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SPECIAL FEATURE

NEW HORIZONS FOR THE TEXTILE VALUE CHAIN



ENERGY AND TRANSPORT

**ENERGY OUT
OF THIN AIR**

» PAGE 25



FOOD AND AGRICULTURE

**3D-PRINTED FOOD
TO HELP PATIENTS
WITH DYSPHAGIA**

» PAGE 39

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EDITORIAL

by the editorial team

INNOVATION AND ADDED VALUE FOR FUTURE EUROPEAN TEXTILES

It is no secret that the European textile industry is facing fierce competition from China and other parts of the world where production costs are much lower. Imports continue to grow every year and if this sector — which employed 1.6 million people in 2014 — is to keep prospering over the years to come, it certainly needs to go back to its roots of high quality products and innovation while answering growing concerns over health and pollution.

Over the past years, the European industry has increasingly been capitalising on this historic trademark while building a reputation for environmental and social responsibility. The European Commission is strongly encouraging these changes, notably with a flagship initiative on responsible management for the supply chain in the garment sector and with its research framework programmes.

‘SMEs now account for 90% of the textile industry workforce.’

A closer look at the sector reveals that SMEs now account for 90% of the textile industry workforce and 60% of value added, which goes to show that Europe's most important source of innovation is well anchored in the textile value chain. Since earlier this year, the EU has been lending a helping hand by providing funding to the most ambitious and potentially game-changing concepts and technologies. Some of these projects like VISUALOOK, INE IAPS, UPCYCLINGTHEOCEANS, TAILORFIT and NEWMOON already revealed exciting results for their feasibility studies, ranging from wireless baby-monitoring garments and protective clothing to virtual fitting rooms, innovative software for manufacturers and high-value textiles using marine litter as raw material.

This edition of the *research*eu results magazine* highlights the outcomes and future perspectives of these projects, as well as a handful of results from recent FP7 projects including MACH-TO and MYWEAR. The project coordinators of I-TEX and DIGIFIN — also accepted to discuss their projects' results in this month's interviews.

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

We look forward to receiving your feedback. You can send questions or suggestions to:
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Focus on
Preserving
Europe's cultural
heritage

4 SPECIAL FEATURE NEW HORIZONS FOR THE TEXTILE VALUE CHAIN



4 Led-embedded textiles soon to reach the market

- 6 How high-tech start-ups are shaking up protective clothing
- 7 Wireless monitoring of newborns
- 8 Spanish SME aims for top spot in virtual fitting room market
- 9 Developing smart garments and functional safety shoes
- 10 Seamless software: made to measure for Europe's fashion industry
- 11 Fashion on the high seas: turning marine waste into high-end clothing
- 12 Technology for a better textile industry
- 12 Fewer chemicals for textile printing

14 BIOLOGY AND MEDICINE

- 14 Computational technologies for accurate and safe ear surgery
- 15 Big data to speed up personalised medicine
- 16 Dietary interventions can improve memory performance: EU study
- 16 Predicting lung transplantation outcome
- 17 A common infrastructure for all biomedical research
- 18 Next generation therapeutic antibodies
- 19 New approaches to antiarrhythmic therapy
- 20 Novel tools and technologies enable the production of complex biologics

33 IT AND TELECOMMUNICATIONS

- 33 Nanotech tools open market for more miniature electronics
- 34 Smart sensing system for sinister smells
- 34 Free, open source software to see Earth from above
- 35 The complex road to more wireless bandwidth

36 INDUSTRIAL TECHNOLOGIES

- 36 Designs for LHC upgrade present high-tech opportunities
- 37 Eco-friendly aluminium coating process
- 37 Reliable semiconductor packaging technology
- 38 Increasing carbon fibre use in cars

39 FOOD AND AGRICULTURE

- 39 3D-printed food to help patients with dysphagia
- 40 SMARTSOIL ToolBOX to improve soil carbon management
- 41 RESFOOD delivers solutions for a sustainable and safe food chain
- 42 Feed innovations offer more efficient, ecological meat production
- 43 New nitrite sensor making waves in Europe's aquaculture sector
- 44 High-tech sustainable food packaging

45 PHYSICS AND MATHEMATICS

- 45 Studying the end points of stellar evolution
- 46 Thinking about numbers
- 46 Improved ultrashort-pulse optical lasers

47 EVENTS

21 SOCIAL SCIENCES AND HUMANITIES

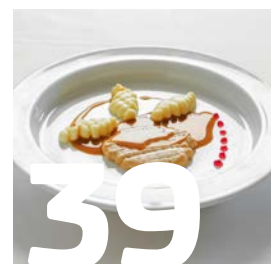
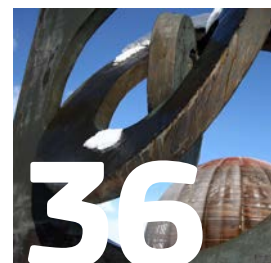
- 21 Policy benefits of research
- 22 Uniting judicial culture in Europe
- 22 Brave new ideas on redistributing wealth
- 23 The civic and political life of Muslim women

25 ENERGY AND TRANSPORT

- 25 Energy out of thin air
- 26 Planning transport solutions for cities
- 27 Instant water heater offers energy and cost savings
- 27 Generating small vortices at large aerofoil surfaces
- 28 Maximising road safety research to keep motorists safe
- 29 Green electricity from low-temperature heat
- 29 Advanced materials for efficient jet engines

30 ENVIRONMENT AND SOCIETY

- 30 Economic consequences of climate change
- 31 Data management for wastewater treatment
- 31 How birds and mammals process sound
- 32 Tree rings reveal climate histories



SPECIAL FEATURE

**NEW HORIZONS
FOR THE TEXTILE
VALUE CHAIN**

LED-EMBEDDED TEXTILES SOON TO REACH THE MARKET

An EU-funded project aiming to develop market-ready light-embedded textiles has been completed in the form of a joint venture between two of the project partners: Philips and Sioen. Together they hope to release new products within the next six months.

Whilst LED lighting was a technological revolution in its own right, it has so far failed to result in a totally new generation of products that breaks with previous design tradition. A way to change this would be to bring to market flexible lighting systems that would remove most existing barriers to designers' creativity, and that's precisely what Philips and Sioen — along with research centres under the I-TEX (Intelligent and luminous textiles) project — have been working on since 2011.

'This is not a project just for the sake of presenting a nice gadget at a conference or exhibition,' says Dr Bert Groenendaal, R&D project coordinator at Sioen. 'Our

objective is to come up with a product and even create new product segments: Philips concentrates on light-embedded textile for decorative or functional lighting systems, whereas we focus on light integration in the likes of trailer curtains or tents.'

Another central difference between I-TEX and previous attempts to embed lights in textiles is the size of the developed products. 'Before I-TEX there was already some kind of state-of-the-art where people had already started to look at different ways to achieve this, but it was rather for A4-sized prototypes without a specific application in mind. We, on the other hand, wanted to show that such products

can also be manufactured at a larger scale. We managed to reach sizes of around 10 metres square of LED-embedded substrates and can even play around with LED concentrations depending on size and potential applications,' says Dr Groenendaal.

Although the project was only granted EU funding in 2011, Philips and Sioen had already started looking into various options over the previous year. They were then joined by three other partners: Fraunhofer, IFTH and the Technical University of Eindhoven. Soon, the new consortium identified the energy-efficient LED technology as being the most promising option for I-TEX: 'We tried different types of LEDs, from low to high power,' explains Dr Groenendaal. 'Then we looked at the different types of coatings that could be applied to add optical functionality, mechanical strength and waterproofing to the systems. The coatings had to be stable and some were not appropriate as they slowly degraded in time, so we put a lot of work into that.'

Another essential part of the device is the conductors. After experimenting with the likes of copper wires and screen

"We managed to reach sizes of around 10 metres square of LED-embedded substrates and can even play around with LED concentrations depending on size and potential applications."

printing, the project finally identified the most efficient solution. Overall, this research phase took two years, after which project partners brought all components together and added infrared and movement sensors to the mix. Unfortunately, the project deadline was reached before the consortium could release its first commercial product.

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Dr Groenendaal

'My initial hope was that we would already have a product on the market at this point, but there are still some weak points related to the production process which we have to simplify, so we are currently working on that,' says Dr Groenendaal. 'But we certainly made big steps,' he adds. 'Three years is a relatively short period to come up with a totally new technology. Despite this time constraint we received very positive feedback from potential customers. For example, products available before I-TEX didn't include coatings, and as the biggest coated textile company in the world we were able to bring our expertise and truly go beyond the state of the art. The point for us is to make products that are reliable and can be used for years.'

Immediately after the end of the project in May 2015, Philips and Sioen agreed on a joint venture to pick up where I-TEX left off. Dr Groenendaal is hopeful that, within the next six months, the first LED-embedded textile industrial prototypes can be developed for some specific markets: 'We have now chosen specific markets and I hope we will be able to communicate about these developments somewhere next year. We also keep Horizon 2020 in the back of our mind. There are definitely some opportunities there, and if we think that the time is right to incorporate other partners we will certainly do so. In the meantime we want to keep it to a bilateral cooperation, but this could change in the coming months or years depending on our needs,' he concludes.



© Fraunhofer

I-TEX

- ★ Coordinated by Philips Electronics in the Netherlands.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/project/rcn/100762_en.html



HOW HIGH-TECH START-UPS ARE SHAKING UP PROTECTIVE CLOTHING

An EU-funded market analysis has enabled an advanced protective clothing start-up to identify a new sector buzzing with potential: motorcycling.

Combining the latest advances in sensor and wireless technology with comfortable protective clothing has opened up new partnership possibilities across a range of sectors. Numerous end users stand to benefit from the inclusion of smart technology in protective clothing.

For example, while French high-tech start-up IN&MOTION has pioneered intelligent active protection systems for ski racers, the company's ambitions do not stop at the chairlift. 'We wanted to investigate whether this technology platform could be used by end users in different markets,' explains project coordinator Rémi Thomas, co-founder of IN&MOTION.

"The next step will be to develop and tweak the technology to suit the specific needs of this sector, and to find partners capable of turning the concept of smart protective motorcycle clothing into a commercial reality."

The wearable ski racing air bags developed by the company combine sensor and wireless communication technology that can detect unavoidable falls and inflate in less than 100 milliseconds. Users can reactivate the device after deployment thanks to easy-to-handle consumable parts, making it cost-effective.

The innovation will be used at international racing events as of the 2015/2016 ski season. With the right partners, Thomas is confident that the sensor and wireless technology platform can be adjusted to suit motorcyclists.

To this end, the recently completed six-month EU-funded INE IAPS project (Intelligent active protection system for motorcyclists: saving lives through optimum use of latest advances in sensor technologies, wireless communication, Smartphone platforms, real-time analysis) enabled the company to carry out an assessment of the technical challenges and market potential of adapting the airbags to suit the needs of motorcyclists. The risk of fatality or sustaining serious injury in motorcycling accidents remains poorly addressed by existing body protection devices, which have to date failed to

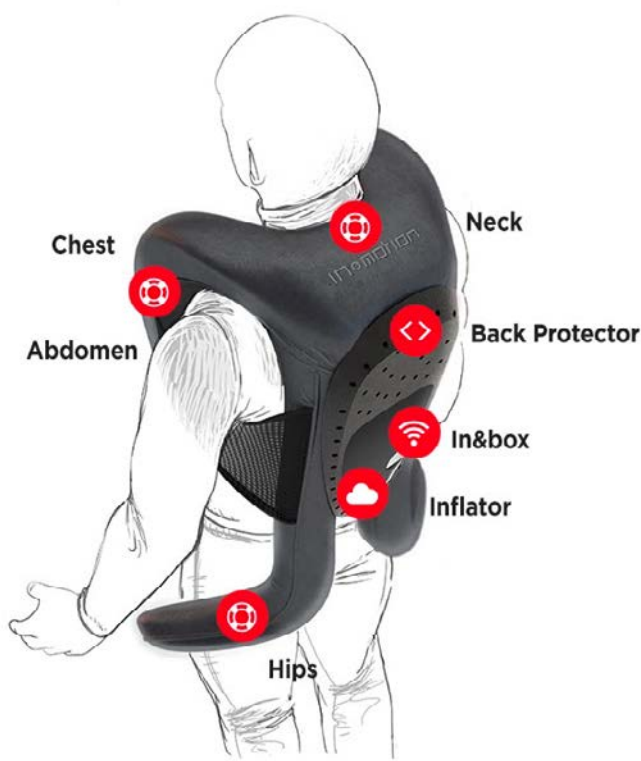
adequately integrate sensor and wireless technologies.

