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into crowd safety and security at transport hubs

New computational methods
to study special materials

SPECIAL FEATURE
**INCREASINGLY SMART,
INCREASINGLY SUSTAINABLE:
EUROPE'S CITIES GET
AN UPGRADE**

Editorial

The city gets a digital makeover and celebrating *that* amazing black hole discovery – welcome to this month's Research*eu magazine

The cities we live in are expanding. More and more people are flocking to them across the world to seek good jobs and a better quality of life for themselves and their families. Two centuries ago, only 3% of the world's population lived in cities. At the beginning of the 20th century, that had risen to 14%. Today, it's over half the world's population that now resides in a city. By 2050, the UN estimates that nearly three quarters of the world's people will be city dwellers. Already over three quarters of Europeans live in urban areas.

Cities have been crucial to human social development. Civilisations have risen and fallen based on the luck (or lack thereof) of their greatest cities. Cities generate wealth, improve living standards and offer jobs that simply are not available in the countryside. They provide the social lynchpin for societies, offering the density, social interaction and networks that allow culture and new ideas to flourish. Across all continents, urbanisation will be a key feature of humanity's story in the 21st century.

But of course, so many people living in one space creates unique challenges that must be overcome to guarantee the quality of life that so many city dwellers arrived for in the first place. Pollution, rubbish and the need for efficient (and clean) public transportation are just three of these challenges. And as drivers of innovation, cities will undoubtedly adapt, both in Europe and across the world.

Indeed, cities will have no choice but to adapt, especially as they will also be crucial actors in battling the world's growing climate crisis due to the fact that so much of humanity will soon be clustered within them.

So, in this issue of Research*eu magazine, we're showcasing EU-funded projects that are using the very best new technologies have to offer to find durable and clean solutions to making our cities that little bit more pleasant. Possibly, you, our reader, have already become aware of your own city's progress towards a smarter, more digital future. And even if your city hasn't begun the transformation yet, it most certainly will do soon – so keep an eye out!

Meanwhile, **Project of the Month** is celebrating the European contribution to a story that was arguably one of the most significant scientific discoveries of the century thus far – the first ever image of a real black hole. Two EU-funded projects were deeply involved in its discovery and we invite you to turn to the end of the magazine to get to know them a little better.

EU Agenda gives you the lowdown on some of the best conferences and events featuring EU-funded projects taking place before the summer slowdown begins and we all happily begin to dream about our upcoming summer holidays. And finally, our nine thematic sections are there just waiting for you to dive into them. What are you waiting for?

Until next month, if you have queries, questions, suggestions (but hopefully never a complaint), please feel free to drop us a line at editorial@cordis.europa.eu

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Pilot line for microfabricated medical devices – an opportunity for SMEs

Healthcare devices are undergoing a radical transformation from large expensive machines to small, minimally invasive diagnostic and therapeutic tools. The EU project InForMed has established an integrated pilot line for a wide range of innovative emerging medical devices.

Numerous small companies and start-ups have innovative ideas for the new wave of microfabricated medical devices. Without appropriate support for production and development, these innovations may never reach commercialisation.

The InForMed (An integrated pilot line for microfabricated medical devices) project has set up an integrated pilot line to cover the complete innovation chain from concept to qualification to ensure system requirements have been met. “Significantly the host for the pilot line is the large industrial end user Philips Electronics Nederland BV (the project coordinator),” states Ronald Dekker principal scientist of the initiative. The initial concept for InForMed was boosted by the successful cooperation on intelligent catheters in the earlier INCITE project.

PLUGGING THE GAPS IN THE PILOT LINE

To give an idea of the sheer scale of this project, there are 39 partners from 10 countries across Europe. This multidisciplinary mix from academia and manufacturing makes sure any gaps are filled in the intricate journey from concept to full-scale production.

“The resulting ecosystem provides a niche where new medical devices can be seeded and nurtured to grow into new business opportunities for Europe,” states Dekker. This major shift in emphasis from the gargantuan machines such as scanners to smart microfabrication of devices like imaging catheters with the ‘eyes and ears’ of these massive pieces of expensive equipment will ensure safer, faster and cheaper diagnosis and treatment.

DEMONSTRATORS SHOW THE POTENTIAL FOR TECHNOLOGICAL EVOLUTION

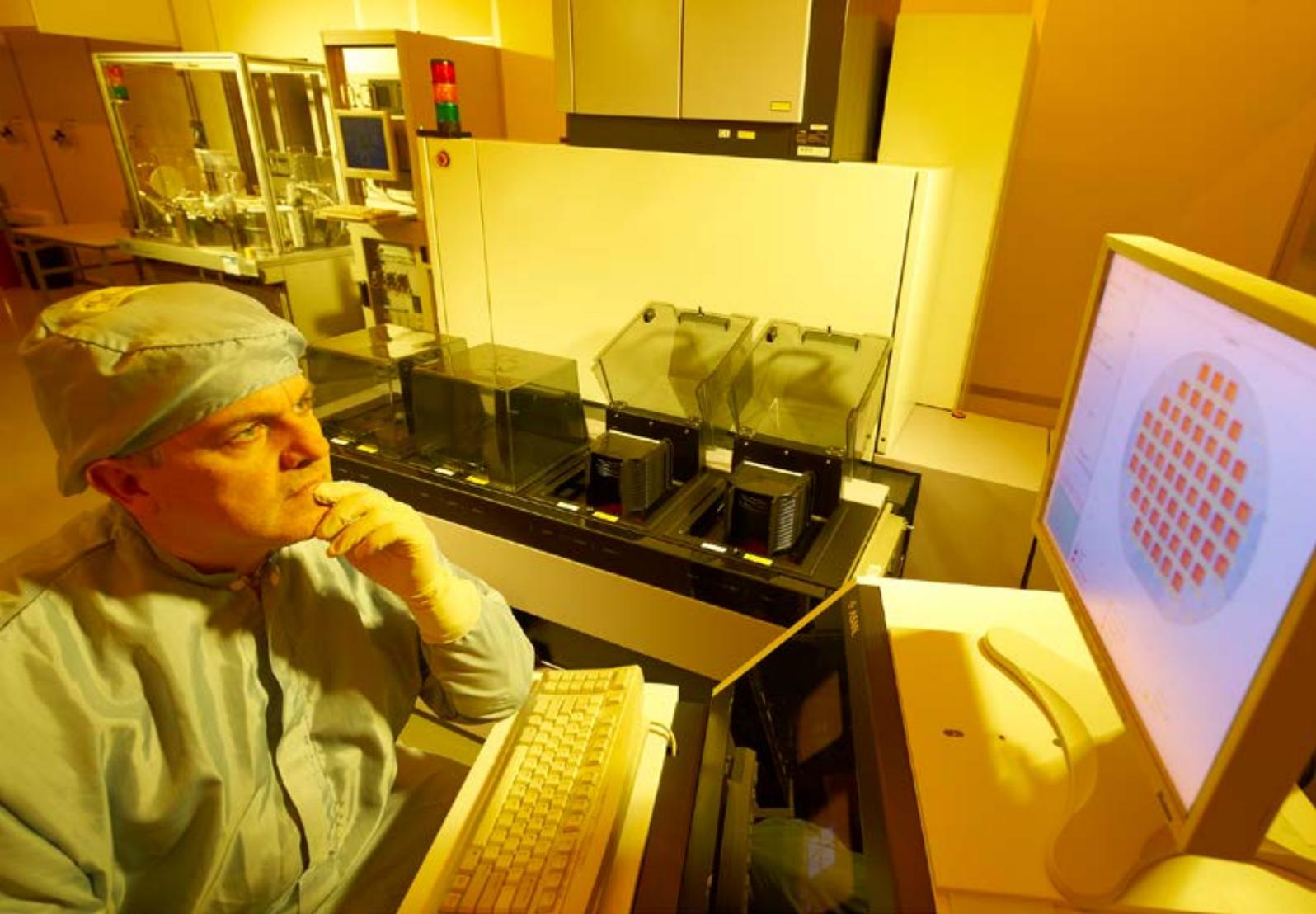
There are six demonstrator products that cover traditional, emerging and entirely new market segments. Irish and Dutch project partners have developed a smart dressing that detects infection through acidity, humidity and temperature measurements.

Many drugs affect the heart rhythm and can cause fatal arrhythmia. For the development of safe new drugs, InForMed has two new devices based on advanced electrophysiology. Partially replacing animal testing, they monitor the electrical activity of heart cells when subjected to new drugs. An organ-on-chip reproduces the physical *in vivo* environment and uses induced pluripotent human stem cells to mimic the human heart. The work in the project resulted in the start-up company BI/OND.

A revolutionary new catheter has been developed for precise ablations to treat atrial fibrillation. It measures the depth of ablation with ultrasound and tracks the location using an optical fibre with a new technology named FORS. FORS technology will practically eliminate the need for harmful X-rays during minimal invasive surgery.

MEDICAL DEVICE INNOVATION TO CATCH UP WITH OTHER SECTORS USING MICROELECTRONICS

“Compared to sectors such as mobile telephony or computing, the speed of innovation in medical devices is worryingly low,” says Dekker. By offering an ‘off-the-shelf’



experience for a microfabrication facility, InForMed compensates for high initial production overheads associated with biocompatible medical device innovation. “Success hinges on the complementary skills of project partners and their buy-in to the platform concept,” adds Dekker. “There has been much excellent medical device research in Europe, but little of it sees the marketplace. We want to change this,” he continues.

FUTURE RAPID INNOVATION FOR PILOT LINE PRODUCTION

InForMed ended in September 2018 but their work will be continued in the recently approved POSITION-II project. This will be jointly funded under the umbrella of the Electronic Components and Systems for European Leadership Joint Undertaking (ECSEL JU). The mission of the

recently established Health.E lighthouse under ECSEL is to accelerate innovation for medical devices.

“Rapid technological advances in the semiconductor industry have been realised for decades,” says Dekker. “We want something similar for medical devices using the new platform-based ecology that brings a continuous and growing stream of innovative medical devices to markets and patients in Europe and worldwide.”

INFORMED

- Coordinated by Philips Electronics Nederland B.V. in the Netherlands.
- Funded under H2020-LEIT-ICT.
- cordis.europa.eu/project/id/662155
- Project website: informed-project.eu

“ *There has been much excellent medical device research in Europe, but little of it sees the marketplace. We want to change this.* ”

A revolutionary technique for faster and more accurate regional anaesthesia

A new technique offers clinicians a regional anaesthesia tool offering increased control and faster, more predictable results. Patients will receive better, 'first time right' procedures, helping healthcare systems maximise efficiency and minimise the waste of expensive and limited resources.

When compared to general anaesthesia, regional anaesthesia – which numbs a larger area than local anaesthesia – could lead to better outcomes for patients, while also reducing costs. Despite this, largely due to a lack of adequate technology, only around one third of anaesthesiologists are thought to regularly perform these procedures. Currently doing so requires anaesthesiologists to rely on their anatomical knowledge, and/or ultrasound interpretation skills, to locate the optimum site for injection.

Philips B. Braun and Oslo University Hospital partnered for the EU-supported INTUI-VIEW (Intelligent needle tracking using ultrasound imaging for improved minimally invasive interventions) project which developed a needle tracking platform (Onvision) consisting of a portfolio of smart trackable needles, a point-of-care ultrasound system (Xperius) and a tracking module.

The collaboration resulted in a market launch of this completely new solution, with the potential to revolutionise the field of regional anaesthesia.

OVERCOMING ADOPTION BARRIERS

One of the principle barriers to clinicians transferring from general to regional anaesthesia, is its requirement for specific needle handling skills, with the use of ultrasound strongly advised. As many anaesthesia departments do not have the required skills or equipment to perform peripheral nerve blocks, INTUI-VIEW set out to design a product that offered these.

“We went through several design phases, each resulting in a prototype that was evaluated pre-clinically with clinicians for performance and ease of use. This learning became input for the next prototype, eventually leading to the final product specifications,” says Dr Henk Stapert.

The Xperius system is a point-of-care ultrasound imager that uses ultrasound transducers, connected to a tablet via a USB. The system is operated through a touch screen, with the image quality superior, or equal, to competitors. Xperius comes with a linear and a curved transducer to enable the support of shallow and deep peripheral nerve blocks. For mobility, the system is mounted onto a cart.

The Onvision tracking system (developed by Philips) consists of a small hardware module integrated into the cart, along with a proprietary smart needle (developed by B. Braun). The tracking system uses ultrasound beams, alongside proprietary signal processing algorithms, to locate the needle in the field of view. Crucially, even



though the imaging system is a 2D single plane image, Onvision can locate the needle outside of the ultrasound imaging plane, making it easier for users to align the needle with the ultrasound image.

The system underwent extensive in-house laboratory tests by Philips, to assess critical to quality parameters and other functional and non-functional requirements. The technology was also trialled in human volunteers and patients by Oslo University Hospital, receiving positive feedback, especially relating to the increased control over the location of the needle tip. "This feedback from clinicians who liked the system, finding it helped them provide better patient care, was the most rewarding," says Dr Stapert.

SMARTER PATIENT CARE

INTUI-VIEW will support easier access to safer and more patient-friendly anaesthesiology procedures, reducing hospital stays and associated healthcare costs. "Additionally, as this technology is new to the world, it underlines the power of European innovation, creating jobs ranging from marketing and sales, to service support and manufacturing," says Dr Stapert.

“Feedback from clinicians who liked the system, finding it helped them provide better patient care, was the most rewarding.”

As only one needle type is currently available (100 mm/20G), the team is working to release the entire needle portfolio (different lengths and gauge sizes). Additionally, the team is looking at other applications that could benefit from the Onvision technology, such as needles for vascular access.

INTUI-VIEW

- Coordinated by Philips Medical Systems Nederland BV in the Netherlands.
- Funded under H2020-Industrial Leadership and H2020-Societal Challenges.
- cordis.europa.eu/project/id/691262

HEALTH

Healthier lifestyles by tapping football fans' fervour

One project proves the adage that for many millions of fans, football is much more than a game, by delivering an evidence-based health programme across European clubs.

The EuroFIT (Social innovation to improve physical activity and sedentary behaviour through elite European football clubs: European Fans in Training) project harnessed the loyalty of football fans towards their clubs, to improve men's health. The EU-supported project used state-of-the-art behavioural science and social science to attract men to lifestyle change that would last a lifetime. Men worked together as a team to make improvements in their physical activity levels, diet, body mass index (BMI), well-being, vitality and health biomarkers.

The results demonstrated improved overall health in a hard-to-reach population from across the socio-economic spectrum.

EVIDENCE-BASED HEALTH PROGRAMME

EuroFIT was designed to support men in maintaining healthier changes for at least 12 months. The programme was delivered at club stadia to groups of 15-20 men over 12, weekly, 90-minute sessions that combined interactive learning of behaviour change techniques, with graded group-based physical activity.

"Club coaches were trained over two days to deliver programme content suitable for the way adults, particularly men, like to learn. Some elements, such as dietary tips, were



© University of Glasgow

adapted to country-specific norms,” says project coordinator Prof. Sally Wyke.

Participants chose from a range of tools, including setting and reviewing goals, action planning and self-monitoring, that emphasised the personally-relevant benefits of behaviour change. Physical training included the FIFA 11+ injury prevention programme. Dietary advice and skills were shared for losing weight.

Materials included manuals for coaches and participants. Personal technologies were also developed, with a device called SitFIT, by Pal Technologies, monitoring physical activity and sedentary time, and a game-based app called MatchFIT, offering social support.

The programme was tested by 1 113 participants across 15 clubs in the UK, the Netherlands, Portugal and Norway, in a randomised control trial. Both at the start of the trial and after 12 months, participants’ physical activity, sedentary time, diet, BMI, blood pressure, well-being and quality of life were assessed, with some also providing blood samples.

“EuroFIT significantly increased physical activity, and decreased body weight (BMI) as well as improved diet, well-being, self-esteem and vitality,” says Prof. Wyke. “The trial also found that the programme was cost-effective in the long term, when looking at risks of colorectal cancer, cardiovascular disease, depression, stroke and diabetes.”

However, the programme did not result in men being less sedentary, as measured by time spent sitting. “We need to emphasise that while increasing physical activity is important, so is sitting less by doing things like moving around for a while when watching TV,” says Prof. Wyke. Currently there are no clear, public guidelines for reducing sedentary time, nor is the association between high levels of sedentary time and health widely known.

