



European
Commission

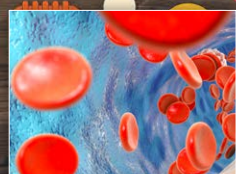
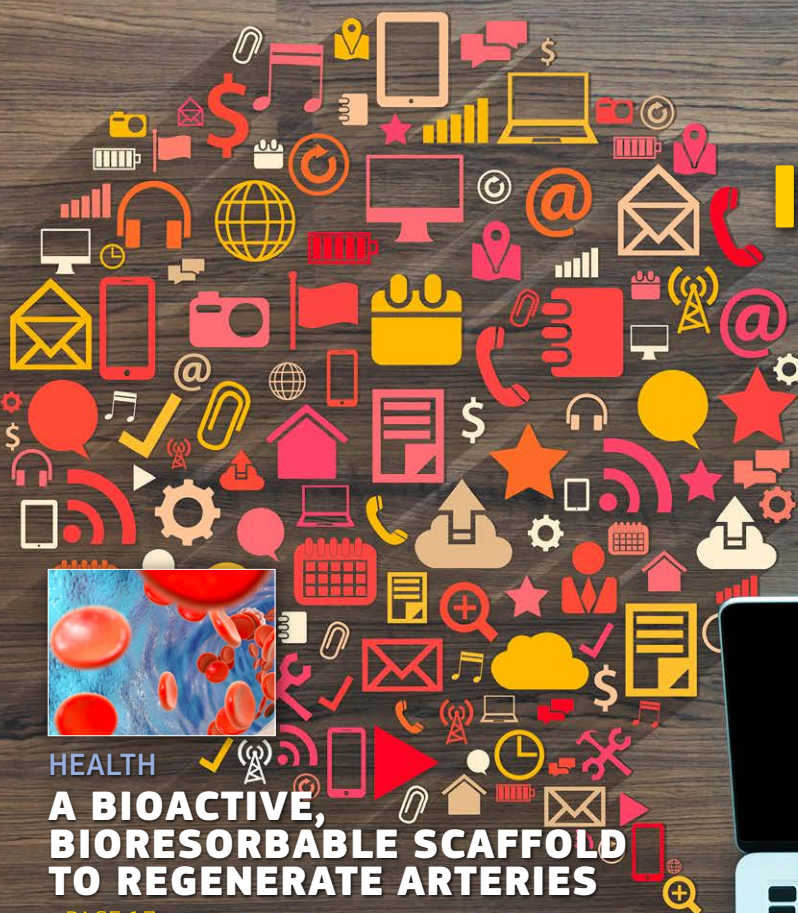
research^{eu}

RESULTS MAGAZINE

N°61
APRIL 2017

SPECIAL FEATURE

KILLER APPS IN ADVERTISING WHAT'S COMING NEXT?



HEALTH

**A BIOACTIVE,
BIORESORBABLE SCAFFOLD
TO REGENERATE ARTERIES**

» PAGE 13



ENVIRONMENT

**HOW TROPICAL
FORESTS CAN STORE
MORE CARBON**

» PAGE 28



Published by

The Community Research and Development
Information Service (CORDIS) managed by the
Publications Office of the European Union
2, rue Mercier
2985 Luxembourg
LUXEMBOURG
cordis@publications.europa.eu

Editorial coordination

Melinda KURZNE OPOCZKY

**THE RESEARCH*EU
RESULTS MAGAZINES
ARE FREE OF CHARGE.**

For all issues of the research*eu Results
Magazine you can:

- download the PDF or e-book version
- order single paper copies
- subscribe to have every issue posted to you
at <http://cordis.europa.eu/research-eu>

Disclaimer

Online project information and links published
in the current issue of the research*eu Results
Magazine are correct when the publication
goes to press. The Publications Office cannot
be held responsible for information which is
out of date or websites that are no longer live.

The technologies presented in this magazine
may be covered by intellectual property rights.

ISSN 1831-9947 (printed version)

ISSN 1977-4028 (PDF, EPUB)

© European Union, 2017

Reproduction permitted, provided the source
is acknowledged. Neither the Publications
Office nor any person acting on its behalf is
responsible for the use that may be made of
the information contained in this publication
or for any errors that may remain in the texts,
despite the care taken in preparing them.
For reproduction or use of photos and any
other artistic material, permission must be
sought directly from the copyright holder.
Excluded from this constraint are the photos
and artistic material owned by the
European Union.

Cover photo © My Life Graphic, Shutterstock



EDITORIAL

by the editorial team

AN EU BOOST FOR DIGITAL ADVERTISING STARTUPS

Long gone are the times when only renowned research institutes, universities or major industry players could count on EU research framework programmes to materialise new concepts or ideas. FP7 was already a step forward in this regard, but with its SME Instrument, Horizon 2020 is providing innovative startups all across Europe with the hope and financial means to establish themselves at the global level.

This is a much needed push especially in highly competitive, dematerialised ICT markets. Let's take digital advertising for instance: the market has been growing steadily each year, but most of that growth only benefits two US companies: Google and Facebook.

Does that mean that there just isn't room for innovative concepts brought by EU SMEs? Judging by the number of SME-Instrument supported projects in this field,

along with the enthusiasm and potential of the startups running these projects, we would be tempted to say no. In countries like France, Finland, Italy, Ireland and Spain, startups are stretching their imagination to come up with a game-changing concept that will shake the market, create jobs and put Europe at the forefront of digital advertising innovation.

Looking at the shortlist of projects covered in this issue of the research*eu Results Magazine, the companies that will manage to stand out will clearly be

those able to find the right balance between respect for privacy, non-intrusiveness, automation, personalised content and contextualised adverts. This certainly seems worthwhile: by 2020, analysts expect global digital advertising spending to reach EUR 264 billion.

This special feature is followed by other highlights across nine thematic branches of EU-funded research: health, society, energy, environment, aquatic resources, industry, information and communication technologies, security and fundamental research. The magazine closes 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



**'Analysts expect
global digital
advertising spending
to reach
EUR 264 billion.'**

Want more information on
the contents of this issue?

For online versions or information
about the contributors in this issue
of research*eu Results Magazine:

CORDIS

- <http://cordis.europa.eu/projects>
- <http://cordis.europa.eu/news>

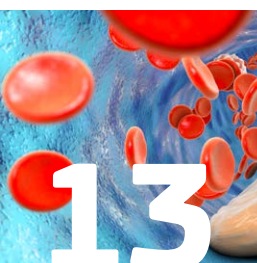


Focus on
Extreme space
weather – Let's
get ready

4 SPECIAL FEATURE KILLER APPS IN ADVERTISING WHAT'S COMING NEXT?



- 4 **Non-intrusive, contextualised video ads**
- 5 The ultimate companion app for enhanced movie or series watching experience
- 6 More effective, less intrusive ad platform makes publishers' lives easier
- 7 Bringing digital advertising to the streets
- 8 Tired of watching videos? Say hello to the video that watches you
- 9 Sensor-based analytics to grow physical retail business
- 11 New social media service has airports on the edge of their seats
- 12 Helping brands speak the language of online video



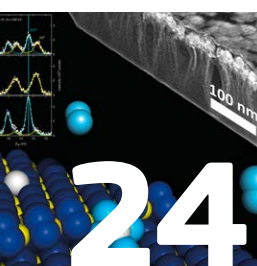
13 HEALTH

- 13 **A bioactive, bioresorbable scaffold to regenerate arteries**
- 14 Understanding immune system processes offers hope of HIV cure
- 15 A simulation and prediction tool for paediatric clinicians
- 16 Handheld scanner to detect disease
- 17 Project findings could lead to new gene-based cancer treatments
- 18 Hypoxia and epigenetic modifications



19 SOCIETY

- 19 **Understanding the marketisation of Europe**
- 20 Impact of new legislation for animal protection in research
- 21 Novel modelling tools to tackle the challenges of promoting sustainable lifestyles in Europe
- 22 Are disabled football fans still an afterthought in the Premier League?
- 23 Understanding the economics of cognitive frictions



24 ENERGY

- 24 **Less precious, more efficient hydrogen fuel cells**
- 25 Sustainable biofuel from algae
- 26 A heterarchical management approach to smarter energy grids
- 27 Hydrogen refuelling under three minutes

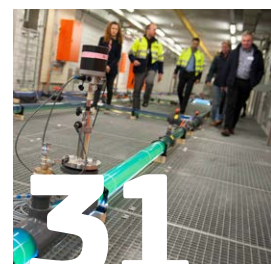


28 ENVIRONMENT

- 28 **How tropical forests can store more carbon**
- 29 *In situ* cleanup of oil-contaminated soil
- 29 Bacteria and soil erosion
- 30 Biodiversity at changing altitudes

31 AQUATIC RESOURCES

- 31 **An all-round solution to better face water contamination events**
- 32 Safer fish products for consumers
- 33 Fluorescence spectroscopy lights the way to better aquaculture



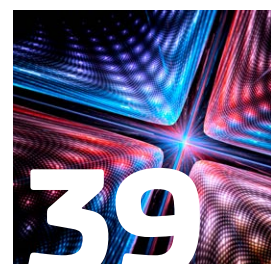
34 INDUSTRY

- 34 **New sorting techniques hold promise for metal recyclers**
- 35 Self-healing polymers for aircraft composites
- 36 A new paradigm in multi-physics simulations
- 37 Exploring particles and the manufacturing process for increased access to high-value products
- 38 New insights into solidification cracking during steel welding process



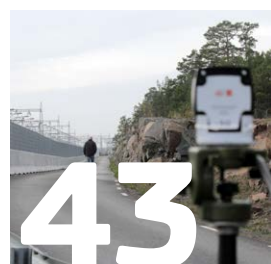
39 INFORMATION AND COMMUNICATION TECHNOLOGIES

- 39 **Quantum computing breakthrough described as 'the Holy Grail of science'**
- 40 Mastering the power of social media for better emergency response
- 41 Multi-sensor system protects health and the environment
- 42 Revealing the future for concealed technology



43 SECURITY

- 43 **Protecting core utilities and services through targeted surveillance**
- 44 High-tech video surveillance to combat petty crime
- 44 New approaches to combating illegal graffiti

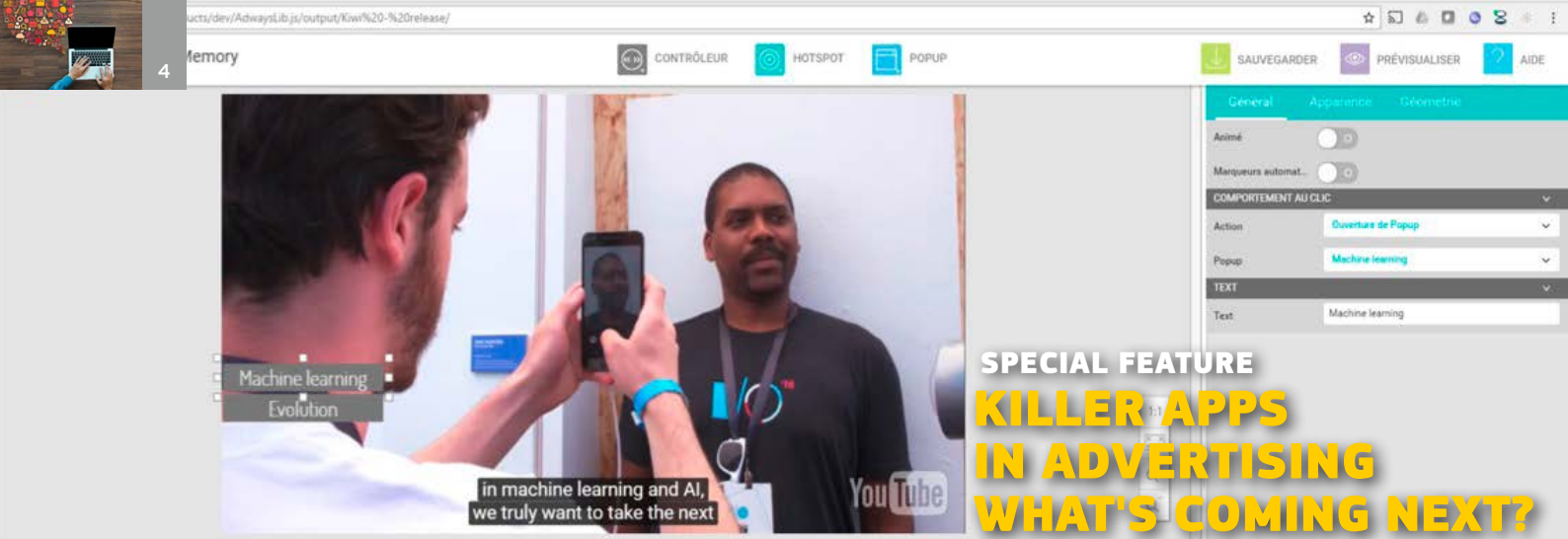


45 FUNDAMENTAL RESEARCH

- 45 **New chemical synthesis methods**
- 46 Possible new antiferroelectric compounds for energy storage
- 46 Gene expression during development: timing matters



47 EVENTS



NON-INTRUSIVE, CONTEXTUALISED VIDEO ADS

Video has become one if not the most popular and effective tool for online marketers — one that is predicted to account for a mind-bending 80 % of internet traffic by 2019. However, invasive advertisement methods and lack of contextualisation are still holding back revenues. French startup Adways hopes to build upon this untapped potential with its non-intrusive, automated video enrichment technology.

Adways' main target is the so-called 'pre-roll' — an advertising method reminiscent of television practices which sees users being forced to watch an ad for a certain time before accessing their content. According to 2016 statistics, such methods inevitably result in 90% of people skipping the ad. In other words, instead of capturing interest, current pre-rolls only cause viewers to eagerly search for the skip button.

'Customers are reaching the saturation point, and this is where Adways can help,' says Jacques Cazin, CEO of Adways. 'We believe that the highest market potential lies in a disruptive advertising format consisting in the placement of a Call to Action from a brand, displayed as an overlay of a content video. Such a non-intrusive format working on all devices allows for boosting video monetisation while reconciling customers with the ads.'

In addition to its user-friendliness, the ad format proposed by Adways in the form of SAAS cloud software boasts 'contextual affinity', which means that all displayed ads are directly relevant to the content the user wanted to be watching in the first place. 'This required the integration of semantic algorithms for transcription, voice to text conversion or image analysis, which was very demanding in terms of engineering,' Cazin points out.

Let's take the example of a web user watching a live stream fashion show: unlike current methods which would force this person to watch a video about, say, the flight tickets he/she was looking for two weeks ago, Adways will automatically display ads from the brands being worn by the models, allowing for quick and easy purchases.

This type of interactivity is at the very heart of Adways' concept. In addition to e-commerce functions, brands can display quizzes, polls, votes, texts, images, social network feeds or even videos within videos — all this whilst leaving the user in control to create his/her own advertising experience. And the icing on the cake, the company claims click rates which can exceed 5 %, thereby doubling average advertising revenues.

'Adways Studio is an intelligent, well-integrated and revenue-oriented platform,' Cazin says. 'Its advantages lie in its easy-to-use interface, integration with the largest "Online video player" (OVP) companies, the low resources and operations required, and the powerful semantic algorithms enabling us to enrich videos with contextual information.'

This high potential led the EU to grant Adways close to EUR 1 million in funding under Phase 2 of the SME Instrument, for the INTERACTIVE VIDEO (Automatic creation of interactive video to double video advertising revenues

whilst decreasing inconvenience for viewers) project that started in April 2015 and came to an end in November 2016. 'This funding enabled us to hire engineers and marketers to further develop our solution and accelerate our international expansion,' Cazin explains.

When the project was launched, the company notably aimed to reach a 50% market share among French media outlets after 18 months, with a revenue forecast of more than EUR 100 million five years after the project's start. Whilst Adways still has a long way to go in order to get there, Cazin is confident that it has a promising future.

'We have just launched our disruptive technology, and for the time being we are the only company to offer this kind of advertising format,' he says. 'YouTube also just announced that the pre-roll will be reduced in early 2018,

which is exactly the type of news that will speed up the deployment of our contextual ad overlay as a viable alternative to pre-roll.'

Adways hopes to deploy its solutions in Europe and the USA, as well as create an Adways Network able to buy a video inventory. 'We want to sell advertisers and media agencies the best media plan including our formats,' Cazin concludes.

INTERACTIVE VIDEO

- ★ Coordinated by Adways in France.
- ★ Funded under H2020-SMEINST-2.
- ★ <http://cordis.europa.eu/project/rcn/196400>
- ★ Project website: <http://www.adways.com/>

INTERVIEW

THE ULTIMATE COMPANION APP FOR ENHANCED MOVIE OR SERIES WATCHING EXPERIENCE

If you are into movie and series-related apps, chances are that you've recently noticed a newcomer with mouth-watering features named Dive (into your movie and series). Something in-between Wikipedia, Shazam and Zalando, the app makes use of the microphone in your mobile devices to provide real-time information about the scene you're watching, or allow you to buy the fancy shoes worn by your favourite actor.



★ **How does Dive technology work exactly? Can you provide an example of a situation where it can come in handy?**

David Gonzalez: All of us have at least once wondered, while watching a movie or a TV series episode, who is that actor, where was that scene shot or where can this dress be bought, or even simply wanted to know more about a specific scene. Dive provides responses on the fly to all these questions, in turn enhancing the traditional and even new ways of watching TV.

Dive provides viewers with the power of interacting with all the elements on the screen, to extend the experience in real time and to be closer to their passions. We do that both on the main screen thanks to strong partnerships with the likes of Samsung (available now in Spain and Germany) and on a second, complementary screen thanks to our iOS and Android app that is also available in Spain and Germany and will come out shortly in other countries like the USA and UK.

★ **How do you proceed to obtain copyright clearance for movies and series?**

The legal strategy, which involves IP rights (copyrights, trademarks, trade secrets and patents), competition law,

Funded under the TOUCHVIE (Catch what you watch; a game-changer technology that will change how people watch TV and revolutionise in-movie advertising and product placement) project, Dive is there to enhance the user experience while helping companies monetise products related to a specific movie or TV show.

On the menu: over 2 500 titles enriched with new content, from actor-related information to fun facts, soundtracks,

location, vehicles being used, as well as clothes and accessories being worn. The additional information can be displayed on a second screen (tablet or smartphone) or on Samsung's Smart TVs.

David Gonzalez, co-founder and COO of Dive, as well as coordinator of TOUCHVIE, discusses the app's successes so far and the opportunities brought thanks to EU funding under Phase 2 of the SME Instrument.

rights to the image of actors and moral rights, is key in this project. Bearing this in mind, we have secured the best protection mechanisms and optimisation of results with prestigious lawyers.

The added value of our company actually lies in both the technology developed and our process and methodology. In fact, the technology was built while considering the IP strategy. The most important part was to make sure that we only use images, text or links that can be used, either because we have a specific authorisation/agreement for their use or because it is creative commons content.

★ What can you tell us about the success of Dive so far?

Success can be measured with the combination of different criteria. First, our user base keeps growing robustly. Then, we have obtained prestigious awards like TiE50 in Silicon Valley, H2020 Phase 2 or the Digital Top 50 award (organised by McKinsey, Google and Rocket Internet). We have already sealed strong partnerships with Samsung, Asos, El Corte Inglés and About You, and we are about to do so with other top VoDs, Telcos and TV Broadcasters.

Equally, research agencies and leading voices like Ovum, Forrester and IHS have recognised the value of Dive for users and the uniqueness of our technology.

★ Why did you decide to seek EU funding and how did it help with your expansion?

One of the insights we have benefited from along the way is the fact that while the catalogue size increased five-fold, the number of regular users increased eightfold. We realised that we needed more interactive titles available in our platform, and for this, we needed to bring more automation to the interactive content creation process.

Our core ambition was to develop sophisticated AI algorithms that automatically detect and identify key elements like actors, characters, places, music or vehicles. As we realised this was a highly demanding project in terms of resources and funding, we decided to seek EU funding.

Now that we are halfway to the end of the project, we can say that we have accomplished significant improvements in terms of automation, with Dive now being available in two key countries.

★ What do you still need to achieve before the end of the project?

Before the end of the project in August, we still need to bring some AI enhancements already developed in our internal production platform, commercialise our technology in the USA, close our already well advanced conversations



DAVID GONZALEZ

and deals with strategic VoDs, broadcasters and telcos, and, finally, we need to close the series A round we officially opened last week.