'We spent time discussing these issues with stakeholders, including end users (motorbike riders) and equipment and clothing manufacturers,' explains Thomas. 'The feedback has been encouraging in that, while there is a clear demand for high-tech protection, there is still dissatisfaction with what is currently available on the market.'

This was the first stage of the project: establishing that a viable market exists for advanced protective clothing in the motorcycling sector. The second stage involved analysing technical challenges and seeing what elements of the company's platform might need to be adapted in order to better suit the needs of bikers.

Feedback from the industry here has proved very useful. 'We are a business to business company,' explains Thomas. 'To us, it makes sense to combine our technological expertise with the knowledge of companies that understand the market better and know exactly what end users are looking for.' The next step will be to develop and tweak the technology to suit the specific needs of this sector, and to find partners capable of turning the concept of smart protective motorcycle clothing into a commercial reality.

Thomas is also keen to organise simulated tests in order to provide scientific proof of the airbag's benefits for motorcyclists. This has not been done to date, and would strengthen the commercial positioning of the product when it comes to market. 'We have identified a number of potential institutions,' he says. 'All this, of course, takes time and investment.'



INE IAPS

- ★ Coordinated by IN&MOTION in France.
- ★ Funded under H2020-SMEINST.
- ★ http://cordis.europa.eu/project/rcn/196542_en.html
- ★ Project website: <http://www.inemotion.com>

INTERVIEW

WIRELESS MONITORING OF NEWBORNS

An Italian SME has developed a wearable monitoring system for babies as they go through the sensitive period of the first two to four hours of life. The technology, whose market potential has been assessed with funding under Horizon 2020, will help prevent critical situations while preserving the important skin-to-skin contact between mother and baby.

ComfTech, a neologism for ‘comfortable technology’, is an Italian SME specialising in the design and production of non-invasive wearable biomedical systems with sensors integrated in clothing. In January 2015 the company was granted EU support under Phase 1 of H2020’s SME Instrument for NEWMOON (Smart Garments in Newborns and Babies Monitoring) — a non-invasive system for continuously monitoring newborns.

The new garment, which is a much-needed alternative to repeated observation by nurses, could prove very valuable in guaranteeing immediate reactions in the event of an emergency, at the same time maintaining skin-to-skin contact between mother and child. Such contact has been demonstrated to positively affect the health of the baby, including their resistance to bacteria, body temperature stability, heart and breathing rates and even sugar levels in the blood. In comparison, a wire-based system would prevent these benefits and also be uncomfortable for the baby.

Alessia Moltani, CEO of ComfTech and coordinator of NEWMOON, gives an overview of the system’s added value while detailing her plans for its future development.

★ **The first two to four hours of life are the most sensitive for newborns. How is NEWMOON a game-changer in this regard?**

Alessia Moltani: Shortly after birth, for the first two to four hours, baby and mother stay in the delivery area: discontinuous monitoring is usually implemented through common visual recognition by the nursing staff. In this

“The composition of the yarns and the texture of the sensors have been carefully studied in order to keep the sensors reliable and comfortable at the same time.”

timeframe, during which the baby is in a transient state from pre- to post-natal, continuous monitoring of bio-signals can be very useful for preventing critical situations. The problem is that the traditional ‘wired’ monitoring systems are invasive and incompatible with the bonding procedure, as well as with the skin-to-skin contact between mother and baby which is considered to be of utmost importance. This is why most hospitals use these systems only for premature babies or if they foresee any risk for the newborn, and this means that the possibility of extending monitoring to all neonates is a real clinical challenge.

We developed our wearable monitoring system with three objectives in mind: the system would have to be accurate and reliable, comfortable and wireless with no impact on ‘bonding moments’, and very easy to use.



★ **What is the added value of NEWMOON for medical staff?**

The monitoring system aims to impact the organisation of the nursing staff’s work, while increasing the quality of healthcare through the use of continuous quantitative monitoring rather than a qualitative observation repeated over time in a discontinuous manner.

It is important to note that the system has not been designed to avoid the visual monitoring recognition implemented by nurses, but rather to complement it with real data (ECG, respiration). In case of anomaly, the monitoring system immediately sends a notification to the caregiver.

★ **Avoiding invasive monitoring was one of the key project objectives. How did you achieve that?**

We actually worked on all three blocks in the system with the ‘non-invasive’ motto in mind. First of all the system is completely wireless, with the ‘sensitex unit’ being a garment with embedded textile sensors manufactured in soft cotton. The shape of the garment has been carefully studied in order to minimise impact during the skin-to-skin contact.

Next, the ‘beat unit’ — a small electronic device that collects the data in order to send it to caregivers via smartphones or hospital systems — is small and compact, and



© NEWMOON

the case that protects the device is soft and covered with waterproof fabric.

Another key aspect is safety: the small electronic patch is rechargeable through induction, which is very important for guaranteeing the electrical safety of the baby, as it prevents any possible contact with the power source. Its case is waterproof and can be sterilised after each use.

★ Can you tell us more about the smart textiles you used and how they function?

Our company specialises in developing and manufacturing textile sensors for different products and purposes, including sports, wellness, automotive and toys. We start from developing the yarns, which gives us flexibility with the textile sensors technology.

In the NEWMOON project we used very small and soft sensors carefully embedded in the sleeves of the garment. The composition of the yarns and the texture of the sensors have been carefully studied in order to keep the sensors reliable and comfortable at the same time.

Price was a key point too, as the textile part is mono-use for hygiene reasons (ComfTech sensors can be washed, but for after-birth situations a mono-use garment is required).

★ Have you tested the device in hospitals yet? What can you tell us about the results?

ComfTech carried out the first clinical trial in the world to be approved by the Italian Ministry of Health and by the Hospital Ethical Committee 1, which studies the compliance, acceptability and reliability of any new monitoring system applied in the first two to four hours after birth.

The software for quick visualisation of all the data has also been discussed extensively with nurses in order for it to be easy and quick to use and to understand.

NEWMOON

- ★ Coordinated by ComfTech in Italy.
- ★ Funded under H2020-SMEINST-1.
- ★ http://cordis.europa.eu/project/rcn/196530_en.html

SPANISH SME AIMS FOR TOP SPOT IN VIRTUAL FITTING ROOM MARKET

Online clothing retailers will soon be able to improve their websites with new tools enabling customers to calculate their size and virtually try their clothes before purchase. Not only does the system hold the promise of higher customer satisfaction, but it can also boost sales and reduce return rates.

With eCommerce sales set to increase by 18.4% this year, this market can hardly be ignored by clothing retailers. But is the investment worth the risk? In Europe, only 7% of online purchases are attributed to the fashion market, and the sector unwillingly shines with the highest return rate in eCommerce — reaching a head-spinning 40% of all clothes sold online.

'Bad fit is the cause of return in approximately 75% of sales, being mostly due to confusing garment

sizing and label systems, as well as the low reliability of advising methods to help customers choose the proper sizing,' says Ana M. Bernardeau, CEO at Visualook. 'When deciding whether to buy or not, the customer relies on the possibility of getting a realistic overview of the look and fit of the garment. E-buyers tend not to trust the online experience, and those who do try, often end up being frustrated.'

Numerous companies have entered a race to resolve this long-standing issue while getting their hands on a potentially huge market. Most of these solutions are still under development, while others have dismally failed to capture the industry's attention, but the one developed by Tecnologías

DIM's high-tech start-up Visualook could actually be a real game-changer. Compared to alternatives plagued by the size recommendation's poor reliability and the preview tool's lack of realism, the system promises to recommend the proper size selection and to accurately represent the user as they wear a selection of garments from an e-shop catalogue. All this is made possible thanks to an algorithm which combines key anthropometric measurements with the different sizing guide of each manufacturer.

'Contrary to other initiatives which rely on generic avatars or avatars generated from 2D pictures or adapted from tape auto-measures to provide garment visualisation to the customer,

"We estimate the benefits to be around 25% in sales increases and 30% in reduced returns."

Tecnologías DIM managed to capture and represent the 3D geometry of the user. This is what we call the “personal avatar”,’ Bernardeau says enthusiastically. The system, which is available via a smartphone application, boasts a 90% success rate in recreating the body dimensions of the customer, along with the possibility of combining up to four garments. It is also very easy to get up and running: Visualook provides a link to the retailer which points to an address hosted on their server, then it’s all set up and ready to go.

Going global

The European Commission, which strongly believes in the technology’s potential, granted Tecnologías DIM funding under Phase 1 of the SME Instrument for the VISUALOOK (Novel clothing e-commerce application for reliable size assignment and realistic fitting visualisation) project. This enabled the company to test the technical and economic viability of its products and assess the potential return on investment for customers. The results are so positive that Bernardeau and her team have already applied for Phase 2.

‘During the development of Phase 1, we have carried out three pilot tests with retailer brands which have already used the initial beta version of the web-based virtual “try on and calculate your size” software. This has helped us to have more detailed information about rates than what we had when we presented the proposal. We estimate the benefits to be around 25% in sales increases and 30% in reduced returns, and these figures are

still expected to grow when we complete the development.’

Bernardeau says users and fashion retailers were equally pleased with the experience and she is now thinking about the next steps: securing a leading position in the sector; rapidly increasing the market share and sales of the company; and becoming a leader in clothing e-commerce.

‘To do that, we need the help of the SME Instrument. We need to optimise the 3D modelling process of virtual clothing — including mobile body capture — and to launch a pilot test in an operational environment with retailers, so that we can validate not only the technology but also the business figures,’ she concludes. ‘Visualook will

first target online fashion manufacturers and retailers in Spain and Italy, followed by other European countries and probably South American ones such as Chile in 2017, as we already have some very good contacts there. In Europe alone, the online apparel retail market represents around EUR 40 billion with annual growth of 20%.’

VISUALOOK

- ★ Coordinated by Tecnologías DIM in Spain.
- ★ Funded under H2020-SMEINST-1.
- ★ http://cordis.europa.eu/project/rcn/196206_en.html
- ★ Project website: <http://visualook.com/es/>



DEVELOPING SMART GARMENTS AND FUNCTIONAL SAFETY SHOES

New highly flexible production methodologies and processes were the focus of EU-backed scientists in a recent project on customising safety shoes, work wear and sportswear for elderly, diabetic, overweight and disabled people. Efforts resulted in the development of new integrated sensors and software systems able to interactively monitor health parameters at work and during sports activities.

European manufacturers have advanced new approaches to serve changing markets, with innovation necessary due to growing environmental awareness and various social phenomena. These phenomena include ageing, increased obesity and increased sensitivity towards disabled people.

The EU-funded MYWEAR (Customised green, safe, healthy and smart work and sports wear) project investigated these new market needs and potential solutions. Specifically, scientists researched high-tech production processes, smart textiles and personalised green clothing and footwear.

Initial efforts focused on creating a platform to gather client data as a basis for customer-driven production. The platform integrated information from a wide range of health and biometric sensors within clothing products.

These sensors were contained in a textile-intrinsic communication layer using textile-based circuitry. For this part of the project, the team had to balance technical performance, technological constraints and environmental aspects.

Other work was dedicated to better usage of light, biodegradable textiles in sports and work garments. For



example, researchers investigated new polymeric materials for protective inserts and customised shoe soles.

In order to produce these smart, eco-friendly materials, MYWEAR developed new production systems and processes. The processes had to adapt to customer requirements, with innovative automated manufacturing approaches continuing to be explored.