MAXIMISING IMPACT

EuroFIT contributes to EU health policies. For example, it supports men in meeting the goals set out in the EU Physical Activity Guidelines and addresses key health challenges faced by men as identified in the European Commission Report on ‘The State of Men’s Health in Europe’.

After the main trial, six new clubs tested the implementation strategy. Based on their experiences, the team developed a European replication model. Updates are currently being made to the coach and participant manuals, ahead of a Europe-wide roll out in Spring 2019.

EuroFIT will be available to clubs over a 12-month period through an individual licence, or a group licence for a cohort of clubs, to deliver EuroFIT, as with the Portuguese Football Federation. The licence will be administered by the public health and sport NGO, European Healthy Stadia, and will be supported by UEFA, the European football governing body.

EUROFIT

- Coordinated by the University of Glasgow in the United Kingdom.
- Funded under FP7-HEALTH.
- cordis.europa.eu/project/id/602170
- Project website: eurofitfp7.eu/
- ▶ bit.ly/2JWqRgF

“EuroFIT significantly increased physical activity, and decreased body weight (BMI) as well as improved diet, well-being, self-esteem and vitality.”

Who better to include in children's literature studies than children themselves?

In literature research, the views and needs of children for the growth of better societies are seldom acknowledged. An EU project has developed a child-led research model based on connectivity, rooted in local communities and addressing global societal issues.

Utopian representations are often found in literature, including children's books. The readings and images found in these materials are crucial for transformation at both individual and societal levels. However, regarding young readers, theoretical discussions have mainly focused on the influence of utopian literature on them.

To counter this, the ChildAct16 (Shaping a Preferable Future: Children Reading, Thinking and Talking about Alternative Communities and Times) project has pioneered a new approach based on child-adult collaboration. It sought "a better understanding of how utopian literature shapes ideas for preferred futures, how these ideas evolve in readers' encounters with the materialities of the local environment and how they call readers into individual and collective action in these environments," explains MSCA fellow Dr Justyna Deszcz-Tryhubczak.

AN UNCOMMON YET TIMELY APPROACH

To achieve this, ChildAct16 proposed a relational approach to children's literature studies and the creation of democratic spaces for intergenerational collaboration with young readers around books and reading. Although not commonly applied in children's literature studies, Dr Deszcz-Tryhubczak stresses the importance of such research as it acknowledges children's impact on societies. Such a process facilitates collaborative reflection and action as well as joint thinking, and doing that is not only critical but also creative and caring.

CHILDREN AT THE RESEARCH HELM

The literature chosen for study was China Miéville's *Un Lun Dun*. This fantasy novel has a strong conservationist agenda concerning waste and air pollution. Dr Deszcz-Tryhubczak says that once the children received



their copies, she was no longer the only organising agent at work. “The children, the book itself, the school, the teachers, the parents and even the weather all affected the flow of the subsequent research process.”

The young readers actively contributed to all elements of the research process. They offered input on the research needs and participated in designing the study’s framework and methodology. The young research group was also involved in the development and administration of research tools, and then in an analysis of the findings.

BREAKING NEW GROUND IN CHILDREN’S LITERATURE SCHOLARSHIP

Joint child-adult dissemination of the results through conference presentations was a core element of the project’s approach. One of ChildAct16’s own undertakings in this regard was co-organising with the University of Cambridge the 2018 international conference on ‘Intergenerational Solidarity in Children’s Literature’.

Dr Deszcz-Tryhubczak has published one article in Children’s Literature in Education and co-authored another that “is unique and unprecedented in children’s literature studies.” The latter titled ‘Children’s voices in the Polish canon wars: Participatory research in action’ is the product of a collaboration with another researcher, a primary school teacher and five primary school/junior high school pupils.

Other dissemination activities include the presentation of results at the University of Antwerp’s Children’s Literature Summer School and a film adaptation of a fantasy novel for young readers. Project work has also been communicated via social media and in letters to authorities and environmental protection NGOs.

The publications “innovatively position the field of children’s literature studies as a site of cross-generational bonds, creating possibilities for a socially impactful inquiry into the culture of childhood.” Importantly, ChildAct16 outcomes could potentially impact policymaking concerning the literature curriculum and, in more general terms, democratic teaching methods. Dr Deszcz-Tryhubczak concludes: “The opening of academia to children’s questions and ideas concerning the research process constitutes further evidence of the validity of children’s literature scholarship practised against the dominating binaries of childhood and adulthood.”

CHILDACT16

- Coordinated by Anglia Ruskin University Higher Education Corporation in the United Kingdom.
 - Funded under H2020-MSCA-IF.
 - cordis.europa.eu/project/id/745888
 - Project website: cypic.wordpress.com/2018/08/03/child-act-shaping-a-preferable-future-childrens-reading-thinking-and-talking-about-alternative-communities-and-times
-  bit.ly/2UnhDOq

Following the European elections, we invite our readers to dive into one of our latest **CORDIS Results Packs** that focuses on 11 EU-funded projects that are contributing to a better understanding of the future direction of **elections and other forms of democratic participation**.

Since 2016, democratic politics has become increasingly polarised amidst a surge of protest and so-called ‘populist’ politics that have in a short space of time redefined the political space in many democratic countries and what it means to participate politically as a citizen.

Technology, especially the rise of social media, has also transformed the way in which we, as citizens, engage politically. Technological change has also seen the introduction in many countries over recent years of e-voting machines that have replaced the traditional pencil ballot, as well as the increasing popularity of ‘direct’ forms of democracy that could be facilitated through digital advances.

These themes and others are explored in depth by the projects featured in this Pack – browse, download or order it from our website at: cordis.europa.eu/article/id/401447



How ‘savage warfare’ characterised violence and control in Western imperialism

The legacy of Western imperialism came to the forefront following 9/11 and the ‘War on Terror’. In response, the EU-funded Savage Warfare (A Cultural History of British and American Colonial Campaigns 1885-1914) project has focused on the idea of savage warfare in a study that could reconfigure how historians debate Europe’s colonial past, as well as influence current popular interpretations of this crucial period of world history.

The concept of savage warfare as a distinct military doctrine emerged during the high-point of European colonial expansion between the Berlin Conference of 1885 and the outbreak of the First World War. This was a period when the rules governing conflicts between ‘civilised’ powers were being inscribed in international law, yet no such rules were formulated on how these powers should militarily engage with ‘un-civilised’ peoples. Instead, colonial military practice dictated the use of extreme violence

and force as ‘the only thing the natives understand’, a doctrine that lasted well into the 20th century.

AMERICAN AND BRITISH CASE STUDIES

When compared to other imperial powers, colonial military campaigns undertaken by the UK and the United States are usually considered to have been moderated by cultural knowledge and the rule of law. Further research indicates that this is not entirely true. “Even today, the ‘savage warfare’ tactics employed by British and American colonial authorities are being read and hailed as successful models for 21st century counterinsurgency campaigns,” explains Marie Skłodowska-Curie fellow Dr Kim Wagner. “One very infamous colonial-era military manual published in 1896 was even used by British and American troops in Iraq and Afghanistan following 9/11.”

Using British colonial rule in India and American rule of the Philippines as two key case studies, Dr Wagner has shown how ‘savage warfare’ spread and evolved between the different powers. “The Americans in the Philippines very deliberately and clearly drew inspiration from British colonial experience in fighting Muslim ‘fanatics’,” says Dr Wagner. “The use of pigs’ blood by American troops was inspired by rumours of British practice in Singapore, which itself was sustained following British experiences in the North West Frontier (now part of Pakistan).”



REINTERPRETING THE AMRITSAR MASSACRE

Dr Wagner points to one specific incident that will be marking its solemn centenary in 2019 – the April 1919 Amritsar massacre which saw British colonial troops open fire and kill hundreds of unarmed Indian civilians, an event recognised as kick-starting the Indian struggle for independence.

“It was a defining moment of the British Empire but remains poorly understood,” says Dr Wagner. “The massacre was not simply a response to the feeling of imperial decline after 1918 but rather as the final stage of a much longer process – by examining the structural continuities of the Amritsar Massacre, we can re-envision the way we think about colonial violence across imperial formations. Indeed, the research goes beyond simply vilifying the British as racist bigots, and it does not delegitimise the Indian rioters as crazed, bloodthirsty ‘mobs’, rather it provides an even-handed analysis.”

Whilst Dr Wagner’s work on Amritsar specifically aims to inform public debates during the centenary year, it is also part of a larger comparative examination of the British Empire’s post-First World War crisis, which saw unrest in India, Ireland and Egypt from 1916-1922. “As the centenaries of these events approach, it’s vital to understand the legacy of European colonialism. My research speaks directly to current political and public concerns regarding issues of modern warfare, and calls for reparations and official apologies for the crimes of empire,” he concludes.

SAVAGE WARFARE

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- Coordinated by Queen Mary University of London in the United Kingdom.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/658047
- Project website: qmul.ac.uk/history/people/academic-staff/profiles/wagnerkim.html#third

SOCIETY

Educational multimedia tools bringing teens closer to science and technology

It’s commonly observed that science education and scientific careers aren’t attractive enough for young people in most EU countries. An EU initiative has developed several educational materials to get high schoolers more engaged in science, technology, engineering and mathematics (STEM).

In Asia, STEM students account for up to 20% of the student population. In Europe, only 2% of students study subjects involving science or technology. The main reason for this STEM skills gap is the way science disciplines are traditionally taught at European schools. “Core STEM subjects are presented mostly through a theoretical approach and often as separate unrelated areas,” says coordinator Dr Przemek Duda from the EU-funded STEM4youth (Promotion of STEM education by key scientific challenges and their impact on our life and career perspectives)

project. “STEM education usually has no broader societal context on how these skills are applied in real life and future careers.”

GETTING STUDENTS TO THINK ABOUT SCIENCE AND TECHNOLOGY

To address the gap, STEM4youth produced a comprehensive, multidisciplinary series of courses for students

aged 12-19. The courses present more than 60 key STEM challenges and hot topics from six main STEM disciplines: mathematics, physics, astronomy, chemistry, engineering and medicine. A transversal module involving citizen science is also included. Through online games, educational toolkits, storytelling and experiments, the courses explain how core principles of each discipline shape our daily lives.

Project partners presented these challenges largely through their practical applications and impact on everyday life and work. They demonstrated which skills are developed in each discipline and how they fit labour market needs. "These educational materials will help young people to make conscious decisions about their interests, field of education and finally their career paths," notes Dr Duda.

ONE-STOP ONLINE SHOP FOR EDUCATIONAL MATERIALS

The STEM4youth team created an educational platform for content sharing and for student and teacher support. Teachers and students can download and upload all course materials, games and self-testing tools and interact with one another through the forum. Teachers can use the resources and other freely accessible content as sources for extracurricular lessons. Students are able to expand their knowledge, get a more holistic view of STEM and obtain more information about which career opportunities are available thanks to STEM education. An



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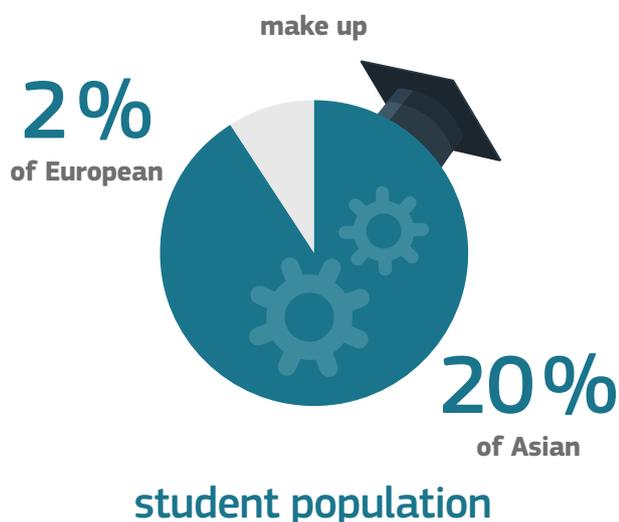
international student and teacher community built during the project complements the online repository.

Extensive feedback from teachers and students fed into a set of recommendations for policymakers and public authorities. They outline how to improve and adopt the best STEM educational methods in school systems locally, nationally and across Europe.

Lastly, STEM4youth organised a competition for secondary and high-school students. Participants set up 14 teams from across Europe and EU candidate countries to work on one of four interdisciplinary problems. Winners went on a scientific trip to the European Organisation for Nuclear Research (CERN) in mid-2018.

"Thanks to STEM4youth, teachers and students have got a consolidated source of information that will influence the way STEM is taught and learned," concludes Dr Duda. "We hope all these tools will encourage more young people to study STEM and pursue STEM-related careers in the science domain and industry."

Science and technology students



STEM4YOUTH

- Coordinated by Warsaw University of Technology in Poland.
- Funded under H2020-Science with and for Society.
- cordis.europa.eu/project/id/710577
- Project website: stem4youth.eu



Making sure shale gas doesn't fracture the society-energy relationship

With the effects of shale gas extraction uncertain within the EU, researchers assessed the possible environmental impact of this activity.

Europe has an abundance of shale formations of such potential that their extraction could become a practical necessity for the next 30-50 years. Yet, shale gas production faces many challenges, chief among which is the uncertain environmental footprint of this process.

The EU-funded ShaleXenvironment (Maximizing the EU shale gas potential by minimizing its environmental footprint) project was established to better understand the environmental impacts of shale gas extraction in Europe. "Securing abundant affordable and clean energy remains a critical scientific challenge," says project leader Professor Alberto Striolo.

Great care is needed to assess and pursue this energy resource in the safest possible way for the future of Europe whilst protecting its diverse natural environment. The team assessed the environmental footprints of this process by examining its impact on freshwater usage, seismicity and greenhouse gas emissions.

FINDING THE BEST DATA TO PROTECT THE ENVIRONMENT

Project work was set up to ensure safeguarding of the public, to encourage industrial best practices in shale gas extraction in Europe. The research team used experiments and models to learn about many fundamental properties around rock-fluid interactions, fluid transport and fractures initiation and propagation in rocks.

"The underlying rationale was that understanding is key to minimise the environmental footprint related to producing a unit amount of shale gas," notes Prof. Striolo. "If the community learned to extract more of the gas 'in place', with environmentally acceptable technologies, the environmental footprint would decrease."

The research team began by identifying the main unknowns, and they built upon collaborations with research groups in

North America and elsewhere. They delivered results that could grow the collective understanding of the processes that go into shale gas production.

TECHNOLOGICAL ADVANCEMENTS

Among other achievements, group members designed an instrument that allowed them to observe a fracture as it occurred in a rock sample. The researchers performed the experiment using a synchrotron and obtained results that can help the scientific community understand how fractures occur in different materials. The team also designed a fluid for fracturing that only contains environmentally friendly chemicals that are even edible, and that can work better than conventional hydraulic fracturing fluids.

The ShaleXenvironment team identified best practices to reduce water consumption while stimulating shale formations, which could increase public acceptance of the technology. They also discovered some important relationships between minerals found in shale and their mechanical properties. This result should help the community better understand, and maybe predict the mechanical properties of shale formations around the world.

Project partners developed instruments to simulate the conditions found in geological formations, and they discovered relationships between porosity and permeability.

"What is truly remarkable is that all these individual advancements have been obtained synergistically and collaboratively in understanding shale gas production," underlines Prof. Striolo. "We expect that, in due time, our contributions will promote progress toward several grand scientific challenges."

While hydraulic fracturing has remained controversial worldwide due to its contested environmental impacts, the team maintained an open channel of communication with



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other researchers and the public. Project researchers maintain that the public is the ultimate decision-maker with respect to what resources are to be exploited and how they should be exploited.

SHALEXENVIRONMENT

- Coordinated by University College London in the United Kingdom.
- Funded under H2020-ENERGY.
- cordis.europa.eu/project/id/640979
- Project website: shalexenvironment.org

ENERGY

The future of solar power with efficient and safe perovskite solar cells

One EU project's work is making more efficient perovskite formulations, used in solar power generation, more readily available to us all.

Perovskite (a crystal made of three components) solar cells could give the photovoltaics energy sector the boost it needs. The benefit of solar cells is that they can be made semi-transparent, while displaying a much higher kWh/nominal power ratio when compared to traditional silicon solar cells.