TOUCHVIE

- ★ Coordinated by Tagsonomy in Spain.
- ★ Funded under H2020-SMEINST-2.
- ★ <http://cordis.europa.eu/project/rcn/205024>
- ★ Project website: <https://www.dive.tv>
- ★ <http://bit.ly/2naQzRu>

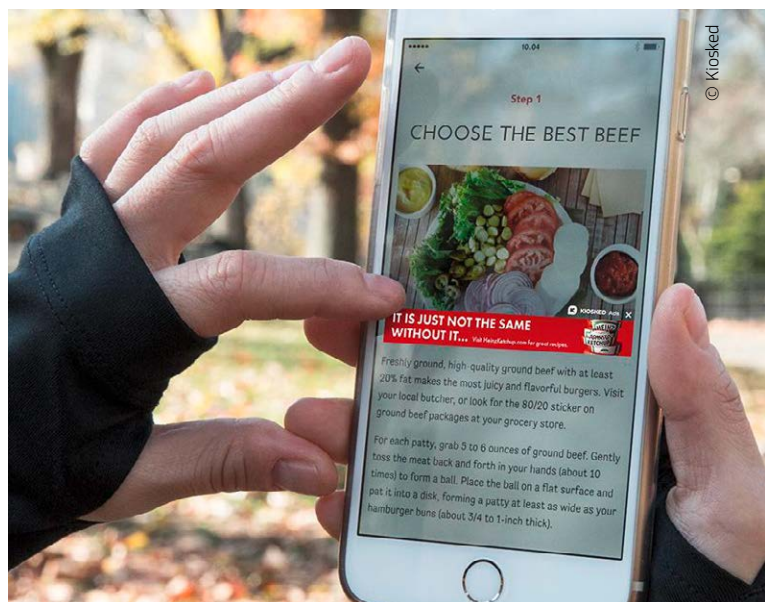
MORE EFFECTIVE, LESS INTRUSIVE AD PLATFORM MAKES PUBLISHERS' LIVES EASIER

Besides how intrusive they are — which results in resorting more to ad blockers — the lack of contextualisation of online ads and their inefficient placement on webpages often results in disappointing revenues. A Finnish company is proposing a novel 'in-content' advertising platform solving all three problems at once.

The concept of 'in-content' advertising may sound scary at first, but the way Kiosked conceives it actually provides ad-averse web users with a glimpse of hope. 'In-content advertising is by far more effective than placing ads in the old/standard way, that is, on the periphery of the page,' says company co-founder and CEO Antti Pasila. 'Better ad placements allow publishers to reduce the number of ads on their page, which in turn makes the user experience better. This results in an increased amount of content being consumed on the site, hence generating more revenue from each page.'

And this actually works: the company grew 400% in 2015, just one year after the launch of its platform, and is not intending to stop its ascension anytime soon. 'It's difficult to plan over the long term, but as a technology-focused and growing startup, we are aiming for annual triple digit growth for the next three years,' Pasila enthuses.

When it launched its SME instrument project called LONGTAIL (Transforming digital in-content advertising to deliver global



scale) in September 2015, the company was already serving 250 million people with over 3 billion ads each month.

From personalised to contextualised apps

But it's not just web users that Kiosked aims to appeal to. Its in-content advertising platform, which was launched in 2014, balances their reading comfort with tangible improvements for publishers too.

While most of these publishers have been used to displaying ads irrelevant to their content on their website, they are indeed starting to care more and more. This has already pushed the likes of Google and Facebook to create personalised ads, but experts in the field agree that the real solution lies in personalised ads that are also contextualised and that leave publishers with more freedom in ad placement. Kiosked is bringing exactly that whilst not taking control away from the user, which provides its technology with a unique appeal that has not gone unnoticed by publishers like the Daily Mail, News Corp and CNN.

One of the platform's notable features is combining the utilisation of browser data with real user eye-tracking data to improve selection of ad inventory placement: 'We utilise a company that has a panel of people around the world with a device connected to their computers. This device tracks eye movement when the user is browsing content and creates a

visualisation of where people are looking when they are on a site. This heatmap gives us information on where our script should create the ad inventory. We use this data to tell our software what placements are most effective,' Pasila explains.

This is all part of a bigger plan to move away from manual inventory optimisation to a fully automated solution, which the company describes as a 'publisher end-to-end self-service'. This service package notably includes a 'sniffer' creating ad-placements in new areas of the site in no time, as well as new types of ad placements not yet seen anywhere else.

Eventually, Pasila hopes that the company will keep growing and continue to challenge the world's biggest players in digital advertising. 'Facebook and Google dominance essentially comes from the unparalleled reach that both networks have, along with the fact that both have self-served capabilities and a very active partner network built around them. I believe that increased standardisation and collaboration between other companies in this sector, which we can already see happening, can really shake things up,' he concludes.

LONGTAIL

- ★ Coordinated by Kiosked in Finland.
- ★ Funded under H2020-SMEINST.
- ★ http://cordis.europa.eu/project/rcn/198800_en.html
- ★ Project website: <http://www.kiosked.com/>

BRINGING DIGITAL ADVERTISING TO THE STREETS

An innovative Lithuanian start-up is using EU funding to scale up an online market place concept that brings together advertisers, car drivers and digital technology.

Outdoor advertising – until now the preserve of major brands – has been largely untouched by the digital revolution. Lithuanian start-up Intenova intends to shake things up with WOWTTO, an innovative high tech solution that will open the market up to smaller businesses, increase advertising effectiveness and, perhaps most interestingly of all, eventually depend on public involvement.

Driving effective digital marketing

'The WOWTTO concept is an outdoor advertising marketplace that is based on digital displays attached to the backdoor windows of cars,' explains project coordinator Laurynas

Jokubaitis, founder of Intenova. 'Through an app, advertisers will eventually be able to target specific geographic areas or even desired streets via a bidding platform, and decide what time they wish to advertise. The digital

display content on the cars will therefore change in real-time, based on targeting preferences set by our clients.'

This is a hugely ambitious concept and the five month EU-funded WOW project – due for completion in July 2017 – is crucial to helping the company scale up. Phase I involved validating the concept using printed stickers; the



company must now prepare for the mass-production of digital displays and refine the algorithms that will be used to efficiently run the online marketplace.

In addition to the advertisers and the digital technology, the third key element of the concept is of course is the vehicles. WOWTTO's online marketplace will bring advertisers together with drivers who perhaps commute along a daily route that

"Our platform will create opportunities for SMEs who will now be able to deliver messages to potential customers even with very limited budgets."



might be interesting to a company looking to advertise their DIY shop, for example. This will be similar to how Uber works; drivers who own their cars can earn money by displaying WOWTTO digital screens in their back windows.

'We will start with Uber-like taxi drivers, people who spend a lot of time on the road,' explains Jokubaitis. 'But once we have achieved a marketplace balance between advertisers and drivers, then we will say to the general public that anyone can join this scheme.'

Marketing for local SMEs

Jokubaitis believes that once up and running, the concept will be hugely beneficial to local companies and businesses. Outdoor advertising tends to be expensive and static; the WOWTTO concept will up end this by bringing the flexibility and targeted nature of Facebook and Google advertising onto the streets.

'Our platform will create opportunities for SMEs who will now be able to deliver messages to potential customers even with very limited budgets,' says Jokubaitis. 'If you are a local baker for example, you might want to advertise on just a couple of streets between 6 and 8 am. We can show

small companies that they can have great exposure to the general public for as little as, say, EUR 1 000, and can spend this in the timeframe they need.'

Jokubaitis says that initial field testing has shown that compared to other outdoor advertising channels, SMEs were able to increase the number of received quotes by up to 150% and sales by up to 50% for the same budget.

Thanks to EU support under the WOW (Digitalization of outdoor advertising) project, Intenova is now set to launch Phase II testing of its digital displays in Vilnius. Jokubaitis hopes that by the end of the year, at least 200 cars will be advertising on the streets of the Lithuanian capital. Next steps include completing the front end solution – the interface that prospective advertisers and drivers will use to access the online marketplace – and the development and testing of digital displays that can be affixed to the outside of car windows.

WOW

- ★ Coordinated by UAB Intenova in Lithuania.
- ★ Funded under H2020-SMEINST-1.
- ★ <http://cordis.europa.eu/project/rcn/207968>

INTERVIEW

TIRED OF WATCHING VIDEOS? SAY HELLO TO THE VIDEO THAT WATCHES YOU

Imagine an online video whose content changes according to your gender, age and facial expression/emotions. This revolution is being made a reality by Italian SME Cynny with support under the MORPHCAST project.



© Stefano Bargagni

STEFANO BARGAGNI

MORPHCAST (Real time video creation according to your emotions) supports the technology of the same name, which enables ad producers to bring personalisation to the next level. It allows for light and low-band consumption of tailor-made videos 20 times lighter than in-stream mp4 format, and makes use of smart devices' cameras to

change video content according to the person viewing it. The technology boasts some impressive results, with Cynny claiming 95% accuracy for the gender, precision of about seven years for the age, and 85% accuracy for emotions.

Stefano Bargagni, CEO of Cynny, agreed to discuss the technology, its market potential and his ambitions, helped along by EU funding under the SME Instrument — which he hopes will result in commercialisation of MorphCast by 2019.

★ What are the main problems with today's personalised adverts?

Stefano Bargagni: There are actually quite a few. These include current limitations of Big Data analysis, the costs and risks related to new privacy barriers in the near future, the fact that not all situations allow content producers to acquire the needed data about users, and, last but not least, the low reliability of user tastes.

★ How can facial recognition help overcome these problems?

The challenge faced by the MORPHCAST project consisted in radically changing the

advertising sector, providing an innovative solution to maximise consumers' engagement, delivering targeted advertising to individual users while keeping their personal data totally private and, at the same time, disintermediating the analysis of Big Data related to user profiling and related costs.

★ Can you provide an example of a typical situation where MORPHCAST would bring added value to advertisers?

MorphCast technology can compile a unique video made of several tracks and plots created by the publisher, which are activated or not depending on the characteristics of the viewer as well as on the emotion while watching the video. In sum, a different video for each and every person. Theoretically MorphCast can provide unlimited combinations of contents which are delivered automatically to the viewers without any need for Big Data analysis.

★ Why did you decide to seek EU funding?

We achieved very good results with intensive R&D activities carried out over the last three years and financed

with our own resources. Now, we must move ahead faster than other big players if we are to successfully introduce our product in the market.

★ **What were the main results of your feasibility study under Phase 1 of SME Instrument funding?**

We confirmed the technical feasibility of our solution and we identified some weaknesses to be overcome within the next project phase.

Now we know that we have to work more on the cross pollination factor. Analysing the market, talking with key players and also investors, we also identified the best distribution channels for our product and we set up a solid and rather aggressive commercialisation strategy that, hopefully, will allow us to go viral in a few months and to achieve our business forecasts. We made contact with future commercial partners and venture capitalists which will enable us to better manage the risks related to this project.

★ **Are you planning to apply for Phase 2 funding? If so, to what end?**

Yes, of course. We have planned for additional developments to achieve the system optimisation that we have in mind before MorphCast launches.

"MorphCast technology can compile a unique video made of several tracks and plots created by the publisher, which are activated or not depending not only on the characteristics of the viewer but also on his emotion while watching the video."

© Cynny

EU funds under Phase 2 will allow us to speed up this process. We have planned activities for the 18 months ahead, and the Horizon 2020 SME Instrument, which we applied for, is actually the best funding instrument for a medium enterprise such as Cynny which focuses its activities on innovation.

We hope to meet our objectives quickly. The SME-Instrument Phase 2

funding will also be pivotal to boosting our project.

MORPHCAST

- ★ Coordinated by Cynny in Italy.
- ★ Funded under H2020-SMEINST-1.
- ★ <http://cordis.europa.eu/project/rcn/205079>
- ★ Project website: www.cynny.it/en

INTERVIEW

SENSOR-BASED ANALYTICS TO GROW PHYSICAL RETAIL BUSINESS

e-Commerce retailers have been benefitting from insightful analytics for years, whilst their physical counterparts have mostly had to rely on instinct, hunches and trial and error. Sensor technology now allows for these physical retailers to benefit from advanced analytics too — and Irish startup Measurence intends to tap into this huge market potential.

Even in the so-called digital era, 90% of retail business still arises from physical stores. Measurence believes that its STOREHERO (An AI (Artificial Intelligence) Virtual Business Coach for Physical Retailers) project's virtual coach — a smartphone app relying on sensors and third-party data like door counters, POS or advertising tools' APIs to gather useful information on customer behaviour and make business decisions accordingly — can capture this dormant market.

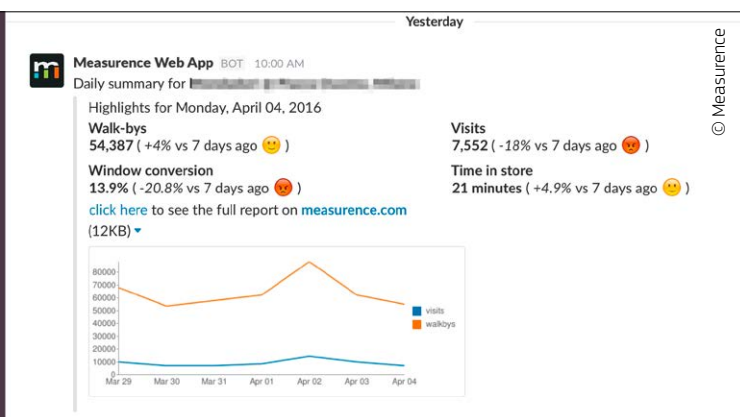
The benefits of StoreHero technology are summed up in a single quote available on its website: 'My store is near a concert hall, but I seldom noticed if there was an event because I was too busy. Now I get notified when that happens, I put a beer offer on the window, and I get a steady flow of customers in return: it works!' Compiling a wide range of sources of data, StoreHero can tell business owners all about how potential customers behave outside and inside their shop and when they do so. This, in turn, allows for more targeted and context-aware marketing.

The retailer gets notifications when interesting trends are observed, and can even chat with StoreHero to get help for their business. Conscious of their app's potential, Measurence is now using EU funding to estimate their growth potential for the next five years.

★ **Why do you think physical retailers need a virtual business coach?**

Elio Narciso: Despite the growth of e-commerce, 90% of total retail sales are still generated by offline retailers.

An extensive amount of data is available for these retailers to make proper business decisions, but most of them still find it hard to make sense of all the available data and use that intelligence to drive their decision making. The bottom line is, they are sinking in data from POS systems, intranets, and internal transaction processes, but they can't factor in all the new and complex analytical technologies that vendors have made available. In order to solve these problems, Measurence has developed and will soon be launching StoreHero.



★ How does StoreHero work exactly?

Measurence has developed a platform of internet-connected sensors that detect presence, location and activity of people within physical spaces.

We use this hyperlocal data to help retailers build a model that can monitor, predict and manage performance at any commercial physical location. We then connect our proprietary data to other data sources, like marketing data, campaigns, events, weather and point of sales data, and correlate all of this data in our machine learning platform.

In itself, StoreHero is an AI-based app, a virtual business coach that helps store owners and operators grow their retail business. Thanks to the data collected through this variety of sources, along with the intelligence generated by our proprietary platform of interconnected and remotely-managed plug-and-play sensors, StoreHero can send text messages and notifications with insights and recommendations on how to improve the retail business.

★ How far do these recommendations go? Does StoreHero actually advise on types of promotions that could be successful?

StoreHero has various features which can be grouped under three categories: descriptive analytics, predictive analytics and geospatial analytics.

Our descriptive analytics provide insights into past business events and their performance by analysing historical and real-time data on traffic (number of visits and unique visitors over a certain period of time), daily captured growth (as a percentage), loyalty (based on repeated visits, return rates, etc.), timing (the time when shoppers come the most often), and A/B testing of store windows (comparing store-front conversion in a certain timeframe). These also include benchmarking analysis to allow for comparisons of store performances, as well as trend analysis to know how much time people stay on an hourly, daily or weekly basis.

Then we have predictive and geospatial analytics. The first provide predictive models related to customers' in-store behaviour, and the second provide in-store funnel, paths and heat maps to identify places customers visit the most within a store as well as track window conversions.

In other words, we can monitor, predict and manage performance at any commercial physical location. This can be: a franchise looking to better manage a new location; a bank that needs to better understand how to serve its customers in its various branches; a retailer aiming to increase his/her conversion rate; a property owner or manager wanting to provide tenants with better services; or even an airport aiming to better configure stores and traffic in order to optimise business and minimise movement time.

★ How has the app been received so far?

Measurence's sensors platform has been available for the past two years and the company has been steadily gaining new clients and revenues. The platform is super easy to install, and our customer list includes prestigious brands like Mercedes.

StoreHero right now is in a testing phase, and the SME Instrument Phase 1 grant aims to support us in the creation of our prototype and a feasibility study to investigate potential further developments within the next stage of funding. We are planning to apply for Phase 2 in June.

★ Why did you decide to seek EU funding?

In February 2016 we were chosen among the top 15 tech startups with a European presence, and we were given a grant of EUR 100 000 to join IMPACT, a startup accelerator supported by global brands. We graduated at the top of our class, and were selected as one of the best companies to implement Fiware. We are proud to say that we have built one of the most elegant Fiware solutions in Europe.

We loved the IMPACT programme, which is funded by the EU, so we decided to explore other ways to work with available EU funding programmes.

★ What have you learned from the feasibility study so far?

It's a bit too soon for us to disclose information, but a lot of work is still ongoing, so check back with us in May and we will tell you more! What I can tell you is that Measurence and StoreHero are the result of over two years of work focused on innovating in the area of data analytics for physical commerce. We already have paying customers and the need is only increasing.

STOREHERO

- ★ Coordinated by Measurence in Ireland.
- ★ Funded under H2020-SMEINST-1.
- ★ <http://cordis.europa.eu/project/rcn/207134>
- ★ Project website:
<http://www.storeheroapp.com/>
- ★ <http://bit.ly/2ocj66G>



ELIO NARCISO



NEW SOCIAL MEDIA SERVICE HAS AIRPORTS ON THE EDGE OF THEIR SEATS

What do London, Sydney, Dubai, Melbourne and Bradley airports have in common? Well, they all try to answer customer queries as efficiently as possible, and they entrusted the same company to take on this challenge. TIC, an Irish tech startup, is providing them with an automated solution to deliver personalised and relevant information to each traveller via Facebook and Twitter.



With its BIZTWEET (Achieving excellence in travel experience through personalised, real-time communication with mass audiences) project, TIC is a case in point of successful use of funding under Horizon 2020's SME Instrument. 'The results from our feasibility study were extremely positive, to the point where it led to actual clients onboarding. We are now trading in four continents,' explains Paul Brugger, founder and CEO of TIC.

The Phase 1 project, which ended in October 2016, helped TIC investigate potential data privacy or patent-related issues, assess the market and develop a business model for its technology. Since then, airports have kept coming their way: since the beginning of the year, the airports of Sydney, Bradley and Melbourne have joined the growing list of TIC clients. Glasgow airport will follow soon. Why? Because the BizTweet service cuts down dramatically on the resources needed to reply to customer queries individually. 'Our service will reduce the workload for clients who have been manually providing the requested information to passengers,' Brugger points out.

IATA award-winning software, BizTweet uses Twitter and Facebook to allow clients to communicate automatically with their customers, be it airports, airlines or any

other relevant business looking to improve its communications with customers.

The system is as easy as it gets: when visiting the airport's arrival and departure pages, passengers can simply enter their social media account next to the flight number or send a tweet or message to a dedicated airport account in order to start receiving real-time flight updates.

Customers are segmented based on 'artificial intelligence' (AI) and available data such as social media profile information, passenger records, flight details and information from the surrounding environment, after which specific, pre-configured messages are sent to them in real-time depending on which sub-group they belong to. The content and tone of messages can be changed based on the customer's age, gender, or social media influence, to name just a few.

Airports that partnered with TIC have been very pleased with the service so far. Sydney Airport Managing Director and CEO Karrie Mather, for instance, said of BizTweet: 'We're proud to engage with our passengers through this information service, which provides access to the latest details on international and domestic flights, departure gates and boarding times at the touch of a button. Passengers will be able to access personalised flight information in their native language, 24

"The content and tone of messages can be changed based on the customer's age, gender, or social media influence, to name just a few."

hours a day, seven days a week, when and where they need it.'

BizTweet includes a multi-lingual functionality to communicate with users in up to 41 languages, and the system can even be used to send commercial offers such as, say, discounts at the closest shop to the boarding gate.

'Whilst some of our clients focus purely on customer service, others also focus on revenue, and our commercial messages also provide a new avenue for revenue generation,' Brugger says.

TIC has already applied for Phase 2 funding in order to continue their expansion, and is currently waiting on the European Commission's decision.

BIZTWEET

- ★ Coordinated by TIC in Ireland.
- ★ Funded under H2020-SMEINST-1.
- ★ <http://cordis.europa.eu/project/rcn/205078>
- ★ Project website: <http://tic.ie/>

HELPING BRANDS SPEAK THE LANGUAGE OF ONLINE VIDEO

EU funding has helped an innovative and ambitious Sicilian tech start-up to develop an online 'marketplace' platform that could transform the way that companies use videos to market their brands.

The concept, called TILES (Tiles: the first platform for shared entertainment), brings together companies, marketers, video developers and distribution partners on one easy-to-access online platform. An internal match-making algorithm means that brands can find ready-to-be-branded videos, while creators have a platform from which to sell their productions and monetise their talent. Finally, digital channels can decide what to publish.

Revolutionising online video

'We saw a big gap between how videos are viewed online and how users interact with these videos, and how brands and companies actually use video content as a communication instrument,' explains TILES project coordinator Delia Di Bona from Mosaicoon in Italy. 'For us, video is the new language of communication, and it's a language that brands still need to learn. Also, the advertising industry has not adapted to this new reality, which means that brands are not able to use video to market their products in an effective way.'

