosols to changes in ambient RH increased understanding of the behaviour of aerosols in the atmosphere. Results suggest there is a link between chain-length and temperature dependence on the nucleation mechanism.

BBOT will provide a deeper understanding of the indirect effects of aerosols and their impact on global warming by supplying data for developing more accurate climate models, thereby improving their predictive ability. The results will also be used to inform science policy.

BBOT

- Coordinated by ETH Zurich in Switzerland.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/182821>
- Project website: <http://aerosolopticaltrap.wordpress.com/>

EU RESEARCHERS DISCOVER HOW THE VENUS FLYTRAP BECAME A PREDATORY PLANT

The EU-funded CARNIVOROM project has published research detailing how the Venus flytrap's genome has allowed it to become an insect-feeding carnivorous plant.

Venus flytraps have fascinated biologists for centuries due to the fact that the molecular underpinnings of its carnivorous evolution have remained largely unknown. Publishing in the journal 'Genome Research', researchers from the project CARNIVOROM (Molecular basis of carnivory Excitability, movement, and endocrinology of plant traps) have now cast light on this enduring biological mystery.

The Venus flytrap is by no means the only carnivorous plant — the sundew plant snares prey with sticky tentacles, while pitcher plants use beckoning pools of enzymes to attract their next meal. The aggressive feeding habits of carnivorous plants allow



“Many biologists have long suspected that this predatory behaviour evolved when the ancestors of today’s carnivorous plants turned typical defence mechanisms against insect pests into offensive weapons.”

them to survive in poor soil by giving them a new source of nitrogen and other nutrients. Many biologists have long suspected that this predatory behaviour evolved when the ancestors of today’s carnivorous plants turned typical defence mechanisms against insect pests into offensive weapons.

This hypothesis has now gained further support following a detailed genetic study of Venus flytraps undertaken by the CARNIVOROM team, led by biophysicist Professor Rainer Hedrich and bioinformatician Professor Jorg Schultz from Julius Maximilian University in Würzburg, Germany.

Specifically, Venus flytraps recognise their prey by using touch-sensitive trigger hairs located on the trap’s inner surface. When stimulated, these hairs generate an electric signal that

is transmitted to the plant. After the first stimulus, the trap remembers the signal but does not close; it is only after the second stimulus that the trap snaps shut. Prey that is captured will repeatedly activate the trigger hairs leading to repetitive electrical signals that are ‘remembered’ by the plant.

To date, no carnivory-specific genes have been identified in Venus flytraps. To understand the molecular pathways involved in insect feeding, the researchers from Germany and their partners in Saudi Arabia generated genome-wide transcription profiles of traps before feeding and then again after they had snared a cricket and began to digest it alive. They then compared these genome profiles to other plant tissues.

Non-stimulated traps have gene expression patterns that largely resemble a leaf base, supporting the common assumption that traps are modified leaves. However, the glands inside the trap, which promote insect digestion and are activated after a few hours to help it absorb nutrients from its meals, more closely resemble the genetic expression pattern of roots. These are of course essential for nutrient acquisition for non-carnivorous plants.

The key to the Venus flytrap’s extraordinary evolution appears to revolve around chitinase, an enzyme that digests chitin in insect exoskeletons. ‘Contact with chitin normally means danger for a plant — that insects will eat the plant,’ Prof. Hedrich commented. ‘In the Venus flytrap, these defensive processes have been reprogrammed during evolution. The plant now uses them to eat insects.’

The researchers also used electron microscopy to study the ultrastructure of the trap’s glands, finding specialised cell layers involved in active secretion, nutrient transport, lipid energy stores and protein biosynthesis necessary for trap function.

Funded partly by the European Research Council (ERC), the CARNIVOROM project officially ended in February 2016 and received nearly EUR 2.5 million in EU funding.

CARNIVOROM

- Coordinated by the University of Würzburg in Germany.
- Funded under FP7-IDEAS-ERC.
- <http://cordis.europa.eu/news/rcn/125301>

IN-DEPTH EXPLORATION OF EU INFLUENCE ON THE ARCTIC

The EU lacks a roadmap that states what powers it has and how best to use them when it comes to protecting marine biodiversity in the Arctic region. An EU-funded initiative aimed to examine Europe's capability in addressing such issues.

In recent years, several EU decision-making bodies have called for Europe to play a more active role in challenges and opportunities concerning the Arctic. However, there is very little action being taken in terms of evaluating the EU's present and future actions in this respect. On top of this, existing laws are fragmented and ineffective in implementing an ecosystem approach needed for preserving marine biodiversity.

With this in mind, the EURO-ARCTIC LAB (The European Union and the legal protection of marine biodiversity in the Arctic) project set out to determine how the EU can most effectively work towards achieving the objectives set out and implementing strategic initiatives to protect Arctic marine biodiversity.

To achieve its aims, EURO-ARCTIC LAB mapped the state-of-play in Arctic marine biodiversity and existing legislation, gaps in law and actions the EU has taken within and beyond its jurisdiction with varying levels of success.

Project partners produced a policy brief focusing on the EU and the legal protection of Arctic marine biodiversity. It proposed two central measures for the EU, namely promoting the establishment of marine protected areas and the implementation of the ecosystem approach or ecosystem-based management. The document also recommends possible actions that the EU can carry out within and beyond its borders. These concern shipping, fisheries and offshore oil and



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gas operations that have the potential to improve the international legal regime for the protection of marine biodiversity in the Arctic. Findings were presented at top international conferences and published in leading journals.

EU policies in environment, climate change, energy, research, transport and fisheries have a direct impact on the Arctic. By contributing to the preservation of Arctic marine biodiversity, EURO-ARCTIC LAB will enable the EU to address challenges and opportunities in a coordinated and systematic manner together with Arctic states, territories and key actors.

EURO-ARCTIC LAB

- Coordinated by the University of Dundee in the United Kingdom.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/182846>

HOW ISOLATED SPECIES GO EXTINCT

Researchers have studied 'ancient DNA' (aDNA) from a long-extinct Mediterranean herbivore to understand how climate change influences the extinction of species isolated on islands.



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Myotragus balearicus was a goat-like herbivore that lived on two western Mediterranean islands until it went extinct around 5 000 years ago. Recent advances in genetic sequencing mean that scientists can study the genetics of extinct animals like *M. balearicus*.

To determine if climate change drove these creatures to extinction, researchers

sequenced aDNA from *M. balearicus* fossils for the EU-funded project MEDITADNA (Ancient DNA and climatic change: New perspectives from insular environments).

M. balearicus is an ideal species for studying the effects of past climates for several reasons. During its 5 million-year isolation on the Balearic Islands of Mallorca and Menorca, major climate changes occurred, however the animal was unable to escape from them. The many fossils present on these islands allowed the researchers to link genetic changes over time to these climatic events.