The EU-supported GOTSolar (New technological advances for the third generation of Solar cells) project developed new perovskite formulations which were stable and easy to prepare, while displaying very high photovoltaic efficiencies; a so-called 'triple cation' formulation, now standard in the field.

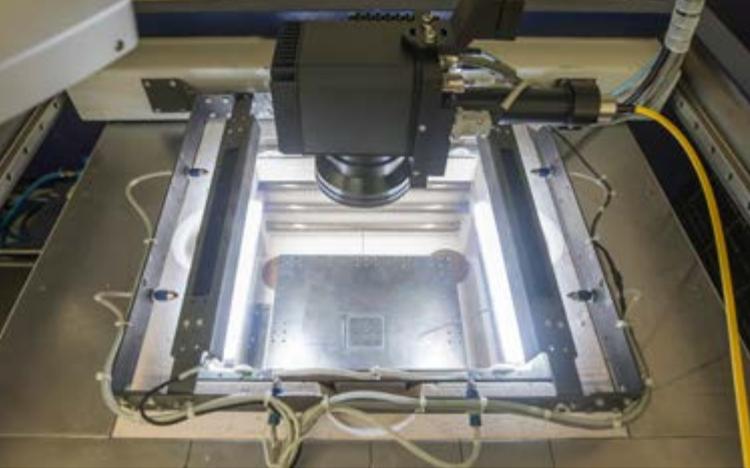
The project also created a laser-assisted glass-sealing encapsulation process, at a temperature of around 85 °C,

also a landmark. This invention allows encapsulation of very efficient perovskite solar cells without leaking lead, making it more stable and safer than alternatives.

NEW MATERIALS AND PROCESSES

GOTSolar used a metal oxide scaffold to hold the perovskite, with the mesostructure assisting in the crystallisation of the perovskite, to form a highly efficient light harvester system. The assemblage was completed with solid-state Hole Transport Materials (HTMs) and a counter-electrode.

"When you have a semiconductor that absorbs light, one electron of low energy is promoted to a higher energy level, leaving a 'hole' in the low energy level," explains project



© Prof Adélio Mendes

coordinator Prof. Adélio Mendes. “The excited electron can flow to either surface of the semiconductor but it can only cross the interface when there is an Electron Extraction Layer on the other side, in this case titanium dioxide. The ‘hole’ can flow to either surface but can only cross the interface with an HTM.”

The interactions of the electron extraction layer, the metal oxide scaffold, the perovskite absorber and the HTM layer were examined and measured to identify the circumstances in which electrons and the hole collection favourably optimise the whole device.

This work enabled the team to push the PV power conversion performance up to 23.25% efficiency for the lab-size instrument and to produce devices stable for 500 hours under 85°C. Lead-less light absorbers were also developed in lab-size cells which achieved a power conversion efficiency of 14%.

A 16 cm² glass encapsulated prototype was built to demonstrate the scalability of production for the first perovskite solar modules with an energy efficiency of 12.5% and a potential lifetime of 20 years. GOTSolar expects the first PSC panels to become commercially available by 2020.

DOING MORE WITH LESS

One key application of the technology will be for off-grid buildings. But for this to become viable the cost of ownership will have to be lower than for traditional houses. This is obviously easier to accomplish in southern, sunnier countries. “For northern and central European countries, new silicon-PSC tandem cells will be critical, as they are expected to display around 30% power conversion efficiency, producing more power from a smaller photovoltaic area,” says Prof. Mendes.

It is through GOTSolar’s contribution towards making these PV cells far cheaper via local production, that the project has made its greatest contribution.

The team continues to explore the fundamental properties of PSC, to develop new formulations and architectures, as well as new HTM materials and more electrically conductive and transparent glass substrates. It is also pursuing new manufacturing strategies while improving the glass-sealing encapsulation process, towards more efficient, cheaper, robust and aesthetic devices.

GOTSOLAR

- Coordinated by the University of Porto in Portugal.
- Funded under H2020-FET.
- cordis.europa.eu/project/id/687008
- Project website: gotsolar.eu
- ▶ bit.ly/2tD0Fg8

ENERGY

New solution for open-air Spent Nuclear Fuel dry storage

After time, a nuclear reactor’s fuel stops making energy efficiently and must be replaced. Managing Spent Nuclear Fuel, still highly radioactive and generating a lot of heat, has been difficult for nuclear power producing countries, but one project offers an answer.

During the enriched Uranium depletion process, fission reactions produce a series of unstable radioactive isotopes. Trapped inside fuel rods, these turn the fuel assembly into a highly radioactive heat source. Once the rods’ fissile

material is spent, they are removed from the reactor core and replaced. Nuclear power plants typically store Spent Nuclear Fuel (SNF) underwater in pools (wet storage) to cool them and protect against radiation leakage.

Saturation of SNF pools has necessitated the use of dry storage, with the rods air cooled and their storage casks used as protective shields. Nowadays, cask storage on an Independent Spent Fuel Storage Installation (ISFSI) is the preferred solution, pending permanent disposal. But these ISFSIs must comply with regulated dose limits, restricting the number of casks an ISFSI can store.

The EU-funded project ASM (Novel concept of cost-effective hybrid concrete/steel Auxiliary Shielding Module for enhancing the Radiological, Thermal and Structural behaviour of Spent Nuclear Fuel Dry Storage metallic casks) came up with a cost-effective solution, known as the Auxiliary Shielding Module (ASM), for interim dry SNF storage that optimises quantity by using enhanced dual-purpose (storage and transportation) metallic casks.

A NEW SOLUTION

The ASM consists of several stainless steel rings with two flanges (inferior and superior) and two ferrules (internal and external) filled with concrete, which surround the metallic cask holding the SNF. After the preliminary design was completed, the solution underwent a verification process, including radiological, structural and thermal analysis, to enable design improvements.

Radiological analysis optimised the shielding, including thickness and height, while taking into account ISFSI weight restrictions.

Structural analysis assessed the likely influence of accidents based on known incidents and found that the ASM behaved successfully as an additional layer of protection against impacts, overturns or seism lifting.

Thermal analysis checked the maximum safe temperatures, alongside the design of a ventilation system consisting of six intakes in the lowest ring, allowing air flux in the gap between the metallic cask and the ASM.

“The ASM not only improves the metallic cask’s radiological behaviour but also provides superior thermal and structural performance, avoiding the long construction and permissions phases of alternatives such as covered ISFSI and at 32 % of the cost,” says project coordinator Mr Jokin Rico.

Designed to be light, the ASM along with the metallic cask remains under 100 metric tons (MT), while achieving the dose reduction of concrete casks. Its thickness can be adapted according to dose requirements. It can also be installed using the same crane as for cask manipulation, making additional facilities unnecessary.

A FAST-GROWING PROBLEM

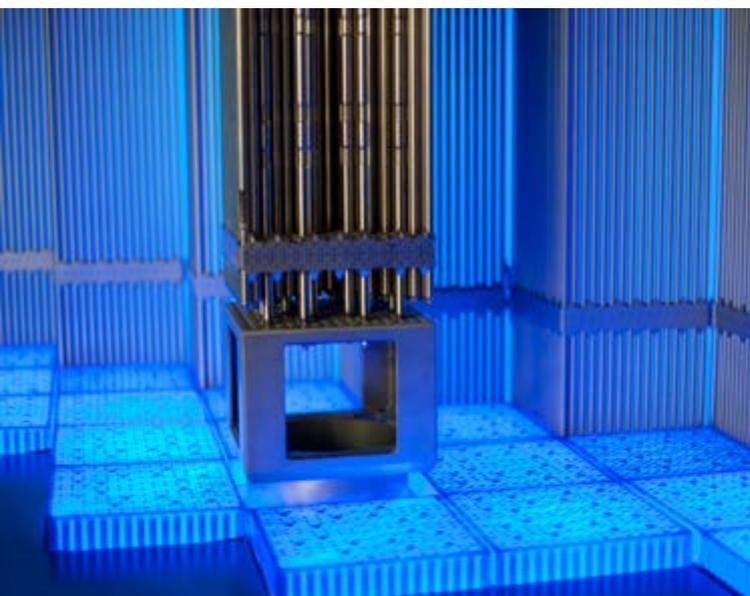
Currently out of the 370 000 MT of SNF globally, two thirds (around 250 000 MT) remain in spent fuel pools. With SNF generation calculated to increase from 10 000 MT/year to 15 000 by 2030, space will have to be created by moving older SNF into dry storage, requiring over 25 000 casks, with an estimate indicating that 70 % of the projected 560 000 MT of spent fuel will require dry storage by 2030.

“ASM addresses the concerns of SNF stakeholders about the lack of a cost-effective way to store waste fuel that meets compulsory dose levels, while enabling a large number of containers in pre-existing ISFSIs,” says Mr Rico.

The next phase will see the construction of an ASM prototype that demonstrates the manufacturing and installation process, as well as the assembly’s performance. Additionally, work is ongoing to achieve certification for the solution, now benefiting from ASM’s most recent fuel and cask data.

ASM

- Coordinated by INGENICID in Spain.
- Funded under H2020-Societal Challenges, H2020-Industrial Leadership and H2020-SME.
- cordis.europa.eu/project/id/827407





Analysing complex socio-economic interactions to improve our ability to tackle climate change

IMPRESSIONS offers decision-makers effective solutions to address climate change by identifying innovations and transformations which realise synergies between adaptation and mitigation.

The consequences of climate change are rendered even more complex and challenging to predict when coupled with rapid and uncertain socio-economic changes, such as population growth, technological advances and shifting international cooperation.

Taking this complexity into account, the EU-supported IMPRESSIONS (Impacts and risks from higher-end scenarios: Strategies for innovative solutions) project applied a cross-sector approach to identify effective pathways for climate action, efficacious across a range of multi-scale case studies.

Analysis of these pathways showed that beyond the 2°C (above pre-industrial levels) threshold, conventional solutions may prove insufficient. Rather, transformative solutions which adopt radically different institutional arrangements, leveraging synergies between adaptation and mitigation efforts and linked to sustainable development, become paramount.

ADAPTATION, MITIGATION AND TRANSFORMATION PATHWAYS

The participatory approach of IMPRESSIONS involved in-depth interviews, workshops and online engagement



with decision-makers, to reveal what tools and knowledge they needed.

Stakeholders were then asked to co-create a vision of a sustainable future for each of five case studies – selected to represent different scales, sectors and regions of Europe – for the year 2100. The vision described aspirations for governance, energy, social equity, living and lifestyles, the environment and other factors essential to human well-being.

Stakeholders also co-created pathways of actions for achieving the vision (regarding people, nature, markets or technology). The robustness of the pathways was explored using four scenarios reflecting potential future socio-economic development. These involved: a commitment to sustainability; conflict for resources; increased inequality; and fossil-fuelled development. These scenarios of changes to socio-economic drivers (demographic, technological or political) were paired with climate scenarios based on the Intergovernmental Panel on Climate Change Representative Concentration Pathways (RCPs).

IMPRESSIONS applied a multi-scale modelling framework, developed by the team, to analyse the complex interactions, synergies and trade-offs between different sectors such as agriculture, forestry, biodiversity, urban development, health and tourism as they compete for resources under the impaired climate and socio-economic scenarios.

The resultant simulations of the likely cross-sector impacts indicated whether the system was becoming more or less sustainable under each scenario.

Further modelling and qualitative analyses then evaluated how effective the chosen pathways would be at meeting sustainability goals under different scenarios. “This resulted in a set of three pathways for climate action common to all case studies: sustainable lifestyles through education and awareness-raising; good governance for sustainability and climate resilience that is participatory and transparent; and integrated and sustainable resource management that ensures both resource security and environmental protection,” says project coordinator Prof. Paula Harrison.

“ Our research demonstrated that all impacts are more severe under higher levels of climate change. As adaptation pathways alone cannot avoid them, mitigation – alongside early action – is also essential. ”

MAKING DECISIONS WHEN SCIENTIFIC INFORMATION IS UNCERTAIN

A key finding of IMPRESSIONS was that benefits in some regions and sectors are offset by detrimental effects in others. For example, increases in agricultural and forest productivity in northern Europe are offset by severe water scarcity and loss of productivity in southern Europe and parts of central and eastern Europe.

“Our research demonstrated that all impacts are more severe under higher levels of climate change. As adaptation pathways alone cannot avoid them, mitigation – alongside early action – is also essential,” says Prof. Harrison.

IMPRESSIONS will inform decision making and policy development in key areas such as the EU Adaptation Strategy, Water Framework Directive, Biodiversity 2020 and the Floods Directive as well as for meeting international commitments such as the Paris Agreement and the Sustainable Development Goals.

The approach and results are presented in the High-End Solutions Information Hub.

IMPRESSIONS

- Coordinated by the Natural Environment Research Council in the United Kingdom.
- Funded under FP7-ENVIRONMENT.
- cordis.europa.eu/project/id/603416

Microbial fuel cells help clean up waste water

EU-funded researchers have improved the design of microbial fuel cells (MFCs) to create a reliable and cost-efficient system for decontaminating waste water in remote areas.

Clean water is vital for human life, but this crucial resource is threatened around the world by pollution from the residential, industrial and commercial sectors. Fortunately, society is moving towards a circular economy, where water recycling plays a major role, replacing the traditional 'take-make-consume and dispose' model of growth.

Currently, the world's population is growing by about 80 million people each year, which means demand for freshwater is increasing by 64 billion cubic metres a year. There is therefore an urgent need to reuse water, exacerbated by the threat of water scarcity that has encouraged the development of water treatment systems to meet ever-growing demand.

The Horizon 2020 MEMBio (Application of Microbial Fuel Cells for waste water treatment) project addressed this challenge by developing an efficient, versatile and environmentally friendly process for the industrial synthesis of biocompatible ceramic scaffold membranes for treating waste water. "Our system will reduce energy demand and thus the generation of sludge, with minimum maintenance," says Dr Jonas Gurauskis, project coordinator and founder of AENEAM Advanced Membrane Technologies.

IMPROVED TECHNOLOGY AND POLICIES

MEMBio membranes are MFC devices, featuring a design that improves upon standard MFCs, which use respiring microbes to convert organic substrate directly into electrical energy. "Our cells are not focused on electrical production, they are aimed at the consumption of contaminants by microbial species within the cell's anode," explains Dr Gurauskis.

Researchers conducted full operational tests to validate the system ahead of full commercialisation and used market analysis to develop a technical roadmap.



"We identified three different types of clients to target and initiated targeted pilot studies," notes Dr Gurauskis. "We will evaluate the performance of three different prototypes in real environments and this will lead to re-engineering/re-design of our membranes and bring us closer to market readiness."

Apart from the technical roadmap, other key results include a redefined intellectual property (IP) policy, which was achieved with the help of an EU mentor. Dr Gurauskis comments: "We are extremely happy with the guidance we have received. Being a small company, it is difficult to devote resources to classical IP management based on patenting everything. After some brainstorming we decided to go for a 'freedom to operate strategy'."

FULL TECHNICAL SUPPORT

The project will publish MEMBio's findings and designs in open source journals, following the principle 'as open as possible and closed as necessary'. "This approach will

Demand for

freshwater

is increasing by 64 billion m³
a year



simplify the patenting process and will ensure that any other company will not patent anything similar to our membranes,” notes Dr Gurauskis.

MEMBio offers companies in the agro-industrial sector not only the water treatment system but also

maintenance and consultancy services. The cells will be deployed in remote agricultural or industrial sites with waste water streams that require water treatment before disposal/reuse. “It is important to stress that the cells require very little maintenance. This makes them the perfect choice in third-world locations where standard waste water treatment technologies fail due to lack of trained personal or options to keep them running,” Dr Gurauskis points out.

MEMBIO

- Coordinated by AENEAM Advanced Membrane Technologies SRL in Spain.
- Funded under H2020-Societal Challenges, H2020-SME and H2020-Industrial Leadership.
- cordis.europa.eu/project/id/816085
- Project website: aeneam.com/ABOUT-NEAM

CLIMATE CHANGE AND ENVIRONMENT

Simulation model aims to facilitate climate change projections

The impact of iron atmospheric deposition on the ocean's ecosystem is a highly complex phenomenon. ODEON has contributed knowledge about chemical changes in the gas and aqueous phase of the atmosphere to EC-Earth, a global model which accurately represents the iron-cycle.