This is a massive missed opportunity. Billions of videos are replayed on social media sites every day, while videos that integrate questionnaires and surveys can help businesses turn static videos into active tools and drive greater consumer engagement. Europe's digital advertising enjoyed a growth rate in 2014 of 11.6% compared to a mere 0.4% increase in EU GDP. Nonetheless, many businesses and brands feel lost in this new digital world, which is where the TILES platform comes in.

'Clients will simply access the platform online, and from a single dashboard chooses a creator, perhaps propose a video project or select a video that is already available to be branded,' says Di Bona. 'What we've tried to do is put creative content at the centre; in the past, clients would make a brief and say what they wanted to communicate, but the problem now is that brands simply don't always know what they want, or who to target and how. Moreover, creative process was extremely complex and we searched for a way to make it simpler and cost-effective. So we wanted to encourage brands to trust in their creative sources, and to really use this platform as a way of finding their ideal creative partner and the right distribution channel. With Mosaicoon, brands can realise their video strategy in a quick and easy way.'

"The platform is set to be launched at the end of April 2017, and the company is especially interested in tapping the Asian Pacific and US markets."

Global ambitions

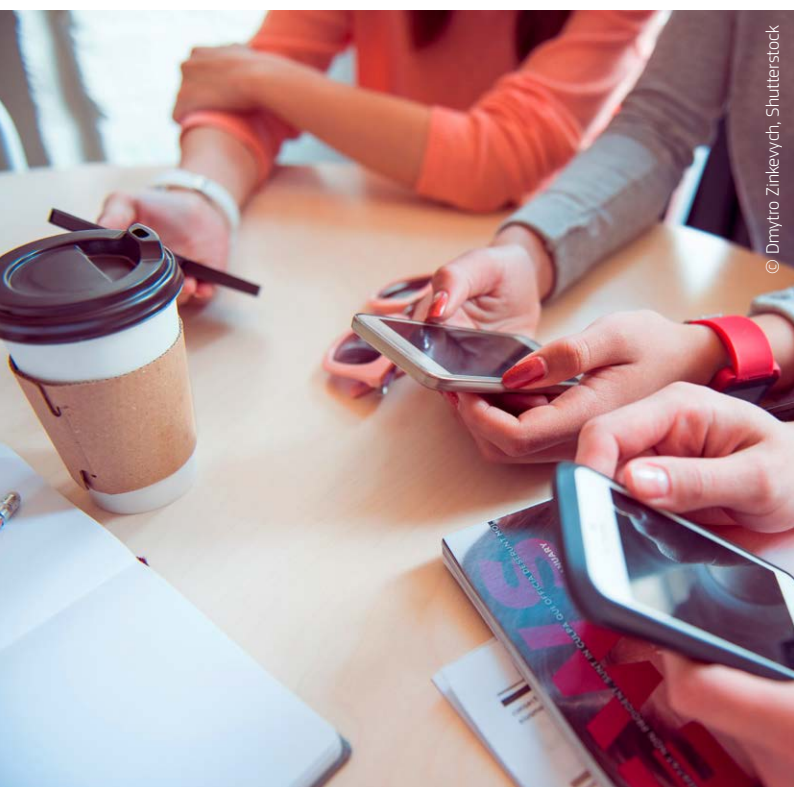
The platform is set to be launched at the end of April 2017, and the company is especially interested in tapping the Asian Pacific and US markets. 'It is absolutely our objective to go international,' says Di Bona. 'We feel proud to be able to show that it is possible to revolutionise an industry from Sicily, which is a region not usually associated with digital innovation.' Di Bona also points out that Mosaicoon has been named by Facebook as a marketing partner on video content, one of the few in Europe and worldwide. 'This shows that our technology is reliable and it works,' she says.

Di Bona also sees EU funding as an acknowledgment of the firm's vision, and as something that has provided support beyond the financial. 'This project has been really useful for a company like us, moving from start-up to scale-up,' she says. 'Having milestones to meet means that we have to clearly define our objectives and this has worked really well because we've had to manage so many variables. The experience has also enabled us to network with other SMEs and venture capital firms in Europe.'

The company is currently finalising the platform ahead of the launch, and recently opened offices in Singapore, Seoul and New Delhi to better understand the Asian-Pacific market. By making it easier for brands to tap into a new generation of digital consumers, the TILES project could transform video marketing in the years to come.

TILES

- ★ Coordinated by Mosaicoon in Italy.
- ★ Funded under H2020-SMEINST-2.
- ★ <http://cordis.europa.eu/project/rcn/199598>
- ★ Project website: <https://mosaicoon.com/>



© Dmytro Zinkevych, Shutterstock

HEALTH

A BIOACTIVE, BIORESORBABLE SCAFFOLD TO REGENERATE ARTERIES

Being the primary cause of cardiovascular disease, atherosclerosis has been the focus of much research leading to rather effective treatments. Still, these treatments have a major shortcoming: they are mostly short term solutions, failing to restore vessel integrity and patency. A European consortium set out to solve this problem with a bioactive and bioresorbable scaffold.

The two main therapeutic options for the treatment of atherosclerosis — bypass surgery and angioplasty — tend to prioritise the reestablishment of arterial flow. However, both options leave scars that eventually lead the patient back to the hospital.

In the case of bypass surgery, native veins or synthetic grafts become occluded after a few years. On the other hand, recurrence of the disease in patients treated by angioplasty tends to affect the long-term patency of the treated blood vessel.

THE GRAIL's (Tissue in Host Engineering Guided Regeneration of Arterial Intimal Layer) 'Synthetic intimal layer' (SIL) has been created to prevent these issues. This bioactive scaffold replaces the diseased and stiffened area of the blood vessel with a soft, compliant, intelligent scaffold that eventually resorbs once its task is completed — leaving a physiologically responsive, regenerated tissue.

Built with smart biopolymers, the scaffold induces a regeneration of the intima layer by recruiting circulating endothelial cells. These biopolymers are delivered *in situ* by means of an ad hoc catheter also designed and engineered by the project team.

'Thanks to five years of EU support, we were able to progress THE GRAIL from a simple sketch on a paper to a working

prototype,' says Davide De Lucrezia, coordinator of the project and principal investigator at Explora Biotech. 'We demonstrated the scaffold's full biocompatibility *in vitro* and safety *in vivo*, and preliminary results on efficacy are extremely encouraging.' Although not without hurdles, the project reached its objectives notably thanks to an early definition of end-user and regulatory requirements.

'We had to perform *in vivo* safety and efficacy tests to collect enough data, file the technical dossier to the notified body and obtain the CE marking. We were able to prove the complete *in vivo* safety of the device on a porcine model. No adverse event was recorded either during *in vivo* deployment or during the 6 and 12-week follow-up,' De Lucrezia says. All in all, complete intima reconstitution is expected 3 to 4 months after the scaffold is implanted.

The device has now reached TRL7 (prototype demonstration in an operational environment), and the consortium is getting ready to engage in a long-term preclinical study to demonstrate the long-term efficacy of their solution — a defining step in the progress towards first in-human trial. 'We can only speculate on preliminary results that show an encouraging regeneration without any significant hyperplasia,' De Lucrezia notes.

Although the project's exploitation strategy doesn't foresee direct sales of the developed technology, the three SMEs involved in THE GRAIL will operate through a dedicated spin-off company that will own the intellectual property and know-how generated during the project.

'This spin-off will engage with larger companies able to support sales and surveillance. All in all, our latest industrial plan foresees the first in-human trial by Q1 2019, so it is reasonable to expect

the device to be available to the first patients by Q2 2020,' De Lucrezia concludes.

THE GRAIL

- ★ Coordinated by Explora in Italy.
- ★ Funded under FP7-HEALTH.
- ★ <http://cordis.europa.eu/project/rcn/101797>
- ★ Project website: <http://www.thegrail-project.eu/>

UNDERSTANDING IMMUNE SYSTEM PROCESSES OFFERS HOPE OF HIV CURE

Through a better understanding of how the HIV virus gets past the body's immune defence, EU-funded scientists hope to be on the path towards a cure.

A potential breakthrough in understanding how the HIV virus gets past immune defences might one day lead to a cure, say EU-funded researchers. Thanks to a European Research Council Advanced Grant, a team led by University College London (UCL) has identified how the virus infects macrophages — a type of white blood cell — despite the presence of a protective protein.

Hope of a cure?

Taking this discovery further, researchers have been able to develop a treatment designed to maintain macrophage defences. This is one of the key findings to date of the five-year HIVVINATE (Characterisation and Manipulation of Primate Lentiviral Interactions with Innate Immunity) project, which was launched in 2014.

The project team found that macrophages produce an antiviral protein that typically prevents HIV from replicating. This however can be switched off during normal cellular processes, providing HIV, the virus that ultimately causes AIDS, with an opportunity to invade. But by treating the cell with inhibitors that are sometimes used in cancer treatments, researchers were able to close this window of opportunity.

This could be significant say researchers, because once a macrophage is infected, it will continually produce the HIV virus. Cutting off this particular point of infection could therefore be an important step towards safeguarding the entire immune system, and thus finding a cure.

HIV remains one of the most serious communicable diseases in Europe. Despite significant advances in the development of effective treatments to delay the onset of AIDS, the virus still leads to thousands of deaths every year

and shortened life expectancy. Around 6 300 people a day are infected by HIV.

The virus has long been difficult to treat due to its ability to effectively hide in dormant cells where the immune system is unable to reach it and destroy it. The fight against HIV also involves high ongoing treatment costs, putting pressure on public health systems.

Next steps

The HIVVINATE team is now busy defining the sensors and examining the details of the antiviral pathways that are activated in macrophages, using cutting edge RNA interference techniques. Small molecules that might potentially inhibit HIV by revealing HIV to innate immune sensors have also been characterised. Understanding the mechanism by which HIV attacks the body has become a key focus for scientists; in another recent EU-funded project, antibodies bound to the virus were analysed to reveal HIV's vulnerabilities.

In collaboration with crystallographers and medicinal chemists, the project will then set about improving the potency and specificity of inhibitor drugs, and use them in further studies of the anti-HIV innate immune response. The project is also interested in examining the effect of triggering innate responses using drug-treated viruses by measuring T cell proliferation.

In this way, the team hopes to uncover the molecular details of HIV's interaction with innate immunity and discover how the virus replicates in primary immune cells without detection. This, say researchers, will contribute significantly to our understanding of the complex relationship between HIV and innate immunity.

HIVVINATE

- ★ Coordinated by University College London in the United Kingdom.
- ★ Funded under FP7-IDEAS-ERC.
- ★ <http://cordis.europa.eu/project/rcn/111106>



A SIMULATION AND PREDICTION TOOL FOR PAEDIATRIC CLINICIANS

An EU-funded project has developed a digital repository storing paediatric clinical data for millions of young patients, enabling physicians to make more informed decisions. This project is already inspiring the creation of similar platforms in other medical fields.

Has the growing political and scientific focus on active and healthy ageing come at the expense of children's health? Prof. Bruno Dallapiccola, OPBG Scientific Director and Project Coordinator, certainly thinks so. With a consortium of 22 organisations from across Europe, he — with the support of Prof. Edwin Morley Fletcher, president of Lynkeus and Project Manager — has spent the past four years developing an advanced digital repository (infrastructure) that integrates data from the likes of clinical, genetic and metagenomic analysis, MRI and US image analytics, haemodynamics, real-time processing of musculoskeletal parameters, and fibres biomechanical data. The platform allows clinicians to look for similarities with their own patients, access model-based simulations and predictions, and look for patient-centric clinical workflows.

'Our idea stemmed from the need to optimise existing treatments towards a predictive and personalised clinical approach, in order to foresee the outcomes of clinical interventions and to tailor them to a single patient's physiological parameters. The ultimate goal is to reduce medical errors and

suboptimal treatments, as well as decrease overall medical costs,' Prof. Dallapiccola explains. In addition to the fact that 'our world is becoming increasingly unfair towards the younger generations,' he observes

"Early reactions from clinicians involved in the project have been noticeably welcoming and encouraging."

that diseases in infants, children and adolescents are a large and underestimated public health problem. One that the MD PAEDIGREE (Model-Driven European Paediatric Digital Repository) project is meant to help overcome.

MD PAEDIGREE hosts data leveraged by advanced analytics tools such as deep machine learning or similarity search, so as to identify hidden common patterns. From thereon, physicians can build personalised models able to reproduce the individual patient's physiological parameters — either at pre-interventional level or as a result of a given clinical intervention — and categorise patients based on disease risk.

'Using these tools would minimise the chance of medical error and increase treatment efficacy, reducing in turn the risks of complications and relapse, time of recovery and clinical costs,' Prof. Morley-Fletcher points out.

A promising future

Prof. Dallapiccola is proud of the project outcomes, and says that early reactions from clinicians involved in the project have been noticeably welcoming and encouraging. 'Although the user interface has not yet reached the maturity level required for a seamless integration in everyday clinical practice, clinicians have largely recognised the added value of the implemented technological solutions, particularly for supporting their



clinical decision making,' he explains. 'Also, the tentative model integration in the clinical workflow has been highly appreciated, allowing for intense engagement of clinical partners at every step of the model-driven workflow implementation.'

Although the project was completed at the end of February, the MD-Paedigree repository will continue to be fed with routine clinical datasets coming from the affiliated clinical centres, and various research initiatives are already building upon its results.

A project named CARDIOPROOF adopted the very same infrastructure for conducting its research on model-based cardiology prediction, and the MHMD project has been implementing an innovative EU-based platform for sharing of patients' 'Electronic health records' (EHR) by including and extending the MD-Paedigree infrastructure.

'I am confident that several research initiatives will continue to flourish upon the project outcomes, as MD-Paedigree has provided tools and systems which will contribute to pioneering the new era of precision medicine,' Prof. Dallapiccola concludes.

MD PAEDIGREE

- ★ Coordinated by the Bambino Gesù Children's Hospital in Italy.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/project/rcn/108228>
- ★ Project website: <http://www.md-paedigree.eu/>

HANDHELD SCANNER TO DETECT DISEASE

A new technology combining photoacoustics with ultrasounds has enabled the University of Twente to differentiate between arthritic and healthy fingers, diagnose liver fibrosis and even measure blood velocity. Soon, this device could also be tested for mapping the likes of skin cancer, burns or hardening of the arteries.



© University of Twente

Integration of pulsating diode lasers in the ultrasound probe — this is what it took for University of Twente's Phd candidate Pim van den Berg to be able to bring both ultrasound and photoacoustics technology to a single, handheld device capable of seeing beneath patients' skin.

Concretely, once put on a patient's skin, the device emits short laser pulses which, as they hit blood vessels or other tissues, generate light. This light in turns generates heat and a small increase in pressure — resulting in a sound wave that can be picked up by the device. This is the photoacoustics part.

Ultrasound imaging, on the other hand, transmits sound into the body. The sound bounces off as it meets obstacles, producing waves that can also be detected on the patient's skin.

Three use cases

Whilst the device cannot currently go deeper than 15 millimetres, a new European project already intends to reach greater depths. First medical applications are expected 'in the short term,' the university states.

Pim van den Berg's research — partly funded under the FULLPHASE (Fully integrated real time multi-wavelength photoacoustics for early disease

detection) project — focused on three use cases: arthritis detection, liver fibrosis in laboratory animals, and blood velocity measurement.

In the first series of experiments, van den Berg could demonstrate that his device was able to diagnose inflammation of the joints in rheumatoid arthritis patients. 'We have looked at fingers with and without inflammation using this device,' he explains. 'The difference is clear. This method shows the many extra blood vessels that form in the area of an inflammation.' Whilst additional research is needed to identify the degree of inflammation instead of simply detecting its presence or absence, this is already a great achievement for doctors who currently have to rely on their own perception in order to diagnose inflammation.

Another achievement was the detection of liver fibrosis in laboratory animals. As researchers currently use mice to find new drugs for this condition, the use of the FULLPHASE device could allow disease progress tracking and evaluation of drug effectiveness for longer periods of time, thereby reducing the number of mice used in such studies.

Last but not least, the technology was used to measure blood flow. In cooperation with University College London,

van den Berg used the device to define the flow rate of blood and use it to quantify the level of inflammation. 'The test has been very successful,' he said. 'We would like to find out how fast the blood flows, how many blood vessels there are near the site of the inflammation and the levels of oxygen and nutrients. This information will tell us more about the inflammation.' The components of blood and the relationship between them can be measured using this system.

'We were able to take excellent measurements in our laboratory environment. The next step is reviewing whether the device is able to do the same measurements on the human body,' Pim van den Berg concludes.

FULLPHASE

- ★ Coordinated by Esaote Europe in the Netherlands.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/project/rcn/104914>
- ★ Project website: <http://www.fullphase-fp7.eu/index.php?id=1121>
- ★ <http://bit.ly/2mdh2K9>

PROJECT FINDINGS COULD LEAD TO NEW GENE-BASED CANCER TREATMENTS

A breakthrough in understanding the role of a specific lymphoid cell gene has been achieved thanks to an EU Marie Curie research grant. The findings could lead to new targeted treatments for leukaemia and other types of cancers.

The body's immune system is a true marvel of biological engineering, made up of structures and processes that cooperate to identify and attack viruses, bacteria and parasites while sparing the body itself. Lymphoid cells (lymphocytes) for example, which wait to respond to microbial invasion, provide resistance against an enormous range of pathogens.

However, an unnecessary attack by lymphocytes can have devastating outcomes (such as the development of autoimmune diseases), which is why they need to constantly remain on guard — in a so-called 'quiescent' state — and attack only when needed. Thanks to an EU-funded Marie Curie grant, one researcher has been able to make significant advances in understanding the role that certain genes play in maintaining this quiescent state. Signals responsible for maintaining quiescence have been identified, as have certain mechanisms for then translating these signals into action.

'The aim of this research was really to clarify these crucial questions, and importantly, to better understand how we could exploit our findings to better treat immune-related diseases and leukaemia (cancer of lymphocytes) and improve cancer immune-therapy,' explains SLFN OF T-CELLS (Enforcement of T-cell quiescence by Schlafen2) project coordinator Michael Berger from the Hebrew University Medical School in Jerusalem, Israel. 'I hope this research will convince the scientific community that targeting lymphocyte quiescence has great potential as a new approach to treating leukaemia and manipulating lymphocytes so as to be able to exploit them better to fight pathogens and cancer.'

Building on breakthroughs

The findings build on some groundbreaking work that was recently done at the Scripps Research Institute as part of Berger's post-doctoral research. 'Our discovery of a mouse strain with a mutated *Slfn2* gene, *elektra*, enabled us to provide a dramatic illustration of what happens when quiescence fails,' explains Berger. 'The *elektra* mice showed an abnormally high frequency of lymphocytes in a semi-activated state, and as a result suffered from immunodeficiency.'

Since *Slfn2* had no previously known function, Berger and his team at the Hebrew University Medical School were able to demonstrate — for the first time — that the gene plays an essential role in immune defence. 'We have only started to fully understand that lymphocytes quiescence is critical for the development and function of the immune system and must be actively maintained,' says Berger.

Novel approaches to fighting cancer

Indeed, many questions surrounding lymphocytes quiescence still remain, and this is why the SLFN OF T-CELLS project was launched in 2013. During this four-year project, Berger was able to unravel a previously unknown functional connection between the lymphocyte quiescence factor, *Slfn2*, and protein homeostasis in immune cells. 'We also demonstrated that targeting *Slfn2* leads to impaired survival of leukaemia initiating cells, which suggests that targeting lymphocytes quiescence could serve as a novel approach for treating leukaemia and other types of cancer,' he says. 'Finally, we discovered a new mechanism that controls quiescence of certain T-cells by inhibiting their mitochondrial (energy supplier of the cell) proliferation.'

*"Berger was able to unravel a previously unknown functional connection between the lymphocyte quiescence factor, *Slfn2*, and protein homeostasis in immune cells."*

The research has been presented in numerous academic journals and received positive responses from the scientific community. 'Our goals now are to better understand the role of quiescence in lymphocytes development and function, and to collaborate with pharmacologists in order to develop specific inhibitors and activators of the human homologue of *Slfn2* and other quiescence maintaining proteins,' concludes Berger. The project was completed at the end of 2016.

SLFN OF T-CELLS

- ★ Coordinated by the Hebrew University of Jerusalem in Israel.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/104255>



HYPOXIA AND EPIGENETIC MODIFICATIONS

European researchers have provided a causative association between low oxygen levels in cancer and epigenetic modifications. Their results suggest that restoration of oxygen levels might serve as an effective anti-cancer strategy.

Epigenetic modifications such as DNA methylation are central to the regulation of gene transcription and impact genome stability and development. The enzymes responsible for DNA demethylation were only identified a few years ago. Indeed, the discovery of the 'Ten-eleven translocation' (TET) family of enzymes capable of 5-methylcytosine oxidation has greatly advanced our understanding of DNA demethylation.