Researchers collected aDNA from fossilised bone and faeces of *M. balearicus* and two rodent species that lived in the same area during the same period. They managed to obtain good-quality aDNA from 16 *M. balearicus* bone samples, all of which came from

caves located in the northern mountains of Mallorca.

After compiling the genetic data into a more useful form, researchers compared how populations differed over time, and how *M. balearicus* evolved during climatic changes. They also identified plentiful gut bacteria but limited plant species in the herbivore's faecal samples, providing clues to the animal's diet.

By understanding how the genetic diversity of *M. balearicus* changed over time as it slid towards extinction, MEDITADNA's results will provide valuable information for future species conservation efforts.

MEDITADNA

- Coordinated by CSIC in Spain.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/165030>

IT AND TELECOMMUNICATIONS

MOVING MOBILE COMMUNICATION ONTO THE CLOUD

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An EU project aims to ensure that European mobile tele-communication providers are not left behind as cloud computing becomes the norm.

The EU-funded MOBILE CLOUD NETWORKING (Future Communication Architecture for Mobile Cloud) project, which was officially completed at the end of April 2016, has effectively integrated domains, cloud computing services and mobile networks in order to provide the canvas upon which Europe's future mobile network services can be run. This is vitally important. If European companies are to take advantage of the technologies offered by cloud computing, then communication networks must be appropriately re-designed.

At the European Conference on Networks and Communications (EUCNC) last year, the project team unveiled some of their achievements, demonstrating the deployment of a 'Mobile core network' (MCN) on cloud infrastructure and showing how this can be utilised for developing typical mobile networking services. Much of this work is now available for further exploitation and eventual commercialisation.

EU action in the telecommunications sector has in recent decades led to greater consumer choice, falling call costs and higher standards of service. However, mobile services have yet to fully tap the vast commercial potential offered by cloud computing, which is why the results of the MOBILE CLOUD NETWORKING project could be of great industry interest.

By leveraging Europe's excellence in mobile communications and extending this into the cloud arena — at present almost exclusively in the hands of US companies — the project will help European telecommunication companies remain globally competitive in an industry worth around EUR 300 billion in the EU alone.

Cloud computing is about sharing computing resources rather than having local servers or personal devices handling 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's power to perform tens of trillions of computations per second can be tapped into for consumer-oriented applications.

The arrangement pioneered by the MOBILE CLOUD NETWORKING project works like this. Instead of contracting mobile connectivity from one or several mobile operators, an organisation such as a utility provider with demand for mobile communication would sign a contract with an MCN provider. The MCN provider itself would maintain contracts with a set of cloud-ready mobile networks and data centre providers.

Furthermore, the proliferation of mobile internet access and services has driven huge increases in mobile data traffic. The internet now performs millions of tasks, from online banking to tsunami monitoring, and data traffic volumes are expected to grow 12-fold by 2018. Tapping the full potential of the cloud, as this EU-funded project has done, is a key way of reducing infrastructure expenditure, achieving efficiencies and creating space for further anticipated data growth.

MOBILE CLOUD NETWORKING

- Coordinated by SAP in Germany.
- Funded under FP7-ICT.
- <http://cordis.europa.eu/news/rcn/125300>
- Project website: <http://www.mobile-cloud-networking.eu/site/>

INNOVATIVE TOOLS FOR BETTER SOCIAL MEDIA MARKETING

Social media has become an integral part of marketing strategies, but current tools for monitoring and analysis are proving ineffective in measuring campaign impact and return on investment. An EU initiative has created technology to improve the efficiency of social media campaigns.

Social networks produce hundreds of millions of posts every day. This overwhelming flow of online activity is becoming increasingly difficult to measure, leading to poorly defined strategies and unsuccessful marketing campaigns. New monitoring solutions are needed to sort through information spread across multiple social networks.

“After identifying end-user requirements, the system specifications and architecture were defined.”

To tackle such pressing social media marketing challenges, the EU-funded OPTIMIZR (Online analysis tool for the optimization of social media campaigns) project aimed at understanding

social network structure and its impact on information spreading.

Project partners developed a novel tool and campaign optimisation system to enhance the efficiency and maximise the impact of social media marketing campaigns for products, services and brands targeted at customers. After identifying end-user requirements, the system specifications and architecture were defined.

The technology works by analysing the transmission of content-based information and the structure of popular social network services. This helps to reveal who the influencers are in a given space, determine the most optimal online communities for a targeted campaign and forecast the potential impact on social networks. Benchmarks can then be created to measure the efficiency of an online

marketing campaign and monitor its performance.

OPTIMIZR technology can help revolutionise social network analysis, enabling the marketing industry to carry out effective online marketing activities and to spend wisely on internet advertising. By encouraging digital entrepreneurship, this project will also help support the EC's Digital Agenda for Europe.

OPTIMIZR

- Coordinated by Ateknea Solutions Catalonia in Spain.
- Funded under FP7-SME.
- <http://cordis.europa.eu/result/rcn/165047>
- Project website: <http://optimizr.eu/the-project/>
- <http://bit.ly/1RZbNpE>

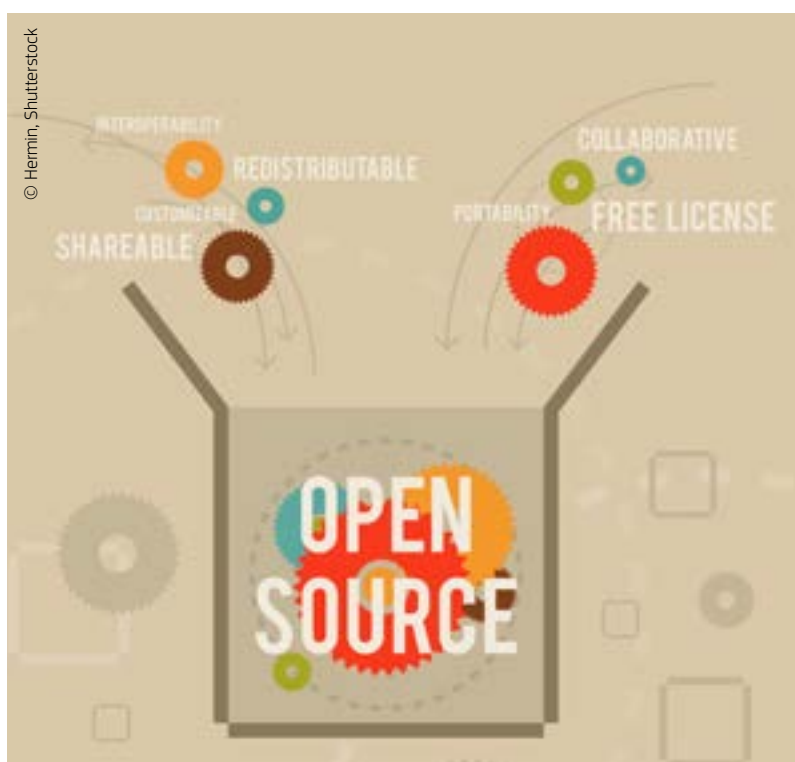
THE CASE FOR OPEN-SOURCE SOFTWARE

Studying the economics of open-source software and how it could supersede proprietary software could help Europe innovate, while offering cost-effective solutions to users.