Ongoing research in this area is available on the project website and on the Mass Customisation Knowledge Network site. MYWEAR has completed its mission of sustainably developing a new generation of work clothing and sportswear goods.

“The team had to balance technical performance, technological constraints and environmental aspects.”

MYWEAR

- ★ Coordinated by Base Protection in Italy.
- ★ Funded under FP7-NMP.
- ★ http://cordis.europa.eu/result/rcn/147164_en.html
- ★ Project website: <http://www.mywearproject.info/>

SEAMLESS SOFTWARE: MADE TO MEASURE FOR EUROPE'S FASHION INDUSTRY

Integrated software and new material cutting methods will provide the fashion world with a cost-effective means of offering personalised services.

The EU-funded TAILORFIT (TailorFit; The Integrated ‘made to measure’ workflow automation for menswear) project is developing cost-efficient software and automated material cutting technologies that will enable fashion houses from Italy and abroad to offer personalised, made-to-measure menswear quickly and at competitive prices. ‘All fashion houses that manufacture menswear are focused on providing made-to-measure products to their customers,’ explains project coordinator Mirko Zilli, CEO of Crea Solution. ‘This market is lucrative, but at the same time also increases in-house costs.’

The six-month TAILORFIT project is therefore pioneering automated solutions to help the fashion world create customised products faster and more efficiently. This will be achieved principally by integrating and automating the whole process, from

receiving the order right through to customising the clothing. Indeed, while automated custom clothing solutions do exist, they do not provide management of the entire process: instead they separate the process into parts.

‘We are confident that the results of this project will have great commercial potential, not only among SMEs but also among big enterprises in the fashion industry,’ says Zilli. ‘Our key target is Italian companies of course, but also other European, American and Asian companies. What is important for us is that they are keen to achieve automatic production for tailor-made manufacturing. What we are developing is not just software, but a new process of production that involves a new cutting system that will help companies increase efficiency and productivity.’

When a client’s measurements and specifications are received — collected in a store potentially anywhere in the world or online — this data is sent to a design/project management area where the right textures, colours, patterns and fabrics are selected and ‘Computer-aided design’ (CAD) modifications are made. This integrated intelligent CAD-based system generates the optimal tailored outfit design. The software

includes high-resolution artificial vision systems capable of ‘reading’ striped and plaid textiles to ensure that the patterns are coherent when the fabric is cut.

For outfit manufacturing, the software identifies the optimised fabric cut according to the material and physical characteristics (such as fabric patterns) and then cuts it rapidly, increasing time and fabric savings. ‘A cutting plant has been bought and will be modified in order to run some demonstrations,’ says Zilli. ‘A second cutting plant will also be bought before completion of the project.’

A 3D product configurator is also being developed and will be integrated into ‘Business to customer’ (B2C) and ‘Business to business’ (B2B) e-commerce websites, giving users a real sense of what their model and texture modifications will look like. The TAILORFIT project is due for completion in December 2015.

TAILORFIT

- ★ Coordinated by Crea Solution in Italy.
- ★ Funded under H2020-SMEINST.
- ★ http://cordis.europa.eu/project/rcn/197163_en.html

“We are confident that the results of this project will have great commercial potential, not only among SMEs but also among big enterprises in the fashion industry.”

FASHION ON THE HIGH SEAS: TURNING MARINE WASTE INTO HIGH-END CLOTHING

An EU-funded feasibility study has helped an ambitious SME assess the potential of collecting marine plastic litter to produce high-quality clothing.

Ecoalf, a Spanish SME that designs and markets high-quality textile products and accessories made from recycled materials such as PET bottles, discarded fishing nets, used tyres, post-consumer coffee and post-industrial cotton, aims to expand its range to include fabrics and clothes made from marine plastic litter.

An EU-funded feasibility study, entitled UPCYCLINGTHEOCEANS (High-quality clothes made from marine plastic litter), was launched to analyse the economic feasibility of this initiative, identify logistical challenges to obtaining marine plastic litter and to carry out a survey among clients and distributors to assess market reaction.

‘Our objective is to develop production technologies using sophisticated R&D processes to recycle debris from the ocean floor,’ explains project coordinator Paloma Oñate from Spanish SME Ecoalf. ‘We want to create the first generation of recycled products from marine debris with the same quality, design and technical properties as the best non-recycled products.’

In order to realise this ambition, the EU-funded study underlined the importance of coordinating with fishing organisations. As a result, Ecoalf has met with various industry leaders, and agreements are now in place with regional organisations in Valencia. ‘Ecoalf’s intention now is to collaborate with fishing organisations to collect plastic from seas, and to introduce new industrial processes including waste management, pellet production and fabric spinning from recycled material,’ says Oñate.

The study also found that a lack of waste collection points at ports has severely hampered attempts at marine recycling in the past. ‘An integral system of waste management therefore needs to be put in place in every harbour,’ says Oñate.

Another key issue the study identified was the need for a training plan to be devised in order to promote a culture of waste collection among fishermen. ‘Fishermen are pulling up a huge amount of plastic, but have been throwing it back

into the sea simply because this is what has been done for generations,’ says Oñate. ‘But with the help of these fishermen, we can give this waste a second use.’

Indeed, reusing debris and waste from the sea will create new opportunities for

‘minuscule plastic pieces have been scattered by the oceans’ currents,’ says Oñate. ‘These micro-plastics have a structure that due to their small size, concentrates contaminants like sponges along with other chemical pollutants.’ This noxious material is currently not collected, while most waste caught up in nets is simply thrown back into the sea.

The environmental benefits of this initiative are not just limited to the removal of a primary source of marine pollution. The manufacturing of PET thread from recycled materials — rather than from non-renewable raw materials — means 20% less water waste, 50% less energy consumption and a 60% reduction in air pollution production during the production process. ‘Also, if this petroleum-based waste were removed from the ocean, it would end up in a dump or incinerated, which would cause emissions that are harmful to the environment or result in contaminated land waste,’ adds Oñate.

UPCYCLINGTHEOCEANS

- ★ Coordinated by Ecoalf in Spain.
- ★ Funded under H2020-SMEINST-1.
- ★ http://cordis.europa.eu/news/rcn/124321_en.html

“We want to create the first generation of recycled products from marine debris with the same quality, design and technical properties as the best non-recycled products.”

SMEs and have a positive impact on the environment. Plastic — a non-biodegradable disposable material — has begun to seriously pollute oceans across the globe.



TECHNOLOGY FOR A BETTER TEXTILE INDUSTRY

An EU-funded project has demonstrated the benefits of a knitting machine upgrade for the European textile industry.

A previous EU research project known as Nu-Wave designed a prototype Retrofit Kit, an upgrade for knitting machines that generated significant interest at industry trade fairs. This upgrade showed reductions in both energy use and operation costs.

To bring the Retrofit Kit to market, the EU-backed project MACH-TO (Industrial validation of Nu-Wave new generation

“The Retrofit Kit will increase production speed by 20%, reduce energy consumption by 80% and expand the uses of knitting machines.”

of sustainable and efficient textile machinery and development of a strategy to enter the market), involving several small and medium-sized enterprises in the industry, set out to build a

full-scale demonstrator of a Retrofit Kit, perform stress testing and develop a business model.

The consortium designed and fitted a Retrofit Kit for two different knitting machines in textile factories. MACH-TO also completed a rigorous stress test on these machines.

Cost and risk analyses on bringing the Retrofit Kit to market were also conducted, and based on these a preliminary business model was built. Overall, the Retrofit Kit will increase production speed by 20%, reduce energy



consumption by 80% and expand the uses of knitting machines.

The Retrofit Kit will now be brought to market by the MACH-TO partners, to help the struggling European textile industry. Improving textile machine performance may help the industry become more productive and competitive.

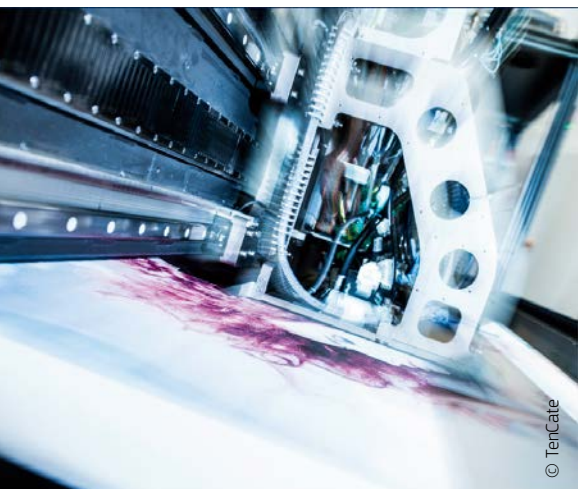
MACH-TO

- ★ Coordinated by Invent in Germany.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/result/rcn/92631_en.html
- ★ <http://bit.ly/1kkJvNI>

INTERVIEW

FEWER CHEMICALS FOR TEXTILE PRINTING

Printing on textiles requires many chemicals, which eventually will leak into the environment. Thanks to groundbreaking advances in digital printing, an EU-funded consortium has managed to divide the number of chemicals necessary for textile printing processes by 10.



of water and energy. The process involves a different screen for each colour required in the final design, and a certain amount of print paste needs to be produced to ensure quality throughout the whole lot. This paste remains in the screens, eventually becomes waste and has to be cleaned using water, which then needs to be treated. In total, it is estimated that 90% of chemicals used in dyeing operations do not stay on the fibre.

With inkjet methods, on the other hand, these forms of vast waste are no longer created: the only waste remaining is linked to the maintenance of the print heads. This method has been entering the textile process market progressively over the past few years, but technical limitations have prevented a widespread market adoption. Speeds were limited to maximal 5 m/min due to required intermittent operation being used in most existing digital textile printers. This pales

in comparison to traditional finishing process speeds reaching up to 40 m/min.

By joining forces with machine supplier Reggiani Macchine, TenCate has come up with a new high-speed inkjet technology which promises to remove all obstacles to the large-scale adoption of digital textile printing (and finishing). The DIGIFIN (DIGital finishing with High Speed Inkjet technology, significantly improving sustainability, flexibility and economic performance of the textile FINishing industry) project, which ended in July, has not only demonstrated the technical and industrial reliability of inkjet technology for economically feasible applications: its technology also outperforms traditional processes from a technical, economical and environmental perspective.

Gerrit Koele, coordinator of the project and managing director of TenCate Digital Finishing, told us about the first products to be commercialised based on this

Could textile printing be on the verge of a major breakthrough? For years, conventional processes — known as rotary screen printing — have required a high amount of chemicals to be applied on the textile, involving excessive amounts

technology and how it will completely reshape the value chain.

★ **How do you explain the current lack of industry interest into digital finishing?**

Gerrit Koele: I wouldn't say there is no interest. I think the interest in digital finishing is there and growing, but it fails to materialise because of two main reasons. First, most digital printer OEMs mostly concentrate on printing colours and do not know much about textile finishing. Next, existing printers are all Drop on Demand (DOD) printing techniques, which means they use a minimum quantity of finishers. In order to have better finishing we would need better coating systems, like the ISIS inkjet printing system formerly developed by Osiris, whose activities are now continued by TenCate.