In cancer, DNA methylation is deregulated, and hyper-methylation of tumour suppressor gene promoters gives growth advantages to cancer cells. The conversion of 5-methylcytosine to 5-hydroxymethylcytosine by TET enzymes requires oxygen, whereas hypoxia is common in cancer, suggesting a potential synergistic effect. In addition, hypoxia induces the activity of HIF transcription factors, which alter gene expression in cells to cope with hypoxia. However, the association of HIF factors with the epigenome is currently unknown. Furthermore, murine breast tumours become hyper-methylated

when rendered hypoxic, whereas vessel normalisation rescues this effect.

The primary objective of the EU-funded CHAMELEO (Cellular hypoxia alters DNA methylation through loss of epigenome oxidation) project was to investigate the influence of hypoxia on the epigenome and the resulting phenotypic response in cancer. Researchers demonstrated that tumour hypoxia reduced the activity of oxygen-dependent TET enzymes. This was independent of hypoxia-associated alterations in TET gene expression, basal metabolism, HIF activity and nuclear reactive oxygen species.

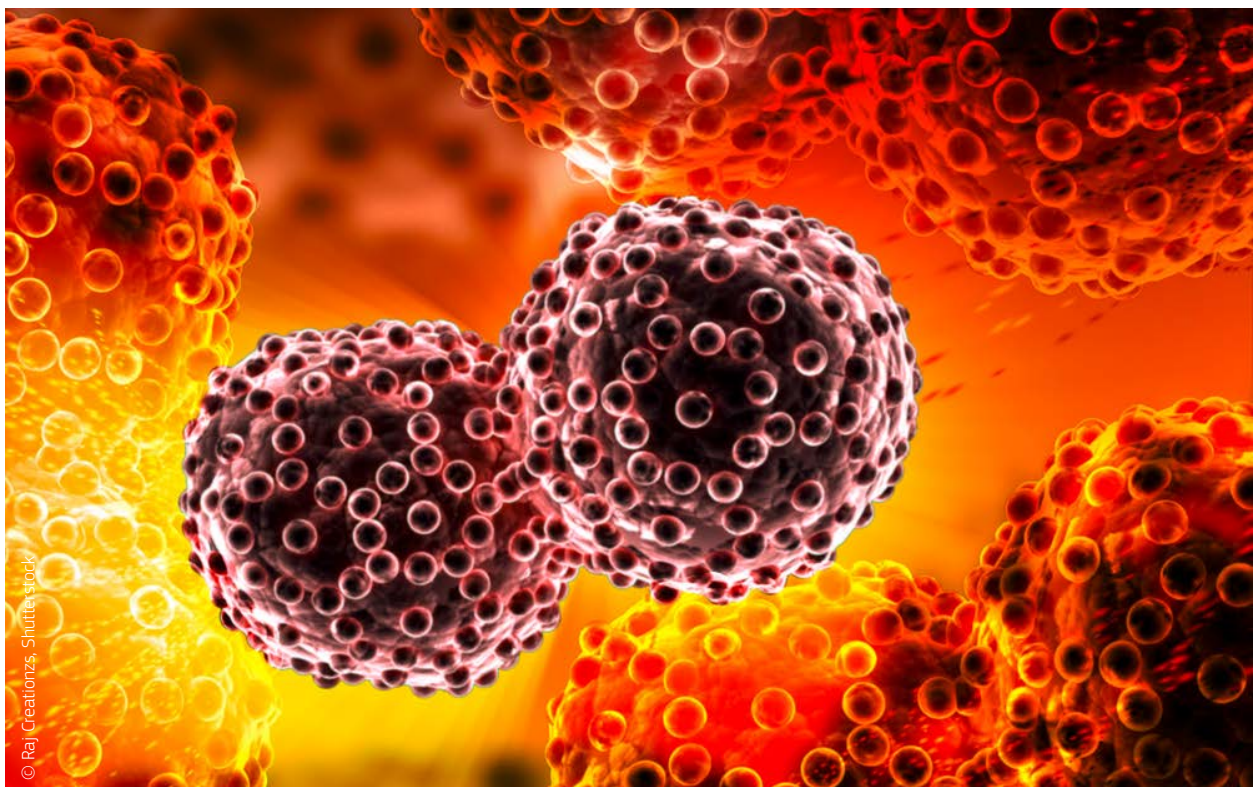
The loss of TET activity depended solely on oxygen shortage and increased the hyper-methylation of gene promoters. Similar observations of the methylation of gene promoters were made in patient tumour samples where genes involved in DNA repair, cell cycle regulation, angiogenesis and metastasis were frequently involved. Furthermore, this suggested a clonal selection of hyper-methylation events to support growth and metastasis.

“The loss of TET activity depended solely on oxygen shortage and increased the hyper-methylation of gene promoters.”

Collectively, the findings of the CHAMELEO study support the regulatory role of tumour hypoxia on DNA methylation. Importantly, they suggest that strategies destined to normalise intra-tumour oxygen levels will reverse epigenetic changes and might modulate cancer cell properties.

CHAMELEO

- ★ Coordinated by VIB in Belgium.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/108383>



SOCIETY

UNDERSTANDING THE MARKETISATION OF EUROPE

EU-funded researchers show how Europe's single market has led to an intensification of marketisation — resulting in a number of social consequences.

According to the EU-funded TEMS (The Effects of Marketization on Societies: The Case of Europe) project, the European Union's pursuit of an integrated single market is an unprecedented experiment in state-enforced marketisation. 'Marketisation, or the introduction and intensification of price-based competition, is not a new concept, but one that has an almost ghostly presence in Europe,' says Lead Researcher Professor Ian Greer. 'There have been decades of constant effort at the European level to promote the free flow of goods, services, capital and labour — all of which has ratcheted up the disciplinary power of the markets over citizens.'

The TEMS project set out to better understand the intended and unintended consequences of marketisation. The project asks whether there is a link between marketisation and growing inequality and, if so, what is its nature? 'Even though our work may seem pretty

far outside mainstream EU policy, our hope is that by better understanding the concept we will be able to better address its social consequences.'

Based on an array of interviews and data analysis, TEMS researchers have found a variation in the degree of marketisation happening in Europe. 'Despite decades of efforts promoting more competition across European borders, extreme competition remains the exception, not the rule,' says Geer. 'However, we do see intense marketisation in specific groups, such as live musicians, along with incrementally increasing marketisation in many health and social welfare systems.'

What are the limits to imposing marketisation?

According to Greer, although there are a range of policy concerns, social movements and vested interests that frustrate market-making in various ways, researchers are finding limits to

marketisation that reflect contradictions in mainstream European economic policy. For example, with austerity come limits to marketisation. 'Thus, the Greek public sector cannot be marketised in the sense that we see in Northern and Western Europe because management autonomy has been greatly curtailed in order to reduce costs,' says Greer. 'We may find, when our analysis is complete, that restricting public spending slows the development of the single European market in numerous areas.'

On the other hand, areas that have a high degree of marketisation exhibit a relatively low capacity for society to shape its effects. Thus, in the UK's state-dominated National Health Service, unions and patient groups are far more effective in preventing privatisation than in Germany's more marketised municipal-run hospital systems, even though German campaigners are, according to Greer, 'better organised'.

'Our finding is not that civil society is made quiescent by marketisation, but that trade unions and others within civil society are weakened and face existential risks if they do not oppose it,' says Greer.

Tackling the destructive aspects of marketisation

And herein lies the complexity of the situation. Whereas the EU is committed to the development of a single market, such development is also

responsible for the social consequences of marketisation. Yet it is precisely this Catch-22 of sorts that underlines the importance of funding research like TEMS, as it allows all players to better understand — and address — the consequences of marketisation in Europe.

'The TEMS team stands ready to help those working within the EU's institutions who want to identify and tackle the socially destructive aspects of marketisation,' adds Greer.

"We may find, when our analysis is complete, that restricting public spending slows the development of the single European market in numerous areas."

TEMS

- ★ Coordinated by the University of Greenwich in the United Kingdom.
- ★ Funded under FP7-IDEAS-ERC.
- ★ <http://cordis.europa.eu/project/rcn/106462>

IMPACT OF NEW LEGISLATION FOR ANIMAL PROTECTION IN RESEARCH

In 2010 the European Commission introduced a new directive to address animal ethics in scientific research. As Member States are implementing Directive 2010/63/EU, researchers are welcoming uniform standards that ultimately enhance the quality of research. One EU-funded initiative recently investigated regulation of animal research in Europe under this bold directive.

Scientific progress and concern for animals can potentially come into conflict. The EU has striven to balance the needs of medical and scientific advancement with ethical concerns for animal use in research. This is being achieved through Directive 2010/63/EU, adopted in 2010 and based on the principle of the Three Rs: replace, reduce and refine the use of animals in scientific research. Currently, the Directive is close to being fully implemented in the Member States, which gives rise to a development that is slowly but surely upping the ante in the quest to strengthen animal ethics without compromising research and innovation?

Against this backdrop, the EU-funded ANIMPACT (An ethical, legal and practical perspective on the impact of a new regulatory framework for the scientific use of animals on research and innovation) project investigated how Directive 2010/63/EU affects the way in which animal-based research is being conducted. It looked at both internal and external decision-making mechanisms, norms and rules in order to understand the Directive's impact. 'Research is regulated not only from "the outside" by legislation, but also from "the inside" such as through peer review and through

researchers' own motivation,' says Anna Olsson, the project coordinator from the Institute for Molecular and Cell Biology in Porto, Portugal.

A closer look at external regulation, which focuses on project review and authorisation, revealed important differences in the composition and organisation of the entities across Europe that authorise animal experiments. 'Considering the effect of committees on authorising research, possible variations in evaluation will be an important issue to address in the future,' commented Olsson.

The team went a step further by delving into the internal regulatory framework, particularly researching journal practices and the influence of discipline-specific guidelines for animal-based research. Interestingly, in a case study, ANIMPACT found that guidelines reflect existing standards within a field but did not find evidence that the introduction of guidelines had changed standards. 'There was no obvious difference between research emerging before or after the publication of the guidelines,' says Olsson. She did however note that the severity levels tolerated in research based on guidelines were clearly less than in a comparable discipline without such guidelines.

It was a pleasant surprise for the project team to find that bench researchers agreed with the need for regulation of animal research and with the intentions of the Directive. On the other hand, researchers were concerned about the related paperwork, bureaucracy and possible delays in project authorisation that the new legislation may bring.

Nonetheless, the acceptance and engagement bodes well for a regulatory framework widely supported by those it regulates — i.e. the researchers. 'To ensure that this support is maintained, the system must be designed to function well in practice without unnecessary bureaucracy,' advises Olsson. 'Self-regulation plays an important role in advancing animal ethics, but its implementation varies. Wider discussion among stakeholders of where responsibility lies could improve this.'

While the Member States have already transposed Directive 2010/63/EU into national legislation, in many places some key instruments downstream of legislation have to be built from



© unol, Shutterstock

scratch and will require a few more years for completion. This is especially the case in European nations that had not already established a national committee for the protection of animals used for scientific purposes. 'Implementation is still an ongoing process, but it is already very clear that there is an EU-wide engagement with this legislation and a clear sense of sharing a legislative framework,' comments Olsson.

The EU Directive is considered the most advanced legislation worldwide on animal experimentation. It was developed to set a uniform standard across the EU without lowering the

standard in any single Member State. Webinars and dissemination of information material on the project website will enable sustained communication between stakeholders beyond the duration of ANIMPACT.

ANIMPACT

- ★ Coordinated by IBMC in Portugal.
- ★ Funded under FP7-HEALTH.
- ★ <http://cordis.europa.eu/project/rcn/109347>
- ★ Project website: <http://www.animpact.eu/>

NOVEL MODELLING TOOLS TO TACKLE THE CHALLENGES OF PROMOTING SUSTAINABLE LIFESTYLES IN EUROPE

How Europeans live, work and play directly impacts sustainable lifestyles. The focus on consumption patterns and attempts to change them has not to date delivered the desired outcomes.

With this in mind, the EU-funded GLAMURS (Green lifestyles, alternative models and upscaling regional sustainability) project adopted an alternative approach to creating sustainable lifestyles to help reduce the global ecological footprint while increasing overall well-being.

'The overall aim was to develop an understanding of the main obstacles to and prospects for transitioning towards sustainable lifestyles and a green economy in Europe, and the most effective means to support and speed up these shifts,' says project coordinator Dr Adina Dumitru from the People-Environment Research Group at the University of A Coruña in Spain. 'We considered the dynamics of lifestyles, the conditions under which economic systems are transformed and the policies that might enable a sustainable transformation in order to support policy-makers, businesses and citizens in making knowledgeable choices towards a sustainable future.'

GLAMURS developed a comprehensive framework of lifestyle choices, dynamics and interactions so that relevant stakeholders can adopt informed decisions towards the scaling up of sustainable lifestyles in Europe.

To support policymaking, the project made robust recommendations for governance design and policy mixes for sustainable lifestyles and a green economy at European and regional levels.

Researchers studied and compared seven European regions and six lifestyle domains that are relevant to sustainability. This was done to understand the regions' characteristics and

© violetkaipa, Shutterstock



their potential for shifting to sustainable lifestyles and green economies.

'The project indicated how the lifestyles of sustainability innovators could inspire regional actors to change political circumstances so that transitions to sustainable regions will become reality,' notes Dumitru. 'The decision to spend time on sustainable activities depends on our aspirations and identity, and the social norms prevalent in each context.'

Research supported the fact that sustainable lifestyles do not necessarily conflict with the pursuit of individual well-being, societal wealth and economic green growth. 'On the contrary, people seeking sustainability report increased well-being in the long run, and they express a desire to change their life in a more sustainable direction,' explains Dumitru. 'These wishes require the support of institutions and authorities at local, national and

"People seeking sustainability report increased well-being in the long run, and they express a desire to change their life in a more sustainable direction."

European levels in order to turn them from simple aspirations into well-established habits and shared behavioural norms in the larger society.'

The project created a series of integrated models that assessed different lifestyle change circumstances, alternative economic approaches and sustainable transitions. Results support the assumption that a more shared adoption of sustainable lifestyle choices would also be socially and economically sustainable in

the medium and long term, in line with green economic growth scenarios.

'We also show that policy interventions have to tackle the interaction between determinants of sustainable lifestyles at different levels,' adds Dumitru. 'Psychological factors that might support the adoption of sustainable lifestyles at individual levels interact with factors affecting large group diffusion of these lifestyles to create particular social "tipping points" for which policy interventions are particularly promising.'

Even though the project ended in December 2016, dissemination events

are being planned in each region. Several partners have invited various stakeholders to engage in a debate on the implications of GLAMURS' results for regional development.

Professor Ricardo García Mira, former project coordinator and current Spanish Parliament member, is involved with Spain's Commission on Climate Change. He championed a bill on the promotion of sustainable lifestyles in Spain that relied on the GLAMURS approach and results.

Dumitru believes GLAMURS will accelerate the shift towards a sustainable society in line with Europe 2020 goals and

beyond. 'We fully expect the project to leave a positive and lasting legacy for smart, sustainable and inclusive growth at local, national and European levels.'

GLAMURS

- ★ Coordinated by the University of A Coruña in Spain.
- ★ Funded under FP7-SSH.
- ★ <http://cordis.europa.eu/project/rcn/111220>
- ★ Project website: <http://www.glamurs.eu/>
- ★ <http://bit.ly/2lOuw3N>

ARE DISABLED FOOTBALL FANS STILL AN AFTERTHOUGHT IN THE PREMIER LEAGUE?

An EU-funded researcher has made a major contribution to a landmark report over the English Premier League's failure to meet the needs of disabled fans.

A three-year EU-funded project, FREE (Football Research in an Enlarged Europe: Identity dynamics, perception patterns and cultural change in Europe's most prominent form of popular culture), which researched the importance of football with disabled supporters, crucially influenced recommendations made by the UK's House of Commons Culture, Media and Sport Committee. In the Committee's 16 January 2017 report, there is a strong call for legal sanctions to be taken against the wealthy football clubs of the Premier League who continue to neglect their disabled fans.

High profile media reports such as a 2014 BBC investigation into whether the Premier League was failing disabled fans led the Committee to open an inquiry into access to sport stadia. The BBC investigation highlighted amongst other things the poor provision of access to sporting grounds in the Premier League, with 17 of the 20 clubs in top-flight football failing to meet the needs of the disabled.

Joyce Cook, chair of the Level Playing Field charity, said that 'the experience for a disabled football fan is very varied, but it's nothing like that of a non-disabled fan.'

The EU-funded research carried out and published in the November 2016 'European Sport Management Quarterly' by academic Dr Borja García-García, a senior lecturer in

sport management and policy, at Loughborough University's School of Sport, Exercise and Health Sciences, underlined how clubs fail to provide inclusive access and understand the various forms of disability.

'Those concepts need to be understood in a more holistic way, so access does not mean only getting into the ground and disability does not mean only a person in a wheelchair,' stressed Dr Borja García-García. 'In other words, both our research and the report share the opinion that the problem lies in the fact that clubs are simply ticking boxes of wheelchair seats provision.'

A failure by the richer clubs to adapt all facilities in transport, parking, ticketing allocation, toilet and catering facilities, and make them more adaptable and accessible could lead to legal action. 'If facilities are not appropriate, these supporters are therefore deprived of an important social experience that contributes to their integration in the wider community, to their social and mental well-being,' added Dr García-García.

Hopefully Premier League clubs will now adapt to better serving the needs of their disabled fans, especially after the success of the London 2012 Paralympic Games. The 2012 Summer Paralympics were one of the largest multi-sport events ever held in the United Kingdom, breaking records for ticket sales, heightening the profile of Paralympians and shifting perceptions on disability.

If football wishes to remain the most popular and global sport in the world then the richest clubs in the world, such as those in the Premier League, need to start setting an example and spend some money on making the game accessible to all and truly global.

The FREE project ended in March 2015 and aimed to understand the impact and increase awareness about the issue of cultural diversity, commonality and cultural change in the field of the most popular culture in Europe — football.

FREE

- ★ Coordinated by ESSCA in France.
- ★ Funded under FP7-SSH.
- ★ <http://cordis.europa.eu/project/rcn/102047>
- ★ Project website: <http://www.free-project.eu/>



UNDERSTANDING THE ECONOMICS OF COGNITIVE FRICTIONS

EU-funded researchers are building on existing economic models to better understand how macroeconomic fluctuations affect both the labour market and consumer behaviour.



In a recession, characterised by fewer jobs and more jobseekers, the rules of supply and demand say wages should fall. However, historically, this has not been the case. One common explanation for this, as the Morale Hazard Theory shows, is that the labour contract's inherent incompleteness forces employers to rely on workers' intrinsic motivation. When workers feel they are being treated unfairly, their intrinsic motivation decreases — as does their output.

A new approach to an old theory

To better understand the theory's applicability to current market trends, the EU-funded RDLMF (Reference Dependence and Labor-Market Fluctuations) project is taking a page from behavioural economics. The project proposes a theoretical framework that integrates three leading economic frameworks: macroeconomic models of search and matching; behavioural models of social preferences; and behavioural models of time inconsistent, reference-dependent preference. 'Instead of conducting a traditional macroeconomic competitive equilibrium analysis, we follow the modern approach of non-cooperative game theory,' says researcher Kfir Eliaz.

This approach has led to several new conclusions. First, following a layoff, workers experience downward wage rigidity and a decrease in output. Second, newly hired workers earn relatively flexible wages, but not as much as in the benchmark without reference dependence (benchmark is a model for search and matching, whereas reference-dependent preferences are those where an individual evaluates an outcome as either a gain or a loss relative to a reference point). Third, market tightness is more volatile than under the benchmark. 'This framework helps us explain large fluctuations in unemployment alongside downward rigidity in wages,' says Eliaz.

Applicability to other markets

RDLMF has gone well beyond reference dependence and the labour market, using the same approach to also explore behavioural frictions in other markets. 'We propose a new game-theoretic framework for analysing how firms interact with consumers who purchase multiple types of goods, but are able to examine only a limited number of markets for the best price,' says Eliaz.

What researchers found is that consumers focus their limited attention on their highest expenses. Therefore, a

firm's price can either draw or deflect attention by being among either the most expensive or the cheapest. 'Consequently, limited attention introduces a new dimension of cross-market competition, which leads to the surprising finding that increasing consumer attention can actually reduce consumer welfare,' explains Eliaz. 'Although consumers are more likely to miss the best offers, enhanced cross-market competition decreases average prices, meaning firms will try to stay under a consumer's radar.'

A common thread

The common thread between this consumer research and the research on the Morale Hazard Theory is how market frictions stem from cognitive sources. As Eliaz explains, reference dependence stems from our tendency to evaluate changes, not consequences, from a reference point. 'One cognitive friction that is prevalent in today's information-rich consumer market is limited attention,' he says. 'The question is, does this lead to an effect similar to the one in labour markets — large fluctuations in prices that increase as the bias of consumers with limited attention spans becomes more severe?'

The general conclusion is that in order to understand important market phenomena like this, one has to widen the view of what governs individual behaviour. 'In other words, standard, knee-jerk policy interventions such as encouraging more competition do not necessarily improve welfare,' concludes Eliaz.