Amid the sea of software giants with costly products, ‘Open-source software’ (OSS) is gaining popularity. Such software operates under specific licensing agreements — e.g. ‘General public license’ (GPL) and ‘European Union public licence’ (EUPL) — calling for careful economic considerations to encourage innovation and development. The EU-funded ECONOPENSOURCE (Economics of open source) project studied the economics of innovation through open-source development.

Proposing a new method for investigating open-source innovation, the project looked at how innovators act and what licensing they choose, if any. It also looked at social welfare gains emerging from an open-source model versus a private-investment model, and compared competition between both. In addition, the project team considered whether open-source production could overthrow proprietary production, and whether it should be subsidised.

After closely examining the competition dynamics between two firms, one proprietary firm and one open-source firm, the project team proposed a solution for the dynamic duopolistic competition model. It identified whether or not open-source production could beat the proprietary firm in the long run and outlined the conditions necessary to bring this about.



One important finding in this respect is that there cannot be one single policy recommendation or answer regarding open-source production. In some cases, it may be beneficial for increasing the welfare of people, while in other cases it may not be as beneficial.

On a more legal and cross-European level, the previous decade saw the EU outline many strategies regarding OSS, approving the EUPL in 2009. This represents a major achievement in furthering integrated technology in Europe and encouraging

innovation in OSS. The project's results will help enlighten the debate on OSS, promote cost effectiveness in developing and using software, and continue advancing research, development and innovation in the field.

ECONOPENSOURCE

- Coordinated by Boğaziçi University in Turkey.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/175024>

A BOOST FOR OPTICAL NETWORK EFFICIENCY

An EU team has developed ways to exploit the wasted capacity in optical fibre networks. Testing of an indoor combined radio/optical system demonstrated speeds of up to 5.0 Gb/s.

The radio-spectrum band at 60 GHz is licence-free, and offers reasonably large bandwidth for certain applications. In such a context, several ultra-broadband standards have been defined for wireless personal area networks.

Yet the optical fibre used to carry such networks leaves unused capacity. The EU-funded FIRMWARE (Multimode fiber radio technology for cost-efficient indoor mm-wave remote antenna systems) project aimed to develop technologies to utilise this for indoor networks. The research focused on a new photonic array receiver antenna. The purpose was to achieve fast optical networks over indoor distances up

to 100 m. Such networks were intended to be low-cost and safe with a low-carbon footprint. Work involved re-purposing a particular standard optical fibre for wireless transmission.

Stages included a proof-of-concept experiment using a radio over fibre scheme, which addressed performance limitations. The resulting transmission of 3.8 Gb/s exceeded the target.

Researchers proposed a converged fibre-wireless network structure, which was expected to support various protocols. The idea was tested using 'Ethernet passive optical network' (E-PON) data.

The group designed and built suitable low-cost, millimetre-wave antennas.

Another plus was the use of environment-friendly materials.

Work produced a new, spectrally efficient, division multiplexing scheme, based on radio-over-fibre technology. The scheme addressed next-generation wireless data traffic demands.

The team also designed a network topology utilising single mode fibre to multimode fibre feeds. Further proof-of-concept experiments achieved 5.0 Gb/s.

Lastly, the consortium addressed a PON/mm-wave converged topology. Experiments demonstrated a fast transmission rate of over 1 km.

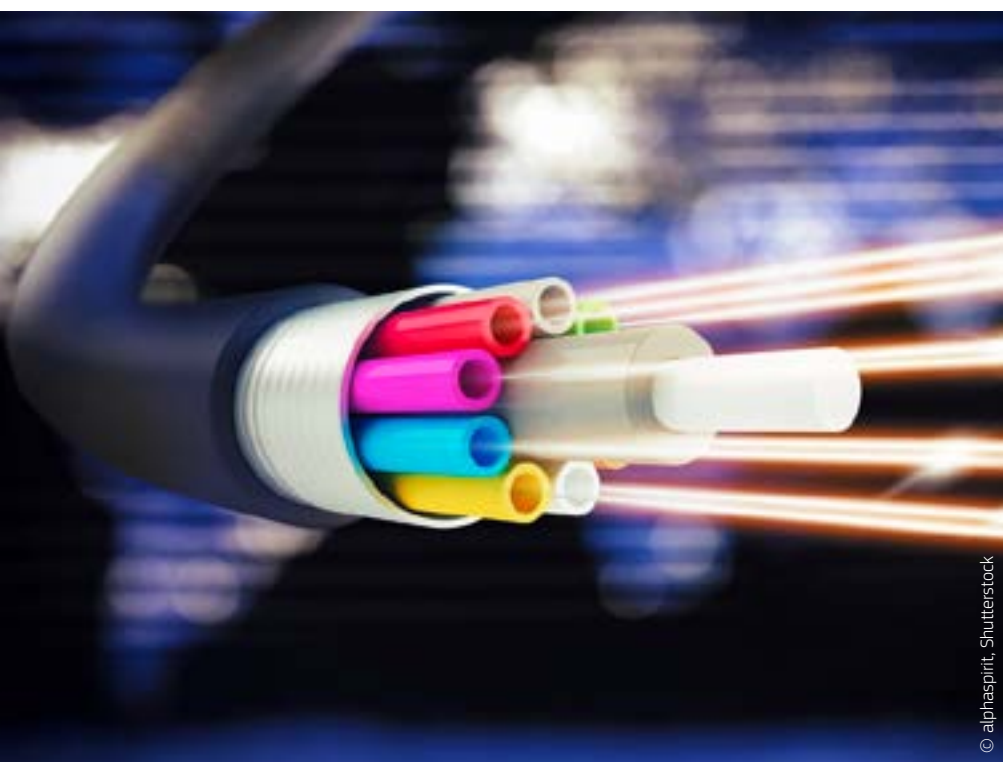
To help share information and transfer knowledge about the project, a university poster day, school open day and public events were held. One notable event saw projects presented to Britain's House of Parliament and a panel of expert judges.

The FIRMWARE project achieved its goal of developing technologies that maximise the utility of optical networks. The work looks set to bring faster computer networks and more environment-friendly technologies.

FIRMWARE

- Coordinated by University College London in the United Kingdom.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/182781>

"Work produced a new, spectrally efficient, division multiplexing scheme, based on radio-over-fibre technology."