★ **What would you say are the main strengths of inkjet technology compared to alternatives?**

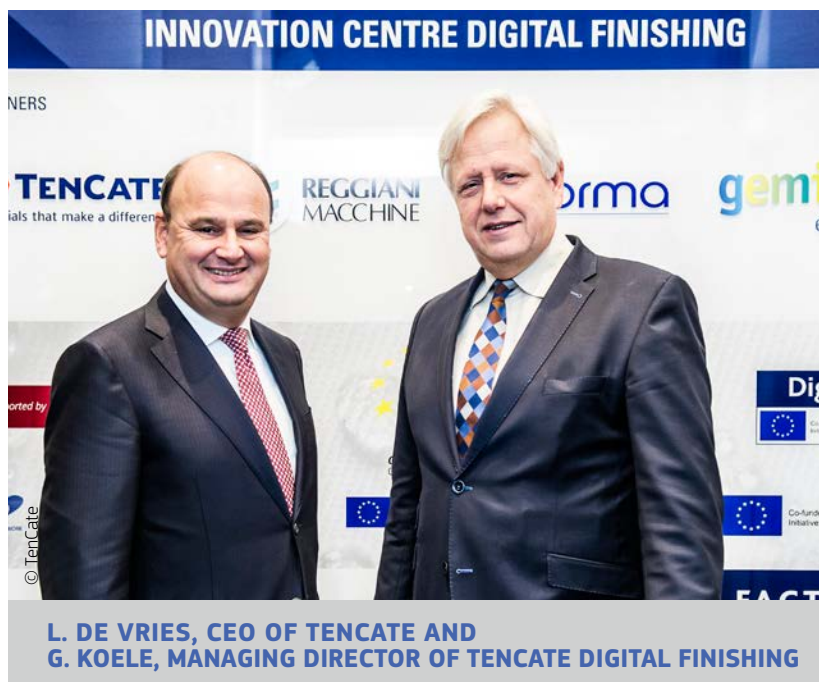
From a production point of view inkjet is a minimum application technology, which means, more concretely, that it makes it possible to dose very precisely the needed amounts of chemicals. When printing we therefore have the possibility to use CMYK. Although this looks very much the same as standard printing to laypeople, from a technical point of view this is completely and fundamentally different.

★ **Can you tell us more about the environmental benefits of this technology?**

DIGIFIN-based technology is a major technological innovation from an ecological point of view. The environmental benefits — which include reduced energy and water consumption, but also less pollution — arise from the fact that we are able to reproduce technical textiles with the same printing quality that we can see with current technologies, but we achieve this by using less than 10% of the chemicals used normally. With existing foulard techniques we need a mix of all kinds of chemicals to achieve our technical textile printing goals, whereas by resorting to digital printing we use pretty much only the functional chemicals themselves.

★ **The project focuses on the outdoor textiles market. Why this choice? What kind of applications have you developed so far?**

We have chosen the outdoor applications market after much reflection, because switching to digital finishing will not only change the production



technology, but also the habits of our customers, the manufacturers, the end-users and even ourselves and our processes. The whole value chain will be affected by this change, and I would say this is really a new industrial revolution in its own right for the sector. The main advantage of choosing outdoor products such as tent and shade fabrics is that everyone will be able to see the benefits of going digital, so it seemed to be an easier and more natural choice than our next targets, such as finishing single-sided hydrophilic, etc.

★ **So you intend to keep expanding the range of DIGIFIN products?**

Yes, the aim is absolutely to expand our range of digitally finished products, and in this way to create a new line of products fulfilling the current and future customer needs and requirements while offering infinite marketing possibilities and boasting important environmental advantages.

★ **Are you happy with market reception so far?**

We are very happy with the market reception, although we had to resort to a marketing push towards end-users before our actual customers, the manufacturers, actually took interest and eventually became very enthusiastic about our technology. Our solution is a breakthrough innovation, so people have to get used to a brand new reality. That takes time.

"The whole value chain will be affected by this change, and I would say this is really a new industrial revolution in its own right for the sector."

★ **When can we expect the first DIGIFIN-based products to become available?**

The first DIGIFIN-based product is already on the market, as our 'digitally-printed sun awning' and 'digitally-printed tent' fabrics are already available and already being sold to our customers in Europe.

★ **Will you keep on developing DIGIFIN-based products in the future? If so, what are your plans?**

We will absolutely keep developing our range of digitally-printed and digitally-finished products in the future, actually we even think that our near future will completely change because of this. We are working on three new products but unfortunately I cannot disclose any more information at the moment.

DIGIFIN

- ★ Coordinated by Tencate in the Netherlands.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/project/rcn/108929_en.html
- ★ Project website: <http://www.tencate.com/fr/emea/digifin/default.aspx>

BIOLOGY AND MEDICINE

COMPUTATIONAL TECHNOLOGIES FOR ACCURATE AND SAFE EAR SURGERY

Technologies to accurately measure inner ears could transform surgery, cut healthcare costs and improve the lives of millions with hearing problems.

The three-year EU-funded HEAR-EU (High-resolution image-based computational inner ear modelling for surgical planning of cochlear implantation) project, which was completed at the end of August 2015, has pioneered groundbreaking imaging technology and surgical planning software to improve the likelihood of successful 'cochlear implant' (CI) surgery.

The project's new high-energy micro CT scanner prototype is now running and the intention is to soon bring the innovation to market. Based on improved images from this scanner, high-resolution cochlear models that show the range of variation in patients can be combined with standard clinical images, giving medical professionals a better understanding of each individual patient's needs. This will help them to choose the best implant model — and position of each implant — in relation to a patient's anatomy.

New computational tools have also been developed to help surgeons achieve safe drilling trajectories to the cochlea along with a combination of metrics designed to evaluate the likelihood of trauma.

'HEAR-EU will help define and design a new generation of cochlear implants with optimal functional performance,' says project coordinator Professor Miguel A. González Ballester from ICREA and Pompeu Fabra University in Barcelona. 'This will significantly improve a patient's quality of life in older age and will also improve the life expectations of very young children by allowing for more efficient CI implantation at a very early age.'

The innovation also has the potential to cut European healthcare costs by reducing hospitalisation and operation times regarding CI surgery. 'This will be achieved by making available these new computerised surgical planning and diagnostic tools,' adds González Ballester. 'HEAR-EU also contributes to promoting the position of European industry in the EU and worldwide market of products and services associated with medical technologies. Furthermore, due to the complexity of the surgical procedure, novel technologies such as computer assisted planning could greatly benefit the training of young surgeons.'

Cochlear implantation aims to overcome hearing loss by direct electrical stimulation of the spiral ganglion cells in the cochlea of the inner ear. Technological progress in this area has led to the development of inner ear implantable devices, which have proved to be of great benefit to patients suffering from moderate to severe hearing loss.


'Implantation surgery is however very complex,' says González Ballester. 'It requires a high level of clinical expertise in order to efficiently access the surgical site — the cochlea, localise nearby critical structures (such as facial nerves) and optimise the position of the implantable device (the electrode array) inside the cochlea.'

Patients also come in all shapes and sizes, making individual optimal fitting an extremely difficult task. The length of the cochlear duct, for example, can vary between 25 and 35 mm. It is crucial therefore that anatomical variability is considered not only during the surgical planning process, but also in the design phase of implants.

'Overall, the project has produced very important advances both theoretically and technically,' says González Ballester. 'The consortium is proud that all the project objectives have been achieved. Significant improvement in cochlear implant output is expected, even under more difficult hearing conditions.'

The project results will be used to help plan interventions and optimise the design of future generations of CI electrode arrays that fully take into consideration individual patient requirements.

HEAR-EU

- ★ Coordinated by Pompeu Fabra University in Spain.
- ★ Funded under FP7-HEALTH.
- ★ http://cordis.europa.eu/news/rcn/124222_en.html
- ★ Project website:
<http://www.hear-eu.eu/>
- ★  <http://bit.ly/1GSW9gW>

BIG DATA TO SPEED UP PERSONALISED MEDICINE

Heralded as the future of healthcare, personalised medicine still has a long way to go before it fully replaces traditional practices based on trial and error. An EU-funded project has developed a set of tools and services incorporating all legal, ethical and scientific aspects to accelerate its adoption.

The EUR 18 million P-MEDICINE (From data sharing and integration via VPH models to personalised medicine) project brings together the top of the crop in the fields of healthcare, basic science, IT, law and ethics around a common objective: accelerating individual diagnostic and treatment by means of a large database where patient-related information can easily be accessed. This is an ambitious quest which will be at the heart of healthcare research efforts over the years to come, both in Europe and overseas.

‘Obstacles are manifold,’ explains Prof. Norbert Graf, Head of the Clinic for Paediatric Oncology and Haematology of Saarland University and coordinator of the project. ‘The first is the availability, sharing and joining of heterogeneous data from hospitals, research institutes, “Electronic health records” (EHRs), etc. This is closely related to questions of

empowerment. These include the P-MEDICINE portal where patients, clinicians and researchers can collaborate and share data, as well as an ontology-based clinical trial management system (ObTIMA), a simulation system for tumour growth (Oncosimulator), a platform to simplify access to biobanks (p-BIOSPRE), a tool which helps to visually explore associations between drugs (Correlation Viewer), a system enabling temporal multimodal image analysis (Dr Eye) and e-learning modules.

A bottom-up approach

Prof. Graf points out that this could all be achieved thanks to the involvement of all stakeholders. ‘The project was clinically driven right from the beginning, meaning that relevant clinical questions were posed and answered right from the start. A legal and ethical framework was built for data protection and privacy, and developed tools, models and services were built in an iterative way between all stakeholders of the project. During this process a special focus was put on guaranteeing usability of the tools and on training activities.’

An entire work package was also dedicated to patient empowerment. A tool called Interactive Empowerment Service (IEmS), which includes a questionnaire for assessing the psycho-cognitive status of the patient, helps medical staff to improve communication with the patient and better understand their needs, eventually resulting in better treatments. ‘Another tool developed is the patient’s donor tool which enables patients to decide who is allowed to use their data or biomaterial for further research,’ Prof. Graf adds.

Validation of the tools developed was also a key aspect in the project: ‘We used retrospective data for building our tools and validated them with prospective data. The validation was done according to standardised procedures. Evaluation of tools was carried out by ECRIN, against the question of whether these tools can be integrated into the ECRIN clinical trials workflow and whether these tools meet

legal and ethical compliance aspects of “Good clinical practice” (GCP).’

All in all, over 100 peer-reviewed papers were published during and after the project, which will live on through other EU-funded initiatives such as the CHIC, MYHEALTHAVATAR and IMANAGE projects. The P-MEDICINE platform will be maintained by the Study Trial and Research Centre (STaRC). A business model is currently under development and will be decisive in ensuring the long-term impact of P-MEDICINE’s work: ‘It is of utmost importance to exploit our results within the clinical community to attract physicians and convince them to use our developed tools. Patients will gain an important role in asking for individual treatments for their diseases, and this will have a great impact on our healthcare system in the future.’

“The project was clinically driven right from the beginning, meaning that relevant clinical questions were posed and answered right from the start.”

data protection and privacy. The second obstacle is the fact that only a few clinicians are aware of the importance of “big data” in healthcare. Where there is a need to join data, there is also the need to network between many different stakeholders, including clinicians, IT people, lawyers, ethicists, basic scientists and others. The third obstacle is that patients need to be aware of the topic. Without patient empowerment, it will be difficult to pave the way to personalised medicine.’

To tackle these three problems, the consortium has developed an integrated technological solution relying on tools for data collection, semantic interoperability, data sharing and storing, data mining, data integration into models as well as tools for decision support and patient

P-MEDICINE

- ★ Coordinated by Saarland University in Germany.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/project/rcn/97572_en.html
- ★ Project website: <http://p-medicine.eu>



DIETARY INTERVENTIONS CAN IMPROVE MEMORY PERFORMANCE: EU STUDY

Dietary supplements designed to tackle age-related diseases like Alzheimer's could dramatically improve the quality of life of millions of Europeans.



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Dietary supplementation could play a crucial role in keeping Europe's ageing population healthy, an EU-funded study has confirmed. The LIPIDIDIET (Therapeutic and preventive impact of nutritional lipids on neuronal and cognitive performance in ageing, Alzheimer's disease and vascular dementia) project, which was completed in March 2015, demonstrated that women susceptible to Alzheimer's disease (i.e. those who possess a gene variant associated with the disease) lose weight more sharply after the age of 70, whether they go on to develop dementia or not. Results of the study were recently published online in the *Journal of Alzheimer's Disease*, and suggest that there is a significant untapped market here for the nutrition and supplements sector.

The findings, which support the notion that body weight change may aid in the diagnosis and management of Alzheimer's disease, spurred the researchers to develop supplements and identify nutritional guidelines that might help prevent further progression.