RDLMF

- ★ Coordinated by Tel Aviv University in Israel.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/104663>

"One cognitive friction that is prevalent in today's information-rich consumer market is limited attention."



ENERGY

LESS PRECIOUS, MORE EFFICIENT HYDROGEN FUEL CELLS

To increase the cost-efficiency in ‘Proton exchange membrane fuel cells’ (PEMFCs), EU-funded researchers have designed a new family of thin-film catalysts, after discovering mechanisms behind single-atom catalysis and exploiting its benefits.

PEMFCs use a water-based, acidic polymer membrane as their electrolyte together with ‘platinum’ (Pt)-based electrodes. Hydrogen fuel is processed on the surface of a Pt-based catalyst at the anode where electrons are separated from protons. The protons pass through the membrane before reaching the cathode side of the cell.

On the cathode side, the precious metal electrode combines protons and electrons with oxygen, and water is produced, which is expelled as the only waste product. Specifically, oxygen can be produced in a purified form or extracted at the electrode directly from the air.

The EU-funded project CHIPCAT (Design of thin-film nanocatalysts for on-chip fuel cell technology) was launched to search for a viable alternative to the use of Pt nanoparticles. As a precious metal, Pt increases the price of hydrogen fuel cells, comprising up to 50% of the manufacturing cost.

During the four-year project, researchers explored different aspects of physical deposition technology. Typical industrial electrode-fabrication processes involve wet steps, which are incompatible with the technology of silicon-based electronic devices.

“Platinum doped cerium oxides” (Pt-CeOx) thin-film catalysts, for which patent applications had been filed before CHIPCAT, were proposed to maximise the efficiency of platinum used in fuel cells,’ explains Dr Daniel Mazur from Charles

University in Prague, the Czech Republic, a researcher and management secretary of the project.

The new thin-film nanocatalysts consist of the Pt atoms, predominantly in ionic state, dispersed within a matrix of a reducible oxide — ceria. The oxide crystallites have diameters of a few nanometres to ensure that the majority of Pt atoms end up on the surfaces of the crystallites and are catalytically active.

‘We had to convince ourselves and others that this compound works as proposed. After that we had to discover the key mechanisms that make these nanocatalysts work, so that we could refine them and find additives to make the best out of it,’ Dr Mazur recalls.

He stresses that ‘a host of experiments on simplified materials and of sophisticated model calculations had to be done to enable reaching the targets of the project.’

Dr Mazur also noted that ‘eventually, our published results indicated that the new catalysts can outlast conventional ones, because dispersed platinum atoms hardly coalesce at all and, therefore, keep the original performance so long as the scaffolding (carbonaceous material) holds.’

He also added: ‘With the use of high-resolution transmission electron microscopy, we were eventually able to visualise the individual Pt atoms embedded in the ceria crystallites. This

evidence has long been called for by our scientific peers, who were not convinced by our claim of the “atomically dispersed” nature of the catalyst.’

Significant efforts were also devoted to the construction of a miniature fuel cell so that it could be incorporated in an integrated circuit device. Researchers designed a system on a chip, in which hydrogen flows through microfluidic channels etched on a silicon wafer chip.

However, ‘the different geometry as compared to the sandwich structure of conventional PEMFCs meant that only processes at the channel edges contribute to the performance of the micro-fuel cell. This limits its performance and the amount of power that can be harvested,’ said Dr Mazur.

There are several strategies proposed to overcome this serious barrier, including the catalyst being deposited onto the membrane rather than on the trench walls.

CHIPCAT findings are described in more than 60 scientific papers published in high-impact peer-reviewed journals, including Nature Communications and Nature Materials.

These publications document the deep understanding obtained of processes taking place in the studied materials and were key to reaching the final outcomes.

The first steps have also been made towards commercialisation of the new thin-film catalyst technology. ‘Charles University in Prague, the project coordinator, in partnership with the Jablotron Group have created a spin-out venture under the leadership of Prof. Vladimír Matolín (holder of the patents mentioned earlier),’ said Dr Mazur.

The company LEANCAT s.r.o. is already offering the atomic nanocatalysts as a product. At the same time, they are manufacturing and selling fuel cell test stations that were developed at Charles University as part of the CHIPCAT project.

CHIPCAT

- ★ Coordinated by Charles University in the Czech Republic.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/project/rcn/106161>
- ★ Project website: <http://chipcat.eu/>

SUSTAINABLE BIOFUEL FROM ALGAE

Microalgae are photosynthetic organisms that produce a variety of energy-rich molecules. An EU-funded consortium investigated and demonstrated a ‘well to wheel’ process that uses microalgae for the future production of sustainable biofuel capable of replacing fossil fuels.

In the new bio-based economy, one of the most promising sustainable sources of chemicals and biofuels for food and non-food products is microalgae. However, to realise their full potential an increase in the scale of microalgae production needs to be matched with a simultaneous decrease in production costs.

“The consortium designed a pilot plant for outdoor production and set up microalgae production in three pilot plants.”

Currently, the technology required to fully exploit microalgae is still in its infancy. The EU-funded FUEL4ME (Future European league 4 microalgal energy) project was established to develop a sustainable production chain that would enable second generation biofuels to compete with fossil fuels.

The aim was to exploit algae’s unique ability to produce lipids using energy from photosynthesis. These lipids form excellent starting materials for biofuels and other products such as animal feed. Moreover, the target algae used in the project do not compete with food crops for land and freshwater as they are grown in saltwater.

‘Project scientists investigated in detail the molecular and metabolic mechanisms governing lipid accumulation in two microalgae species and demonstrated enhanced lipid accumulation by metabolic engineering. Furthermore, we compared the current two-step batch production process for microalgal lipids with a newly developed continuous one-step process and optimised lipid production under different growth conditions,’ says project coordinator Dr Dorinde Kleinegris.

‘Researchers developed the various steps of the downstream processing chain, which involved harvesting, cell disruption, lipid extraction and fractionation and hydro-treatment of the lipids to create biofuel. They were shown to be successfully applicable to microalgae and are now ready to be used in commercial processes, which are not limited to the production of biofuels.’

Although with lower lipid content, the one-step process had comparable lipid productivity as compared with the traditional batch process, but required testing on a larger scale. The consortium designed a pilot plant for outdoor production and set up microalgae production in three pilot plants based in Italy, the Netherlands and Israel respectively, and one demonstration facility in Spain.

A life-cycle assessment study was carried out to determine the actual state of the technology as well as how key

parameters influence the sustainability of the FUEL4ME integrated process. According to Dr Kleinegris, ‘the main influences upon sustainability were cultivation and harvesting, electricity demand, sources of freshwater and carbon dioxide and suitable land. The research has addressed some of these parameters by improving productivity of cultivation and harvesting efficiency, including water and resource re-use in cheap desert land.’

Further improvements, however, need to be made to make the process of biofuel production with microalgae fully economic and environmentally sustainable. Currently the process is best suited for the production of high-value products such as polyunsaturated fatty acids, while a promising biorefinery approach has been shown to strongly improve economic stability.



'We believe that FUEL4ME's long-term innovation strategy, which features a greater focus on high-value products, will result in economically feasible and environmentally sustainable microalgae-based products. This will ensure a further decrease in production costs and an increase in the scale of production. Biofuel from microalgae can then become a possibility,' Dr Kleinegris explains.

The project has provided an excellent opportunity for industrial partners to

conduct pilot tests of their technologies to achieve more reliable and scalable industrial solutions for microalgae cultivation and downstream processing. Moreover, it has produced highly skilled professionals with expertise in algal microbiology and microalgae cultivation and processing systems.

FUEL4ME has made a valuable contribution to Europe's research capacity and bioeconomy by developing knowledge and skills as well as sustainable valorised

products from microalgae. Furthermore, this eco-friendly process has the capacity to reduce dependence on fossil fuels.

FUEL4ME

- ★ Coordinated by Stichting Wageningen Research in the Netherlands.
- ★ Funded under FP7-ENERGY.
- ★ <http://cordis.europa.eu/project/rcn/106424>
- ★ Project website: <http://www.fuel4me.eu>

A HETERARCHICAL MANAGEMENT APPROACH TO SMARTER ENERGY GRIDS

Electrical power grids are getting increasingly complex, even more so when 'Distribution system operators' (DSOs) need to consider the integration of renewables into their management strategies. The DREAM project aimed to make these operators' life easier with a heterarchical approach to such management.

The DREAM (Distributed Renewable resources Exploitation in electric grids through Advanced heterarchical Management) promise consisted of two aspects: a stable and cost-effective integration of distributed renewable energy sources in existing networks, and more involvement of end-users eager to rationalise their energy use from an economic and ecological point of view. All this, with a smooth transition and at the lowest possible cost.

To reach this ambitious objective, the consortium opted for a 'heterarchical' management approach that it hopes will appeal to DSOs. Under this system, 'advanced Remote Terminal Units' (aRTUs) connected to a larger control centre enable decisions to be made locally, allowing in turn for more flexibility in voltage management, optimal power flow, reconfiguration, etc.

As Raphael Caire, coordinator of the project and associate professor at Grenoble Institute of Technology explains, there are three key arguments in favour of such a heterarchical approach. It enables global network optimisation by aggregating local needs; it allows distribution feeder automation closer to the whereabouts of the resources at lower cost; and it saves DSOs the cost of very expensive distribution management systems, where a central server has to account for all flexibilities required at the local level.

'The project consisted of two major parts,' he explains. 'The first was to create a framework for distribution network management with solutions ranging from day-ahead to real-time control in

case of emergencies. The second was to engineer the necessary hardware (the aRTUs) with a built-in virtual machine capable of running a part of this framework.'

Over their three years of intensive work, the consortium tested different solutions at five different trial sites, in the lab (in the Netherlands and France), with a single-user DSO (the Malpensa airport) and with an 800 000 and an 8 million-DSO respectively in France and Greece.

'Various scenarios involving congestion management, voltage profile mitigation and self-healing automatic restoration after a fault have been tested along with interactions between them,' Caire says. 'These pilots showed us that deciding to distribute software between the aRTUs was a good call. This actually helps to validate energy and capacity offering by pulling low voltage and overcurrent bids (what the Decentralised Energy Resources expect to consume or produce) to the primary sub-station.'

The resulting system has been designed to be plug-and-play so as to reduce development time for DSOs to the strict minimum, which Caire hopes will convince DSOs to opt for the DREAM system.

'We need to convince traditional DSOs immersed in the culture of centralised systems and notably ease their concerns related to cyber-security. From their understanding, it is more difficult to protect a distributed architecture than a centralised one. But the truth is that feeder automation, when compared to the DMS/SCADA approach, is more robust as its central point is less critical. With DMS/SCADA, control centre failure puts the whole system in jeopardy. A distributed approach, on the other hand, gives more robustness to the entire system. Cyber-security is of course always an issue, but solutions exist and research on critical infrastructure protection is only in its early stages.'

With the project now completed, the consortium will focus on fine-tuning the system before proceeding to dissemination and tests at a larger scale.

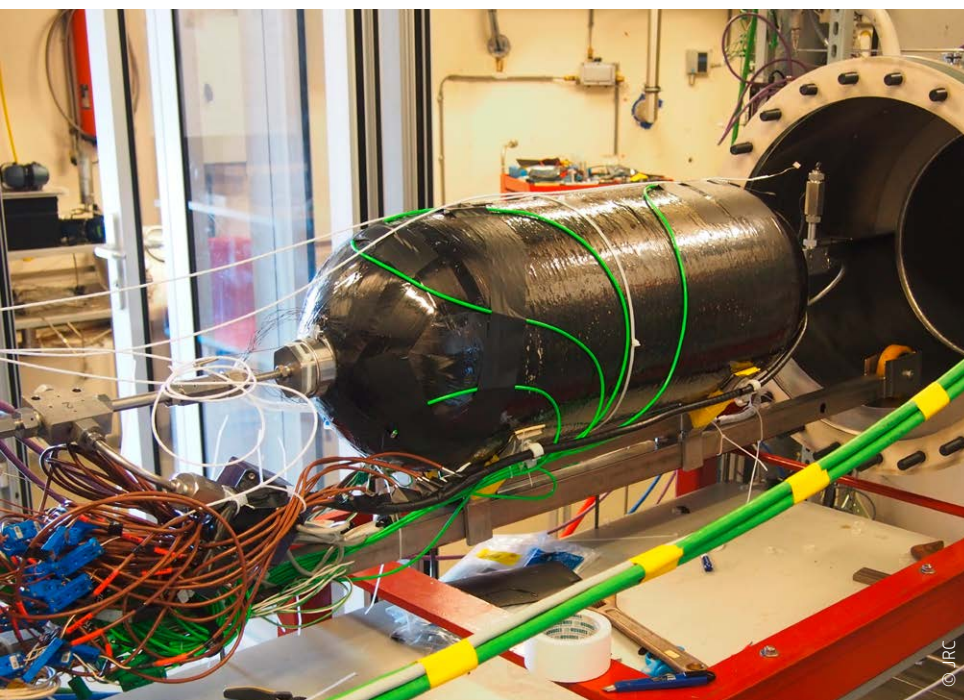
DREAM

- ★ Coordinated by Grenoble Institute of Technology in France.
- ★ Funded under FP7-ENERGY.
- ★ <http://cordis.europa.eu/project/rcn/109909>
- ★ Project website: <http://www.dream-smartgrid.eu/>



HYDROGEN REFUELLING UNDER THREE MINUTES

The cost of hydrogen vehicles has begun to fall and cities around Europe have started to build some of the necessary infrastructure. A new protocol that ensures refuelling of hydrogen vehicles in three minutes or less is one further step forward in the successful rollout of hydrogen mobility.



The EU considers finding alternatives to petrol-powered vehicles as a key element in its plans to reduce 'carbon dioxide' (CO₂) emissions. One significant step along this way is the use of fuel cell-powered vehicles that have near-zero lifecycle CO₂ emissions. Even highly optimised internal combustion engines are not likely to emit less than 110 grams of CO₂ per kilometre.

Major automotive manufacturers have hydrogen fuel cell vehicles ready for mass production. However, building a new hydrogen refuelling infrastructure is a major impediment to the successful rollout of the new vehicles to the market. Ensuring the efficiency of the refuelling process under all different ambient conditions is challenging.

The HYTRANSFER (Pre-normative research for thermodynamic optimization of fast hydrogen transfer) project was launched with financial support from the EU to improve the fuelling of hydrogen vehicles. The ultimate aim was to reduce investment and operating costs while increasing the reliability

of refuelling stations and reducing maximum refuelling time.

Experiments have shown that the heat transfer between hydrogen gas and the tank wall is rather ineffective. Even when the hydrogen inside the tank reaches a temperature of 85 °C (the maximum temperature specified in regulation, codes and standards for on-board tanks), the tank wall temperature will remain lower.

Using thermodynamics to determine the relation between injected hydrogen, filling parameters like the hydrogen flow rate and ambient temperature can help optimise the hydrogen transfer process.

As Jan Zerhusen from Ludwig-Bölkow-Systemtechnik GmbH in Germany, the new project coordinator explained: 'a significantly deeper understanding of temperature conditions within the involved tanks and tank systems was gained by an extensive experimental campaign in combination with thorough thermodynamic modelling. Based on this new knowledge, improvements in hydrogen refuelling were proposed.'

He went on to add that 'a new and innovative protocol for vehicle refuelling and its resulting regulations, codes and standards recommendations were developed and presented to relevant stakeholders. With this proposed protocol, the investment and operating cost of a hydrogen refuelling station can be reduced significantly. Moreover, the protocol enables shorter refuelling times which positively impacts on customer experiences.'

Specifically, the HYTRANSFER protocol entails a significant reduction in the pre-cooling temperature from -40 °C to about -20 °C, allowing for cutting down investment and operation costs of the pre-cooling unit, which is a central part of refuelling stations. Station operators could increase their profits by as much as EUR 20 000 annually. For the customers, the resulting reduced refuelling time, as well as hydrogen prices, could provide the incentive to adopt or continue using hydrogen-powered vehicles.

Zerhusen noted that 'we are currently at the beginning of building a hydrogen refuelling infrastructure as well as of the fuel cell vehicle rollout. A delayed introduction of the proposed refuelling protocol may require changes to existing stations or vehicle tanks, causing unnecessary costs.'

Along these lines, the HYTRANSFER team completed a series of tests on tanks and tank systems supplied by industrial partners. Optimisation opportunities for the hydrogen transfer process within existing regulations, codes and standards and state-of-the-art technology were also analysed to develop a path forward for the new refuelling protocol to international bodies.

HYTRANSFER

- ★ Coordinated by Ludwig-Bölkow-Systemtechnik in Germany.
- ★ Funded under FP7-JTI.
- ★ <http://cordis.europa.eu/project/rcn/108580>
- ★ Project website: <http://www.hytransfer.eu/>

"Trees with more big neighbours grow more slowly; however, nutrient-rich soils counteracted the impact of competition among neighbours."

ENVIRONMENT

HOW TROPICAL FORESTS CAN STORE MORE CARBON

Tropical forests are important for absorbing carbon dioxide from the atmosphere and moderating climate change. EU scientists have researched the factors that influence the carbon storage capacity of trees, and how managers can enhance this.

Trees and plants absorb and store carbon as they grow, helping to moderate climate change. As such, forests are a critical part of international climate change strategies, and the United Nations (UN) is developing strategies for rewarding countries that avoid deforestation and preserve carbon in biomass.

However, scientists' ability to predict the capacity of forests to absorb carbon is limited. This is partly due to a lack of knowledge about how trees' carbon storage capacity responds to changes in the environment.

Scientists from the EU-funded SPATFOREST (Spatial dynamics of tropical forest biomass change) initiative developed statistical models of carbon storage, tree growth and tree death in tropical forests to address this challenge. Their models explicitly account for environmental variation.

To do this, the scientists examined the distribution of biomass on a fine scale in a tropical forest in Panama. They also assessed the factors that influence tree growth and mortality.

They found that tree biomass above the ground is not randomly distributed at a small scale, but depends on environmental factors, especially the distribution of climbing plants which compete with trees for space, light and soil nutrients. This means that it is possible to predict which areas will store more carbon and thus target conservation accordingly.

Their results also showed that trees with more big neighbours grow more slowly; however, nutrient-rich soils counteracted the impact of competition among neighbours.

Using information collected from whole trees harvested around the world, the researchers also established that tree size and water availability influence root biomass. This in turn affects the ability of trees to store carbon below ground.

These findings have implications for the scientific community and forest managers, who could enhance tree growth rates — and carbon storage — through targeted actions. These include reducing competition, enhancing soil nutrients and conserving the largest trees (which grow more quickly and store more carbon).

The models developed by SPATFOREST will improve predictions of changes in tropical forests and their capacity to store carbon. This will contribute to policy development in the EU and internationally.

SPATFOREST

- ★ Coordinated by the University of Aberdeen in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/187710>

IN SITU CLEANUP OF OIL-CONTAMINATED SOIL

Oil pollution of soil is a growing problem around the world, posing a serious threat to both ecosystems and human health. Thanks to an EU-funded initiative, soil contaminated by hydrocarbons can now be cleaned more easily and cheaply.

The EU-funded SORBENT project developed an innovative solution based on pulp and paper-mill waste and a bioremediation process with three integrated stages. This can be applied to various types of oil (including crude and heavy) in different soil profiles and under different climatic conditions. Despite its many advantages, the wide-scale application of SORBENT has been hindered by its limited demonstration and verification in real-life studies.

The project SORBENT-DEMO (Demonstration of soil remediation technique for *in situ* cleaning of soils contaminated with heavy hydrocarbon mixtures) was established to conduct full-scale demonstrations of the SORBENT technique and to establish the framework for achieving regulatory approval for its use.

The SORBENT system comprises sorbent material, biosurfactant, hydrocarbon eating bacteria and nutrients. It is applied in three stages to ensure the most effective treatment of oil-polluted soil, namely: the SORBENT system; SORBENT bacterial preparation; and phytoremediation, where specific plants are used to complete the cleaning of the soil.

Two large-scale demonstration sites were selected in Lithuania, while seven small-scale sites were selected in Lithuania and Spain. A series of experiments was conducted to ensure maximum viability and efficiency of SORBENT products on selected types of soil, which were contaminated with different types of oil.

The successful demonstration of SORBENT-DEMO has helped to significantly reduce the cost of soil remediation,

“Two large-scale demonstration sites were selected in Lithuania, while seven small-scale sites were selected in Lithuania and Spain.”

as it can be treated *in situ*, rather than having to be removed for treatment. It will also help in environmental protection and support the Convention on Biological Diversity, which identifies soil biodiversity as an area requiring specific attention.

SORBENT-DEMO

- ★ Coordinated by UAB Grota in Lithuania.
- ★ Funded under FP7-SME.
- ★ <http://cordis.europa.eu/project/rcn/185467>

BACTERIA AND SOIL EROSION

An EU team has examined the factors affecting soil stability. The study determined that soil bacteria and trees protect against erosion, and that careful transplantation of bacteria improves stability.

A considerable portion of farmland includes sloping ground subject to soil erosion. While careful planting practices can avoid erosion, in many cases the optimal specifics have yet to be determined.