INDUSTRIAL TECHNOLOGIES

SPIDERS TEACH SCIENTISTS HOW TO CREATE A COMPLETELY NOVEL LIQUID-SOLID MATERIAL

EU-funded scientists learn how to replicate a spider's silk thread and its unique ability to always remain taut.

Look closely at an active spider's web and you will notice that it always retains its shape. Even after trapping an insect, a spider's orb web can reel in the stretched thread to regain the web's tension. This phenomenon is something that has fascinated scientists for decades. The tiny and seemingly incredible forces of physics at work in a spider's web were baffling; only now are scientists beginning to uncover the truth.

Fritz Vollrath, coordinator for the EU-funded SABIP (Silks as Biomimetic Ideals for Polymers) project has discovered that a web consists of both the silk spun by a spider and microscopic glue droplets that sit on the silk thread. These droplets are not made by the spider itself. Instead, the spider coats the thread with a thin layer of sticky material that then absorbs water from the atmosphere. The glue swells, becomes unstable, then it forms droplets, Vollrath explains.

The droplets are mainly used to capture prey, but they can also reel in the silk filament keeping the whole web under tension. One tiny droplet, which measures about a tenth of a millimetre across, can reel in over 20 cm of thread packing it tightly inside the droplet. The thread can then be reeled in and out again many times.

Remarkably, the silk-droplet combination behaves like both a solid and a liquid, leading the Oxford-based SABIP team and its collaborators at Paris' Pierre and Marie Curie University to baptise it 'liquid wire'. 'When the spider's web thread is stretched it's like a particularly stretchy solid owing to its molecular nanosprings, but when it is compressed it switches its behaviour to that of a liquid, shrinking with no apparent limit while exerting a constant tension,' says Vollrath.

'This really is a novel class of materials. A complex silk composite that people never thought possible,' adds Herve Elettro, key researcher of the Paris team who focussed his PhD on this discovery.

Understanding this unique behaviour has led the team of researchers to create synthetic silk with the same properties as a spider's web using a nylon thread and sugar solution. Moreover, this synthetic silk is produced at ambient temperatures, without any harsh chemicals and is easily recyclable.

'Now we are tackling the question of what we can do with this material. Can we upscale it? Does it have to be integrated into something? The technology is so new and we're at the phase of exploring the possibilities where such small forces could be used,' Vollrath continues.

A second PhD student is currently working in the Paris team on exploring ideas for novel devices based on this discovery, funded principally by French Research funding.

'EU funding, and the mixing of French and Anglo-Saxon academic cultures encouraged by the EU, was key to our fantastic discovery and the creation of synthetic liquid-wire,' concludes Vollrath.

SABIP

- Coordinated by the University of Oxford in the United Kingdom.
- Funded under FP7-IDEAS-ERC.
- <http://cordis.europa.eu/news/rcn/125439>

INDUSTRIAL TECHNOLOGIES

FEWER DEFECTS BY IMPROVING EQUIPMENT RELIABILITY

An ambitious, EU-supported team of researchers has targeted near-zero defect levels in manufacturing high-value parts, high-performance products and custom design manufacturing with intelligent systems for process control.

The EU-funded project IFACOM (Intelligent fault correction and self optimizing manufacturing systems) aimed for near-zero defect levels in all kinds of manufacturing. Fifteen academic and industry partners joined forces to develop simulation methods and tools that can predict manufacturing system behaviour and process performance.

A key step was developing and demonstrating new manufacturing strategies and methods in five real industrial cases. The methods work on three different levels, namely closed-loop control of process parameters based on real-time measurements, medium-time process tuning and, lastly, long-range performance improvement.

At all three levels, intelligent sensing and advanced signal analysis result in a defect diagnosis and prognosis system.

These include a set of methods for real-time self-correcting mechanisms that ensure immediate effect and, for medium- and long-range optimisation, increase the overall performance and stability of manufacturing processes.

The new technology relies on the monitoring of fluctuations in product and process parameters through equipment integrated into the machinery. Advanced computational intelligence methods for measurement analysis and decision-making enable more predictable and higher-level product quality. Self-adaptive devices optimise process parameters to ensure a high level of stability at minimum manufacturing cost.

IFACOM team members demonstrated the applicability and versatility of the new technology in applications for each of the five end-user partner organisations. Specifically, its benefits were proven for precision manufacturing of superalloys, tool status monitoring under extreme conditions, and electrical discharge machining. Demonstrators for polishing, boring and milling machine tools were also delivered.



Researchers have developed a virtual demonstrator for simulations using fuzzy logic-based algorithms for predicting quality defects based on input process parameters. The end of the project saw the process measurements extended from a few areas where they had been applied to a broad range of operations where there is a need to control key parameters.

It is well known that such a need exists in the manufacturing of automotive parts, aerospace components, medical instruments, and electronic and other high-performance products. IFACOM's self-optimising manufacturing process control is, therefore, expected to have a major impact on the competitiveness of numerous industries.

IFACOM

- Coordinated by NTNU in Norway.
- Funded under FP7-NMP.
- <http://cordis.europa.eu/result/rcn/92062>
- Project website: <http://www.ifacom.org/>

HERMETICALLY SEALED AIRCRAFT ELECTRONICS

Demand for composite materials in structural parts of the latest aircraft is high, as these materials are designed to be both strong and light, thereby offering weight reductions and energy savings. Thanks to EU funding, composites are also making their mark on electronic equipment enclosures, generating savings of more than 30% in weight compared to aluminium covers.

Advanced fibre-reinforced composite materials bring a host of advantages that are extremely useful in aerospace applications. Unlike their metallic counterparts, they are lighter in weight, offer the opportunity of tailoring lay-ups for optimum strength and stiffness, and have improved fatigue strength and corrosion resistance. With good design practice,

they also reduce assembly costs as a result of having fewer detailed parts and fasteners.

The SEALED BOX (Aerospace housing for extreme environments) project successfully demonstrated the use

of composite materials to protect electronic equipment located in unpressurised areas of aircraft. A motor control unit was selected to demonstrate the SEALED BOX solution of a hermetically sealed, low-weight and low-cost enclosure.

Researchers re-engineered the top and bottom covers to demonstrate the technical and economic viability of using composite materials for electronic housing. Standard high-strength

carbon fibres together with aerospace grade infusion epoxy resin were selected as the main materials for producing the covers. Resin infusion was the ticket to keeping manufacturing costs low. The team conducted trials at sample level to explore the different material solutions.

Detailed analyses demonstrated that the covers could withstand the highly dynamic conditions. The laminate selected fulfilled both weight and stiffness requirements, while the thermal results obtained were in line with the aluminium counterpart.

The composite structures manufactured successfully passed the electrical bonding and sand and dust tests. Optimisation work also helped prevent damage during painting.