Iron deposits from dust and combustion aerosols are essential for marine primary productivity, the synthesis of organic compounds from atmospheric or aqueous carbon dioxide (CO₂). This enables the ocean – largely through phytoplankton growth – to play a significant role in carbon (i.e. CO₂) sequestration from the atmosphere mitigating anthropogenically-accelerated climate change.

Yet, iron is relatively rare in the open ocean. While geoengineering experiments to enrich specific regions with iron have resulted in increased phytoplankton growth, uncertainty remains about the wider impact of atmospheric nutrient depositions on marine functioning.

MODEL BUILDING BLOCKS

To explore the effect of air quality on iron atmospheric processing and marine primary productivity, the EU-supported ODEON (Online DEposition over OceanNs: Modeling the effect of air pollution on ocean bio-geochemistry in an Earth System Model) project conducted simulations for preindustrial (1846-1855), present day (2001-2010) and end of the century (2091-2100) time periods.

“We developed novel simulation tools for gas and aqueous phase chemistry, along with an ocean biochemistry model to propagate the effects of atmospheric chemistry on iron

“We developed novel simulation tools for gas and aqueous phase chemistry, along with an ocean biochemistry model to propagate the effects of atmospheric chemistry on iron deposition onto marine biota.”

deposition onto marine biota,” explains project coordinator, Prof. Maarten Krol.

These tools were then coupled to the base code of EC-Earth, a European community Earth System Model (ESM) together with numerous scripts (written in python) for model evaluations.

By integrating current knowledge about the Earth’s physical, chemical and biological processes in the atmosphere, oceans, biosphere and land, EC-Earth’s state-of-the-art tools attempt to simulate all the aspects relevant for the functioning of the Earth’s system. The goal of this collective effort is to help with seasonal to decadal prediction and climate change projections.

“Long coupled model simulations are extremely interesting scientifically but computationally very demanding. Using a combination of techniques, such as time-slice simulations, we managed to perform our analysis successfully,” Prof. Krol says.

ODEON’s long simulation for the present day shows a total global production in the world’s oceans of 45 petagram of

carbon per year (45 Pg-C/yr). The corresponding net carbon uptake by the ocean amounts to 2.2 Pg-C/yr, roughly 20-25% of current anthropogenic carbon emissions. These numbers agreed with estimates from the observations and predictions of other models.

However, the ODEON model calculated stronger regional changes in carbon flux compared to other studies. This they attribute in part to the human influence on iron-mobilisation, for example through the combustion aerosols emitted from biomass burning and fossil fuels. “Deposition of iron doesn’t always mean that it is bio-available,” Prof. Krol says.

INSIGHTS INTO ATMOSPHERE-OCEAN INTERACTIONS

ODEON’s results also shed light on the links between atmosphere and eutrophication (overabundance of nutrients) leading to increased plant growth and often undesirable ecosystem changes. Examples include the economic effects of algal blooms on commercial fisheries and tourism. Indeed eutrophication has been cited by the GESAMP as one of the most damaging effects that humans have on the oceans.

In addition to communicating results across the scientific community, including the EC-Earth consortium, ODEON targeted initiatives such as the TM5-Fast Scenario Screening Tool for potential air-quality impacts and PISCES which is looking at marine primary production. With the results available as open-access, the reliable Earth system information will be of use to policy makers.

Increasing the accuracy of the ESMs’ climate projections requires more complex and detailed evaluations of the ocean ecosystem. “The next goal is to extend this research to other limiting nutrients for the ocean, bringing EC-Earth to the forefront of international carbon-cycle studies,” says Prof. Krol.

ODEON

- Coordinated by the University of Utrecht in the Netherlands.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/705652
- Project website: uu.nl/en/research/institute-for-marine-and-atmospheric-research-imau



INCREASINGLY SMART, INCREASINGLY SUSTAINABLE: EUROPE'S CITIES GET AN UPGRADE

Editorial

Welcome to the Smart City: Population – you (sooner or later)

It's predicted that by 2050, 70% of the world's population will live in urban areas, up from 55% in 2018, largely driven by societal shifts in Asia and Africa. In Europe, 50% of Europeans already lived in urban areas as far back as 1950. According to Eurostat, this rose to over three quarters of Europeans living in urban areas as of 2018.

Cities have been a defining motor of human social development since the beginning of recorded history. From the first cities that arose in ancient Sumeria and the Indus Valley, through to Rome, Constantinople and Tenochtitlan, to today's vast megacities (Tokyo, 38 million people, and Jakarta, 30 million people, to give just two examples), cities have been central to humanity's story. They act as incubators for technological innovations, social and economic progress and new, and sometimes radical, forms of cultural expression.

Even if Europe's share of the overall world population is declining, urbanisation as a general trend is still alive and kicking. And with more and more people living on top of each other, working next to each other, and enjoying themselves together in the same urban spaces, problems and challenges will undoubtedly arise. Pollution, rubbish, road congestion, creaky public transport, and poor urban planning and administration are just some of the major gripes that blight city dwellers the world over. Crucially, these problems must also be addressed within the context of the growing worldwide concern over climate change.

Technology promises to address many of these pressing challenges, especially advances in apps, Big Data, cloud computing and the Internet of Things. Indeed, it's becoming increasingly clear that cities need to become not only sustainable but also 'smart'. Importantly, these two ambitions can complement and reinforce each other, providing a better quality of life and allowing city dwellers to play an active role in the decisions that impact their lives.

Thus, in this issue of Research*eu magazine, our special feature highlights seven EU-funded projects that have made important steps into turning the notion of a 'digital city' from concept into reality, taking into account smarter and more efficient mobility, waste management, air quality and citizen engagement. One of the key trends from these projects is the sheer number of European cities where their ideas and solutions were tried, implemented and, in some cases, retained by the impressed city authorities. Your editor counts at least 15 cities from across the continent that took part in these projects and even some in countries beyond Europe's shores, such as Japan – highlighting that Europe can and is playing a key role in designing, implementing and guiding the development of what will be the cities of tomorrow.

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

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A much-needed boost for sustainable mobility in EU cities

Citizen-centred tools help address urban challenges worldwide

The digital age is transforming how city authorities design for and respond to people's needs. An EU initiative facilitated this transformation by combining the benefits of central governance and flexibility to incorporate the interests of city stakeholders.

The EU-funded OrganiCity (Co-creating smart cities of the future) project sought to design technologies and services to make cities more inclusive and explore how smart cities can grow organically by involving a wide range of stakeholders. These include citizens, communities, policymakers, researchers, developers, entrepreneurs and city services. "OrganiCity brings software, hardware and associated human processes together into a new living city that is replicable, scalable, as well as socially, environmentally and economically sustainable," says project leader and coordinator Dr Martin Brynskov.

BRIDGING THE GAP BETWEEN KEY ACTORS IN URBAN DIGITAL TRANSFORMATION

The underlying premise of OrganiCity was that the growth of the digital city must involve everyone in it. To explore how citizens, businesses and city authorities can work together to create digital solutions to urban challenges, the project combined top-down planning and operations with flexible bottom-up initiatives where citizen involvement was key.

Project partners created a service framework for collaborative city-making based on the Experimentation-as-a-Service (EaaS) model. The framework is built on four service pillars: systematic experimentation; co-creation; federated ethics and privacy; and management of liability and intellectual property rights. It's underpinned by five values: experimentation, iteration, co-creation, transparency and inclusivity. "We believe our cities should be built around these values too, so we encourage our experimenters and participants to embody these themselves," explains Dr Brynskov.

BUILDING A STRONG FOUNDATION FOR FUTURE SUSTAINABLE CITIES

In addition to the framework, the developed EaaS platform provides a set of novel tools to facilitate collaborative innovation for the cities of the future. The platform is uniquely positioned



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“OrganiCity brings software, hardware and associated human processes together into a new living city.”

Communities, SynchroniCity, Next Generation Internet of Things and the Urban Technology Alliance are building on OrganiCity experience and values. Promoted at key international events like the Connected Smart Cities Conference and IoT Week, elements of OrganiCity are being taken further by many communities, both locally and globally.

to combine benefits of central governance and flexibility to incorporate the specific interests of city stakeholders. It can be launched in and adopted for use by any city. Currently, 14 cities have used the EaaS technical platform.

Project partners conducted 43 experiments in European cities and Colombia. They tested and validated how the OrganiCity approach can help address urban challenges.

The project finished in mid-2018, but it continues to shape the digital transformation of cities around the world. The OrganiCity brand is now with Open & Agile Smart Cities, a global network that connects over 100 cities to create a global smart city market based on the needs of cities and communities. Multi-helix actions such as the European IoT Large Scale Pilot for Smart Cities &

“By offering OrganiCity tools, especially the OrganiCity Playbook, to stakeholders like citizens and businesses, cities will effectively empower them to be active in the development of solutions to tackle their local issues,” concludes Dr Brynskov. “This relationship between a city authority and active citizens enables us to build the future of the city together, with citizens at its core.”

ORGANICITY

- Coordinated by Aarhus University in Denmark.
- Funded under H2020-LEIT-ICT.
- cordis.europa.eu/project/id/645198
- Project website: organicity.eu
- ▶ bit.ly/308XZ9d

Analytics technology for your waste containers

Finnish SME Enevo is taking over the European market with a technology able to reduce the cost and environmental impact of waste collection, providing a highly welcome solution that could go a long way towards keeping our cities cleaner and healthier.

No matter what type of business you are in, chances are that someone in your company or organisation is struggling with a waste management conundrum. For that person, reducing waste costs whilst ensuring optimal recycling rates is, and will continue to be, a growing problem. And that’s not even considering the grander scheme of things, with cities obstructed by hordes of waste collection trucks sent to pick up waste in often half-empty containers.

This is the context in which a company like Enevo was set to thrive. In 2016, the Finnish company was granted funding under Horizon 2020’s SME Instrument phase 2, to prepare the ground for expansion of its services across Europe after it successfully took over the US market.

The reason for all this enthusiasm? A new technology able to analyse waste in containers and optimise



Mr Mika Uusitalo
Project coordinator of SmartWASTE
© Mika Uusitalo

“ Enevo can collect the same amount of waste or recyclables with a smaller truck capacity. ”

collection time accordingly. Project coordinator Mika Uusitalo explains further.

What kind of services does your company propose exactly?

Mika Uusitalo: We have two offerings. The first is waste analytics: we offer technology to customers in the waste and recycling industry, which helps them monitor and analyse waste streams and optimise collection operations. This, in turn, lowers costs and improves the recycling rate and quality of service.

The second offering consists in a fully-blown waste service. We offer waste management as a full service, still using the aforementioned technology.

How can this technology help reduce waste cost whilst at the same time benefitting the environment?

A substantial part of waste collection costs is related to transport. Enevo can help by enabling companies to collect the same amount of waste or recyclables with a smaller truck capacity. It means less driving time spent to collect the same amount of waste, which ends up reducing cost, emissions, noise and traffic jams caused by the trucks.

Enevo also provides customers with an overview of waste accumulation across different streams in real time. This helps with the evaluation and implementation of new recycling activities that can increase recycling rates.

Can you provide a few concrete examples of clients who had the chance to witness these benefits?

For example, the city of Espoo in Finland started using Enevo's waste analytics offering and was able to move away from static scheduling of waste collections to a dynamic model where waste gets collected only when needed. Their waste management costs went down and they were able also to handle waste collection internally with fewer resources.

Another example is the McDonalds group which contracted with Enevo for its restaurants in Nottingham, UK. They handed over the management of their waste operations to Enevo and this helped decrease their costs by 12% as well as increase their recycling rates by 50%.

What's your market reach so far?

We are operating mainly in Europe and the United States, but we've also had small entries into the Japanese and Australian markets. Our biggest market is the US, and our primary goal is to keep growing both there and in Europe.

Why did you decide to seek EU funding?

We saw that there is a great complementarity between what Enevo is doing and the objectives of the Horizon 2020 programme. This is also true for many other EU initiatives such as the circular economy package.

What were the main challenges you faced in further establishing your company on the European market, and how did you overcome them?

European countries are very different from each other. When our offering was almost ready for one market, it was still not working in another for various reasons including technical, cultural and commercial aspects of the industry. So, we learned how to adapt to each market and we shifted our market entry model to a more local approach with the help of regional reseller partners.

Another big challenge was to learn how to work with public sector customers. Such customers can be very slow to adapt to new technology and change their way of operating. Usually it also takes a long public tendering process before a full commercial solution can be procured from any vendor. We knew this, but the process was even slower than we had imagined so we had to revise our market penetration plans accordingly.

What are the main outcomes of the SmartWASTE project so far?

We have learned so much on so many new markets in the EU, and we could obtain valuable feedback to develop our offering and address the needs of each of these markets. We have also sealed several valuable partnerships with local resellers during the SmartWASTE (Smart logistics for WASTE and recycling operations in European cities) project.



What are your follow-up plans?

We will pursue our commercialisation plans for our technology in Europe as well as develop new ways to work with customers, in both the private and public sectors, to deliver the benefits of the solution in an optimal way in each market.

SMARTWASTE

- Coordinated by Enevo in Finland.
- Funded under H2020-TRANSPORT, H2020-LEIT-ICT and H2020-SME.
- cordis.europa.eu/project/id/724613
- Project website: enevo.com/smartwaste
- ▶ bit.ly/2WrK63C

Innovative app enables next-generation parking management

The EU-funded FastPrk-2 project is a smart mobility solution that lets cities better manage traffic flow and helps drivers find free parking spaces more efficiently.

Every day, our roads are packed with vehicles taking millions of commuters in and out and all around cities. With 70% of the global population predicted to live in urban areas by 2050, road congestion will only increase, thus creating new challenges to both mobility and sustainability.

The key to managing the megacities of tomorrow is smart technology, such as the next generation parking management system developed by the EU-funded FastPrk-2 (Enhanced On-Street Parking Management System) project. “The FastPrk-2 smart mobility solution not only enables cities and parking operators to manage parking spaces in real time, it also improves the citizens’ quality of life by helping drivers efficiently locate free parking spaces,” says project coordinator Francisco Hernandez.

BENEFITING CITIES AND CITIZENS

The FastPrk-2 system uses small parking sensors installed in each parking spot, which guide drivers via electric panels. Once a car is parked, the sensor wirelessly relays this information to the gateway. Utilising the system’s mobility software platform, city managers obtain real-time analytics about parking occupancy per area and by the time of day. This information can then be used to, for example, predict parking occupancy, foresee availability and make planning more efficient.

The system also integrates a list of innovative transport services to facilitate operational intelligence. For instance, by predicting traffic flow, FastPrk-2 can recommend alternative routes that take into account traffic and available public transport options.

By automating such functions as parking reservations and online payments, FastPrk-2 also benefits citizens through its smart parking app. “Using reliable real-time traffic and parking information, the free FastPrk app notifies drivers of open spots,” says Hernandez. “It even remembers where you parked!”

According to Hernandez, the app has reduced the time drivers spend searching for an available parking spot by 35 to 60%, or from 15 minutes to between just five and seven minutes. “Needless to say, this reduces the frustration drivers experience when trying to find a free space, not to mention the savings in time and fuel,” he adds.

REAL-WORLD TESTS WITH PARTNERS ACROSS THE GLOBE

The FastPrk-2 technology has been validated through an ambitious pilot campaign carried out in Spain, France, Belgium, Poland and Austria and involving stakeholders and key players from the smart parking industry.



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FastPrk-2 is also part of the world's largest parking project, which is currently happening in Los Angeles, United States. Together with Parking Sense, a global leader in parking management, FastPrk-2 partner Worldensing is deploying 20 000 outdoor parking sensors in the proximity of LA

Metro stations. The combined solution enables drivers to see real-time availability of spots for car-sharing and electric vehicles, as well as those requiring special permits like spaces for disabled drivers.

“Had I not seen it with my own eyes in LA, I would not have believed how good the FastPrk-2 product works,” says Parking Sense Vice President of Operations Larry Eade. “With 97-98 % accuracy and hitting sensors from the gateway over 300 metres away, the FastPrk-2 solution has left us all very impressed.”