The study trialled a cocktail of ingredients containing omega-3 fatty acid found in fish oil on patients with mild cognitive impairment as a means to slow the progression of Alzheimer's dementia down. What made this study different from previous studies was that participants were

suffering from slight memory loss and not yet Alzheimer's dementia and took the supplement over an extended period of time. The results suggest that diet-based early intervention can significantly increase memory performance.

Scientists have long known that high levels of cholesterol around mid-life greatly increase the risk of developing dementia 30 years later. Cholesterol boosts the production of so-called beta amyloid peptides, which are the main component of the amyloid plaques found in the brains of Alzheimer's patients. However, it has until now been unclear as to whether changing the diet could prevent dementia.

The study also found that people who had a diet rich in vegetables and fruits, fibres, fish and unsaturated fats, drank coffee, drank alcohol only moderately, and consumed less meat, saturated fats and food products with high contents of salt or carbohydrates (e.g. sugar, sweet soft drinks and confectionery) were less likely to develop dementia and Alzheimer's disease. The dietary patterns identified in the study are similar to general healthy dietary patterns recommended by the National Nutrition Council in Finland and the World Health Organisation (WHO).

Results from observational studies in the LIPIDIDIET project also showed that vitamins B12, E and D are associated with protection against dementia, cognitive impairment and related brain changes. While healthy individuals with a balanced diet should already be getting the vitamins they need, vitamin deficiencies can be common at older ages or in people with diseases.

An important legacy of the LIPIDIDIET project has been the development of a healthy diet index, along with dietary advice in relation to the prevention of Alzheimer's disease and cognitive impairment. This index is based on data from the population-based study that was carried out in Finland.

LIPIDIDIET

- ★ Coordinated by Saarland University in Germany.
- ★ Funded under FP7-KBBE.
- ★ http://cordis.europa.eu/news/rcn/124122_en.html
- ★ Project website: <http://www.lipididiet.eu/>

PREDICTING LUNG TRANSPLANTATION OUTCOME

European scientists have developed a novel clinical mathematical tool capable of interpreting a particular molecular signature and predicting the outcome of 'lung transplantation' (LT).

LT is often the only treatment option for patients with chronic respiratory failure. However, LT procedures are associated with 'Chronic lung allograft dysfunction' (CLAD), a condition that presents with obstructive and restrictive ventilation in nearly 50% of LT patients. This requires administration of immunosuppressant drugs or even re-transplantation.

Early prediction of CLAD could improve disease outcome through the implementation of novel interventions. With this in mind, the EU-funded SYSCLAD (Systems prediction of chronic lung allograft dysfunction) project set out to identify a clinical and molecular signature profile predictive of CLAD and a computational model of disease mechanisms for interpreting and validating

"Over 400 patients with LT were recruited and their samples analysed by transcriptomics, proteomics and sequencing at selected time points."

the molecular data. This would speed up diagnosis and allow for early intervention before significant organ damage ensues.

Over 400 patients with LT were recruited and their samples analysed by transcriptomics, proteomics and sequencing at selected time points. The data was integrated into a mathematical model alongside clinical information, leading to the identification of signatures of each CLAD sub-phenotype. These phenotypes were based on

differential gene and protein expression as well as specific patterns of pulmonary microbiota composition and alveolar inflammation.

SYSCCLAD combined systems biology and clinical events to successfully model the full spectrum of CLAD mechanisms. Their computational model is capable of interpreting molecular and clinical information to accurately predict LT recipients at risk of developing CLAD three years post-transplantation. Given the poor median survival figures

from the time of CLAD diagnosis, this medical tool should expedite intervention and improve LT outcome before lung function is irreversibly lost.

SYSCCLAD

- ★ Coordinated by Hospices Cantonaux CHUV in Switzerland.
- ★ Funded under FP7-HEALTH.
- ★ http://cordis.europa.eu/result/rcn/169992_en.html
- ★ Project website: <http://www.biomax.com/project/respiratory-health/sysclad/>

A COMMON INFRASTRUCTURE FOR ALL BIOMEDICAL RESEARCH

For every scientific field that could benefit from data integration to bridge basic and application-driven research, one of the most difficult points on the development agenda is that of interoperability. An EU-funded project has made important steps forward in this regard, with tools specifically aimed at biomedical researchers.

Bringing together 12 European biomedical sciences research infrastructures, BIOMEDBRIDGES (Building data bridges between biological and medical infrastructures in Europe) aims to remove the stumbling blocks to data-sharing and interoperability within and across life science domains. It bridges data across different spatial scales, species, technologies and research communities to enable new ways of analysing problems and eventually answer new, more complex scientific questions.

To do so, the project relies on two groups of tools and specific use cases in order to demonstrate their power: on one hand, tools aimed at biomedical researchers across a number of disciplines, and on the other hand tools more specific to certain user communities or research questions.

‘An example of the first type of tool is the BIOMEDBRIDGES Service Registry. It brings a variety of biomedical software and tools together to one single point of access and makes it easy for researchers to find, compare and use biomedical software and tools. It can help them address a scientific question or research support task such as “What are all of the Gene Ontology tools?” or “Which of these is most highly cited?” By returning relevant, structured results, the registry complements search engines like Google: the user can specify exactly what they need, using various search and filter options, and get a tailored list of suitable resources. From sequencing to structures, imaging to indexing, the registry’s domain scope is very broad, ensuring coverage of most parts of the BIOMEDBRIDGES partners’ activities,’ explains Janet Thornton, coordinator of BIOMEDBRIDGES.

Another example is the ‘Legal and ethical requirements assessment tool’ (LAT), which guides researchers who want to share potentially sensitive data and provides initial advice on when to consult experts. By clarifying if and how a specific type and form of data can be shared, precious time can be saved and the threshold for data sharing is lowered.

The DIAB Ontology is an example of the second group of tools, bridging the gap between mouse models and human studies in Type 2 diabetes and obesity. ‘Researchers working on human patients and those working on mouse models belong to different, mostly separate communities, each of which has its own ontology. There are over 100 human “Genome-wide association studies” (GWAS) annotated with “Diabetes” and over 750 mouse models (phenotypes) annotated with “increased circulating glucose level”,’ Thornton says. He continues: ‘The DIAB ontology tool “crosses the species bridge” between mouse models and humans data by establishing a diabetes-specific ontology for both and opening up extensive mouse phenotype data to clinical researchers. Clinicians can now compare human genomes with those of a well-established experimental model — the mouse — showing the same condition, and look deeper into the pathways behind glucose metabolism.’



With these computational bridges, the project aims to accelerate the research process from basic science to market applications, for example drug discovery. 'BIOMEDBRIDGES extended the UniChem tool, originally developed to interlink

between many different chemistry databases on small molecules. We have developed the connectivity search function that allows users to find not only the "same" chemical compounds across

different resources, but also "similar" compounds that differ in some of their characteristics. In this way, the UniChem tool finds and links 60 million related molecules from 21 data sources worldwide, including information on whether a specific compound has been patented or what research has been done on it,' Thornton explains. 'This functionality can boost research into the mechanism of action of an existing drug and its possible off-label uses, which is particularly important in the development of new pharmaceuticals, where early candidate triage (filtering out compounds that are most worthwhile to pursue) can save significant amounts of time and money.'

A total of five use cases were established, looking at data integration from the perspective of their user community or a concrete research topic: PhenoBridge, which crosses the species bridge between mouse and human; the interoperability of large-scale image data sets from different biological scales; personalised medicine (integrating complex data sets to understand disease pathogenesis and improve biomarker and treatment selection); cells to molecules (integrating structural data); and finally the integration of disease-related data and terminology from samples of different types.

A layered approach

BIOMEDBRIDGES has taken a layered approach to the integration of available data: interoperability is achieved via harmonising resources across research infrastructures. This initially involves using established technologies, but over

the long run the project aims for more sophisticated semantic interoperability and user interfaces that will enable researchers to find — in one single step — information most relevant to a scientific question or a specific disease across millions of data entries.

'This stepwise, layered approach ensures that all research infrastructures and data resources can systematically be brought to a higher level of integration,' Thornton says. 'Almost as a side effect, this creates the necessary expertise of all involved to further advance data interoperability in future efforts. This continued collaboration also provides the opportunity to achieve real integration — possibly even a change of culture — across the life sciences with respect to data.'

The next step: CORBEL

Many of the tools developed by BIOMEDBRIDGES have already been released and are now available through the participating research infrastructures. They have been or will be embedded in different services. For example, the knowledge gained from the development of the BIOMEDBRIDGES Meta Service Registry prototype has been absorbed into the ELIXIR Tools and Data Service Registry (bio.tools), and the LAT will become part of a more comprehensive service to support users and providers of sensitive data as part of 'Ethical, legal and social implications' (ELSI) common services to be developed within the new cluster project CORBEL.

Started in September 2015, CORBEL will build on the results of BIOMEDBRIDGES to create a platform for harmonised user access to biological and medical technologies, biological samples and data services required by cutting-edge biomedical research.

BIOMEDBRIDGES

- ★ Coordinated by EMBL in Germany.
- ★ Funded under FP7-INFRASTRUCTURES.
- ★ http://cordis.europa.eu/project/rcn/101852_en.html
- ★ Project website: <http://www.biomedbridges.eu>

NEXT GENERATION THERAPEUTIC ANTIBODIES

Therapeutic antibodies represent one of the fastest-growing areas in pharmaceutical biotechnology. Pioneers in the field have joined forces to comprehensively study and further optimise these promising therapeutic agents.

Therapeutic antibodies provide considerable benefit to some cancer patients as well as those with chronic inflammatory conditions such as rheumatoid arthritis. Ongoing development efforts should expand their applicability in the cardiovascular field to prevent graft rejection.

The EU-funded PRIAT (Profiling responders in antibody therapies) project therefore set out to develop novel methodologies for the characterisation of therapeutic antibodies in patients. Since T cells recognise

peptides presented on HLA molecules, it is essential to profile the HLA peptidome to identify targets for future immunomodulation strategies.

Scientists conducted an HLA peptidome analysis of melanoma patient-derived specimens and identified hundreds of antigens that could be therapeutically exploited. The peptides identified included previously reported melanoma rejection antigens, thus supporting the robustness of the procedure.

PRIAT also carried out multiplex analysis of specimens to gain functional



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information about the status of immune activation and/or cytokine levels in these patients. Similar analyses on leukocyte infiltration and cytokine levels were carried out in preclinical experiments to elucidate the action mechanism of antibody-based therapeutics.

Not all therapeutic antibodies localise efficiently at the site of disease. The consortium employed innovative imaging techniques such as PET and near-infrared fluorescence imaging to address antibody biodistribution. Studies were performed in various animal models of disease through administration of

radiolabelled preparations of therapeutic antibody products. This provided important insight into antibody selectivity *in vivo* in rodent models of cancer, rheumatoid arthritis and graft rejection.

In a worldwide clinical trial in patients with rheumatoid arthritis, scientists utilised PET imaging to assess antibody biodistribution and optimise future development of antibody products. Assessment of the impact of antibody therapy in oncology patients has also demonstrated significant benefit.

Overall, the PRIAT methodologies and tools facilitate the development and mechanistic study of antibody-based drugs, which

should lead to improved antibody products. Study findings also support the therapeutic validity of antibodies such as the therapeutic agent that cured established rheumatoid arthritis in preclinical models.

PRIAT

- ★ Coordinated by ETH Zurich in Switzerland.
- ★ Funded under FP7-HEALTH.
- ★ http://cordis.europa.eu/result/rcn/170004_en.html
- ★ Project website: <http://www.priat.eu/>

NEW APPROACHES TO ANTIARRHYTHMIC THERAPY

'Sudden cardiac death' (SCD), typically caused by arrhythmias, can be averted with 'implantable cardioverter defibrillators' (ICDs). An EU-funded project has studied interactions of antiarrhythmic drugs with ICD therapy and ischaemia.