Proper electronic enclosures protect electronics against harsh conditions, prevent heat dissipation and radio frequency interference, and provide electrostatic discharge protection. The use of composite materials that are inherently stronger has important implications for more efficient power electronics.

SEALED BOX

- Coordinated by Tecnalia in Spain.
- Funded under FP7-JTI.
- <http://cordis.europa.eu/result/rcn/182796>

“Researchers re-engineered the top and bottom covers to demonstrate the technical and economic viability of using composite materials for electronic housing.”

FOOD AND AGRICULTURE

INSECT LARVAE AS AN ADDITIONAL SOURCE OF PROTEIN FOR EUROPE'S ANIMAL FEED

The EU-funded PROTEINSECT project has recommended a comprehensive review of European legislation to allow for insect larvae to be used as a source of protein in animal feed.

Europe currently imports 70% of its protein for animal feed, putting it at risk of ever-growing competition for feed protein from a global population that is set to exceed 9 billion by 2050. Developing nations in particular are seeing a huge increase in demand for animal products, and there has been a five-fold increase in the total consumption of meat since the mid-1940s. The project PROTEINSECT (Enabling the exploitation of Insects as a Sustainable Source of Protein for Animal Feed and Human Nutrition) believes that adapting European legislation to allow for the use of insect protein in animal feed will make a substantial contribution in addressing these challenges.

Benefits of insect protein

To address this growing challenge, PROTEINSECT experts from Europe, China and Africa have been investigating the use of two species of fly larvae in the diets of chickens, pigs and fish, carrying out feeding trials and analysing the quality and safety of rearing farmed flies on organic waste substrates such as manure.

Insects are rich in protein and are a natural component of the diet of many fish and free-range poultry. The project argues that fly larvae can be reared on a wide range of wastes and by-products offering a way of recovering value from materials that may traditionally be disposed of by the agricultural and food industries.

The biological reprocessing of organic waste was a key concept for PROTEINSECT, as not only would insect use for animal feed help to alleviate Europe's protein deficit, but it would also facilitate significant reductions in waste volumes. The project found that fly larvae can reduce the mass of organic waste by up to 60% in just 10 days, contributing towards the realisation of a truly circular economy. The project's research has also demonstrated that the use of insect protein in animal feed to complement traditional plant sources could contribute to making more agricultural land available for crops to be consumed directly by the human population. This would additionally provide for greater overall food security.


Fish, poultry and pig feeding trials were conducted by the project in 2015 in Belgium and the UK based on PROTEINSECT UK-derived insect protein. These trials evaluated weight gain and growth rates, as well as specific segment factors such as survival rates in Atlantic salmon. Overall, the project observed that there were no significant differences in the animals' performance and even recorded improvements as a result of the insect feed. For example, levels of good micro-organisms (*Lactobacilli*) were significantly higher in the insect-fed piglets.

Next steps for the project

The project team believes that Europe could become a major global contributor to this alternative and additional source of protein, as well as provide innovative solutions for reducing organic waste. However, they argue that conservative and outdated European legislation concerning the use of insects in feed and food are a major barrier for potential investors, and consequently market entry for insect-derived protein. Specifically, they argue for a review of two EU Regulations that currently prohibit the use of insects as a source of protein for animal feed for animals raised for human consumption, as well as the rearing of insects on manure or catering waste.

Speaking during the event, the PROTEINSECT coordinator, Dr Elaine Fitches commented: 'The protein gap in Europe is a very real risk to social, economic and environmental progress... As we seek sustainable European long-term solutions we must consider the benefits that the introduction of insects — specifically fly larvae — could have on the content of animal feed.'

PROTEINSECT

- Coordinated by Fera Science in the United Kingdom.
- Funded under FP7-KBBE.
- <http://cordis.europa.eu/news/rcn/125262>
- Project website: <http://www.proteinsect.eu/>
-  <http://bit.ly/1UkXKk0>

NOVEL AUTOMATED TECHNOLOGY TO BETTER HARVEST ASPARAGUS

Asparagus is currently harvested by hand. To reduce both dependence on labour and the production costs, an EU initiative has introduced an automated harvesting machine.



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Manual harvesting has several drawbacks. Cold weather wreaks havoc on the harvesting period, pushing the work of seasonal workers either forwards or backwards. This results in hired personnel running up costs while waiting out the delay, or a lack of available workers if harvest begins too early. Furthermore, harvesting can only be carried out during the day.

To address these issues, the EU-funded DASH (Demonstration of the AutoSpar harvesting machine used for white and violet asparagus) project set out to develop a fully functional, reliable, automatic asparagus harvesting machine.

Project partners had initially aimed to build on the automatic and selective harvesting machine prototype for white and violet asparagus created during a previous EU initiative but which was not ready for commercial use. However, they decided to build a new prototype by implementing novel technological solutions and technical improvements.

The prototype underwent rigorous testing during the 2014 and 2015 harvesting seasons. In terms of performance, 80% of existing or available asparagus stalks were successfully harvested. Off-season demonstrations were also carried out at three exhibitions.

A business plan focused on the commercialisation of the prototype. It also contained an analysis of material costs and how to reduce them, along with a

marketing plan that highlighted potential market barriers and competition.

DASH delivered an automatic asparagus harvesting machine that is expected to go to market in the next two years. Asparagus farmers and producers stand to benefit from a solution that no longer depends solely on manual labour and does not rely on the time of day, the elements and other external forces.

DASH

- Coordinated by Biozoon in Germany.
- Funded under FP7-SME.
- <http://cordis.europa.eu/result/rcn/182849>
- Project website: <http://www.autospar.net/>

"80% of existing or available asparagus stalks were successfully harvested."

SUSTAINABLE FRUIT JUICE PACKAGING FROM ORGANIC MATTER

EU-funded researchers have created novel sustainable packaging materials using wastewater originating from the fruit juice industry.

Over 67 million tonnes of packaging waste is generated annually in the EU, which corresponds to around one third of all municipal solid waste. In developed countries, food packaging represents 60% of all packaging. As a result, food packaging has become the most obvious source of waste generated by the public.

Additionally, the fruit juice industries consume large volumes of water, both for the cleaning of equipment and facilities, as well as for the washing of fruit before it is transformed into juice. In recent years, the global volume of wastewater production by the juice industries has increased to 34200 million gallons when considering the general processing of fruits such as apples, apricots, cherries, citruses and peaches.

During a final workshop in Brussels on 18 April 2016, the FP7-financed project PHBOTTLE (New sustainable, functionalized and competitive PHB material based in fruit by-products getting advanced solutions for packaging and non-packaging applications) gave an overview of its results and showcased the innovative packaging it has developed, which it hopes will contribute towards alleviating these extremely high levels of waste.