The EU-funded project FIXSOIL (Understanding how plant root traits and soil microbial processes influence soil erodibility) explored how roots and microorganisms affect soil stability. Specifically, the team studied how various crops and forests provide the ecosystem service of soil erosion prevention and maintenance of structure. The research determined the soil fixation function of root systems and

The study found that land use affected soil aggregate stability, soils near trees had higher stability than open areas, and altitude determined the extent of the effect in subalpine environments. Furthermore, land use and tree proximity were both correlated with microbial diversity, while a climatic gradient affected microbial diversity and thus other soil properties.

Researchers assessed the relationship between different microbial communities and soil stability. They sterilised soils, then transplanted microbes and grew two species having different types of root systems. Investigators then collected and

“FIXSOIL’s discovery of the links between microbial communities and soil stability helped identify more effective soil management strategies.”

microbial communities, and the effect on soil stability.

Researchers selected a mixture of natural forest, agroforest and organic farmland in both temperate and

Mediterranean regions. The team compared bacterial and fungal DNA extracted from soil samples against public databases so as to identify species. Investigators also assessed soil stability using a standard method, and conducted other physical and chemical soil tests. The purpose was to determine whether soil chemistry or root/microbial properties were more important for soil stability.



ENVIRONMENT

measured the root traits, soil aggregate stability and soil microbial diversity.

Results determined that soil inoculation was useful for managing microbial diversity. Inoculations also improved soil stability in the control test. The procedure made little difference to the presence of soil compounds such as ergosterol and glomalin-related soil proteins.

FIXSOIL's discovery of the links between microbial communities and soil stability helped identify more effective soil management strategies. Its findings highlight the importance of

the soil biodiversity providing the ecosystem service of soil aggregate stability. The work helps prevent soil erosion while making farms more productive through the use of agroforestry and maintaining soil biodiversity.

FIXSOIL

- ★ Coordinated by INRA in France.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/188039>
- ★ Project website: <http://sites.google.com/site/luismerinomartin/research>

BIODIVERSITY AT CHANGING ALTITUDES

Many people in the developing world depend on traditional medicine for healthcare, which is linked to understanding plant biodiversity. Researchers have shed light on how a changing altitude affects the evolutionary history and biodiversity of plants.



Human lives have heavily depended on floral biodiversity for millennia, and biological resources are still paramount for human livelihood. Understanding how humans rely on nature for their livelihoods is an important goal of biodiversity research and ethnobotany.

The EU-funded BIODIVERSITYALTITUDE (Plant evolutionary and ethnobotanical diversity changes along an altitudinal gradient) initiative worked to reveal patterns in biodiversity turnover and evolution along a changing altitude using modern methods. The researchers shed light on the processes that shape plant biodiversity and plant usage in changing ecosystems.

To understand these processes better, the researchers used large biodiversity data sets and several modern comparative methods.

BIODIVERSITYALTITUDE chose the altitudinal gradient of the Nepalese Himalaya, where traditional herbal medicine makes it an ideal area for studying ethnobotanical diversity. The researchers collated databases of the altitudinal ranges of plants and their uses, and generated a genus-level phylogeny of the flora.

The researchers found that plant biodiversity initially increases with altitude, until it reaches a diversity peak at around 1 300 to 1 800 m, above which it decreases with altitude. BIODIVERSITYALTITUDE showed that conservation strategies should consider evolutionary history, as lower species diversity at higher altitudes does not necessarily imply a less diverse community.

In an additional study, BIODIVERSITYALTITUDE investigated patterns in palm tree use in South America. The researchers found that reliance on availability may have limited ethnic use of wild plant diversity, since rare yet important clades may have been overlooked.

These results provided important findings in biodiversity and ecosystem services research, which can be used in conservation programmes. This can help maintain ecosystem resilience to meet societal needs in a changing world.

BIODIVERSITYALTITUDE

- ★ Coordinated by the University of Copenhagen in Denmark.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/109076>

AQUATIC RESOURCES
INTERVIEW

AN ALL-ROUND SOLUTION TO BETTER FACE WATER CONTAMINATION EVENTS

The SAFEWATER project has developed a complete toolkit for a better management of chemical, biological, radiological and nuclear water contamination events.

The EU can pride itself for the quality of its tap water. But what would happen if a contamination event were to occur? Surely, authorities would need the best possible tools to help them identify, manage and resolve the crisis efficiently while avoiding potentially dramatic consequences on public health. But state-of-the-art technology makes them ill-prepared.

With this in mind, the SAFEWATER (Innovative tools for the detection and mitigation of CBRN related contamination events of drinking water) project has developed an affordable, generic and all-round solution to enhance real-time response capacity to drinking water security crises. This solution encompasses an event detection system, an event management system, offline and online simulators, as well as chemical, biological and radiological sensors.

Anna Ellinge Madar, coordinator of the project, discusses the project's outcomes, its market potential and future plans for the consortium.

★ What's the added value of SAFEWATER in case of CBRN contamination?

Anna Ellinge Mada: SAFEWATER is able to capture and analyse the data collected by sensors and from other information systems used in drinking water networks.

It provides a technology platform that will enhance a water utility's ability to rapidly detect a contamination event, analyse its repercussions using real-time online hydraulic and water quality models, mitigate the damage using simulation tools and swift operating procedures, as well as deal more effectively with the event using an advanced decision support system and a comprehensive event management tool.

★ What were the main problems posed by existing tools?

Existing tools suffer from a range of serious shortcomings. First, the set of available CBRN sensors which can be used to detect contamination threats to water drinking quality in the distribution system is currently very limited.

But there are other problems: Real-time detection and alarm capabilities are insufficient or non-existing. Current limitations of propagation models make the effective assessment of potentially contaminated zones very difficult. Models for response, mitigation and recovery which are running in real-time are almost inexistent. Finally, there is currently no event management system available on the market — especially not one that provides a user interface for decision makers, connects all software components and provides all relevant information in a web-based 'Geographical information system' (GIS).

★ Has the solution been tested in real case scenarios yet?

The SAFEWATER solution has been tested against several true-to-life use cases, including the contamination of a municipal storage tank, a major water trunk line and a local supply line.

We did this while using several families of contaminants such as organic compounds, toxic waste, and radioactive material. Trials and measurements of individual components as



ANNA ELLINGE MADA

well as the entire completed system have been performed in special hydraulic test networks set up in three different water utility companies: Águas do Algarve in Portugal, Hagihon Company in Israel, and Wasserversorgung Zürich in Switzerland.

★ **What can you tell us about market reception so far?**

End users have shown great interest in SAFEWATER, both as a complete system and in its individual applications. Several of these applications are market-ready with commercial discussions well underway, and we even closed some commercial contracts. The event detection system and the simulators have been particularly successful.

★ **What are your plans now that the project is completed?**

Several collaborations between individual partners were established thanks to the project, and will continue after its end. Some of the partners joined a new project proposal submitted in August 2016, with a view to pursuing collaborations. This proposal was unfortunately not successful, but there might be others to come in the near future.

SAFEWATER

- ★ Coordinated by ARTTIC in France.
- ★ Funded under FP7-SECURITY.
- ★ <http://cordis.europa.eu/project/rcn/110459>
- ★ Project website: <https://www.safewater-project.eu/>
- ★  <http://bit.ly/2myHsuM>

SAFER FISH PRODUCTS FOR CONSUMERS

Despite efforts to ensure that only safe, high-quality products are made available to consumers, fish-borne parasites continue to pose a risk to human health. This risk may take the form of zoonotic infections and allergic reactions following the consumption of raw, under-cooked or lightly marinated seafood.

The aim of the PARASITE (Parasite risk assessment with integrated tools in EU fish production value chains) project was to provide new scientific evidence and technologies to detect, monitor and mitigate zoonotic parasites. These mainly involve anisakis nematodes, but also trematode metacercariae flatworms, which can be found in European and imported fishery products.

Project partners conducted a quantitative risk assessment of parasites in fishery products, from net to plate, in EU fish production value chains. The epidemiological study represented the most comprehensive compilation of epidemiological data on anisakis to date, in terms of geographic range, number of host species and sample sizes.

These studies provided extremely useful information for improving the fish industry's operation strategies designed to control the threat from parasites. They also provided the

scientific framework for conducting official veterinarian inspections and guaranteeing the quality and safety of fish products for consumers.

Tools were developed to manage traceable and high-quality storage samples for use in diagnosis, trials and experiments. Researchers also created a biobank for zoonotic parasites in fishery products and a computer-aided epidemiological geo-referenced database for zoonotic parasites in fish stocks and products marketed in Europe.

The project has also contributed to road-mapping future research and helped to establish a collaborative EU scientific network on the role of parasites in marine ecosystems. It notably addressed parasite species of significant economic and public health concern.

PARASITE findings suggested improving molecular hazard identification, antigen/allergen characterisation, parasite exposure assessment and detection methods for industrial and other end users. It will contribute to enhanced seafood safety with subsequent benefits for public health and consumer confidence. It will also boost the competitiveness of European seafood and improve EU food safety policies.

"These studies provided extremely useful information for improving the fish industry's operation strategies designed to control the threat from parasites."



PARASITE

- ★ Coordinated by the Spanish National Research Council in Spain.
- ★ Funded under FP7-KBBE.
- ★ <http://cordis.europa.eu/project/rcn/105075>
- ★ Project website: <http://parasite-project.eu>

FLUORESCENCE SPECTROSCOPY LIGHTS THE WAY TO BETTER AQUACULTURE

Researchers have used fluorescence spectroscopy to monitor and improve water quality in EU fish farms.



© sergeimonov, Shutterstock

Aquaculture plays an important role in sustainable international food production, providing more than 50% of the world's fish stocks in 2012. However, aquaculture in coastal waters can generate large amounts of organic waste due to the inherent density of fish within these systems.

'Recirculating aquaculture systems' (RASs) are closed-loop systems in which fish stocks can be grown and harvested away from natural marine environments. These systems have significant benefits over harvesting wild stocks: increased food safety, source traceability and sustainability, and decreased environmental impact.

The EU-funded FAMORAS (Fluorescence analysis and monitoring of recirculating aquaculture systems) initiative worked to optimise RASs using fluorescence spectroscopy. The researchers wanted to greatly improve the productivity of EU fish farming industries.

Researchers sampled RASs to establish typical fluorescence signatures during

normal operation. They sampled and analysed RAS water over extended periods to capture variability and directional changes in water quality.

The team used fluorescence data and statistical tests to identify subtle changes in RAS water quality. They then designed, constructed and tested an online, real-time fluorescence sensor for RAS water quality monitoring.

The researchers found differences in organic matter character due to changes in feeding strategies. These small changes are likely very important in managing RAS water quality and subsequent treatment requirements.

According to FAMORAS' findings, these changes in organic matter character occurred during the start-up/build-up phase of a freshwater RAS. The researchers found out how each organic matter component comes to equilibrium with the biological treatment systems and how each component behaves once at equilibrium.

"The team used fluorescence data and statistical tests to identify subtle changes in RAS water quality."

Project results show the potential of fluorescence spectroscopy as a viable way to monitor organic matter within RASs. There are also potential benefits for EU aquaculture industries to further develop an online sensor to optimise the management and operation of aquaculture facilities.

FAMORAS

- ★ Coordinated by the Technical University of Denmark.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/186276>

INDUSTRY

NEW SORTING TECHNIQUES HOLD PROMISE FOR METAL RECYCLERS

An EU research team has aimed to resolve a problem that has been challenging metal recyclers for decades. It has come up with an industrial system that can sort non-ferrous metals, including cast and wrought aluminium, from scrap to a high degree of accuracy and in a cost-efficient way.

The SHREDDERSORT (Selective recovery of non-ferrous metal automotive shredder by combined electromagnetic tensor spectroscopy and laser-induced plasma spectroscopy) project harnesses two technologies to offer a new way of sorting non-ferrous metals, one which will allow the sorting process to take place automatically and at high speed. The project, led by Spanish SME Lenz Instruments, could improve the recycling of high-value metals such as aluminium, copper and bronze from vehicle scrap and reduce the demand for raw materials.

When cars and other vehicles come to the end of their useful life, they are chopped into pieces around 1-10 cm in size by shredder plants to facilitate recycling and disposal. Separating the ferrous metals from the pieces using magnets is relatively simple, according to Jacobo Alvarez, project coordinator and R&D Manager at Lenz Instruments.

But sorting the remaining matrix of non-ferrous metals is a lot harder. Existing methods such as wet separation are expensive to manage and use large amounts of water. Using x-ray fluorescence sensors, a more recent approach, works well but can only separate metals of the same density.

New sorting techniques

The SHREDDERSORT team is using electromagnetic tensor spectroscopy to analyse the electrical properties of the scrap at different frequencies. They then combine

the resulting data with information on the morphology of the scrap fragments to determine their conductivity. Since different metals have different levels of conductivity, this allows them to be sorted.

They have developed a second sorting technology based on laser-induced breakdown spectroscopy or LIBS. 'While this technique is well known in the laboratory, using it in a high-speed sorting system is technologically challenging,' says Dr Alvarez. The SHREDDERSORT system sends metal fragments along a one-metre-wide conveyor belt at a speed of two metres per second. Two short, high power laser pulses are fired at each fragment as it passes by, ablating a small mass from its surface and generating a plasma plume at an extremely high temperature. As the plasma cools, a high-speed spectrometer identifies the different aluminium alloys by measuring the characteristic emission lines of elements in the ablated material. Air ejectors then take care of the sorting.

'As a result of this work, we have been able to demonstrate that our system can sort cast and wrought aluminium alloys with an accuracy above 90%,' says Dr Alvarez. Operational since April 2016, the LIBS system can handle a throughput of up to two tonnes per hour.

Good timing

This innovation comes at the right moment. Currently most aluminium scrap, both cast and wrought, is recycled to

produce secondary cast aluminium. But as early as 2018, the supply of cast aluminium will begin to outstrip demand, while demand for purer wrought aluminium scrap to produce secondary wrought aluminium alloys is expected to rise.

The SHREDDERSORT team now aims to fine-tune its system to produce one which is robust enough to withstand the harsh operating conditions to be found in recycling plants. This calls for redesigning some of the critical elements of the system and the project's industrial partners are exploring ways to fund this step.

'The use of these technologies is not limited to processing automotive metal scrap. The technology could be easily adapted to the recovery of target metals from industrial, electronic or any other type of waste which contains metal,' says Dr Alvarez.

SHREDDERSORT

- ★ Coordinated by Lenz Instruments in Spain.
- ★ Funded under FP7-ENVIRONMENT.
- ★ <http://cordis.europa.eu/project/rcn/110783>
- ★ Project website: <http://shreddersort.eu/>
- ★ <http://bit.ly/2mx2xCw>

SELF-HEALING POLYMERS FOR AIRCRAFT COMPOSITES

Reducing repair costs would provide a boost for the aeronautical sector and self-healing composite materials might be a solution. The EU-funded HIPOCRATES project has made several composites that contain self-repairing polymers. Tests show once repaired these new materials can withstand greater impacts.



© shutter, Shutterstock

Self-healing materials need minimal maintenance and have the ability to repair their own micro-cracks and breaks. They have become a holy grail for the aerospace industry. HIPOCRATES (Self-healing polymers for concepts on self-repaired aeronautical composites) has made their use a step closer following its mission to design epoxy-based self-healing composites. They based these new self-healing materials on already widely used resins, so that they could be simply incorporated into current aerospace production methods.

Laminated polymer composite materials are used in aircraft parts such as engine propellers, the fuselage and interior components and micro-cracks. But micro-cracks are a big problem, reducing the strength of the materials. Up to now, repairs have needed manual intervention, but the development of self-healing polymeric materials over the last decade could change this. Self-healing mechanisms have already been explored for concrete, asphalt, hydrogels and biomedical polymers. 'The strategy provides a promising path to extend the life of polymeric components,' says HIPOCRATES coordinator, Dr Sonia Flórez of TECNALIA in San Sebastián, Spain.

Designing structural self-healing polymer composite materials for the aerospace industry has been a challenge says Flórez — 'there are several practical limitations that needed to be overcome.' These included the rate of healing, the stability of the process as well as materials and production costs. 'A critical step is the compatibility of such technologies with current processing and manufacturing methods,' she adds. To do this, HIPOCRATES has translated known self-healing chemistries into epoxy resin systems already commonly used in aerospace composites and developed methods to incorporate self-healing technologies into existing processing techniques.

The HIPOCRATES project has investigated two different self-healing strategies. One involves encapsulating micro-cracks. Flórez explains, 'Microcapsules containing self-healing agents are added to the composites polymer mix, in which a catalyst that starts the reaction has already been dispersed. When a micro-crack occurs, the capsules break

and release the healing agent, which comes into contact with the catalyst. The resulting polymerisation reaction closes the crack and prevents further crack growth.' HIPOCRATES has been able to take this strategy one step further in developing an 'all in one microcapsule' self-healing system which is entirely self-contained. Rather than the catalyst being dispersed through the resin matrix, it is encased in the shell of the capsules in a higher concentration, so the healing reaction can occur more efficiently.

The second method has been to use reversible polymers. 'These materials contain internal linkages, which will reverse the damage and close a crack upon delivery of an external stimulus such as heat, radiation or electrical induction,' say Flórez. This behaviour can be achieved using various reversible polymers and HIPOCRATES synthesized and tested two that are compatible with epoxy systems and can be made from cost effective commercial raw materials.

The materials designed by HIPOCRATES were tested in small-scale demonstrators by mimicking the kinds of high velocity impacts experienced by aircraft due for example to collisions with birds, debris and hail. The effect of compression on the repaired materials was tested to see if they would de-laminate and break apart.

Ultrasound analysis of the tested new materials found that impact and compression damage could be mitigated by using self-healing materials. 'The incorporation of capsules provided some protection against the initial mechanical impact, however after healing both strategies showed higher resistance to compression than before,' explains Flórez. The new materials showed 5-10% higher resistance to compression forces making the repaired materials resistant to the sorts of impacts that would cause damage before the repair.

The new composites designed in the HIPOCRATES project still need to undergo more testing before they can be used in real applications, but the project team hope that in the next five years these self-healing materials might help reduce aircraft costs by providing an alternative to expensive manual testing and repair.

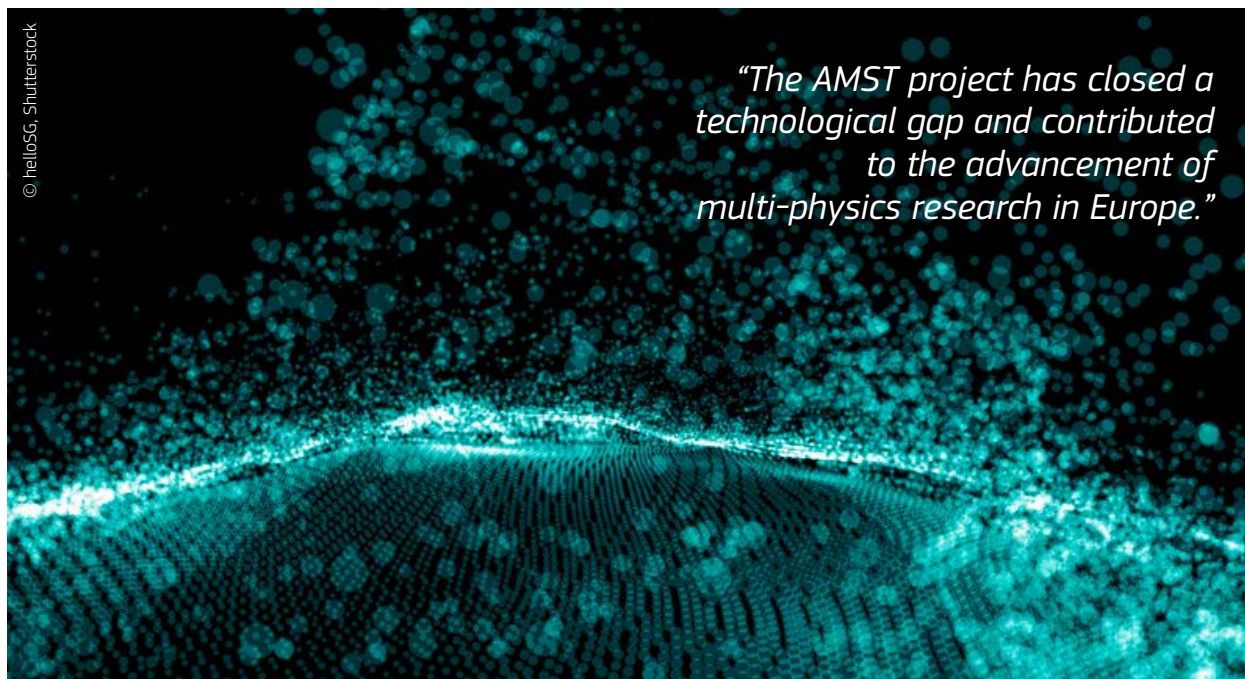
"The new materials showed 5-10% higher resistance to compression forces."