Antiarrhythmic drugs interfere with ion channel activity and may lead to cardio toxicity and ventricular arrhythmias, resulting in increased ICD therapies. Antiarrhythmic drugs can also lead to morphological changes present in the electrogram, interfering with the ICD function. As the majority of SCDs treated by ICD are induced by ischaemia or coronary artery disease, a new level of understanding of drug-ICD-ischaemia interaction is needed to provide efficient treatment.

The EU-funded project CARDIODEF (Multiscale investigation of drug-implantable cardioverter defibrillator interactions for antiarrhythmic therapy) aimed to provide such understanding. The two-year multidisciplinary project combined modelling and simulation with 'electrocardiography' (ECG) signal processing to elucidate the interplay between ischaemia, antiarrhythmic drugs and ICDs.

CARDIODEF developed computational models of human ventricular electrophysiology to simulate the effects of antiarrhythmic class I and III drugs in ischaemic and non-ischaemic conditions. Scientists studied the inter-subject variability in response of the human ventricles to acute myocardial ischaemia. This study also showed the variability of the most important mechanisms during ischaemia, which may lead to arrhythmia at the single-cell level.



Computer modelling helped in understanding the role of the sodium inactivation gates affected by class I antiarrhythmic drugs. Both modelling and clinical data suggested that sodium channel availability plays an important role in the dynamics of acute ischaemia. The mechanisms of class III antiarrhythmic drugs were investigated during regional ischaemia in whole human ventricle simulations.

The results showed that antiarrhythmic effects of class III drugs were based on prolonged repolarisation, particularly in the normal tissue. At increased doses, pro-arrhythmic mechanisms became predominant. In addition, CARDIODEF evaluated a novel ECG-based biomarker to predict arrhythmic risk following administration of an antiarrhythmic drug (sotalol). Increased dispersion of restitution associated with an increased risk of arrhythmia was quantified from the body surface ECG.

"Both modelling and clinical data suggested that sodium channel availability plays an important role in the dynamics of acute ischaemia."

Overall, project results support the need for a dose-dependent evaluation of the safety and efficacy of antiarrhythmic drugs in patients with coronary heart disease.

CARDIODEF

- ★ Coordinated by the University of Oxford in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/169993_en.html

NOVEL TOOLS AND TECHNOLOGIES ENABLE THE PRODUCTION OF COMPLEX BIOLOGICS

An EU-funded consortium has set out to develop protein production tools able to match the sophistication and complexity of living organisms. The project unveiled promising results earlier this year and has already launched a spin-off company.

Over the past few years, research and development in the healthcare sector has been hampered by the difficulty in providing the increasingly complex biological specimens identified in assayable or druggable form. However, the toolkits developed by COMPLEXINC (New Technologies and Production Tools for Complex Protein Biologics) overcome this problem: they provide high-throughput assembly of complex biologics and metabolic pathways in eukaryotic expression systems, enabling micro- to large-scale production of high-quality protein specimens for drug discovery and bio-therapeutics.

‘Shortly after being developed, these toolkits proved their worth in unlocking protein assemblies which were hitherto inaccessible, including high-value complex targets such as influenza polymerase. The COMPLEXINC platforms have been disseminated and put to use in many laboratories worldwide, and resulted in scores of high-impact publications. Moreover, they have provided the SME partners in the consortium with numerous next-generation biologics, and a competitive edge,’ says Prof. Dr Imre Berger, Senior Investigator at Wellcome Trust and Coordinator of the project.

The toolkits include innovative next-generation HT DNA assembly pipelines for automated multigene expression construct generation, a superior synthetic viral genome, genetically engineered animal and yeast cell lines with unique capabilities with respect to protein maturation and modification, as well as novel methods for bioprocessing and integrated quality control. These are expected to help meet current and future demands in academic and industrial R&D, and ultimately drug discovery and new treatments for human diseases.

One of the early results, obtained through COMPLEXINC’s MultiBac technology — an advanced ‘Baculovirus expression vector system’ (BEVS) particularly tailored for protein complex production — includes the discovery of the

architecture of influenza C polymerase, which was recently unveiled in *Nature*. Recombinant influenza C polymerase was crystallised and one of the project teams at the University of Oxford determined its structure by X-ray diffraction methods. The crystal structure reveals a new conformation adopted by influenza polymerase in the apo state, complementing earlier crystal structure analyses of influenza A and B polymerases that were determined in the presence of viral RNA substrates.

Geneva Biotech: setting the benchmark

‘The next-generation tools developed in COMPLEXINC are already being validated commercially, not only by the partner SMEs but also in a number of pharma companies including globally operating TOP 10 enterprises. Applications include but are not limited to HCS, SBDD, multigene delivery, vaccinology, immune therapy, alternative scaffolds, and monoclonal antibodies,’ points out Dr Berger.

A spin-off high-tech SME has been set up to commercialise COMPLEXINC technologies, something that Dr Berger considers to be the most important success of the project. ‘Geneva Biotech was a COMPLEXINC spin-off with an exclusive license for the project’s intellectual property held by EMBL. Geneva Biotech sells toolkits, reagents and licenses for the production technologies created in COMPLEXINC. Moreover, it has an in-house drug discovery programme based on the project’s technology platforms in the area of Type 2 diabetes.’

The newly founded SME has already signed licenses with numerous biotech and pharma enterprises, including global TOP 10 players. This is to be added to the collaboration agreements signed by academic partners in COMPLEXINC with several of the leading pharma giants in Europe, which include co-developments in addition to contract research.

Geneva Biotech has signed licenses with numerous biotech and pharma enterprises, including global TOP 10 players. Collaboration agreements have been signed by academic partners in COMPLEXINC with several of the leading pharma giants in Europe. These agreements include co-developments in addition to contract research. ‘The founding of two further start-ups, each exploiting unique COMPLEXINC outcomes, is currently being evaluated,’ Dr Berger reveals.

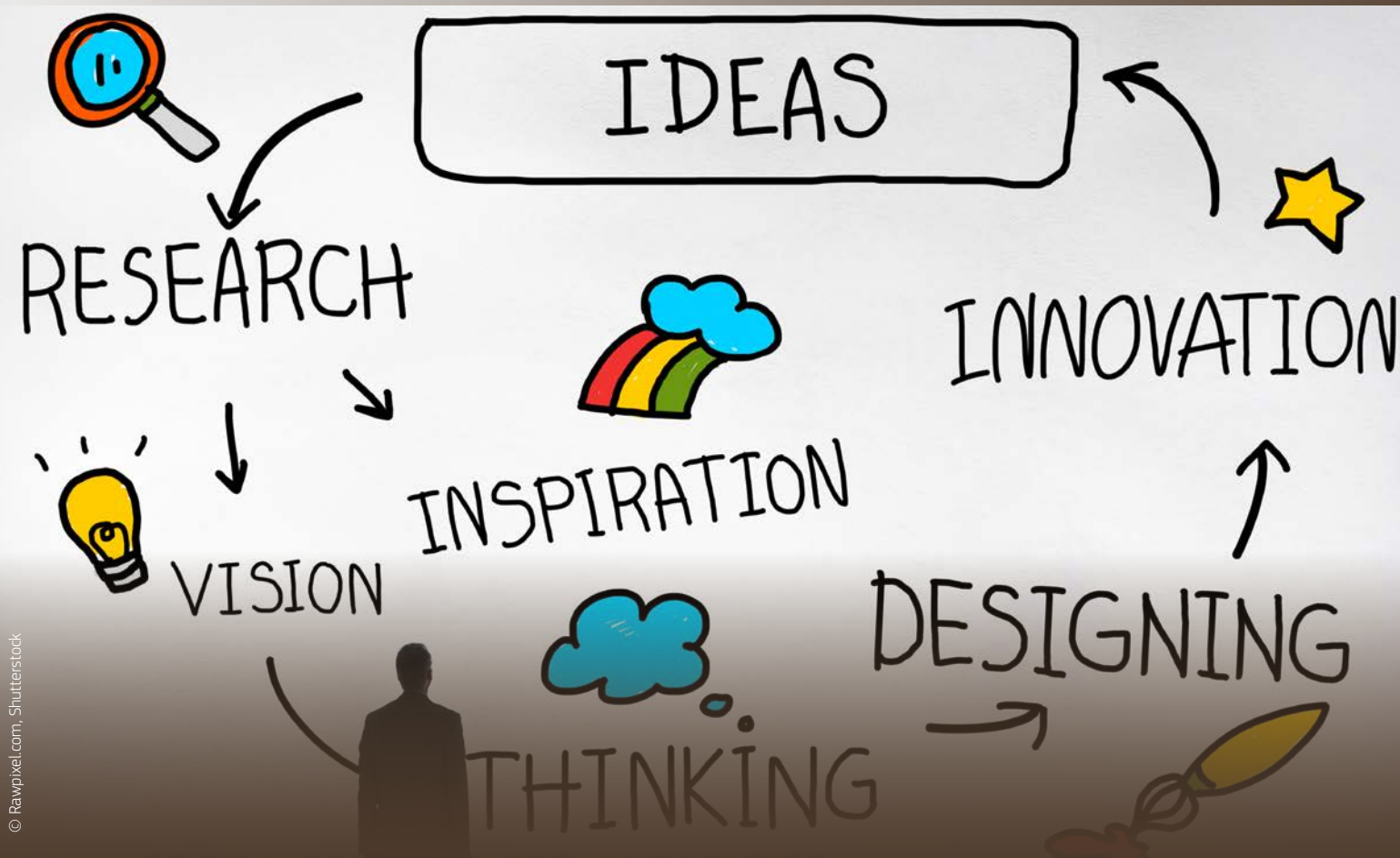
COMPLEXINC is set to have a dramatic impact on the availability of challenging proteins and protein complexes including those of human origin, with tailor-made properties specifically geared towards commercially available applications.



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COMPLEXINC

- ★ Coordinated by EMBL in Germany.
- ★ Funded under FP7-HEALTH.
- ★ http://cordis.europa.eu/project/rcn/102213_en.html
- ★ Project website:
<http://complexinc.eu>



SOCIAL SCIENCES AND HUMANITIES

POLICY BENEFITS OF RESEARCH

An EU team helped illustrate the policy applications of European research via a series of targeted publications. The intent was to improve policymaking with effective dissemination of Sixth and Seventh Framework Programme (FP6 and FP7, respectively) results and to foster policy dialogue.

While FP6 and FP7 research programmes produce considerable worthwhile results relevant to EU 2020 policy, certain communication gaps remain between researchers and policymakers. Reasons include ineffective dissemination and lack of standardisation for project data management.

The EU-funded FLASH-IT (Facilitating access to socio-economic research through information and communications technology) project intended to close the gaps. The aim was to contribute to evidence-based policymaking concerning EU 2020 priorities using effective dissemination of the Social Sciences and Humanities (SSH) programme results. A second goal was to facilitate science and technology policy dialogue. The five-member consortium ran between late 2011 and late 2014.

Team members collated policy-relevant research findings from approximately 100 FP6 and FP7 SSH-funded projects. Subjects addressed several broad themes including smart, inclusive and sustainable growth. From the findings, the project prepared a set of nine policy snapshot syntheses, highlighting government applications of the research.

Additionally, FLASH-IT prepared 21 policy research alerts. The monthly documents were similar to press releases, and highlighted newsworthy and policy-relevant angles of SSH research.

Such documents were distributed via email and hosted on the project website. The website also hosted hundreds of other project publications, including brochures, a poster and a five-minute video.

The group's extensive database was also accessible via the webpage.

The consortium hosted several thematic workshops which facilitated dialogue among relevant stakeholders. The purpose was to establish long-term communication and collaboration.

FLASH-IT increased the dissemination of results from around 100 SSH projects pertaining to EU policy. Such efforts helped achieve a better match between research and policy outcomes.

FLASH-IT

- ★ Coordinated by APRE in Italy.
- ★ Funded under FP7-SSH.

UNITING JUDICIAL CULTURE IN EUROPE

In-depth research on how new EU Member States bridge their judicial practices with those of the EU will help support institutionalisation and convergence of the judicial system Europe-wide.