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Transforming organic matter

The prototype PHBOTTLE packaging was obtained from the transformation of organic matter (mainly fermentable sugars such as glucose, fructose and maltose) present in the wastewater of the juice industry into a bioplastic material 'polyhydroxybutyrate' (PHB). The concentration of fermentable sugars in juice processing wastewater can reach 70% of the total organic load, containing almost 20 g/l of fer-

"This material was enhanced with antioxidants to increase the shelf life of the juice, as well as its resistance characteristic."

mentable sugars, and making it an abundant source of cheap feedstock for PHB bioproduction.

This material was enhanced with antioxidants to increase

the shelf life of the juice, as well as its resistance characteristic. Progress has been made possible by combining the latest advances in biotechnology, packaging and microencapsulation technologies, to demonstrate the value of organic waste from the juice industries as a raw material to produce packaging for their own products.

Contributing to a sustainable Circular Economy

Revealing a number of the PHB-based prototype bottles during the workshop, the project coordinator Dr Ana Valera outlined the added environmental value of the project. 'Our innovative packaging contributes to reducing the damage caused by conventional plastic materials,' she commented. 'Our packaging is environmentally friendly not only due to its natural origin (and not based on petroleum products) but also by the fact that the packaging production contributes

to a decrease in the environmental impact of wastewater management in the juice industry.'

The PHBOTTLE project also uniquely contributes to the development of the concept of a 'Circular Economy' in Europe in two ways. Firstly, food industry wastewater treatment is a costly process due to the energy needs in the aeration basin and the cost of waste sludge disposal. Recovering valuable materials from raw wastewater will therefore reduce treatment and disposal costs. Second, the use of biodegradable food packaging material will reduce energy use, carbon dioxide emissions, and waste treatment costs.

Moreover, the PHBOTTLE team also believes that the material developed during the project can be utilised in other sectors aside from the packaging industries. One example highlighted by Dr Valera during the workshop was the material's potential for use in the automotive sector for producing caps for car batteries.

With the concept of the 'Circular Economy' currently being a major policy issue at EU-level, the PHBOTTLE project has made an important contribution to the growth of 'green chemistry' solutions for developing products and processes that reduce environmental impacts and society's dependence on petroleum-based products.

The PHBOTTLE project was due for completion at the end of April 2016 and received just under EUR 3 million in EU funding.

PHBOTTLE

- Coordinated by Ainia in Spain.
- Funded under FP7-NMP.
- <http://cordis.europa.eu/news/rcn/125140>
- Project website: <http://www.phbottle.eu/>
-  <http://bit.ly/1QTM40S>

NEW GUIDELINES AND TOOLS TO COMBAT FOOD WASTE

An EU-funded project has used its final project meeting in Brussels to showcase its final results and inform policymakers on how significantly reducing food waste can lead to a more resource-efficient Europe.

The FUSIONS (Food Use for Social Innovation by Optimising waste prevention Strategies) project, due to finish in July 2016, was initiated with the aim of significantly reducing food waste in Europe throughout the entire supply chain. Food waste has been singled out as a major policy issue to address, particularly due to the EU's ambitious environmental targets and commitment to the development of a truly circular economy. The FUSIONS project team has estimated that current food waste levels for the EU-28 amount to approximately 88 million tonnes per year, which is the equivalent of 20% of all food produced in the EU. This comes at a cost of EUR 143 million and

304 million tonnes of CO₂ emissions, 6% of the EU-28's annual greenhouse gas emissions.

Policy analysis and social innovation pilots

One of the first tasks that the project set itself was to conduct a detailed policy analysis of existing EU legislation and policies that had implications for food waste. They identified 53 acts that impacted on food waste in a variety of policy areas, including agriculture, fisheries, enterprise and industry, taxation, trade, health and consumers, and the environment. The project partners are also still in the process of finalising a similar detailed analysis of relevant national legislation in the EU-28, covering Member States both within and outside the FUSIONS consortium.

Armed with such detailed knowledge of EU and national-level policies and legislation, the project has developed a set of recommendations on which mark-based

instruments could be best utilised to support food waste initiatives and stimulate social innovation initiatives. They identified two distinct clusters, one emphasising subsidies and grants/tax credits, and the second emphasising informational tools addressing food waste reduction and prevention — this includes general public awareness campaigns, voluntary agreements and marketing standards.



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FUSIONS has pioneered seven social innovation projects in six Member States with the capacity to inspire similar projects across the EU-28. The projects were supported by FUSIONS consortium members in collaboration with local organisations. One project focused on schools, by providing a set of guidelines for teachers and households on how to lower food waste, as well as how to better inform both parents and children about the importance of food waste prevention. Another project compiled detailed recommendations on encouraging the development of 'social supermarkets', organisations which sell food, at least a part of which is sourced from surplus food, to poorer people at a reduced price. Social supermarkets are seen as bridging the gap between traditional food retailing and donation.

Food Waste Quantification Manual

Another key tool developed by the FUSIONS team is a detailed Food Waste Quantification Manual, aimed specifically towards relevant national authorities in the EU Member States. The manual provides practical guidelines for a standard approach regarding how to quantify food waste at different stages of the food

supply chain. These guidelines cover three main activities: quantifying food waste in each sector (i.e. 'stage') of the food chain; combining sectoral quantifications using a common framework at national level; and reporting the results of the national food waste quantification study at country level in a consistent and comparable manner. Member States are not obliged to use the manual, but if a Member State claims to have used the manual's approach for quantifying and reporting food waste at national level, then it needs to follow certain core requirements to ensure uniformity and consistency.

National representatives from Belgium (Flanders) and the United Kingdom presented their experience of using the manual at the project's final conference. They highlighted the manual's common language and its good balance between harmonisation and flexibility, allowing national authorities to utilise the data and strategies that they have already developed, rather than having to build entirely new methodologies and processes from scratch. However, it was suggested that the integration and interaction of the manual with Eurostat food waste monitoring could be further explored in the future.

Next steps

Overall, the FUSIONS team hopes that the project will make a significant contribution to the EU taking the global lead in the quest to reduce food waste. The large collaborative network developed throughout the project's lifespan is also likely to remain active and contribute to future projects and programmes.

More immediately, the project has submitted all of its findings and tools to the European Commission to be further developed, particularly as part of the delivery of the Commission's 'Roadmap towards a Resource Efficient Europe' and its target of achieving a 50% reduction in food waste by 2020.

The FUSIONS project held its final conference in Brussels on 19 May 2016 and has received nearly EUR 4 million of EU funding.

FUSIONS

- Coordinated by Stichting Dienst Landbouwkundig Onderzoek in the Netherlands.
- Funded under FP7-KBBE.
- <http://cordis.europa.eu/news/rcn/125379>
- Project website: <http://www.eu-fusions.org>
-  <http://bit.ly/1UawMtW>

TRADING COMMON PLANT DEFENCES FOR METAL ACCUMULATION

New insights into the evolution of metal hyperaccumulation as a defence against diseases in plants could be useful for agricultural and bioremediation technologies.