FASTPRK-2

- Coordinated by Worldensing in Spain.
- Funded under H2020-TRANSPORT, H2020-LEIT-ICT and H2020-SME.
- cordis.europa.eu/project/id/726607
- Project website: fastprk2.eu
- ▶ bit.ly/2vHQ78

How Big Data is enabling distributed intelligence for smarter cities

The BigClouT project is helping smart cities improve efficiency and quality of life by leveraging the power of big data.

As the global population shifts towards urban areas, ICT solutions have the potential to change the way we live, work and play. Technologies like the internet of things (IoT), Big Data and cloud computing are particularly well-positioned as key enablers for increasing the efficiency of using shared urban infrastructures and natural resources.

Jointly funded by the EU and Japan, the BigClouT (Big data meeting Cloud and IoT for empowering the citizen cloud in smart cities) project is working to leverage these enabling technologies to give cities ‘an analytical mind’. To do this, project researchers are developing distributed intelligence that can be seamlessly embedded within a city’s network.

“The project aims to provide cities with the analytic capability needed to exploit the Big Data coming from IoT

devices, open data sources, social networks and mobile applications,” explains project coordinator Levent Gürgen. “The goal is to improve the efficiency of cities and the lives of their citizens.”

FROM BIG DATA TO SMART APPLICATIONS

The core of the project is an interoperable platform that accesses a vast set of heterogeneous data sources. Based on a modular architecture, the BigClouT platform is comprised of three levels. The first level collects and unifies data from a large variety of data sources (IoT devices, legacy platforms, web pages, mobile apps, etc.). The data is then redistributed to the second level, where it is processed for online and offline data analysis and visualisation. In the final layer, citizen-centric applications can be easily built with the provided service composition tools.



Distributed intelligence
for smarter cities

© BigClouT

For the end user, all services will be available via a range of attractive, smart city applications. For example, on the sustainability front, the platform’s monitoring and prediction capabilities alert users when they consume more energy than normal and provide best practices for saving energy – and money.

Trying to figure out the most efficient way to get to work? BigClouT helps with that too. Analysing all public transportation schedules, traffic conditions, car sharing availability and carpool seats, the app provides users with the quickest and greenest option.

To help cities better maintain infrastructure, BigClouT empowers users to report problems. For example, if you spot a pothole while driving, you can take a photo of it via the application. The app automatically geotags the pothole and sends this information to the relevant city department.

AN INTERNATIONAL SUCCESS STORY

A work in progress, the project is finalising the testing of its distributed intelligence platform in: Bristol,

“The project aims to provide cities with the analytic capability needed to exploit the big data coming from IoT devices, open data sources, social networks and mobile applications.”

England; Grenoble, France; and Tsukuba and Fujisawa, Japan. “International coordination on a highly-technical project like this can be quite challenging,” says Gürgen. “But thanks to the tight collaboration and trust between the project partners – a relationship built from our work together on prior initiatives – the BigClouT project has been a resounding success.”

Following the final review, researchers will focus on preparing the BigClouT platform for commercialisation through a new start-up enterprise. The project’s results will be further promoted via the Urban Technology Alliance (UTA), an association founded by the partners of several EU-Japan and EU-Korea smart city projects, including BigClouT. “Through this unique initiative, we will be able to continue deploying a range of smart city solutions and share best practices around the world,” adds Gürgen.

BIGCLOUT

- Coordinated by the French Alternative Energies and Atomic Energy Commission in France.
- Funded under H2020-LEIT-ICT.
- cordis.europa.eu/project/id/723139
- Project website: bigclout.eu
- ▶ bit.ly/2Y3wMSN

Living Labs engage citizens in urban air quality improvements

The EU-funded iSCAPE project is not only in line with the EU’s objective to improve air quality in its cities: it makes use of participative democracy principles to inform better policies and technology deployments.

The past 50 years have seen European cities adopt new pollution control policies, air quality-related regulations

and remediation technologies to conform to ever more stringent standards. But even though these are welcomed



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improvements, the 800 000 premature deaths caused by pollution every year – in the EU alone – act as a constant reminder of the need to do more.

For members of the EU-funded iSCAPE (Improving the Smart Control of Air Pollution in Europe) consortium, this need doesn't only concern public authorities. It should involve all citizens, to help inform better policies and make the most of available technologies. By leveraging passive control systems and behavioural changes, the project launched in September 2016 hoped to help achieve air pollution-free cities.

A TALE OF SIX CITIES

Six cities have been selected for the project's research: Bologna, Bottrop, Dublin, Guildford, Hasselt and Vantaa. In each of these cities, the team led by Dr Francesco Pilla from University College Dublin (UCD) started by conducting a thorough and neutral assessment of existing and future challenges and opportunities for each city with respect to air quality and climate change.

“Once the possible solutions were identified, we initiated a dialogue with the citizens and relevant stakeholders of each test city through Living Labs.”

“Once the possible solutions were identified, we initiated a dialogue with the citizens and relevant stakeholders of each test city through Living Labs, to assess non-technical challenges to the implementation of relevant passive control systems and behavioural interventions,” Dr Pilla explains. “Those activities are then integrated thanks to the use of sensing technologies and the development of two quality monitoring kits.”

The first, high-end monitoring kit assesses the effectiveness of the implemented solutions, which can consist of low boundary walls, trees and hedge-rows, green walls and roofs, photocatalytic coatings, urban design or road geometry. The second one, however, is perhaps the main singularity of the project: a low-cost monitoring kit to involve and educate citizens, and ultimately build a community around the global challenge of air pollution.

“As such, iSCAPE focuses on research activities. We ran air quality and meteorological simulations at various scales to pre-empt the effects and improve the impact of our solutions, as well as extensive monitoring to assess the effectiveness of these solutions. This evaluation was then complemented by simulations having a direct impact on population behaviour. These include bottom-up feedback for policymakers, which links anthropogenic urban activities to environmental models. The idea is to provide new insights into how traffic policy measures need to be designed to improve environmental quality,” says Dr Pilla.

EACH CITY A UNIQUE CASE

Each of the cities running an iSCAPE Living Lab was treated differently, based on the results of the assessment phase. The project consortium identified the most pressing issues for each one and prioritised actions accordingly. For example, the priority in Bologna and Dublin was to create a 'living lab mindset' among relevant stakeholders. In Bottrop, the team focused on understanding the role of 'sensors and citizens', while in Guildford, Hasselt and Vantaa, the focus was on 'communicating the project' and on establishing more collaborative relationships with stakeholders, respectively.

In each city, the project team provided a bespoke practical guide for citizen engagement, while promoting a

sense of ownership of the Living Lab to ensure that the interventions would outlive the project.

All in all, iSCAPE successfully provided: scientifically-validated results and evidence-based data for stakeholders; guidelines and policy recommendations; advanced sensing technologies; new ideas and promising concepts; and increased collective awareness of air pollution and its impact on city life.

ISCAPE

- Coordinated by University College Dublin in Ireland.
- Funded under H2020-ENVIRONMENT.
- cordis.europa.eu/project/id/689954
- Project website: iscapeproject.eu
- ▶ bit.ly/2H8vKj6

Big Data enables better urban transport networks

Improving public transport can be a very difficult task. But what if cities could tap into Big Data's unlimited potential to make better decisions? Thanks to SIADÉ SaaS, they can now discover passenger mobility patterns and uncover the strengths and weaknesses of current or planned urban transport networks.



The SIADÉ SaaS (Spatial Decision Support System for Transportation Planning) project essentially marks a change in the positioning of Spanish SME Terrain Technologies. From a consultancy service built around an algorithm to infer passengers' destinations, the company requested support from Horizon 2020 to become a software supplier.

Now, cities across Europe can benefit from a solution enriching Big Data with a spatial component, enabling complex analysis of travellers' behaviour to improve public transport networks.

María J. Arguelles, project coordinator, tells us more about the company's solutions and accomplishments so far.

How can Big Data help provide a better public transport experience in Europe?

María J. Arguelles: Smartcard ticketing systems currently available in many cities' public transport systems enable a vast amount of data. These datasets reflect how people



Ms María J. Arguelles
Project coordinator of SIADE SaaS
© María J. Arguelles

“*We can infer up to 88% of passengers’ destinations with an accuracy of 96%.*”

behave, which in turn means it is possible to assess their transport needs and provide an accurate picture of their habits, either as groups (based on fare types, such as student, elderly, etc.) or at an individual level. Thanks to Big Data analytics, we can adapt public transport to these needs, plan new services, minimise walking time, etc.

What have been the shortcomings of attempts to use this data so far, and how does your software stand out in this regard?

It is important to clarify that Big Data brings great complexity to transport because of something inherent to it: what is commonly defined as the ‘5 Vs’ (volume, velocity, veracity, variety and value).

For example, a large amount of data volume implies large storage capacity. We can’t forget that cities like Madrid, for example, generate almost 500 million trips per year, and around 1.2 billion for the whole of the greater Madrid area which is almost as many as in Istanbul.

The variety dimension involves datasets generated from different sources such as bus validators or mobile phones, while veracity highlights the importance of quality data and the level of trust. To complicate the picture even more, the fact that transport records are related to geographical locations means that we are dealing with data with a spatial component, or Spatial Big Data.

To overcome those difficulties, SIADE SaaS has been designed as a core-GIS development, merging the spatial nature of data with advanced data analytics methodologies.

How exactly do you make up for the absence of information on passengers’ destinations?

That’s one of SIADE’s core algorithms. We can infer up to 88% of passengers’ destinations with an accuracy of 96%. These results confirm that we are very strong in building origin destination matrices based on transport data, and are much faster, less expensive and more complete than those generated by using a traditional methodology in public transport: interviews. It is important

to note that our matrices are based on millions of records, while interviews are based on a small percentage of the whole population.

What have you been able to achieve thanks to EU funding so far? What do you still need to achieve before the end of the project?

The project was based on the understanding that we needed to change the business model and turn it into SaaS (Software as a Service). But this is a costly process, so without EU funding we wouldn’t have achieved that goal so fast. The project also involves several transport consultancy companies, transport operators and/or transport agencies across Europe, which have been paramount in testing SIADE versions. Besides that, we are lucky to be supported by a group of coaches provided by the EU that guide our decisions in the market strategy.

We have already finished two of the three phases of the project, including the full analytics module and the simulator. The simulator can predict with an accuracy of 93% the changes in passengers’ flow after altering or deleting any of the elements in a transport network, such as bus stop, lines, transfer policy, frequencies, etc. We are currently in the Big Data phase, solving all the problems related to the 5 Vs. Parts of the algorithms have been successfully refined to adapt to the new framework.

Can you provide a few examples of challenges from specific clients that have been overcome thanks to your technology?

Sure. For example, we have successfully shown that bus transport in Oradea (Romania) wasn’t covering the whole city centre efficiently. In Gijón (Spain), we found, thanks to the simulator, that changes in route 14 would increase the commercial speed, but at a price: people living in one of the neighbourhoods affected by the new route design would stop being bus customers, while most of them would use another route (18) instead of using transfers. In Modena (Italy), the data model has been improved and changed to exploit SIADE’s capabilities much better. Our suggestions to create a circle route in Gijón have also been implemented in the city’s new Mobility Plan.

Can you tell us more about your market reach at this point?

We are currently collaborating with several transport consultancy companies to explore together tender opportunities in Spain, Latin America and Eastern Europe. The fact

that we have a successful project funded by the EU is an extraordinary competitive advantage.

What are your follow-up plans, once the project is completed?

We are succeeding in creating a platform that fits our customers' and partners' needs 100%, so we expect to continue evolving in other markets outside of Europe and Latin America, such as the United States and Canada.

SIADE SAAS

- Coordinated by Terrain Technologies in Spain.
- Funded under H2020-TRANSPORT, H2020-LEIT-ICT and H2020-SME.
- cordis.europa.eu/project/id/778764
- Project website: siade.eu

A much-needed boost for sustainable mobility in EU cities

A large awareness raising, dissemination, training and cross-learning programme has enabled cities from 13 EU countries and regions to make up for lost time in Sustainable Urban Mobility Plans (SUMP). All of these countries are now working on – or already have – a dedicated national programme.

We – regular citizens and public administrations alike – all want the same thing for our cities: less pollution, less congestion and smarter mobility solutions. But whilst meeting these requirements all comes down to effective SUMPs, these plans have yet to materialise in most European cities.

The Prosperity (Prosperity through innovation and promotion of Sustainable Urban Mobility Plans) project aimed to tackle this problem by establishing national SUMP 'task forces'. Over three years, these platforms became the place to discuss cities' needs and requirements, and more specifically the planning and implementation of national SUMP support programmes tailored to these needs in each participating city.

"The idea was to bring about a cultural shift in transport planning at all levels of government," says Robert Pressl, coordinator of the project on behalf of Austrian Mobility Research FGM-AMOR. "But we particularly focused on developing new national government activities to stimulate sustainable urban mobility planning. Besides, we

brought together cities and national-level agencies in each country to build a mutual understanding of SUMP and build capacity, thanks to national-level exchanges of experience and training events."

The project covered a total of 13 countries whose take-up of SUMP concepts was non-existent or needed to be further developed, and successfully helped them in preparing a relevant national programme. The team also carried out a comprehensive set of training sessions for city representatives, with a particular focus on city and site managers, people in charge of budgeting, technical personnel and politicians. In total, over 300 city representatives could benefit from these training sessions.

UTILISING A PEER-TO-PEER APPROACH

To ensure success, the project consortium used a peer-to-peer approach: they identified 'champion' SUMP cities and selected their development leaders to become trainers in other, less advanced cities. "This ensures that the information and content, contained in the training and awareness raising material, are based on the experience of real cities and these messages resonate most with other cities because they provide real evidence," Pressl points out. For those who didn't have a chance to attend these training sessions, the project provided training material and also created 'innovation briefs' describing innovative

“The idea was to bring about a cultural shift in transport planning at all levels of government.”



approaches and ideas in sustainable urban mobility planning and implementation.

Since the project was launched in 2016, partner cities have been used as test beds and role models. The project purposely picked very different cities in terms of size and population to test various ideas.

In Lisbon, for instance, stakeholders are now developing a digital platform to detail measures and objectives, as well as monitoring and evaluation methods. In Fagaras, urban mobility measures were selected to converge with needs and objectives in the area of urban development and energy efficiency, by harmonising the SUMP with land use plans and the energy efficiency strategy. In high density residential neighbourhoods, for instance, the city introduced on-street paid parking.

KEEPING SUMPS ALIVE

Presl is hopeful that the availability of national and regional SUMP supporting programmes will uplift SUMP to a higher policy level in participating countries. The consortium is getting ready to maintain SUMP task forces beyond the duration of the project, whilst all national SUMP networks are still in

operation and have gained significant visibility within their own countries. The Slovenian SUMP network, for instance, currently has 210 active members including national institutions, regional agencies, municipalities, NGOs, public transport operators, the news media, and transport experts.

PROSPERITY

- Coordinated by Austrian Mobility Research FGM-AMOR in Austria.
- Funded under H2020-SOCIETY.
- cordis.europa.eu/project/id/690636
- Project website: sump-network.eu



You are what you eat – healthier livestock through postbiotics

Once a farm vet would reach for the antibiotics at the first sign of infection, but in these days of rising antibiotic resistance, improving the health of livestock through other means is a hot area of research. One EU-supported project has been focusing on the microbiome and its role in strengthening immune systems.

The improvements to the fodder made by Pentabiol, the company behind the HEALTHSTOCK (Fodder for healthier animals and improved livestock production) project, take the form of a postbiotic found in fermented feed. This, when incorporated into animal feed, collaborates with the animal's own microbiota so that it regenerates naturally. In doing so, it increases the animal's digestive capacity, with two substantial advantages: firstly, the animal is able to take more advantage of the nutrients it consumes and this, in turn, makes the animals healthier and more resistant to infections. In a time of increasing antibiotic resistance, this is important.

"Our product, under the trademark PROBISAN, is a transformation of microorganism cultures through a controlled fermentation process which aims to collaborate with the animal's own microbiota. It adheres to the intestinal mucosa, preventing exogenous entry and allowing the microbiota itself to regenerate naturally. This enhances the animal's digestive capacity and stimulates its immune defences," explains Mr Goyo Sanzol, director general of Pentabiol.