The EU continues to grow, with several countries in south-east Europe such as Albania and Serbia expecting to join the bloc in the coming years. In such a context, it is crucial to examine the ‘constitutionalisation’ of the European judicial system and how each country’s reforms are influencing their judicial culture, particularly in south-east Europe. This was the aim of the EU-funded project EURJTC (Judicial training in European enlargement. Towards a common judicial culture?).

In more precise terms, the project team studied the relationship between judicial training and judicial culture in different

European countries. It assessed institutionalisation from five perspectives: transnational judicial networking, judicial training policies, judicial cooperation, dissemination of national judicial

decisions and knowledge management tools. Importantly, EURJTC also examined the role of national courts and judicial procedures to define a ‘judicial Europe’, focusing on sensitive topics not adequately discussed.

One such topic focused on preferring vertical communication (between European and national courts) over horizontal coordination (among national courts). Others included examining supremacy issues, underestimation of informal dialogue and neglecting the role of lower-level judges. Noteworthy as well was the issue of identifying preconditions for courts and



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judges to accept and effectively fulfil their European mandate in applying EU and local law.

Untangling these issues helps define EU justice policy and promote harmonisation of judicial practices, benefiting particularly those who develop and implement judicial training policies. The project’s results could also support policymaking at the level of EU Directorates-General such as DG Justice, DG Competition and DG Environment. Several conference papers and articles have emerged from the project, which will undoubtedly help stakeholders to further judicial research on a pan-European scale.

EURJTC

- ★ Coordinated by the Central European University in Hungary.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/169970_en.html
- ★ Project website: <https://eurjtc.wordpress.com/>

BRAVE NEW IDEAS ON REDISTRIBUTING WEALTH

Many multinationals are viewed in a negative light for siphoning wealth from economically disadvantaged countries. A new taxation regime could help redress the balance.



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The issue of international taxation is a crucial consideration in redistributing global wealth, but not enough research has been undertaken with respect to this complex topic. The EU-funded INTLTAXFAIRNESS (The use of international tax arrangements to promote global wealth redistribution) project aimed to address this shortfall in research. It based its work on the premise that more efficient use of international taxation is not only possible, but could also redistribute resources among nations more equitably.

In total, five key research papers on this pivotal topic emerged from the project. The first two papers, which could support legal scholars, economists and academics in advancing this

premise, focused on the concept as a whole and on normative issues. The publications show how the question of redistributions has not been adequately explored and propose a framework for analysing the potential distributive impact of international tax arrangements. They also argue that in

“In total, five key research papers on this pivotal topic emerged from the project.”

many cases wealth redistribution can be more effective than other balancing mechanisms such as international labour regulations, environmental laws and fair trade.

Beyond the two general papers, the project team produced three technical publications on taxation of multinational companies aimed at tax academics in public finance, accounting and law. Policymakers were also targeted, especially those interested in reforming their international tax system in line with global trends.

One technical paper focuses on the taxation of related party interest payments, proposing an efficient and cost-effective method for allocating multinational

enterprises' financial income. The second and third papers address how tax authorities should determine the location of income streams divided from intangible assets within a multinational group. The two papers propose alternatives to transfer prices and suggest that the income earned from certain types of intangibles be allocated via a cost-of-labour formula.

All five research papers could undoubtedly offer valuable insight not only to academia but also to the policymaking

process. If the redistribution of wealth is taken more seriously, particularly with respect to international taxation, it could potentially alleviate poverty in times of financial crisis.

INTLTAXFAIRNESS

- ★ Coordinated by the Hebrew University of Jerusalem in Israel.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/170023_en.html

THE CIVIC AND POLITICAL LIFE OF MUSLIM WOMEN

Researchers have studied the participation in European civic and political life of women of Muslim background, challenging assumptions of passivity. Empirical research was based on a comparison of Spain, France and the United Kingdom to uncover the group's different modes of participation and action, as well as enabling and/or constraining factors.

The EU-funded project POWER UNVEILED (Power unveiled: Muslim women participation in European civic and political life) endeavoured to understand more about how these women turn themselves into social actors.

In addition to conducting a review of the relevant academic literature, archive research helped amass important material in two areas: the three countries' structural and cultural frameworks, and associations and organisations where Muslim women were involved. Data collection involved in-depth, semi-structured interviews and participant observation

in community associations' events and activities.

Adoption of a sociological intervention approach produced valuable data on Muslim women's capacity for action and participation in civic and political

participation of Muslim women. The knowledge generated has implications for policymaking with a view to improved social cohesion through support for Muslim women's interests and needs. Indeed, their capacity for participation and contribution can be leveraged for better integration of Muslim populations in Europe.

POWER UNVEILED

- ★ Coordinated by EHESS in France.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/169971_en.html

"The initiative brought to the fore the high degree of political and civic participation of Muslim women in Spain, France and the United Kingdom."

engagement. This methodology gave a voice to the subjects and included them in the analysis of their situation and actions.

Project work advanced theoretical developments related to gender and political issues as well as to parameters of action, effectively expanding knowledge on a relatively little-studied topic.

The initiative brought to the fore the high degree of political and civic participation of Muslim women in Spain, France and the United Kingdom. Overall, it serves to challenge prevalent prejudices that attribute characteristics of passivity, subordination and a focus on the home that exclude them from public space.

POWER UNVEILED established a typology of Muslim women's participation, their modes of action and the arenas within which they use them. As such, project findings contribute to an enhanced understanding of civic and political



NOW ON CORDIS

Energy efficiency in buildings

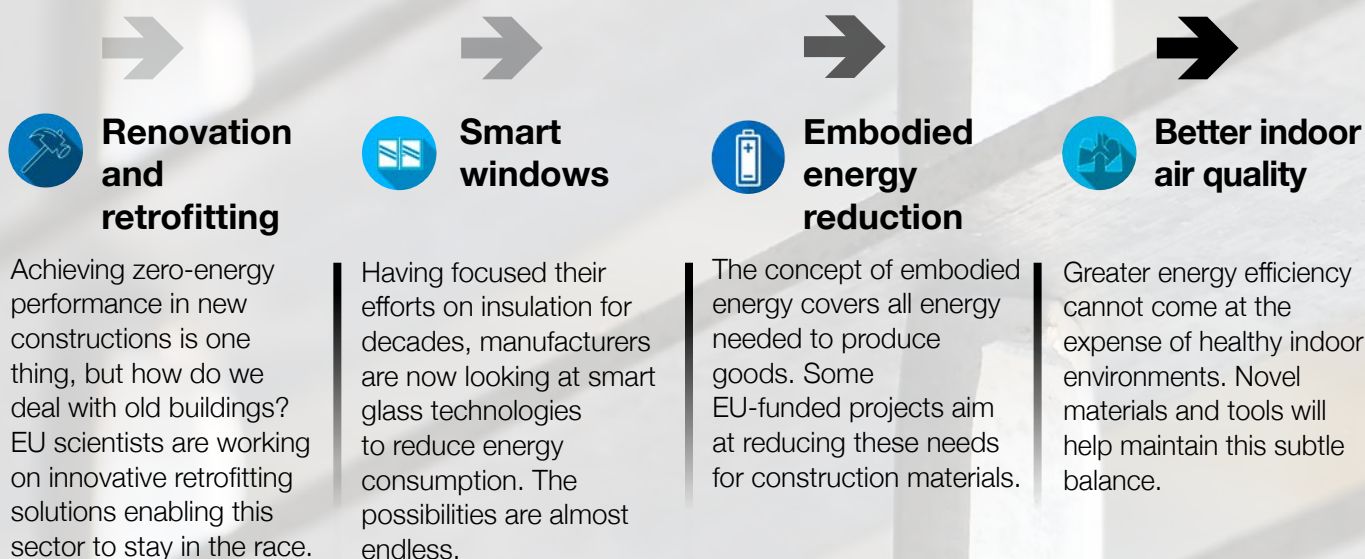
Close-up on a cutting-edge sector ahead of COP21

With the clock ticking on the Kyoto Protocol — which expires in 2020 — the world's eyes were on COP21 in early December. The global climate conference brought together some 195 delegations in the hope of signing a historic global agreement on climate change, with one ambitious objective: to sign up to a legally binding agreement capable of limiting the rise in global temperatures to 2°C above pre-industrial levels.

The European Union attended the conference as the undisputed leader in the fight against climate change. In October, Climate Commissioner Miguel Arias Cañete announced that the EU was already on track to beat its 2020 goal, slashing emissions by 24 % instead of 20 %. The other two key objectives of the EU's climate package, which include a 20 % share of renewables in the

energy market and a 20 % increase in energy efficiency, should also be met. As we wrote these lines, the EU had said it could even go further and agree to raise these objectives to 30 % depending on the outcomes of COP21. Such an ambitious goal is not a threat but an opportunity for industry across the EU. In the construction sector for example, which was severely hit by the recent economic crisis, it opens up a new market in which companies using the most sustainable and innovative products will get a piece of the energy-efficiency pie.

To celebrate COP21 and the construction sector's importance to both employment and growth in Europe, CORDIS released four ResultsPacks on 4 December 2015 showcasing the latest innovations aimed at the building and construction value chain.



About CORDIS ResultsPacks

CORDIS ResultsPacks are a new set of products grouping EU-funded project results per topic and target audience. The objective? Share information about new studies, scientific findings and technologies to the relevant target audience in order to increase take-up and knowledge across Europe.



ENERGY OUT OF THIN AIR

Lithium-air batteries could be the next big thing in the energy storage market, if it wasn't for their very short lifetime. An EU-funded project just so happens to have doubled it.

Since they were first commercialised in 1991, lithium-ion batteries have come a long way. The global market is expected to reach EUR 30 billion by 2019, with applications in almost every industry — from intermittent renewable energy storage devices to smartphones and electric cars.

But as the machines they power become greedier, engineers across the world have had to start looking into alternatives with a higher storage capacity. One of these alternatives resides in 'lithium-air' (Li-air) technology — batteries consisting of a metal-based anode and air-cathode which constantly extract oxygen from the ambient air.

'The main advantage of a lithium-air battery is its high energy density, which is theoretically 10 times higher than that of lithium-ion batteries,' explains Prof. Qiuping Chen, Associate Professor at the Polytechnic University of Turin and coordinator of the STABLE (STable high-capacity lithium-Air Batteries with Long cycle life for Electric cars) project. 'The biggest challenge, however, is to improve their lifecycle which was only 50 cycles maximum before the STABLE project.' This figure pales in comparison to that of lithium-ion batteries, which can reach from 400 to 1 200 cycles over their lifetime.

STABLE's objective was straightforward: increasing this capacity from 50 to 100–150 cycles and demonstrating this breakthrough in functional cells within three years, with the emerging market of electric car batteries in mind. 'The project is a complete success in this regard, with a life that has reached 151 cycles,' Prof. Chen says enthusiastically. 'Although the impact on car mile range per cycle largely depends on the energy density, dimension and quantity of battery cells, we expect it to be quite important.'

To get to this result, Prof. Chen and his team focused their research on the battery anode, cathode, electrolyte materials and technologies, as well as assembly techniques for batteries which play a central role in their performance, cost and environmental impact. 'We improved the lifetime and cyclability of Li-air batteries by different means. First, we found highly active bifunctional catalysts capable of effectively regenerating the battery. We then protected the lithium anode from dendrite formation using suitable membranes, and finished by increasing the stability of the electrolyte to enhance solubility of Li_2O_2 and avoid cathode clogging.'

Prof. Chen believes that the multidisciplinary nature of the consortium, with partners specialised in material sciences, electrochemistry, battery assembly design and others, is what made this success possible. And it should also contribute to its future commercialisation.

'This was an early-stage research project,' Prof. Chen concludes. 'We successfully reached our objectives but only validated these results at laboratory scale. We still have a lot of work ahead in order to bring our new batteries to the market, with challenges ranging from raw material production to the improvement of Li-air battery technologies and equipment.'