The *Noccaea caerulescens* plant is a hyperaccumulator of heavy metals, and seems to have evolved this trait to defend itself against pathogens. It also appears to have lost the ability to use defence mechanisms common to most plants, suggesting a trade-off.

The EU-funded TRADEOFF METAL (Trade-offs in immunity in the metal hyperaccumulator *Noccaea caerulescens*) project aimed to study the processes involved in the gain in metal hyperaccumulation and loss of other defensive traits in *N. caerulescens*. The first step was to identify individual plants that exhibit signs of the trade-off.

Researchers exposed plants to high and low concentrations of zinc, as well as a pathogen. Individual plants were then classified according to their ability to accumulate zinc and to exhibit common defence responses to the pathogen, such as cell death.

They found that plants exposed to high levels of zinc were more resistant to pathogens, and those grown on low levels more susceptible. Plants with reliably reproducible differences were selected for further analysis.

This involved identifying the genes involved in the trade-off between metal hyperaccumulation and inducible defences. The evolutionary information gained is useful for understanding how species adapt and persist in fragmented or damaged habitats such as industrial sites.

TRADEOFF METAL's findings also shed light on how plant responses to biotic and abiotic stressors may be connected at the molecular level. Practically, this research can inform crop improvement strategies as well as efforts to clean up heavy metal pollution through phytoremediation.

TRADEOFF METAL

- Coordinated by the University of Oxford in the United Kingdom.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/182826>

PHYSICS AND MATHEMATICS

HOW GAME THEORY CAN LEAD TO ENERGY-EFFICIENT SOLUTIONS

© Arjuna Kodisinghe, Shutterstock

EU-funded researchers have applied game theory in order to develop new ways of efficiently controlling complex systems such as heating and power.

The EU-funded CASSTING (Collective Adaptative Systems SynThesis with Non-zero-sum Games) project has pioneered an effective new approach to understanding and shaping what are known as collective adaptive systems. These complex systems typically consist of numerous autonomous units, which can interact in a variety of ways. Examples include: the ecosystem; the brain; manufacturing businesses; and the internet.

By developing mathematical methods for identifying how optimal efficiencies might be achieved, researchers hope to be able to design better ordered systems and ultimately boost Europe's high tech industry. Sectors that could potentially benefit include robotics, high tech appliances and medical diagnostics.

The CASSTING project team began by characterising collective adaptive systems through the prism of game theory. This branch of mathematics has been successfully applied in various domains including economics, social sciences, biology, political sciences, engineering and computer science.

Game theory attempts to model strategic situations where several individuals are interacting, and tries to predict what

decisions individuals will take in a given situation, assuming rationality. This theory views components as players, their behaviour as strategies and specifications as winning conditions.

The project's overall objective has been to find ways of arranging components in such a way that will produce the best results through the application of this mathematical theory. This of course is easier said than done. Collective adaptive systems contain components that interact continuously with each other and with their environments, and which may work collaboratively or in an adversarial capacity. Components of collective adaptive systems can also adapt over time and even disappear, if one thinks about how the ecosystem behaves.

Nonetheless, the application of game theory has helped the CASSTING project team to develop new algorithmic analysis methods for predicting the behaviour of complex systems. One project case study involved the development of a complex system for floor heating. Several novel ideas were put forward in order to provide fully automatic communication with the hardware components of the floor heating system.

An adaptive, online synthesis algorithm was developed and is capable of computing

repeatedly optimal strategies for the near future. The tool was then built and demonstrated. The results showed that the tool could control the house considerably better than conventional heating controllers.

Another case study involved the analysis of a block of houses equipped with solar panels connected to the electricity network. Each household consumes and produces energy, which they can therefore buy and sell. Game theory was applied to represent this situation: each household is a player whose actions consist of selling, buying and consuming energy. Algorithms were developed to find good consumption and trading behaviours for each household in different contexts.

The challenge now is to develop algorithms and programmable components for other complex systems. This will create new opportunities for complex systems involved in, say, home automation, smart housing and efficient industrial manufacturing.

CASSTING

- Coordinated by CNRS in France.
- Funded under FP7-ICT.
- <http://cordis.europa.eu/news/rcn/125159>
- Project website: <http://www.cassting-project.eu/>

LASERS TAME UNPREDICTABLE ELECTRICAL DISCHARGES

Despite the ubiquity of electric discharges, only recently have EU-funded researchers been able to shape the exact path of electricity along a trajectory using laser beams.

Electrical discharges have found applications in welding, micromachining and fuel ignition, to name just a few examples. The tiny electrical spark that starts a combustion engine may look a lot different than lightning crackling through the sky, but they have something in common. They are both unpredictable.

Lightning can be drawn towards a lightning conductor, however it has for a long time proved impossible to predict the path it will take to get there. When an electric spark is created, engineers hope it goes where they want it to go. However, researchers have recently discovered a way to control the path of a spark as it arcs between electrodes.

Technological advances and research carried out within the EU-funded KOHERENT (Kerr based OPA for high energy infrared pulse generation) project set the stage for a spectacular demonstration, where an electric spark followed a smooth path.

Specifically, the researchers explored new routes for efficiently using mid-infrared pump lasers and producing long-wavelength radiation (up to 60 micrometres). Extensive investigations of photo-ionisation, induced in the air by the generation of long-wavelength radiation, allowed them to generate pulses that propagate on curved trajectories.

For the demonstration, the researchers mixed and matched different types of laser beams. These were arranged by them so they could make an electric discharge move along a straight or parabolic trajectory. The path does not even have to be a simple one; it could follow curved trajectories, such as S-shaped ones.

Light can be concentrated along a line, as within a Bessel beam, or along a parabola, as within an Airy beam. However, both Bessel and Airy beams have the ability to 'self-heal'. If blocked, these

laser beams can reconstruct themselves on the other side of the obstacle.

The researchers wondered if this unusual beam property could be used for better guidance of electrical discharges. They placed an object between two electrodes and noticed how the electric discharge jumped over the 'obstacle' and made it to the next laser beam, without damaging the object.

The discovery of how to make electrical discharges bend around curves was made at the 'Advanced laser light source' (ALLS) facility of Canada's national scientific research institute (INRS). The researchers worked together with colleagues from Canada, China, France, the United Kingdom and the United States to achieve this breakthrough.

Electric discharges have previously been used in industrial welding and machining, combustion engines and lightning-protection systems. Systematic and precise control of high-voltage discharges will open up an array of possibilities for both scientific research and applications.

"The researchers explored new routes for efficiently using mid-infrared pump lasers and producing long-wavelength radiation (up to 60 micrometres)."