The facts speak for themselves: PROBISAN is able to significantly improve the digestive capacity of animals, especially when their digestive system is in formation. This leads to better protection from digestive disorders and can achieve conversion improvements of up to 14%. For piglets, chicks, lactating calves: these improvements mainly occur when the animal is young, as verified in trials carried out in different universities and livestock farms.

By collaborating with each of the microbiota, the team managed to adapt their product to the needs not only of each animal species, but specifically of each animal: "In this way we get closer and closer to a customised health treatment, which is the trend with human health," says Sanzol. In doing so, the animals will be more resistant to infections.

"We have changed the mechanics of treatment. Previously the vet saw a problem and reached for an antibiotic as an immediate solution, but that is now an old approach. The medication, or the element that replaces it, is necessary when there is an infection, but our goal is to avoid infections in the first place. If they do occur, the animal's own immunology is the first level of resistance."

Pentabiol is a relatively young company which has been researching and designing postbiotics for five years. They create products derived from the transformation of microorganism cultures, through controlled fermentation processes. By doing so they obtain by-products in the form of metabolites with specific chemical characteristics that adapt to animal microbiota. The company has been manufacturing since the end of 2015 and now has customers in several countries.

They started with a product that was initially able to help the animal's digestive track improve the absorption of nutrients to encourage production rates. Through HEALTHSTOCK the company has developed a feed that is able to improve animal health in the intestinal dysbiosis

as a whole. Now the team is also working on specific intestinal conditions such as *E. coli Brachyspira* and so on. They are already researching applications for respiratory problems such as paratuberculosis. And it isn't just mammals. "We have tested a specific postbiotic for aquaculture of salmonids against lactococcosis."

The project is also a shining example of transversal research as they are now in the final stages of testing for an application concerning aspects of glycaemia in human health.

"Our goal is to ensure people eat healthy animals, and to do so the animals have to eat healthily. We are conscious of the dignity that comes through working in an environmentally sustainable way, to promote safe, healthy food for all."

HEALTHSTOCK

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- Coordinated by Pentabiol in Spain.
- Funded under H2020-FOOD and H2020-SME.
- cordis.europa.eu/project/id/733627
- Project website: probisan.es
- ▶ bit.ly/2Ufn4A0

“ Our goal is to ensure people eat healthy animals, and to do so the animals have to eat healthily. We are conscious of the dignity that comes through working in an environmentally sustainable way, to promote safe, healthy food for all. ”

New solution to monitor meat quality and reduce waste

Meat quality problems cause huge financial losses each year in the EU. SliceWatch is an automated meat scanner that quickly sorts the good from the bad.

Annually, thousands of tons of meat are lost or wasted in Europe during slicing operations, due to its poor quality. Under the framework of the Horizon 2020-funded SliceWatch (Monitoring meat texture to optimize slicing yield and reduce wasted meat in high-speed slicing lines) project, the Spanish company Lenz Instruments SL has developed a new device, SliceWatch, to measure Water

Holding Capacity (WHC) – one of the most important attributes of pigmeat quality. The monitor allows pigmeat processors to identify and separate poor-quality meat, reducing waste and discarded meat, and avoiding severe technological and quality problems in the production of dry-cured and cooked ham, among other products.

WHC describes the capacity of meat to retain water in its tissue structure. Meat prone to retaining too much water is inadequate for producing cured products, due to difficulties in ensuring microbiological safety. Excessively low WHC in meat negatively affects flavour and texture, and it can lead to severe technological problems during processing.

“Over recent years, pig producers have followed a strategy focused on improving productivity,” explains Mr Jacobo Alvarez, Research Manager at Lenz Instruments. “This has

“ *We concluded that it was possible to monitor meat quality with a simpler scanner than the one that we initially developed. The final solution is therefore simpler, yet more robust and suitable for being used in industry.* ”



led to the selection of genetic lines leading to pigs that grow fast and lean, but which are, however, more prone to problems related to poor water holding capacity.”

While the incidence of meat with excessive WHC is moderate – below 0.5 % – over recent years the incidence of meat with poor WHC has increased substantially. In Spain, over 30% of meat at several processing plants had low WHC, the project found.

Up to now the assessment of WHC in meat has been time-consuming and complex. In some cases the meat tested could not be used. SliceWatch is a rapid and non-destructive solution. It consists of a magnetic induction scanner that integrates a conveyor belt to automatically feed in meat. The scanner weighs and assesses the quality of the meat passing through in just a few seconds, while a low intensity magnetic field induces a current flow in the sample. Meat with a WHC that is excessive or too low presents a characteristic electrical response pattern which is immediately identified by the scanner’s data processing module.

SliceWatch is intended to be used in automatic reception lines to classify and separate meat into different categories on a piece-by-piece basis. The same scanner can integrate additional sensors to determine the fat content of fresh meat and the salt content of salted products. It can also attest to the microbiological safety of dry-cured products.

A major challenge the project faced concerned the development of a robust and sensitive system to measure the electrical properties of meat in the low frequency range. In the past, several design approaches for this had led to poor results.

“We are glad to have overcome this technical challenge,” Alvarez says.

After developing a working demonstrator, they were able to test the technology systematically. “Incidentally, we concluded that it was possible to monitor meat quality with a simpler scanner than the one that we initially developed,” Alvarez adds. “The final solution is therefore simpler, yet more robust and suitable for being used in industry.”

The firm has already closed a sales agreement with a Spanish slaughterhouse and plans to deploy the first units into the market in 2019.

SLICEWATCH

- Coordinated by Lenz Instruments in Spain.
- Funded under H2020-FOOD and H2020-SME.
- cordis.europa.eu/project/id/711866
- Project website: sliceWATCH.eu

FOOD AND NATURAL RESOURCES

Fish fitness trackers reveal response to changing environments

Climate change is fuelling changes in fish behaviour and energy budgets. An EU-funded project has used fish ear stones to measure fluctuations in metabolic rate linked to adaptation in cod populations.

Fish keep track of their speed and orientation in the water while swimming using calcified structures called otoliths in their inner ear. Carbon, in the form of CO₂ and calcium from the blood, makes up the calcium carbonate in these ear stones. Carbon in these otoliths is found in several

forms – multiple isotopes – including the slightly heavy ¹³C and the lighter ¹²C.

Funded by a Marie Skłodowska-Curie fellowship, the OTOLOG (Otoliths as metabolic loggers: Examining the

“We are now able to develop much better models to illustrate what happens to the fish when the environment changes.”

physiological basis for climate resilience in wild populations of marine fish) research team from Aarhus University in Denmark has demonstrated that the composition of the two isotopes in fish otoliths correlates to the fish metabolic rate.

OTOLITHS – A FISH FITNESS TRACKER

The researchers realised that fish otoliths comprise two sources of carbon in their calcium carbonate: carbon taken up from the water in which the fish swims and from food that it consumes. These sources have different ratios of heavy and light carbon isotopes.

“We coupled the variations in the carbon with the fish’s metabolism. When the fish’s metabolism increases when it swims in warm water or is more active, it burns off more food and the proportion of carbon from the food in the otoliths increases,” explains Prof. Peter Grønkjær, Department of Bioscience, Aarhus University. “In the same way as a fitness tracker, they monitor and store information on the fish’s activity level.”

A TREASURE TROVE OF DATA

Otoliths retain their carbon isotope composition even after the fish is dead. By analysing the carbon isotopic value in each growth ring, researchers can tell how seasonal variations in temperature, food and the fish’s behaviour affected its metabolism. “Our new discovery will be the key to a treasure trove of new information,” says Dr Ming-Tsung Chung a research fellow on the team and the man behind the data published in the journal *Communications Biology* from Nature Research.

Earlier, research relied on artificial experimental set-ups in the laboratory and theoretical models of fish metabolism, making simulation of natural conditions impossible. “Now we can measure and understand how fish are affected and adapt to changes in the environment and the rate of the food intake needed to have enough energy for swimming, growing and reproducing,” Prof. Grønkjær reports. “We are now able to develop much better models to illustrate what happens to the fish when the environment changes,” he adds.

FISHING FOR INFORMATION BACK IN THE 1800S

Researchers had started looking at otolith rings as indicators of growth as far back as the 1890s. Stored in small brown paper bags in the archives of research institutions, these same otoliths can now provide significant new insight into the life of fish.

Very old otoliths may also be found in kitchen middens, or ancient rubbish tips. Even though these otoliths are several thousand years old, they still contain a carbon signal that reveals the fish’s metabolism.

Prof. Grønkjær’s research group has already initiated the analysis of otoliths of Greenland cod, available in an unbroken series since 1926. Hopefully, they will be able to provide yet another important piece in deciphering the puzzling marine environment within a few years. An unexpected bonus, “we will have much better knowledge of what will happen with the different fish stocks when the sea becomes warmer,” concludes Prof. Grønkjær. This could help predict climate resilience in fish.

OTOLOG

- Coordinated by Aarhus University in Denmark.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/707481



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Greener way to make a versatile pigment

A Finnish SME eyes new factory in Germany after developing a green process for producing a versatile pigment for paint, varnish, plastics and paper.

The two-year EU-funded UFPCC project (Scale up of the Continuous Production Method for Nano-sized Precipitated Calcium Carbonate, and market Introduction for Industrial End Use) has seen FP-Pigments, the company behind the project, apply for five patents on a continuous process for producing ultra-fine precipitated calcium carbonate (UFPCC) and its end uses.

Calcium carbonate is a common chemical substance found in marble, chalk and even calcium supplements. When synthetically produced using a precipitation process, manufacturers can control its particle size and shape to use it in all kinds of products, including paint and varnishes.

FP-Pigments, a Finnish SME, has been manufacturing opaque pigments since 2006 with factories in Finland, Germany and the US. Its current success is based on an innovative, patented, continuous production method. Its breakthrough during the EU project was to demonstrate the benefits of a novel manufacturing method for UFPCC.

“Those smaller particles have advantages when mixed into products like water-based clear coats because the UFPCC doesn’t give any white shade, so the coating remains clear and transparent,” said UFPCC project coordinator Mr Sami Haakana, R&D Director at FP-Pigments.

Until now, most methods for making UFPCC have been based on batch production, which made scaling up production difficult. FP-Pigments developed a continuous UFPCC production process in the project, which could be scaled up.

The benefits of refining the method are clear: UFPCC improves blocking resistance in pigmented and transparent coatings. It can prevent permanent, unsightly damage to the coating’s surface and can also be used in coatings to control paint film porosity. The technique has the additional benefit of preventing dirt penetrating the film’s surface.

For the same reasons, the food packaging industry is showing interest in FP-Pigments’ UFPCC as a possible replacement for plastic barrier materials in packaging, making it recyclable and compostable.

A NEW WAY OF MANUFACTURING UFPCC

At its test factory in Valkeakoski, 150 km north of Helsinki, researchers on the project worked with process equipment manufacturers to trial the UFPCC production line. They investigated the best available technology for cost-effective ways to remove water and dry the liquid form of UFPCC into powder.



The global **paints and coatings market** is projected to reach



€230.4 billion, by 2023

The company also found a way to re-circulate process water and energy within the production process. A carbonation process releases heat that is then collected in a closed-loop system so that the energy can be used at a later stage in the process.

The resulting product was tested by 100 potential clients of FP-Pigments. The company is now in talks to secure contracts before investing in an additional plant at a chemical park in Leuna, eastern Germany, where it already operates a 3 000 m² factory for opacity pigment.

“The technical part of the plan is ready and we’re now securing commercial commitments. We expect the product sales to start in 2022,” says Haakana.

The stakes are high: The global paints and coatings market alone is projected to reach USD 262.5 billion, about EUR 230.4 billion, by 2023 according to a report released in January by market researchers ResearchAndMarkets.com.

FP-Pigments currently employs 80 people at its facilities in Finland, the United States and Germany and is aiming to employ ‘close to 200’ more staff once UFPCC production takes off.

“As an SME, the EU funding has been critical to us for accelerating the development of this product. It has also enabled us to introduce the product more broadly to industrial end-users”, says Haakana.

UFPCC

- Coordinated by FP-Pigments OY in Finland.
- Funded under H2020-LEIT-NANO, H2020-LEIT-ADVMAT, H2020-LEIT-ADVMANU and H2020-SME.
- cordis.europa.eu/project/id/738517
- Project website: fp-pigments.com

INDUSTRIAL TECHNOLOGIES

Taking guesswork out of industrial crystal production

Swiss high-tech company Scientific Visual unveiled patented equipment that automatically detects imperfections in sapphire, fluorite, ruby and other industrial crystals. The new technology ensures that only the best-quality material enters the market.

Synthetic sapphire is commonplace in everyday life, as its optical, mechanical, thermal, chemical and structural properties are highly valued in a vast array of fascinating applications. For example, the material is used in wristwatch crystals, surgical systems, as a component in defence and aerospace applications and as a substrate for solid-state electronics, such as white light-emitting diodes (LEDs). However, despite the strong commercial need for it, growing the material reproducibly to the highest grade is not that simple.

With EU funding of the SAPPHIRO (Automated Inspection Tools for Cost-effective Quality Control of Optical Materials) project, Scientific Visual has been able to identify and quantify internal defects in sapphire at earlier stages in the production cycle than previously possible.

Its new system helps address the lack of international quality standards, which ultimately creates uncertainty in end users about the quality of product they are buying or selling.



© Scientific Visual SA

MAKING THE INVISIBLE VISIBLE

Scientific Visual developed the first-ever systems to identify internal flaws reliably in unpolished sapphire. The new automated quality control scanner called SapphiroScan™ visualises and analyses volume defects, including bubbles, cracks, cloudiness, inclusions and lattice distortions in raw sapphire. The technology is ideal for identifying imperfections in pre- and post-polished sapphire watch covers, ingots and wafers.

“SapphiroScan™ relies on refractive-index matching of different liquid and solid substances to improve the overall optical clarity. This data is combined with tomography and image processing software that renders in 3D the detected material defects. The new automated inspection technology is non-destructive and accurately maps all the defects, regardless of their type, size and location in industrial crystals,” explains Ivan Orlov, founder of Scientific Visual. Importantly, manufacturers know in advance where defects are located and therefore decide how to best exploit the material.

SAVING TIME AND COSTS

Industrial crystals just like sapphire and silicon carbide have remarkable hardness close to that of diamond – this is making it difficult to produce large quantities of fine quality. Expensive slicing, grinding and polishing machines are used all day long to produce the final object. “Currently checking for defects in semiconductor wafers, or watch and smartphone camera covers is only conducted after full processing and polishing has been completed. Given that approximately 10 to 15 % of watch covers are rejected after processing due to flaws, a typical sapphire factory wastes at least half a day per week polishing discards,” outlines Frédéric Falise, COO of Scientific Visual.

Another inspection system, SapphiroScope™, detects flaws in sapphire for the semiconductor industry prior to its grinding and polishing, ensuring that only high-quality material enters the LED value chain. The scanner

not only allows materials to meet quality standards but also reduces production time and costs. Offering a fast, highly cost-effective alternative to manual quality control, it helps increase the production yield and saves up to 15% of overall industrial operation costs.

Together with metrology and wafer inspection, defect review, analysis and classification are vital in crystal production, providing the means to monitor and control the quality of individual steps in the crystal manufacturing sequence.

Scientific Visual aspires to reshape current market practices on synthetic crystal processing, setting its disruptive technology as a global industry-wide cross-application standard. By 2022, its technology will allow for reducing the industrial crystal defect rate by a factor of two.

Thanks to Scientific Visual's technology, the higher crystal yield will ramp up electronics production, especially for renewable energies, electrical vehicles and LEDs.

The company is open to partnering with other industrial players to license its technology in specific market verticals such as precision optics, glass and laser ceramics inspection.

SAPPHIRO

- Coordinated by Scientific Visual SA in Switzerland.
- Funded under H2020-Societal Challenges, H2020-SME and H2020-Industrial Leadership.
- cordis.europa.eu/project/id/815696
- Project website: scientificvisual.ch/horizon-2020

10 to 15% of watch covers are rejected after processing due to flaws





Reservoir computing for multitasking sensors

The RECORD-IT project has developed a new generation of reservoir computing-enabled sensors, capable of detecting and processing collected information all at the same time.