HIPOCRATES

- ★ Coordinated by Tecnalia in Spain.
- ★ Funded under FP7-TRANSPORT.
- ★ <http://cordis.europa.eu/project/rcn/111157>
- ★ Project website: <http://www.hipocrates-project.eu/>

A NEW PARADIGM IN MULTI-PHYSICS SIMULATIONS

With the new analysis solution offered by EU-funded scientists, conventional models for one particular type of physics can be easily interfaced to solve coupled phenomena in multi-physics.



"The AMST project has closed a technological gap and contributed to the advancement of multi-physics research in Europe."

Many real-world systems involve complex interactions between fluids — gas or liquid — and solid phases or structures. Examples are found in diverse fields such as the pharmaceutical industry, the food and processing industry, mining, construction and electricity generation from renewable energy sources. Everyday products like renewable fuels and even coffee depend on solid knowledge of the underlying physics of processes involved in their production.

Simulations of multi-component systems are as old as simulations themselves. However, they deserve a fresh start in light of the steadily increasing capacity of supercomputers and greater aspirations for scientific prediction and engineering design. Research carried out in the EU-funded AMST (Advanced multi-physics simulation technology) project provided an innovative approach to multi-physics simulations.

Professor Bernhard Peters from the Université du Luxembourg, coordinator of the project, explains that 'the "Extended discrete element method" (XDEM) for multi-physics and multi-scale simulations has its roots in thermal waste treatment that was investigated earlier at the Karlsruhe Institute of Technology (KIT), Germany.

XDEM forms the basis for an advanced simulation platform combining flexibility and versatility to establish the next generation of multi-physics and multi-scale simulation tools.'

XDEM extends the dynamic behaviour of granular solid materials and particles as described by the classical discrete element method by estimating their thermodynamic state. In addition to the thermodynamic state of each particle, which includes changes in temperature and species distribution because of chemical reactions and external heat sources, stress and strain fields, are predicted.

Professor Peters adds that 'the new simulation platform relies on coupling various predictive tools based on both Eulerian and Lagrangian approaches. The Eulerian approach represents simulation models [considering all phases as a continuum on a macroscopic level.] Such continuum models include computational fluid dynamics and finite element analysis. On the other hand, the Lagrange approach is suited to discrete phases.'

He notes that 'the scientifically sound implementation of the XDEM method was accompanied by the development of a graphical user interface that serves as a pre-processor for the XDEM solver.'

The AMST simulation platform was possible thanks to a fruitful collaboration between the Université du Luxembourg and the German small to medium-sized enterprise inuTech with complementary expertise in simulating physics-based problems and software design.

The AMST project has closed a technological gap and contributed to the advancement of multi-physics research in Europe. Simulating the behaviour of multi-component systems helps scientists and engineers to analyse experimental data and unveil the underlying physics. With these theoretical insights complementing empirical knowledge, our understanding of multi-physics can be considerably broadened.

AMST

- ★ Coordinated by the University of Luxembourg in Luxembourg.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/106365>
- ★ Project website: <http://inutech.de/amst/>

EXPLORING PARTICLES AND THE MANUFACTURING PROCESS FOR INCREASED ACCESS TO HIGH-VALUE PRODUCTS

In search of the optimum manufacturing process for high-value products, the EU-funded IPROCUM project successfully combined experimental investigation with numerical and data-based predictive modelling.

A broad range of industrial sectors use particulate materials within their manufacturing processes; these include precious metals, pharmaceuticals, fine chemicals and ceramic powders. However, in the early stages of product development, ascertaining optimum performance for high value-added products (such as pharmaceuticals and catalysts) using production scale systems is impossible with conventional experimental approaches. This is due to the required amount of feed powders (>100 kg) which is expensive and costly (>EUR 10 000 per kg). With the absence of computer-modelling tools, researchers have had to rely on laboratory and pilot-scale systems, with the challenge of then scaling-up to production.

IPROCUM (The development of *in silico* process models for roll compaction) combined the disciplines of chemical engineering, process engineering, pharmaceutical engineering and computer science, to develop *in silico* process models for roll compaction. These predict the manufacturing process performance of various formulations, based on a thorough understanding of the entire manufacturing process and its constituent products.

A systematic approach to optimised manufacturing

The complicated nature of the manufacturing process itself added significantly to the IPROCUM challenge, as the project coordinator Professor Chuan-Yu Wu summarises. 'Powders experience different stress states and hence their mechanical response varies from process stage to process stage. The team therefore had to take a systematic approach, by first studying the properties of intermediate (ribbons/granules) and final products (tablets/pellets/components), based on the properties of individual particles with identified optimal process conditions and formulations.'

The team studied the characteristics of particles and powders. They identified critical material attributes (i.e. particle properties) that dominate bulk powder properties, alongside the investigation and quantification of the dynamics and microstructures of mixtures. They also analysed the impact of powder properties, roll compactor type and process parameters on the manufacturing process. Additionally, the effect of ribbon properties and milling mechanisms on granule properties was studied using a multiscale approach.

Modelling and computational techniques were applied, with the 'Discrete element method' (DEM) used to investigate the powder filling, mixing and feeding processes, along with segregation phenomena, uniformity and the flow rate. IPROCUM also investigated how powders' performance in roll compaction was affected by particle properties and process conditions. The 'Finite element method' (FEM) identified the critical material properties and process parameters controlling granule and tablet quality. Modelling predictions were then

made of how granule properties and process parameters affected die filling, powder compaction and ejection.

IPROCUM also developed a 'computational intelligence' (CI) model which augmented understanding of: powder mixing to identify critical particle properties and critical process variables; roll compaction processes and critical powder properties; the ribbon milling process; and die compaction to identify critical material properties and process conditions.

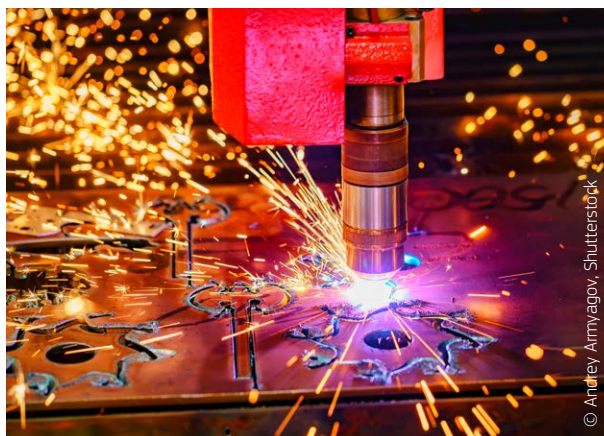
Harnessing the winning formulas

As Professor Wu explains, 'IPROCUM enabled the evaluation of a variety of processing techniques, identifying those best matched to dominant mechanical powder responses during the manufacturing process.' The project underlined the importance of the process control design in roll compaction and has already resulted in LB Bohle (an associate partner) significantly improving performance. The combined DEM and FEM modelling approach has, for the first time, revealed the underlying mechanisms for ribbon density variation, which can be used to accurately predict the roll compaction process. Additionally, as the computational intelligence models were developed to be generic in nature, they have great potential for wider applications (e.g. drug release and continuous manufacturing).

By reducing high-value product development costs, hence ultimately market price, IPROCUM helps make products more accessible to EU citizens. As Professor Wu puts it, 'This could have a marked health and wellbeing benefit when applied to pharmaceuticals, with companies making new medicines available faster and at less cost.'

IPROCUM

- ★ Coordinated by the University of Surrey in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/106577>
- ★ Project website: <https://www.surrey.ac.uk/iprocom/>



NEW INSIGHTS INTO SOLIDIFICATION CRACKING DURING STEEL WELDING PROCESS

The EU-funded MINTWELD project has made a novel breakthrough in understanding how solidification cracking occurs during the welding of steel, a problem that can lead to structural failure if left undetected and is thus a key challenge for industry and the construction sector.

In a new study published in the journal 'Scientific Reports', the project team from the UK's University of Leicester Department of Engineering has proposed that solidification cracks grow by linking micro-porosities in the meshing zone in the solidifying weld pool. Importantly, this is the first time that researchers have observed solidification cracking in steel and sheds new light on why the alloy may crack during the process.

'Welding is the most economical and effective way to join metals permanently and it is a vital component of our manufacturing economy,' commented Professor Hong Dong from Leicester and one of the authors of the study. 'It is estimated that more than 50% of global domestic and engineering products contain welded joints. In Europe, the welding industry has traditionally supported a diverse set of companies across the shipbuilding, pipeline, automotive, aerospace, defence and construction sectors. Solidification/hot cracking is the most

common failure mode during metal processing, such as welding, casting and metal additive manufacturing (metal 3D printing).'

The team obtained their results by using the synchrotron X-ray beamline at the European Synchrotron Radiation Facility (ESRF) for three days in Grenoble, France, to observe the crack formation in real time. Through the modern advances in synchrotron X-ray and imaging techniques, the team was also able to see through metals, providing detailed analysis of the alloy. During the experiments, a total of 27 samples were tested, taken from three steel variants and tested at three different strain rates. Each test was then repeated three times to demonstrate repeatability between tests.

Although no official data exists on the revenue of the EU welding industry due to the diverse applications of the welds, it is estimated that over 50% of global domestic and engineering

"It is estimated that over 50% of global domestic and engineering products contain welded joints."

products contain welded joints, and welding equipment and consumable markets reached EUR 3.5 billion in Europe in 2007. Alongside the industrial importance of the sector, weaknesses in welded parts can have disastrous effects, including putting lives at risk, as well as serious economic repercussions due to damages and insurance payouts for faulty products. They can also cause environmental catastrophes such as pollution if imperfectly welded parts are used in environmentally-sensitive areas, such as the ocean.

The MINTWELD (Modelling of Interface Evolution in Advanced Welding) project officially ended in August 2013 and pioneered new ways of making welding simpler, safer and more economical by using new technologies and state-of-the-art computer modelling techniques. The results of this latest study mark another important contribution to the team's innovative solutions to increase the overall efficiency of steel welding and open up new markets for the European steel welding industry.



© bklung, Shutterstock

MINTWELD

- ★ Coordinated by the University of Leicester in the United Kingdom.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/project/rcn/91206>
- ★ Project website: <http://www2.le.ac.uk/projects/mintweld>

INFORMATION AND COMMUNICATION TECHNOLOGIES

QUANTUM COMPUTING BREAKTHROUGH DESCRIBED AS 'THE HOLY GRAIL OF SCIENCE'

New research part-supported by the EU-funded IQIT project has produced the first-ever industrial blueprint for a large-scale quantum computer that could lead to an entirely new and exciting technological revolution.

Until now, quantum computing has had just a fraction of the processing power that it is theoretically capable of producing and this has hindered the advancement of a possible 'quantum revolution'. Now though, an international team of researchers, led from the Ion Quantum Technology Group at Sussex University, in the UK, believe they have finally found the way to overcome the technical problems that have thus far prevented the development of more powerful machines.

The team, which has published its findings in the journal 'Science Advances', are now building a prototype and estimate that a full-scale, fully-functional quantum computer could be ready to go in about a decade. The device would be many millions of times faster than the best currently available computer and would work by utilising the ability to manipulate effects in customised systems and materials — in effect, harnessing the properties of the 'very small' at the atomic level.

'It is the Holy Grail of science, really, to build a quantum computer,' commented Prof. Winfried Hensinger, who has been leading the research. 'We are now publishing the actual nuts-and-bolts construction plan for a large-scale quantum computer.'

Quantum computing would unleash a level of processing power that could transform life in the twenty-first century,

allowing for the development of new medicines and the construction of communication devices with superior performance capabilities, and providing new tools to help humanity solve the many still-unexplained mysteries of the universe. 'Life will change completely,' said Prof. Hensinger. 'This is really, really exciting... it's probably one of the most exciting times to be in this field.'

The main technical restraint holding quantum computing back is the fact that existing quantum computers require lasers focused on individual atoms, and the larger the computer, the more lasers are required, which then increases the chance of something going wrong. Prof. Hensinger and his team used a different technique to monitor the atoms, which involved a microwave field and electricity in an 'ion-trap' device.

'Within two years we think we will have completed a prototype that incorporates all of the technology we state in this blueprint [published in "Science Advances"],' explained Hensinger. 'At the same time we are looking for an industry partner so we can really build a large-scale device that basically fills a building.' The team estimates that the final cost of constructing and testing the prototype could be up to EUR 116 million.

The IQIT (Integrated Quantum Information Technology) consortium, that included the University of Sussex but was coordinated at the University of Siegen in Germany, was a four-year project that aimed to develop novel methods for

up-scaling quantum physical devices. Although the project ended in March 2015, it acted as an important pillar of support for the design of the ground-breaking quantum blueprint reached by Prof. Hensinger and his team.

Advancing the quantum computing revolution continues to be a major EU ambition, with policymakers understanding that quantum breakthroughs have the capacity to ensure Europe's continued place as a global scientific leader. Overall, the field has received up to EUR 550 million in EU

research funding and as this latest development highlights, it could indeed amount to money very, very well spent.

IQIT

- ★ Coordinated by the University of Siegen in Germany.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/project/rcn/99442>
- ★ Project website: <http://www.iqit-research.eu/>

MASTERING THE POWER OF SOCIAL MEDIA FOR BETTER EMERGENCY RESPONSE

Social media have not only revolutionised the way we use the web, they've also brought a wide range of opportunities for businesses and organisations of all kinds. Emergency services, however, are still struggling to make sense of the overwhelming amount of data coming their way.

As Alexandru Stan, innovation manager at IN2 in the UK, would put it, the richness of social media is both a problem and an opportunity for emergency services. 'They need reliable information, so information from social media cannot be used directly. It needs additional processing to evaluate its reliability, as well as correlation with events and groups likely to be involved in the event. They cannot afford to mistake rumours for real facts.'

Emergency services, however, usually rely on information coming through emergency lines, which are then mediated by officers. As such, using social media to do this could be considered as a natural evolution of these practices — as long as they can rely on tools to filter information and classify it.

This is where the technologies developed under the SUPER (Social sensors for secURity Assessments and Proactive EmERgencies management) project can play a defining role. 'SUPER is a plug-and-play architecture in which social media analytics components of different types can be integrated, to support automatic data enrichment and information extraction by the end-user,' Stan explains.

'Our components can automatically detect events, perform sentiment analysis, make predictions about the credibility of the information or provide real-time reports on the situation at hand. To meet the time-critical constraints of emergency management, our algorithms learn common patterns from social media data collected during similar past events, and, from thereon, build predictive models that can be applied in real-time when a new crisis hits.'

SUPER technology was built in close cooperation with stakeholders, whose requirements drove the development process. The consortium organised several stakeholder events to gather comments and feedback from various experts and professionals from civil protection and law enforcement agencies. They also carried out a number of validation exercises, using either simulations or real data.

'The stakeholders were very interested in the possibilities offered by the use of social media and the tools we offer,' says Danilo Antonelli, coordinator of the project for Vitrociset in Italy. 'Some of them already use social media in their work and are very eager to get more tools that can help them exploit this source of information. Their feedback has also been very useful in identifying many new

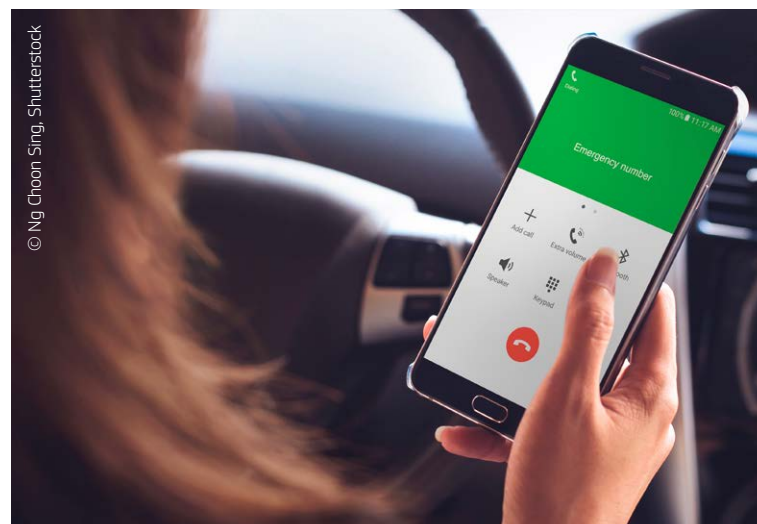
requirements, some of which are related to far reaching issues such as the need for enlarging the pool of information sources or updating regulations.'

Now that the project has been completed, project partners would like to explore further stakeholder suggestions with a view to enhancing the effectiveness of the SUPER framework. 'The final goal is to bring this innovation to market. But we still have some work to do to get there. We are currently considering possible options, such as experimental use and fine-tuning in an end-user organisation or through national plans for innovation,' Antonelli explains.

The SUPER project has managed to reach all of its objectives. Its solution takes on the challenge of social media's fast-paced evolution by providing value-added tools that can easily be updated and extended.

SUPER

- ★ Coordinated by Vitrociset in Italy.
- ★ Funded under FP7-SECURITY.
- ★ <http://cordis.europa.eu/project/rcn/185480>
- ★ Project website: <http://super-fp7.eu/>



© Ng Choon Sing, Shutterstock

MULTI-SENSOR SYSTEM PROTECTS HEALTH AND THE ENVIRONMENT

Workers and homeowners will be able to enjoy a more pleasant, healthier indoor environment thanks to the efforts of an EU-funded consortium. A novel sensor system will help to reduce exposure to hazardous 'Volatile organic compounds' (VOCs) whilst saving energy, thereby reducing emissions of greenhouse gases and pollutants.

Closed windows can reduce a building's energy consumption, but this may result in adverse health effects for those who live and work inside them. This is due to the build-up of chemicals from furniture, carpets, paints and cleaning agents. The solution lies in a cost-effective, intelligent ventilation system that automatically supplies fresh air to individual rooms as and when needed, which can be adapted to specific locations such as offices, schools, hospitals or private homes and even specific rooms.

This challenge was taken up by the project SENSINDOOR (Nanotechnology based intelligent multi-sensor system with selective pre-concentration for indoor air quality control). Project partners have successfully developed a nanotechnology-based microsystem for selective monitoring of hazardous VOCs to allow demand-controlled ventilation in indoor environments.

"The highly sensitive system can detect hazardous VOCs, primarily benzene, formaldehyde and naphthalene at 'parts per billion' (ppb) concentration levels in indoor air selectively against a complex background of other organic and inorganic gases."

'The highly sensitive system can detect hazardous VOCs, primarily benzene, formaldehyde and naphthalene at "parts per billion" (ppb) concentration levels in indoor air selectively against a complex background of other organic and inorganic gases,' says project coordinator Professor Andreas Schütze. 'This was achieved by novel technologies for gas-sensitive layers deposited by "Pulsed laser deposition" (PLD) on two microsensor platforms: metal oxide semiconductor and silicon carbide based gas-sensitive field effect transistors.'



These sensors were combined with selective pre-concentrators based on 'Metal-organic framework' (MOF) materials deposited on micro hotplates, which absorb the target gases. The integration of novel gas sensors and pre-concentrator in one microsystem achieves unprecedented levels of sensitivity and selectivity. If the concentration of one or more hazardous VOCs is above a specified limit, the ventilation system is automatically activated and fresh air is introduced to reduce the exposure, thereby ensuring good air quality.

'Scaling-up all the technologies involved, especially deposition of the gas-sensitive PLD layers and the calibration of the sensors, demonstrated the potential low-cost of the developed systems and thus their commercial viability. This will allow air quality sensors to be installed in each room for comprehensive control of ventilation processes,' Schütze explains.

Researchers have also worked together with other projects in the field of metrology. The purpose was to address the need for standardisation in VOC measurements and to establish reliable standards and benchmarks for comparison of different sensor solutions. These standards are essential for users who cannot check the claims made by manufacturers. They are also an improvement on

other sensors that are on the market that monitor indoor air quality with a sum parameter for VOCs only. The SENSINDOOR technology can distinguish between hazardous and benign VOCs.

According to Schütze: 'The technologies we have developed for selective measurement of gases in the ppb range will also have an impact in the fields of food safety and health, such as for the diagnosis of acute diseases and for cancer screening. They will also improve industrial safety as benzene is a major concern and its threshold limit values are currently being drastically reduced. In addition, these technologies have security applications for detecting explosives in public spaces such as train stations, airports and marketplaces.'

SENSINDOOR will therefore contribute to both the health and security of EU citizens as well as ensuring greater comfort in the home and workplace.

SENSINDOOR

- ★ Coordinated by Saarland University in Germany.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/project/rcn/110553>
- ★ Project website: <http://www.sensindoor.eu/>
- ★  <http://bit.ly/2nbh4XN>

REVEALING THE FUTURE FOR CONCEALED TECHNOLOGY

Contributing to what has been called the 'age of soft matter', the EU-funded SOFT-MAP project has blended techniques of mechanics, physics and electrical engineering to seamlessly embed high technology into everyday life.

Despite advances in electronics over the decades, even so-called 'smart' devices though much smaller and portable than their predecessors, offer far from a truly seamless integration into everyday life. One of the main barriers remains the relatively rigid design application of current digital devices.