KOHERENT

- Coordinated by Heriot-Watt University in the United Kingdom.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/182816>
- Project website: <http://www.koherent.eu/>



UNCERTAINTY FROM THE BOTTOM UP

A collaborative effort in studying uncertainty through a problem-based approach has led to new insights into the role of uncertainty in rational decision-making.

Uncertainty arises when people lack information. People's understanding of uncertainty can play a decisive role in decision-making associated with global issues such as the financial crisis and climate change policymaking.

An EU-funded project RETHINKING (Rethinking uncertainty: A problem-based approach) aimed to improve the understanding of uncertainty through a set of epistemological questions that arise with

formal models of decision-making. Using an interdisciplinary approach, the work aimed at ways to resolve a fundamental problem in the field of uncertainty, namely how to identify an efficient compromise between foundational robustness and expressive power in the quantification of uncertainty.

The project supports the Bayesian approach to second-order uncertainty which arises when decision-makers can (partly) model the parameters of their decision problems. The term Bayesian is derived from the 18th century mathematician and theologian Thomas Bayes. The work therefore involved choice-based semantics combined with real-valued logics, while investigating how this is related to the notion of objective probability.

Objectives included using mathematical models in the social sciences and especially in economic theory in order to resolve the problems of rethinking uncertainty. A

novel algebraic approach was also investigated in terms of defining conditional events. Choice-based probabilities were characterised and defined, and an analysis of their probability functions provided.

Also introduced was a general framework for defining non-probabilistic measures of uncertainty as well as the extension of the classical Bayesian framework. It defined the betting criteria which lead to imprecise and non-standard probabilities.

Results can have a direct impact on economic theory, the foundations of probability and statistical inference, and artificial intelligence.

RETHINKING

- Coordinated by the London School of Economics and Political Science in the United Kingdom.
- Funded under FP7-PEOPLE.
- <http://cordis.europa.eu/result/rcn/182838>

EVENTS

OCTOBER
11►14

Troia (Setubal), PORTUGAL

CONFERENCE

SECOND INTERNATIONAL LEGUME SOCIETY CONFERENCE

Several EU-funded projects will be present at the Second International Legume Society Conference taking place in Troia, Portugal, from 11 to 14 October 2016.

The conference, which will focus on issues such as legume quality and nutrition, farming systems, abiotic and biotic stress responses and breeding, new 'omics' resources for legumes, and legume genetic resources, will also host the final meeting of the ABSTRESS project, as well as the annual meetings of the LEGATO and EUROLEGUME projects.

The health and environmental benefits, as well as the marketing of legumes will be transversal topics throughout the conference. Special attention will be given to fostering the interaction of researchers and research programmes with different stakeholders, including farmers and farmer associations, the seed/feed and food industries, and consumers.

For further information, please visit:

<http://www.itqb.unl.pt/meetings-and-courses/legumes-for-a-sustainable-world/welcome#content>

OCTOBER
11►12

Brussels, BELGIUM

CONFERENCE

EDEN PROJECT AT CBRNE INNOVATION FAIR 2016

The EU-funded EDEN project will be hosting its final conference as a part of the 2016 edition of the CBRNE Innovation Fair, to be held in Brussels, Belgium, from 11 to 12 October 2016.

During the event, the EDEN partners will present their results and achievements obtained in terms of technology, procedures and methods for the management of CBRNE accidents. The EDEN Store and CBRNE equipment will be presented and the film footage from the validation exercises displayed.

Throughout the innovation fair, the industry's top performing companies and end-user organisations, SMEs, suppliers and research institutes will exhibit their products and innovations. The event will also gather together decision-makers from government, operational units, industry, science and research in CBRNE and crisis management for networking and a number of open sessions.

For further information, please visit:

<https://cbrne-fair2016.eu/>

EVENTS

For more forthcoming events:
<http://cordis.europa.eu/events>

OCTOBER
12

Lavrion, GREECE

CONFERENCE

AMBASSADOR FINAL CONFERENCE

The EU-funded AMBASSADOR project will be hosting its final conference in Lavrion, Greece, on 12 October 2016.

The goal of the AMBASSADOR final conference is to present the different outputs that have been developed within the scope of the project in a technical session and to demonstrate their impacts in real conditions on one of the AMBASSADOR test sites in Greek Lavrion.

The work undertaken with the AMBASSADOR District Energy Management and Information System (DEMIS) will also be showcased. Different business aspects of smart districts, smart grids and smart cities will be discussed in a business session.

Finally, the AMBASSADOR team would like to share with its audience, as well as invited guests, the lessons they have learnt from this challenging four-year project.

For further information, please visit:

<http://ambassador-fp7.eu/finalconference/>

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Brussels, BELGIUM,

CONFERENCE

THE EU-FUNDED DEVOTES PROJECT WILL BE HOLDING ITS FINAL CONFERENCE IN BRUSSELS, BELGIUM, FROM 17 TO 19 OCTOBER 2016.

The three-day event is split into two distinct sections, with a stakeholders' conference taking place on 17 October, followed by a scientific conference from 18 to 19 October. During the conference, the organisers will outline the results of the four-year project and dedicate the discussion to the assessment of marine waters. Ricardo Serrao Santos, a Member of the European Parliament on the Fisheries (PECH) committee will speak during the conference.

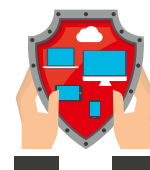
The DEVOTES project has aimed to better understand the relationships between pressures from human activities and climate and their effects on marine ecosystems. The project supports the ecosystem approach to management, and has developed tools to achieve Good Environmental Status of marine waters, relating directly to the EU's Marine Strategy Framework Directive.

For further information, please visit:

<http://www.devotes-project.eu/devotes-final-meeting/>

Cybersecurity

MAKING THE EU'S ONLINE ENVIRONMENT MORE SECURE



A new **CORDIS Results Pack** will be released in **October 2016** during the **EU's annual European Cybersecurity Month**.

It follows the European Commission's adoption in July 2016 of a set of measures to strengthen Europe's cyber resilience and boost the overall competitiveness of the cybersecurity industry, including a **contractual public private partnership (cPPP)** that will advance a cutting-edge European research and innovation agenda, with up to **EUR 450 million** of funding from **Horizon 2020**.

The CORDIS Results Pack will showcase some of the most promising EU-funded projects already engaged in developing novel solutions to combat an ever-increasing number of cybersecurity threats to Europe's critical infrastructures. Be sure not to miss it!

Contact **CNECT-CYBERSECURITY@ec.europa.eu** to be alerted when the Results Pack goes online or find out more about the European Commission's support for cybersecurity at:

<https://ec.europa.eu/digital-single-market/en/cybersecurity> and <https://cybersecuritymonth.eu/>



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