Any tech giant out there would gladly tell you: machine learning is the future of technology, and we've only scratched the surface of its full potential. Soon enough, all software embedded in our smart devices will automatically learn and improve from experience, as we humans do every time we encounter new situations.

The comparison is fundamental, as one of the most successful approaches to machine learning – called reservoir computing (RC) – is inspired from neural networks. As Zoran Konkoli, Professor at the Department of Microtechnology and Nanoscience of Chalmers University of Technology, points out: “The key selling point of reservoir computing is that it doesn't require complex auxiliary equipment. If a system is complex enough, then it can be equipped with a very simple unit, called a ‘readout layer’, which can be easily optimised for any computation.”

In September 2015, Prof. Konkoli took the lead of an eight-strong consortium of universities and research institutes to apply RC to a new generation of intelligent, biocompatible sensing devices capable of detecting behavioural changes in ion concentrations. The RECORD-IT (Reservoir Computing with Real-time Data for future IT) project was born.

Usually, sensors work in two steps. First, they interact with the object to be investigated and produce an output. This output can then be analysed in a second step by an independent unit. When our eyes encounter light, for instance, it triggers the action potential in the neurons that lead from the retina to the brain. In the second step, our brain makes sense of this information.

There are two keys approaches to using RC for sensors: the traditional setup of ‘RC and sensing’, where the RC device is used for the analysis step, and the novel approach of ‘RC for sensing’ developed by the RECORD-IT project. Here, the RC sensor both collects information and processes it at the same time.

“Let's say that you want to find out about the weather outside without having access to a window. If a person enters the room from the outside, you may want to use that person to determine the weather. In an ‘RC and sensing’ setup, you would have to design a very complex camera which would be followed by a complex image processing analysis (by an RC or other type of unit) to see whether the person is wet. With ‘RC for sensing’, you could just interact with the person instead of being a passive observer by asking simple questions,” says Prof. Konkoli.

The main innovation brought about by RECORD-IT lies in how such a dynamic system can be queried over time, accumulating clues about the environment before assessing them with a very simple inference unit. But the team also managed to apply this approach to the very challenging field of ionic systems.

“The list of possible applications is endless,” Prof. Konkoli enthuses. “We expect a huge impact on IoT technologies, where the need to reduce the communication bandwidth is a big challenge. For example, we could envision medical applications such as real-time patient monitoring (we want accurate sensors that are small and energy efficient), swarm intelligence applications with distributed sensor systems, etc.”

Although the project was completed last year, the consortium has been busy exploiting the project’s algorithmic principles for several applications. These include: a sensor for detecting neurological diseases; cryptographic applications; and several distributed sensor network ideas.

“ We could envision medical applications such as real-time patient monitoring (we want accurate sensors that are small and energy efficient), swarm intelligence applications with distributed sensor systems, etc. ”

RECORD-IT

- Coordinated by Chalmers University of Technology in Sweden.
- Funded under H2020-FET.
- cordis.europa.eu/project/id/664786
- Project website: chalmers.se/en/projects/Pages/RECORD-IT.aspx

DIGITAL ECONOMY

AI-powered software a game-changer for 3D graphics

The consumption of 3D content is facing exponential growth. As the supply of 3D artists and content is not meeting demand, something has got to give, and industries are crying out for disruption. One EU project, ArtomatixSuite (An innovative 3D content generation solution for digital artists), created the world’s first AI powered ArtEngine automating up to 80-90 % of the time-consuming and expensive parts of a 3D artist’s scan-based workflow.

The demand for 3D content now goes far beyond the gaming and VR/VFX industries. Fashion, furniture, aerospace, automotive, industrial design, architecture and many other sectors are crying out for more 3D content. To keep up with growing trends, artists are moving to scan-based workflows; scanning the world around us and importing it into the virtual world.

Whether it’s building a virtual world, creating products or designing fabrics, the process is time-consuming and

expensive. Studios creating 3D content are already at capacity, failing to meet the current market demands, and prior to Artomatix had no ability to meet the projected future rise.

Artomatix, the company behind the EU-supported ArtEngine project, has come up with a solution using Artificial Intelligence (AI) and neural networks. It can take the artist’s scans and convert them into production-ready, photo-realistic materials. Everyday activities for an artist

such as seam removal, expanding materials to much larger sizes, removing unwanted features or artefact compression (that currently make up 80-90% of the time-consuming tasks) are now automated.

“Tasks that once took hours and days, now take seconds and minutes. Artists now have their time freed up to work on more value-added tasks. This is a game-changer for 3D content creation!” explains Dr Eric Risser, Founder and CTO at Artomatix.

Advances in Convolutional Neural Network Image-to-Image translation inspired Artomatix to pursue several highly valuable features related to image enhancement or ‘upgrading’. “This feature suite takes low-resolution input images and produces high-resolution outputs by hallucinating new fine-scale details not existing in the original image,” explains Dr Risser.

Using neural networks, ArtEngine can imagine details based on the context provided by the low-resolution image. Powered by this novel and patent-pending network strategy is a suite of related features such as the ability to take heavily damaged images due to compression and restore them to their former quality, with noise removal and deblurring also included.

Another solution the project has developed is Automatic Texture Segmentation. In the scanning process, artists can spend a significant amount of their time masking unwanted features or dividing a heterogeneous scan into its set of individual homogeneous parts. Artomatix has lightened this burden by using AI to automatically



recognise and identify the different textural components from a scan. The core technology for this feature has been developed and a prototype has been built.

ARTISTS WELCOMING THE NEW TOOLS

A big shift for Artomatix, over the past two years, is seeing its target customer base shift, they are now projecting 40-50% of their customer base to be from outside of the gaming and entertainment space. “With the introduction of Artomatix into all mainstream industries, artists can now complete 90% of their tasks in 5% of the time; with Artists seeing 10X productivity gains. The artist productivity gains have put Artomatix on the world stage,” adds Joe Blake, CEO at Artomatix. Independent analysis supports this claim.

Blake says, “Looking back over 2018, in particular, we are delighted to be one of the very few companies to ever secure Horizon 2020 for a second time. We were humbled and excited to be selected as one of the first companies for the Irish Government’s DTIF funding.” Artomatix also secured its first commercial deals this year.

With Artomatix, digital artists can complete



90% of their tasks in
5% of the time

ARTOMATIXSUITE

- Coordinated by Artomatix Limited in Ireland.
- Funded under H2020-LEIT-ICT and H2020-SME.
- cordis.europa.eu/project/id/739322
- Project website: artomatix.com



SECURITY

Factoring cultural differences into crowd safety and security at transport hubs

Despite the increasingly multi-cultural nature of our crowded spaces, there has been little work done to understand how this might influence safety and security management. The EU-funded IMPACT project addressed this by focussing on transport hubs, to develop a methodology that can be integrated into EU and national regulations.

A multi-cultural approach to transport hub management adapts the physical environment, while providing appropriate communications (including signs and signals) to cater for different cultural needs and expectations. Yet there remains a pronounced lack of standardised and culturally aware risk assessments, inter-culturally competent staff, communication strategies and training, with implications for emergency preparedness and response.

The EU-funded IMPACT (Impact of Cultural aspects in the management of emergencies in public Transport) project was set up to develop methodologies and solutions for cross-cultural emergency prevention and

management. Analysing the influence of socio-cultural factors on safety and security management related to public transport systems allowed the team to create the IMPACT Theoretical Framework. This in turn served as a basis for the IMPACT Supporting Measures, which included the use of agent-based models to develop cultural risk assessments, culturally-based emergency communication guidelines and culturally-aware training, with best practices and policy recommendations.

INTEGRATED CULTURALLY-AWARE SAFETY AND SECURITY PRECAUTIONS

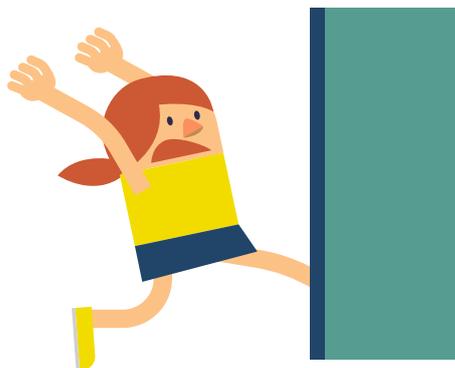
Transport hubs such as airports, railway stations and ports see thousands of travellers from around the world passing through them. This means that transport operators are required to have more multi-cultural competence skills in dealing with both passengers and colleagues than ever before. As the IMPACT project coordinator Dr Alessandra Tedeschi puts it, "I have experienced how much public transport hubs are becoming more crowded multi-cultural environments. In such environments, miscommunication, misunderstandings and hazardous behaviours may arise due to cultural differences."

The IMPACT team began by developing a cultural risk assessment which integrated international standards (such as ISO 31000) which could be modified to cater for potentially hazardous cultural behaviours. The methodology traced the escalation of consequences due to specific cultural characteristics and included possible

Socio-cultural factors can affect

evacuation time

by up to **30%**





mitigation actions. Then the project analysed transport hubs, mapping their characteristics from the psycho-social point of view and consequently documented how these might impact on behaviours.

The next step was to use past events to analyse culture-specific hazardous behaviours, identifying the main behaviours that could either amplify or diminish safety hazards or security threats, or even result in new hazards. Finally, the work identified and evaluated existing standards or best practices for emergency management, including mitigation measures such as first-aid, long-term health care, communication, training and signage, relevant for specific cultural groups and ethnic minorities.

This work formed the basis for the development of four computer-based interactive training lessons on cultural behaviour risk assessment, using agent-based computational modelling. The behavioural modelling and simulations of cross-cultural crowd behaviour in transport hubs considered two principal scenarios: passenger evacuation, looking at specific characteristics that could slow down the process, and stranded passengers to investigate group frustration, with issues such as disputes for resources and priorities in queues.

Explaining the impact of socio-cultural factors on these scenarios, Dr Tedeschi points out, “Cultural aspects like

language, understanding of signage and traditional clothing affect dynamics. For example, cultural groups with traditionally long clothes may be slowed down during an evacuation, increasing the risk of injury. On the other hand, a multi-cultural crowd not understanding the announcements immediately can enable a phased evacuation, avoiding immediate exit congestion. Socio-cultural factors have been found to affect evacuation time by up to 30%.”

The project was able to develop guidelines to tailor emergency messages to particular communities, incorporating techniques such as using inclusive language, alongside the need for sensitivity around different cultural interpretations of non-verbal communication such as eye contact, gestures, facial expressions and personal space.

EXTENDING AND CUSTOMISING IMPACT RESULTS

There is clearly a gap across the aviation, rail and maritime sectors, for the adoption of the IMPACT risk assessment and management, communication in emergency and training methodology, in support of a range of standards and guidelines. Additionally, the tools are also applicable to other scenarios characterised by multi-cultural crowds, such as music festivals, shopping malls and even refugee camps.

The team are currently working to further maximise the project results. This includes the customisation of multi-cultural guidelines for the worldwide railway organisation (UIC), developing a customised training package for the International Air Transport Association (IATA) and a new project with two IMPACT partners to augment the evacuation model and emergency communication package. Additionally the EU-funded LETS-CROWD project may apply IMPACT models, while LEGION is also interested in IMPACT's models.

IMPACT

- Coordinated by Deep Blue Srl in Italy.
- Funded under H2020-SECURITY.
- cordis.europa.eu/project/id/653383
- Project website: impact-csa.eu

SECURITY

New set of guidelines brings crisis resilience to the next level

When dealing with crises, risk and resilience management are two of the main challenges facing businesses and governments. But until now, they have been pretty much on their own: no resilience guidelines have been available to help them refine their strategies.

Disaster – natural or man-made – can impact us all, from individuals to private and public organisations, and even governments. It calls for a capacity to bounce back, which will often take the shape of crisis management plans and procedures.

DARWIN (Expecting the unexpected and know how to respond) consortium members, however, argue that most existing strategies may need improvements. As Ms Ivonne Herrera, coordinator of the project on behalf of SINTEF, one of Europe's largest independent research organisations, points out: "Recent natural and man-made disasters have highlighted the limitations of these types of plans and procedures. At DARWIN, we believe that a more resilient approach is needed to prepare for, and deal with, both expected and unexpected events."

The EU-supported project believes more resilience essentially means taking the constantly growing scientific body of knowledge, bringing it together within a comprehensive set of resilience management guidelines and making it more tangible through a range of actionable knowledge/interventions via the use of serious games and simulation tools.

DARWIN's set of guidelines is the first of its kind, according to Herrera. Instead of being purely prescriptive, it

takes into account the fact that some organisations may already be applying the right resilience management approaches without even knowing it. It can rather be seen as a benchmark, enabling organisations to take a critical stance on their existing crisis management plans and enrich them with DARWIN guidelines.

The guidelines are also dynamic and user-friendly. "They cover a number of resilience management approaches



using a total of 13 capability cards (CCs),” Herrera explains. “The tool proposes concrete interventions that could be implemented in organisations to enhance specific resilience capabilities.” Each CC deals with a specific topic, from establishing networks to communication with the public.

A large community of 170 crisis management experts and researchers from 25 countries co-created and evaluated DARWIN’s guidelines. They provided expert feedback and evaluation during each step of the process, thereby ensuring that the use of guidelines will be sustained over the coming years.

APPLICATIONS IN VARIOUS FIELDS

To investigate and test their approach’s effectiveness, the project team decided to focus on healthcare and traffic management. They identified relevant interventions for both sectors as well as context-specific aspects for each critical infrastructure.

“Our research found ways to enhance a number of practices and methods. For example, inspired by the Resilience Engineering discipline, we reflected on ‘what went well’ and not only ‘what went wrong’ when learning from events. The triggering questions, methods and tools included in the capability cards can be used

“ *The tool proposes concrete interventions that could be implemented in organisations to enhance specific resilience capabilities.* ”

to survey current practices, strategies, procedures and guidelines. For example, based on our guidelines and capability cards, a manager from the air traffic management domain decided to revise their emergency preparation plans,” Herrera says.

Many participating experts, such as critical infrastructure crisis managers, have already begun implementing the DARWIN guidelines in their respective associations. The consortium hopes to ‘keep the momentum going’ and is currently looking for new funding opportunities at both national and EU level.

DARWIN

- Coordinated by SINTEF in Norway.
- Funded under H2020-SECURITY.
- cordis.europa.eu/project/id/653289
- Project website: h2020darwin.eu
- ▶ bit.ly/2Oht5ix

SECURITY

Oil and diamonds: Keeping Europe’s natural resource trade legal

Illegally extracted natural or so-called conflict resources like diamonds are often exported to global markets and enter the supply chain all over the world. The political, social and environmental consequences of this commerce make it necessary for the EU to find solutions limiting such illicit trade.

The EU’s predominant policy response to conflict resource cases has been restrictive measures. A recent trend is supply chain due diligence measures that oblige importers to ensure that the natural resources they use comply with certain minimum social and environmental standards.

For the EU, the challenge lies in fitting these measures with its conflict-sensitive approach to crisis situations. This means that any intervention should take the context into account to ensure that it improves the situation instead of making it even worse. As the EU

acknowledges in recent policy documents, measures can potentially exacerbate conflict and instability if they aren't conflict-sensitive.

To address the issue, the EU-funded GLONEXACO (The Global-Local Nexus of Armed Conflicts: The interlinkages between resource-fuelled armed conflicts and the EU's raw materials supply) project "answered three interrelated research questions that examined both the global context in which these measures are taken, and how they can influence the small-scale dynamics of armed conflicts," says Martijn Vlaskamp who was awarded a Marie Skłodowska-Curie Global Fellowship as principal researcher. "These questions are an immediate response to the European Commission's call for improving transparency across the entire supply chain, and together with key trade partners deal with circumstances where the revenues from industries that extract raw materials finance wars or internal conflicts."

The first question looked at how the dynamics of the global natural resource trade influence the small-scale dynamics of armed conflicts. The second explored to what extent the small-scale dynamics of armed conflicts affect the global natural resource trade. The third and overarching question was how the EU can influence these two dynamics to curtail the natural resource trade that funds armed conflicts, without harming its competitive position.

RECONCILING SMALL-SCALE DYNAMICS OF CIVIL WARS WITH LOCAL DYNAMICS OF NATURAL RESOURCE TRADE

GLONEXACO concluded that there are several questions to consider when thinking about policy measures to tackle conflict resources: the relevance of these resources for conflict dynamics, how effective and efficient this policy can be, what (unexpected) impacts it can have on the ground and how sustainable it is.