The SOFT-MAP (Stretching soft matter performance: From conformable electronics and soft machines to renewable energy) project was set up to develop integrated and ubiquitous high technology applications which are, according to the project coordinator Prof. Siegfried Bauer, 'expected to become ever more indispensable for improving safety and quality of life, without impairing comfort.' In order to do so, SOFT-MAP explored options within the field of 'conformable electronics', by exploiting the stretching performance of soft matter (liquids, polymers, foams, gels, rubber, etc.).

Conformable electronics, soft robots and energy harvesting

SOFT-MAP's development of conformable electronics has resulted in a range of demonstration products. For example, the creation of imperceptible electronics in the form of a foil, 27 times thinner than paper, that can be stretched and even crumpled like a piece of paper, without damaging the circuits. Using a similar approach, the project also developed ultralight solar air stable perovskite cell arrays, which with their maximum power per weight, were able to circle model aeroplanes over the campus skies. Other significant developments included hydrogen bonded organic semiconductors, stretchable, rechargeable batteries and ultra large stroke soft actuators with a world record in area change.

As well as facilitating human interfaces with digital technology, SOFT-MAP's advances were also applied to robotics. Most robots accommodate power systems, sensors and controls in a 'hard' design, rendering them unable to achieve more delicate tasks. In contrast, the SOFT-MAP 'soft-robot' took its



inspiration from the study of natural mechanics which allows for structural instabilities such as buckling, snapping, wrinkling and crumpling.

The project also applied the same paradigm shift, to the field of renewable energy. As the professor summarises, 'We have shown that such "soft" systems efficiently convert mechanical into electrical energy, making them potentially interesting for harvesting mechanical energy from human gait, winds and ocean waves.' Experimenting with wave energy generators, natural rubber was found to be a soft matter material which could meaningfully contribute to renewable energy production sustainability.

Expanding the range of invisible digital devices, often literally

Professor Bauer points out that until relatively recently this research area was viewed as a somewhat exotic branch of materials science and that SOFT-MAP has been highly instrumental in overturning that view. As he puts it, 'Before the start of the SOFTMAP project such a vision was not much more than pie in the sky.' Now, he goes on to say the field has become 'a distinct and booming area, with niche projects already entering the market.'

Some of these project products have already undergone transfer to the market. For example, the spin-off company

isiQiry offers new solutions for human-machine interfaces through optical sensor technologies developed by the SOFT-MAP project. Additionally, the Austrian 'smart plastics' initiative which develops film-insert moulding technology enabling the seamless and cost-effective integration of electrical, opto-electrical or electromechanical features into 3D shaped plastic products, benefits directly from the project. SOFT-MAP also contributes to 'WetFeet', the European research project promoting the use of soft water wave energy generators.

Looking to the future of what he calls 'Concealed systems — virtually indistinguishable from our surrounding,' Professor Bauer talks about his aim to combine 'seemingly antagonistic materials together with tailored open-source lab-ware and modelling.' His ambitions extend to embedding (printed) transducer functionalities from plastics to wood and sheet steel as well as creating biodegradable circuit boards by low-cost, low-temperature, printing-compatible anodisation and expanding the technology to scalable 3D printing.

SOFT-MAP

- ★ Hosted by Johannes Kepler University Linz in Austria.
- ★ Funded under FP7-IDEAS-ERC.
- ★ <http://cordis.europa.eu/project/rcn/101306>

SECURITY

PROTECTING CORE UTILITIES AND SERVICES THROUGH TARGETED SURVEILLANCE

EU-funded researchers have developed new privacy-respecting surveillance technology to detect sabotage and terrorism threats against critical infrastructure.

EU-funded researchers have developed a cutting edge proactive surveillance system to protect major infrastructure such as power stations. Integrated elements of the system can communicate with each other and solve complex surveillances tasks collaboratively, ensuring that large areas can be monitored without infringing privacy.

'We developed this new technology through the P5 (Privacy Preserving Perimeter Protection Project) project in order to protect critical infrastructure in a more efficient and privacy-aware manner,' explains David Lindgren, project coordinator at the Swedish Defence Research Agency. 'We also hope that the new technology will create new business opportunities and employment in Europe. In the future for example, the P5 system could be expanded to include mobile sensors in the form of autonomous drones, in order to give staff great flexibility and the capability to survey large areas with high definition sensory data.'

Intelligent perimeter proactive surveillance systems, like the kind developed in the P5 project, are typically used by critical infrastructures such as power plants, server sites and telecommunication centres to protect against threats such as sabotage and terrorist attacks. They monitor the region outside the security area of critical buildings and infrastructures, and give an early warning if terrestrial or airborne threats are approaching.

By alerting staff to possible threats as early as possible, valuable time can be saved to put in place countermeasures such as the closure of facilities and alerting the police. In an attack on a nuclear power plant where radioactive contamination is a very real possibility for example, every second counts when shutting down operations and evacuating the area.

A key challenge however has been ensuring that these surveillance systems work effectively and efficiently over large areas 24 hours a day, whilst at the same time ensuring that only credible

threats are spotted and followed. For example false alarms can be triggered by wandering animals, whilst new surveillance technology is constrained by legislation concerning privacy.

'In order to address these challenges, we developed an autonomous and intelligent surveillance system by the principle of privacy-by-design, where design choices are based on ethical and legal considerations,' says Lindgren. 'Experts in ethics and law have been part of the project, and we have different filters in the system for removing sensitive information. If one needs to inspect data later, then permission must be sought from a prosecutor. The end results could lead to a much better balance between efficient surveillance and ensuring privacy in the future.'

The system works by detecting danger automatically with the help of algorithms, and then following potential saboteurs. It then analyses the situation and tries to find movement patterns that might indicate whether something criminal is underway. The P5 system was recently demonstrated at the Centre for Teaching and Research in Disaster Medicine and Traumatology in Linköping, Sweden.

Potential interested parties include industries with products and services within the security and surveillance segment, as well as operators of large scale infrastructure. The innovations will also likely appeal to government agencies with responsibilities for legislation and security as well as police forces around Europe.

P5

- ★ Coordinated by the Swedish Defence Research Agency in Sweden.
- ★ Funded under FP7-SECURITY.
- ★ <http://cordis.europa.eu/project/rcn/109306>
- ★ Project website: <https://www.foi.se/en/customer--partners/projects/p5.html>

HIGH-TECH VIDEO SURVEILLANCE TO COMBAT PETTY CRIME

Emerging technology that brings together video monitoring, cloud computing and high-speed internet promises to help fight petty crime.

Petty crime in Europe is on the rise, fuelled by economic difficulties, higher unemployment rates and illegal immigration. Pickpocketing, bag snatching, muggings and holdups have created insecure urban areas, prompting a need for more effective solutions to combat this phenomenon.

The EU-funded P-REACT (Petty criminality diminution through search and analysis in multi-source video capturing and archiving platform) project worked on developing new video capturing and archiving solutions to protect busy areas

and small businesses. It developed a cost-effective system that combines video cameras with the internet and cloud computing to advance situational awareness and incident classification.

To achieve its aims, the project team designed a visual analytics framework that can diagnose incidents at an early stage, using sophisticated offline multimodal visualisation technology that can make decision-making easier. The low-cost technology with local intelligence and real-time alert categorisation exploits a relatively new cloud-based service known as 'Video Surveillance as a Service' (VSaaS). It also employs semantic technologies to rapidly sift through video archive sources, enabling the P-REACT software to forecast, detect and prevent future petty crimes.

Importantly, the system considers all legal and ethical aspects, including privacy issues. It is scalable, modular and can be integrated with other networks or

systems with the overall aim of effectively pre-empting petty crime.

The solution has proven its success after several demonstrations and trial runs, leading to the development of a viable prototype. While further evaluation is needed before the technology is commercialised, the project partners and several related companies have expressed strong interest in taking it to market. If this happens, the promise of a safer urban environment that discourages crime could become a welcome reality for Europeans.

P-REACT

- ★ Coordinated by Vicomtech-IK4 in Spain.
- ★ Funded under FP7-SECURITY.
- ★ <http://cordis.europa.eu/project/rcn/185501>
- ★ Project website: <http://p-react.eu/>
- ★ <http://bit.ly/2meiNaR>

"The solution has proven its success after several demonstrations and trial runs, leading to the development of a viable prototype."

NEW APPROACHES TO COMBATING ILLEGAL GRAFFITI

A study has examined how to counteract the increase in graffiti vandalism by focusing on smart awareness and prevention solutions, all of which has been summarised on an innovative web-based platform.

Enormous amounts of money are spent on attacking graffiti vandalism. However, more effective approaches are called for in order to fight illegal graffiti, including community resources to help understand vandalism problems. An EU-funded project, GRAFFOLUTION (Awareness and prevention solutions against graffiti vandalism in public areas and transport), sought to decrease graffiti vandalism in public areas and transportation networks. The aim was to provide information on smart awareness and available prevention solutions for all affected groups. These include those who manage graffiti and those who use street art as part of urban regeneration.

A qualitative study was conducted in four partner countries (Germany, Spain, Austria and the United Kingdom). This was followed by surveys that addressed all European Member States in order to broaden the scope, gather additional insights and

validate the findings compiled. In-depth interviews were conducted with stakeholders from six fields: police and law enforcement, social and cultural projects, enterprises, transport organisations, graffiti writers and public administrations/authorities. The major findings of the research from the four countries included regional, legal, ethical and privacy aspects as well as graffiti vandalism monitoring, reporting and management tools.

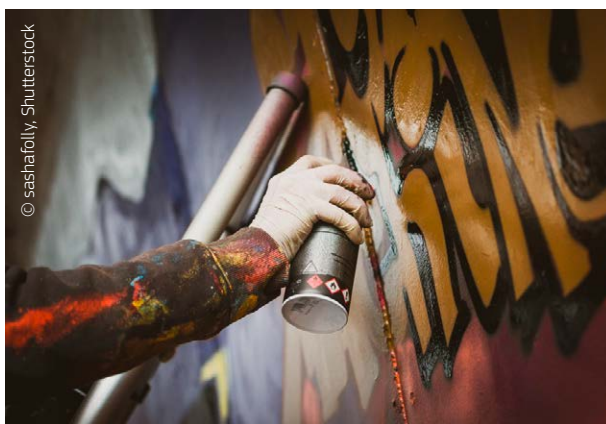
GRAFFOLUTION conducted research on graffiti vandalism in public areas and transport, and identified relevant stakeholders, roles and processes. It analysed initiatives, measures, technical methods and best practices in response to graffiti vandalism in Europe, and surveyed the requirements of all affected stakeholders.

Concepts and solutions were developed to combat illegal graffiti, and a web-based awareness and prevention framework was designed. Furthermore, it offered an Open Information Hub for social media technologies in a bid to increase awareness through the presentation of information and images.

Results were disseminated via the project website, GRAFFOLUTION platform, newsletters and factsheets, social networks, blogs, scientific publications, conferences and workshops. The information is proving useful for policymakers, transport operators and the general public.

GRAFFOLUTION

- ★ Coordinated by Synyo in Austria.
- ★ Funded under FP7-SECURITY.
- ★ <http://cordis.europa.eu/project/rcn/185512>
- ★ Project website: <http://project.graffolution.eu/>
- ★ <http://bit.ly/2mVeTap>



FUNDAMENTAL RESEARCH

NEW CHEMICAL SYNTHESIS METHODS

The structural motifs of synthetic drugs or pharmaceutical products are often restricted by the capacity of traditional synthetic methods. To overcome this issue and produce novel substances, European researchers have developed a new functionalisation methodology.

Small organic molecules work as catalysts in chemical reactions. Recent synthesis strategies have employed the synergistic activity of different catalysts to activate reaction components and facilitate the formation of new bonds. In many cases, this enables a transformation that would otherwise be impossible in the presence of a single catalyst.

Ideally, chemists would like to functionalise bonds between carbon and hydrogen to build up molecular complexity from simple and otherwise inert building blocks. Based on this concept, the EU-funded SYNCAT (Development of a synergistic catalysis protocol for the enantioselective functionalisation of aldehydes) project set out to investigate the development of a broadly applicable synthetic methodology enabling access to privileged structural motifs.

In this context, scientists combined photoredox catalysis and organocatalysis to develop a method for the direct arylation of allylic carbon-hydrogen bonds. The transformation tolerated the addition of a wide range of functional groups and

could be applied to complex substrates. To expand the applications of the carbon-hydrogen functionalisation reaction, they combined it with a transition metal catalyst. The palladium-mediated catalysis generated a variety of substrates that would normally be considered benign under traditional reaction conditions.

Overall, the use of photoredox catalysis to enable previously challenging transformations has exciting implications for the synthesis of a range of pharmaceutically relevant molecules. Furthermore, this new method should provide a broad base for developing novel transformations in the field of synthetic chemistry.

SYNCAT

- ★ Coordinated by the University of Cambridge in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/107263>

POSSIBLE NEW ANTIFERROELECTRIC COMPOUNDS FOR ENERGY STORAGE

A novel class of ternary intermetallic systems (general formula ABC) with predicted antiferroelectric properties has been recently discovered. EU scientists have begun their experimental investigation to understand their properties and to assess if they could overcome the limitations of the existing materials currently used in energy storage devices.

ABC compounds are a new class of materials that are believed to exhibit antiferroelectric properties which could be particularly useful for energy storage applications. Most of these materials have never been fabricated, as such there is currently very limited knowledge about their properties and their potential applications.

EU-funded scientists from the NAGCESA (Novel antiferroelectric glass-ceramics for energy storage applications) initiative made a start on the synthesis and characterisation of the ABC compounds to gain further knowledge on their behaviour.

The experimental investigation was mainly carried out on the MgSrSi system, an ABC compound considered to have a model structure for understanding other similar materials. Different synthesis methods for making MgSrSi were used, and the optimum

synthesis route based on mechanical alloying was established, with potential use in fabricating other ABC compounds. The research team also investigated the crystal structure, chemical bonds, vibrational properties and electronic bands structure of the MgSrSi compound using *ab initio* simulations.

In addition to the investigation on MgSrSi, NAGCESA studied other potentially antiferroelectric ceramics, including SrSnO₃, SrZrO₃, CaGeO₃ and MgGeO₃. It was found that these materials behave as linear dielectrics and are not suitable for energy storage. However, they have shown low dielectric permittivity and loss and they could eventually be suitable for microwave applications.

The main contributions of NAGCESA include the identification of a suitable synthesis route for the ABC compounds and an understanding of the effects of processing

conditions on the phases and microstructure of the oxide systems studied. The project also resulted in the establishment of a new stream of research on electro-ceramics at a European university.

NAGCESA

- ★ Coordinated by the Polytechnic University of Turin in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/187975>

"The experimental investigation was mainly carried out on the MgSrSi system, an ABC compound considered to have a model structure for understanding other similar materials."

GENE EXPRESSION DURING DEVELOPMENT: TIMING MATTERS



European researchers have investigated the temporal coordination of gene expression during development. Their results bring us a step closer to putting the pieces of the developmental puzzle together.

During development, cell specification and differentiation requires the spatial and temporal coordination of gene expression. This is facilitated through accurate interaction between intercellular signalling and gene regulatory networks. Several regulatory motifs driving gene expression have been identified at the cellular level, and we are beginning to understand how morphogens determine the spatial regulation of cells in a tissue. However, little is known about the timing and coordination of gene expression in populations of cells.

To address this, scientists from the EU-funded CELLCOORDINATION (Temporal coordination of gene expression during development) project set out to understand cell dynamics and coordination during differentiation and development over time. They employed 'embryonic stem' (ES) cells to study *in vitro* ES cell differentiation into 'mesendoderm' (ME)/'primitive streak' (PS)-like cells.

Live imaging of individual ES cells differentiated towards a PS-like fate *in vitro* revealed a remarkable resemblance between the behaviour of these cells and the PS in the embryo during gastrulation. Further molecular analysis showed that the motility of PS-like cells was associated with a transient expression of the transcription factor Brachyury and was driven by the Wnt/beta-Catenin signalling pathway.

Insight into the differentiation decision by ES cells in culture revealed an inherent bias towards an anterior neuroectoderm fate, while their ability to generate mesoderm increased with time. Quantitative analysis of the transcriptional dynamics underlying the two fates revealed a mutual repression circuit controlled by Fgf/MAPK signalling. This is speculated to balance the proportions of cells with specific fates.

In another part of the project, scientists studied the dynamics of division and differentiation of pancreatic progenitor cells. Results suggested that the timing during the cell cycle of endocrine differentiation initiation determined the progenitor division mode.

Overall, the project results offered unparalleled insight into the molecular events over time responsible for cell specification during development. Furthermore, the temporal nature of gene expression regulation emphasised the controlled yet delicate nature of development.

CELLCOORDINATION

- ★ Coordinated by the University of Cambridge in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/188082>

EVENTS

MAY
10

Brussels, BELGIUM

CONFERENCE

ECORoads FINAL CONFERENCE

The EU-funded ECORoads project will be holding its Final Conference in Brussels, Belgium, which takes place on 10 May 2017.

In the presence of DG MOVE and road research European stakeholders, the ECORoads (Effective and Coordinated Road Infrastructure Safety Operations) Final Conference will present the results of the tunnel testing sites as well as the final guidelines.

ECORoads aims to overcome the barrier established by a formal interpretation of the two Directives 2008/96/EC (on road infrastructure safety management) and 2004/54/EC (on tunnels), that in practice do not foresee the same Road Safety Audits/Inspections (RSA/RSI) being performed on open roads and in tunnels.

For further information, please visit:
<http://etsc.eu/10-may-2017-ecoroads-project-final-conference/>

MAY
17

Hamburg, GERMANY

CONFERENCE

JOULES FINAL CONFERENCE

Final Conference of the EU research project JOULES (Joint Operation for Ultra Low Emission Shipping) to take place in Hamburg, Germany, on 17 May 2017.

Reflecting the ambition of the project, the conference's theme will be: 'Towards zero emission shipping — Simulating and assessing energy grids for Europe's next generation of ships.'

Reducing harmful emissions from shipping is a technical challenge as well as an urgent political and societal issue. For the last four years, the research project JOULES has been developing assessment and simulation tools to analyse ships' energy grids, and applied them to a variety of ship designs and operation scenarios.

This final conference will present project results and discuss possible approaches for implementation.

For further information, please visit:
<http://www.joules-project.eu/>

MAY
25

Paris, FRANCE

WORKSHOP

3RD INTERNATIONAL 5G RAN DESIGN WORKSHOP

Five EU-funded projects are organising the third International 5G RAN design workshop that will take place during the IEEE International Conference on Communications (IEEE-ICC) that will take place in Paris, France, on 25 May 2017.

The workshop, which is jointly organised by the Horizon 2020 METIS-II, FANTASTIC-5G, MMMAGIC, 5G-CROSSHAUL and FLEX5GWARE projects, will build upon its successful predecessors by focusing on 5G RAN design. All of the five projects aim to take the 5G design one step further in its level of detail and find consensus on key design aspects, such as for instance how tightly novel air interface variants in 5G will be integrated with each other and with legacy technology, and to what extent functionality on different protocol stack layers can be harmonised for all bands, services and cell types.

The workshop will also provide the opportunity to share and discuss final results from the projects mentioned or other 5G research activities.

For further information, please visit:
<https://5g-ppp.eu/event/3rd-international-5g-ran-design-workshop-icc-2017-25-may-2017-paris/>

EVENTS

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

MAY

28 ▶ 31

Santorini, GREECE

CONFERENCE

ERES 2017 CONFERENCE

The EU-funded EREAN and EURARE projects will be organising and hosting the 2nd European Rare Earth Resources conference (ERES 2017) in Santorini, Greece, from 28 to 31 May 2017.

The conference will include both geological and metallurgical topics for production of Rare Earth Elements (REE) from primary and secondary REE resources. The conference will include both oral presentations and in-depth poster presentations (7 minute presentations in an auditorium). The official language of the conference will be English.

The ERES conference aspires to be a European and international forum for the academic, industrial and social stakeholders of the REE industry. Advances in all fields and aspects of REEs are welcome to be presented and discussed at the conference.

For further information, please visit:
<http://eres2017.eresconference.eu/>

→ Book your space in the next magazine!

As an FP7 project partner or coordinator you can request the writing of an article dedicated to your project, free of charge, simply by contacting our editorial team at editorial@cordis.europa.eu.

Should your project meet the criteria to be featured in one of the magazine's sections, our editors will contact you to get some background information and conduct an interview. The article will then be planned for release in the next magazine, enabling your project results to reach our large audience of over 25 000 subscribers in science and industry across Europe.

This service is offered to all completed or close-to-completed EU-funded projects. Priority will be given to those projects which have resulted in the development of a new technology with potential for commercialisation over the next few years, or in potentially game-changing research for a specific field of science. If you feel like your project is a match, please feel free to book your space now!



Free subscriptions, orders and downloads



The research*eu Magazines are free of charge.

To subscribe, please go to: <http://cordis.europa.eu/research-eu>

To order a single issue of a research*eu Results Magazine, please go to:
http://bookshop.europa.eu/research_eu



Publications Office

Find out more about our online services at
publications.europa.eu



Follow us on Facebook and Twitter:
facebook.com/EULawandPublications
twitter.com/CORDIS_EU

EN