“The results argue for the establishment of systems that allow European citizens, in good conscience, to buy products that aren't indirectly funding vicious warlords.”

Overall, results suggest that it's best to refrain from very complicated mandatory supply chain due diligence systems and to choose voluntary systems with strictly established guidelines. This can avoid some of the quasi-sanction effects mandatory measures cause. These guidelines shouldn't be limited to the conflict-free nature of commodities, but rather take a more holistic approach that also includes other social and environmental criteria. By combining all these criteria in one certificate, the costs for producers to maintain a certificate system can be lowered. To encourage use, the EU and other European institutions should make them mandatory for public tenders. In the EU, the public sector spends around 50% of the GDP, and its consumption decisions have a profound impact on producer behaviour.

“GLONEXACO identified several factors that have to be kept in mind to ensure that any EU policy targeting conflict resources doesn't cause more harm than good,” concludes Vlaskamp. “The results argue for the establishment of systems that allow European citizens, in good conscience, to buy products that aren't indirectly funding vicious warlords.”



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GLONEXACO

- Coordinated by IBEL in Spain.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/660245



New computational methods to study special materials

An EU-funded project developed advanced computational methods to study the extraordinary properties of carbon and metal materials on the nanoscale.

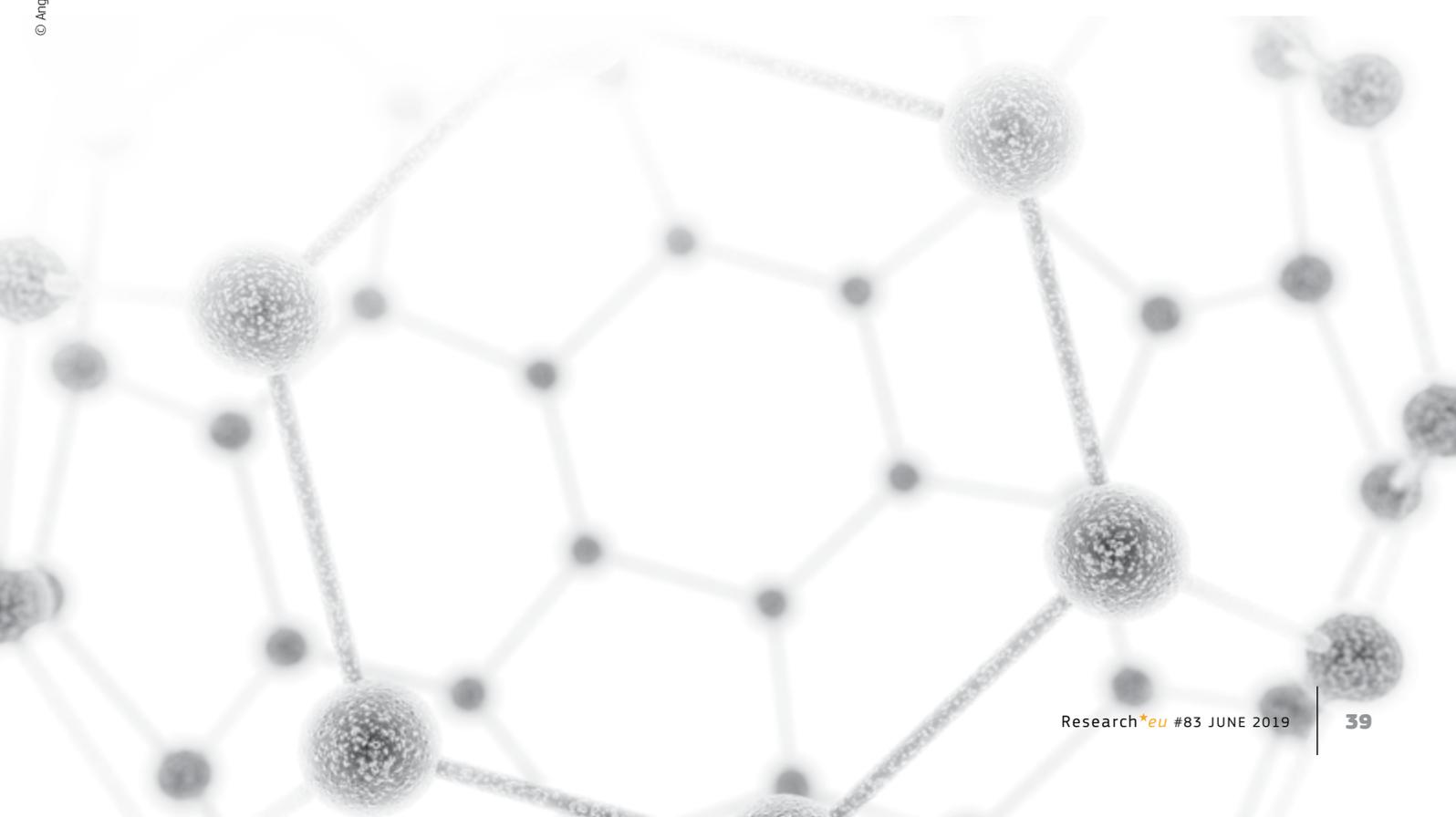
Recent years have witnessed a remarkable surge in the study of the electronic properties of new materials particularly when excited by electromagnetic radiation. A major focus has been placed on exploring the properties of graphene or nano-objects such as nanowires, nanotubes and nanoshells, so that they can be properly engineered to display desired optical properties.

Spurred on by the appealing properties that appear at small scales, the EU-funded QHYDRO (Quantum Hydrodynamics: Applications to nanoplasmonics) project developed new methods and models to study the quantum dynamics of nano-objects in other uncommon materials. The new techniques are akin to those used to study the physics of fluids and gases.

EFFICIENCY MEETS SIMPLICITY

Modern technology enables the production of many sorts of nano-objects in large quantities. “Special materials include extremely small objects whose size approaches a millionth of a millimetre (nanometre). That is about 20 times the size of a hydrogen atom,” notes Dr Giovanni Manfredi, the Marie Skłodowska-Curie fellow who led QHYDRO. Understanding and simulating dynamic processes on the nanoscale often requires costly computational tools that run on large-scale computers.

So far, Mie’s theory has appeared to be the ideal model to describe the optical properties of nanoparticles. However, its strongest limitation is that it neglects quantum



effects, which can be crucial for very small nano-objects. Other standard methods that researchers have been using to study the electron response to electromagnetic radiation include the time-dependent density functional theory and the Hartree–Fock theory – both of which demand much run time and memory storage.

QHYDRO developed and implemented advanced computational methods that are simple enough to run on standard computers. Despite their simplicity, they contain sufficient information that should enable scientists to shed further insight on the electron response of materials to electromagnetic pulses or electric currents. The new methods do not rely on the Mie model but rather allow the study of more complex and realistic geometries such as those formed by networks of interacting nanoparticles.

In particular, researchers placed the focus on exploring the properties of carbon allotrope and metal nano-objects. The first material studied was fullerene C60. This is the most famous type of fullerene and consists of 60 carbon atoms arranged in a polyhedron. “One thing that characterises fullerenes is their hollow core, which lends the material extraordinary electronic properties when irradiated with light. To some extent, they absorb

and reflect light like metals,” explains Dr Manfredi. The project team also studied sodium and gold nanoshells. Unlike fullerenes, these are larger nano-objects whose diameter ranges between 10 and 100 nm.

POTENTIAL APPLICATIONS

Nanomaterials with useful properties are particularly appealing for high-performance computing and electronics applications. “Nano-objects are special because they straddle the boundary between the macroscopic and quantum realms, where classical Newtonian physics and quantum mechanics hold sway,” notes Dr Manfredi. They offer the potential to process, transmit and store larger amounts of information, as well as develop robust filters and waveguides, respectively. They can also contribute to advances in medicine – they can act as carriers in drug delivery, improve radiation therapy, offer faster medical diagnosis and make better biomedical sensors.

QHYDRO

- Coordinated by the National Centre for Scientific Research in France.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/701599

FUNDAMENTAL RESEARCH

Single-photon detector for secure and superfast quantum communications

EU-funded researchers developed an ultrasensitive detector that can sense individual light quanta in the near-infrared spectrum. Sending and receiving quantum information over long distances using single photons sets the path for more secure communications.

Produced on demand with well-defined quantum properties, single photons offer an unprecedented set of capabilities that are of revolutionary importance to modern research fields. These range from quantum information and medical diagnostics to remote sensing, photography and astronomy.

Supported partly with EU funding, researchers from the Qdet (Quantum Detectors) project developed an innovative detector that makes complex quantum experiments easier and faster to perform. “Qdet’s new prototype system is the first to detect single photons in the near-infrared region with near-unity efficiency, ultralow



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noise and ultrahigh time resolution,” notes Dr Sander Dorenbos, chief executive officer from project partner Single Quantum.

TAPPING INTO ADVANCES IN SUPERCONDUCTIVITY

Project researchers built on the success of a new type of detector based on superconducting nanowires that was recently brought to market by Single Quantum. “Superconducting nanowire single-photon detectors (SNSPDs) are significantly better at photon detection efficiency compared to their semiconducting counterparts that are still widely used in research laboratories and the industry,” notes Dorenbos.

The SNSPD is a near-infrared detector that comprises a thin and narrow film of superconducting material. It is patterned in a compact meandering nanowire form through nanofabrication processes. The nanowire is cooled well below its superconducting critical temperature and biased with a current that is close to the nanowire’s superconducting critical current.

The detection principle relies on the nanowire transition from a superconducting to a resistive state. Once a single photon is absorbed in the meandering nanowire, superconductivity is locally broken. As a result, the current is directed towards the amplification electronics and creates a voltage pulse. Superconductivity then recovers within a short time and the SNSPD is ready to detect the next photon.

“Qdet’s single-photon detector represents an important addition to the quantum toolbox that should allow for exchanging and processing information with total security.”

To date, SNSPDs are the fastest detectors that count single photons, enabling many breakthrough applications in quantum information technologies. “Our prototype system completely outperforms state-of-the-art detectors by several orders of magnitude,” notes Dorenbos.

OPTIMISING OPERATION TO THE NEAR-INFRARED

Securely transmitting quantum information over long distances requires ultrafast detectors and a quantum memory scheme that is viable for at least the transmission time. “Qdet’s single-photon detector represents an important addition to the quantum toolbox that should allow for exchanging and processing information with total security,” adds Dorenbos.

The project team refined Single Quantum’s light detector to operate at 795 nm. This wavelength facilitates experimenting with quantum memory techniques that store photons in a gas of rubidium atoms, since rubidium atoms emit at this exact wavelength.

Qdet’s quantum sensor operating in the near-infrared region nicely fills the company’s portfolio, which now includes high-performance detectors optimised for crucial wavelengths: 1 300 nm and 1 550 nm for optical communication research, 900 nm for quantum dots and 1 060 nm for light detection and ranging, to name a few.

QDET

- Coordinated by Delft University of Technology in the Netherlands.
- Funded under H2020-FET.
- cordis.europa.eu/project/id/754481



PROJECT OF THE MONTH

Highlighting the European contribution that led to that first ever image of a black hole

It is arguably one of the biggest scientific announcements of the decade: the first ever image of a real black hole, causing celebrations not just amongst physicists and astronomers but across the world for a truly major breakthrough in advancing humanity's understanding of the universe.

And so this month's Project of the Month feature is being held jointly by two projects. One, the **BlackHoleCam** project, has been funded by the European Research Council (ERC) and played a major role in the extensive international collaboration, Event Horizon Telescope (EHT). The second Horizon 2020 project, **RadioNet**, helped Europe maintain and develop cutting-edge radio astronomy infrastructure that led to this fantastic achievement.

BlackHoleCam has been running since 2014 and aims at capturing the image of, measuring and understanding black holes, whilst **RadioNet** has the ambition of integrating world-class research infrastructures for research into radio astronomy.

For more information, please see:

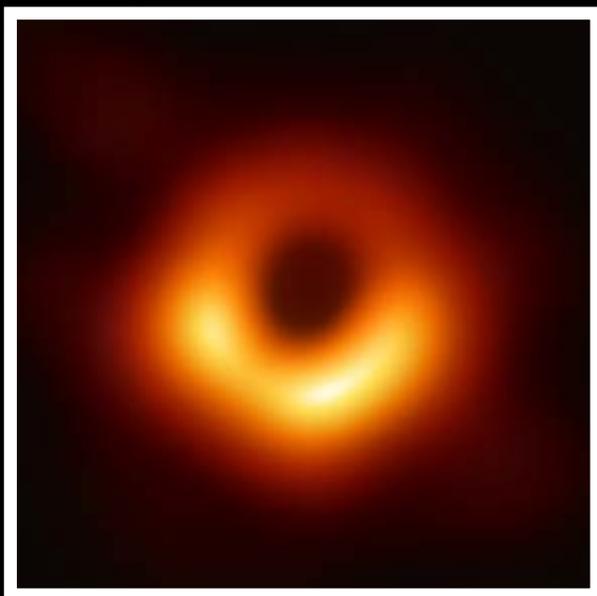
- cordis.europa.eu/news/rcn/131035/en
- erc.europa.eu/projects-figures/stories/astronomers-reveal-first-ever-image-black-hole

BLACKHOLECAM

- Coordinated by Radboud University Nijmegen in the Netherlands.
- Funded under FP7-IDEAS-ERC.
- cordis.europa.eu/project/id/610058

RADIONET

- Coordinated by the Max Planck Institute in Germany.
- Funded under H2020-INFRA.
- cordis.europa.eu/project/id/730562
- Project website: radionet-org.eu/radionet/



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“Fiction often inspires science, and black holes have long fuelled our dreams and curiosity. Today, thanks to the contribution of European scientists, the existence of black holes is no longer just a theoretical concept. This amazing discovery proves again how working together with partners around the world can lead to achieving the unthinkable and moving the horizons of our knowledge.”

Carlos Moedas,
European Commissioner for Research, Science & Innovation

If you are interested in having your project featured in 'Project of the Month' in an upcoming issue, please send us an email to editorial@cordis.europa.eu and tell us why!



AGENDA

JULY 2019

ERLANGEN, GERMANY
Q-SORT International Conference on
Quantum Imaging & Electron Beam Shaping

→ qsort.eu/conference-2019-overview/

**2→5
JULY**

BRUSSELS, BELGIUM

BioHorizon Brokerage Event for
2020 calls

→ [ncp-biohorizon.net/
events?cmd=showDetail&id=242](http://ncp-biohorizon.net/events?cmd=showDetail&id=242)

**3
JULY**

BRUSSELS, BELGIUM
Horizon 2020 Health Partnering
Day 2019

→ [healthncp.net/news-events/
horizon-2020-health-partnering-
day-2019-brussels-be](http://healthncp.net/news-events/horizon-2020-health-partnering-day-2019-brussels-be)

**4
JULY**

UTRECHT, THE NETHERLANDS

Workshop on eLexicography between
Digital Humanities & Artificial
Intelligence

→ lexdhai2019.acdh.oew.ac.at

**9
JULY**

WORLDWIDE
World Population Day

**11
JULY**

WORLDWIDE
World Hepatitis Day

**28
JULY**

**MORE
EVENTS**

[cordis.europa.eu/
news](http://cordis.europa.eu/news)

**8-10
JULY**

HELSINKI, FINLAND

European Bioeconomy Scene 2019

The conference is aimed at raising public awareness and promoting dialogue on the progress towards a bioeconomy. This will be accomplished by bringing together academics, researchers, stakeholders, policymakers, business representatives and civil society across the bioeconomy sector to exchange knowledge, coordinate activities and discuss new actions.

→ bioeconomy.fi/eubioscene19

CORDIS RESULTS PACK ON BIODIVERSITY

Europe is blessed with a rich diversity of flora and fauna, many of which are unique. This natural wealth provides ecosystem services (ES) that give us clean air and water and productive soils, as well as energy and natural resources for economic and social development. One of our latest Results Packs demonstrates the need for biodiversity and ES research to ensure Europe's sustainability, and their relevance for current and future global policy objectives.



Check out the Pack at:
cordis.europa.eu/article/id/401308



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