STABLE

- ★ Coordinated by the Polytechnic University of Turin in Italy.
- ★ Funded under FP7-NMP.
- ★ http://cordis.europa.eu/news/rcn/124022_en.html
- ★ Project website: <http://www.fp7-stable.com/>

PLANNING TRANSPORT SOLUTIONS FOR CITIES

Should governments plan locally or regionally to reduce vehicle use? The answer is both, though with priority given to the regional level, according to an EU study comparing urban form effects on vehicle travel at different spatial scales and contexts.



Growing urban sprawl means longer car trips, and this affects the sustainability of cities. Planning interventions in urban form (e.g. new urbanism, compact city) have been suggested as a possible way to reduce vehicle use. Research in this area runs along a spectrum from total focus on the local spatial scale to total focus on the regional spatial scale, with most studies falling somewhere in between.

“The underlying assumption is that people consider an acceptable travel time to spend on each trip they want to make as a factor that is incorporated in their travel decision processes.”

The Marie Curie project NEWCOMPACTISM (New Urbanism vs. Compact City: Investigation of the relationships between urban micro- and macro-scale effects on travel behaviour) explored the respective roles of local and regional characteristics of urban form on vehicle travel.

The main hypothesis of this research is that urban micro- and macro-scale characteristics exert complementary effects on vehicle trip frequency and ‘Vehicle kilometres travelled’ (VKT). This is due to the existence of two action spaces that individuals consider when they make travel decisions: the local (multimodal) action space, which is defined as the area that the typical walking, bicycle and public transport user can reach within an acceptable travel time for a one-way trip, and the regional (mono- or oligo-modal) action space, which complements the local action space and is dominated by automobiles. The underlying assumption is that people consider an acceptable travel time to spend on each trip they want to make as a factor that is incorporated in their travel decision processes. The researchers explored the hypothesis in two case studies in different spatial contexts: the San Francisco Bay Area in the United States and the Randstad area in the Netherlands.

Multilevel and ordered logit model results for the two case studies showed that the two urban-scale characteristics exert complementary effects on VKT, but not on vehicle trip frequency. However, because people in both areas display significantly lower

VKT in the local than in the regional action space for all trip purposes (work, shopping, social/recreation), it is concluded that regional-scale interventions are more important for the policy objective of VKT reduction, although local-scale design policies might also contribute to achieving this policy goal. Node density and block size (for the local action space models) and regional job accessibility (for the regional action space models) demonstrated the strongest and most significant relationships with VKT. Moreover, results from 36 in-depth interviews conducted in Berkeley, California, and Delft, the Netherlands, as part of this research supported the validity of the concept of acceptable travel time.

In conclusion, evidence from this research suggests that we promote planning on both spatial scales, though with priority given to the regional level to make VKT reduction policies more effective.

NEWCOMPACTISM

- ★ Coordinated by Delft University of Technology in the Netherlands.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150593_en.html

INSTANT WATER HEATER OFFERS ENERGY AND COST SAVINGS

An EU-funded water heating innovation could transform the vending industry and provide significant energy savings for factories, offices and homes.

Traditional water heaters take time to reach the desired temperatures, thus wasting water and energy. A new instant hot-water solution, developed through the EU-funded RAPIDHEAT (The development of a high power density RAPID response on demand water HEATING technology) project, successfully optimised heating and control technologies to develop a lightweight, low thermal-mass heater that provides full temperature output within two seconds of switching on.

'Here in Britain we drink approximately 165 million cups of tea per day, along with 70 million cups of coffee,' says RAPIDHEAT project coordinator Peter Duncan from Cressall Resistors in the United Kingdom. 'That's a lot of hot drinks and a lot of hot water. Many of us rely on vending machines and those who do know the difference between a coffee that has been made with freshly boiled water and one that contains pre-heated water.'

In addition to vending machine suppliers, white goods (domestic appliance) manufacturers and hot water tap providers also stand to benefit from the innovation. An instant hot water solution installed in the home offers customers a water- and energy-saving solution: as Duncan points out, the average United Kingdom household wastes 24 litres of water a day waiting for the shower to heat up. 'That's five per cent of your water bill that you're pouring down the drain,' he adds.

The high power density of the RAPIDHEAT solution also means the heater is smaller and lighter than other technologies on the market, which makes it useful for applications where space is limited, such as in the home. The consortium was keen to ensure that the heater would be protected from dust and water infiltration, enabling it to be installed in a variety of environments ranging from the home to the office and the factory.

Another advantage is that by removing the need for hot water reservoirs — the heater does not use a supply of pre-heated water — the heater cannot run out. Water heaters capable of producing large volumes of 'instant' hot water are needed in many commercial, industrial and public

buildings and also in process and manufacturing industries that have intermittent demands for large volumes of hot water. These are cases where peak demand for hot water is many times the average, and the cost of heat losses from the hot water stored to meet that demand can be significant.

'There are a number of applications that the team simply did not foresee at the outset of this project,' says Duncan. 'How we should take this opportunity forward is currently under discussion, and we are now looking for partners interested in developing the project further and integrating the technology into applications that require instant hot water.'

The project was officially completed at the end of August 2015, and the project consortium has since compiled a one-page guide explaining the space, heat and energy savings that can be made by installing the RAPIDHEAT instant hot water technology.

RAPIDHEAT

- ★ Coordinated by Cressall Resistors in the United Kingdom.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/news/rcn/124042_en.html
- ★ Project website: <http://www.rapidheat.eu/>



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GENERATING SMALL VORTEXES AT LARGE AEROFOIL SURFACES

Active control of air flow over large moving structures can significantly improve behaviours in targeted applications. Advanced vortex generators will modify air flow over helicopter or wind turbine blades to increase the efficiency with which they do their jobs.

Adjusting air flow over helicopter blades can decrease drag, reducing fuel consumption and emissions. In the case of wind turbine blades, active flow control can significantly increase the efficiency of power generation.

The EU-funded STA-DY-WI-CO (Static and dynamic piezo-driven streamwise vortex generators for active flow

control) project exploited numerical simulation and experimental validation to develop active flow control technology for such applications.

Vortex generators are small devices placed on aerofoils to create swirling motions at the boundary layer (close to the aerofoil surface) to prevent flow separation (when the flow is

unable to follow the surface). The team focused on a vortex generator based on a microelectromechanical systems actuator of a piezoelectric membrane. Piezoelectric materials produce a physical displacement in response to an applied electric signal.

Preliminary numerical models facilitated the design of two actuators; the

vortex generators were then tested in wind tunnel tests. Experimental outcomes confirmed the potential to reduce flow separation. Given the very light weight and low energy consumption of the piezoelectric actuators, their potential to reduce drag and fuel consumption is very high.

“Given the very light weight and low energy consumption of the piezoelectric actuators, their potential to reduce drag and fuel consumption is very high.”

Researchers also conducted acoustic and flutter analysis, the latter relating

to rapid and irregular motion of the helicopter blades creating dynamic instability. Simulations proved the ability of an acoustic analysis tool to capture near-field sound wave propagation and use it to locate major contributors to noise level. Advanced flutter analysis based on computational fluid dynamics confirmed that ineffective flow control leads to unstable flutter, shortening the lifetime of the blade.

In additional investigations, a rotating machinery test stand was used in conjunction with numerical models to evaluate the structural dynamics of non-linear systems. As a result, the team identified non-linear damping and stiffness characteristics.

All models of subcomponents were integrated on a numerical platform

and implemented on a powerful supercomputer.

The STA-DY-WI-CO project has delivered an active flow control technology together with a powerful multi-physics simulation code for designers of next-generation aircraft and wind turbine blades. The technologies will reduce fuel consumption, emissions and noise associated with helicopter flight, and increase the efficiency of power generation.

STA-DY-WI-CO

- ★ Coordinated by the Szwedowski Institute of Fluid-Flow Machinery in Poland.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/170009_en.html
- ★ Project website: <http://stadywico.eu/>

MAXIMISING ROAD SAFETY RESEARCH TO KEEP MOTORISTS SAFE

With Europe aiming for zero road deaths, road safety research can play a key role in this ambitious goal. An EU initiative has delivered a roadmap that sets clear priorities for road safety research, and helped to improve networking among all relevant stakeholders.

In spite of recent improvements, road accidents still kill on average 80 Europeans each day, with thousands more severely injured. Europe aims for a complete end to such casualties, but achieving the goal will require intensified research and prioritisation.

The EU-funded PROS (Priorities for road safety research in Europe) project set out to create a European network to establish road safety research priorities. Overall, the aim was to deliver a concrete roadmap and improved networking among stakeholders.

Work started with a review of societal trends and scenarios that affect road safety research. Project partners gathered and analysed approximately 30 current national, EU and global research agendas and examined the state-of-the-art in existing road safety research activities at EU and national levels.

Based on this, the team identified gaps in existing research and prioritised related research topics with the assistance of various stakeholders. As a result, about 120 experts from over 40 organisations helped deliver a roadmap for the future of European road safety. It contains 11 prioritised research topics to assist policymakers in defining Horizon 2020 calls.

A pan-European network was set up to develop long-term joint priorities in road safety research and overcome existing fragmentation among related stakeholder groups.

Finally, project members devised a plan for dissemination, specifying the target audience and tools required. More than 20 presentations were delivered on the work, at either conferences or other meetings.

PROS developed a list of priority research topics for road safety, paving the way for safer and more sustainable road transport.

PROS

- ★ Coordinated by fka in Germany.
- ★ Funded under FP7-TRANSPORT.
- ★ http://cordis.europa.eu/result/rcn/151517_en.html
- ★ Project website: <http://www.pros-project.eu/>



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GREEN ELECTRICITY FROM LOW-TEMPERATURE HEAT

EU-funded scientists successfully developed a system that generates electricity from low-temperature waste heat ranging from 60 to 120 °C. Harnessing low-grade heat should help to significantly mitigate the negative environmental impact of industrial plants.

The manufacturing sector is vitally important to the EU economy. With 'Small and medium-sized enterprises' (SMEs) representing 99 % of the sector, manufacturing contributes around 17 % of EU gross domestic product and accounts for 22 million jobs. Being resource-intensive in terms of both raw materials and energy consumption, SMEs are under increasing pressure to remain competitive against non-EU-based companies.

Funded by the EU, the project ICARUS (An innovative, environmentally friendly CO₂/lubricant absorption power system for highly efficient power generation from low temperature industrial waste heat to reduce emissions and costs) successfully developed a 5-kW prototype system that provides cost-effective heat recovery,

reducing electricity demand and 'carbon dioxide' (CO₂) emissions.

After exploring end-user requirements for the system, scientists developed thermodynamic models to evaluate the most suitable working fluid in terms of system efficiency and operating pressure. In addition, they identified a suitable expander that generates the electricity as the working fluid passes through it.


The heat from the waste heat stream is transferred to an absorption system. An absorption power generation system achieving the cost and power requirements for low-temperature heat recovery would be a real breakthrough in the industries. The system developed enables electricity to be generated from industrial waste heat without affecting industrial processes, with conversion efficiency up to 20%.



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Project work laid the groundwork for follow-up projects to design innovative technology such as a 20-kW organic Rankine cycle system for commercial use. This unit should reduce CO₂ emissions by approximately 90 tonnes in the United Kingdom and 120 tonnes in Greece.

ICARUS

- ★ Coordinated by European Thermodynamics in the United Kingdom.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/result/rcn/170008_en.html
- ★ Project website: <http://www.icaruspower.eu/>
- ★  <http://bit.ly/1L6zEQA>

ADVANCED MATERIALS FOR EFFICIENT JET ENGINES

An EU-funded project has worked on improving the design and processing of jet engine parts. The optimised materials should be able to endure very high temperatures.

The aviation industry is increasingly looking to geared turbofan engines for more efficient flights. Innovative materials with optimised mechanical and physical properties will result in major cuts in fuel consumption and harmful emissions.

Geared turbofan engines may induce very high temperatures in some areas of the turbine and the engine casing and mount. The EU-funded project HITNIFO (Development

of an advanced design and production process of high temperature Ni-based alloy forgings) was initiated to produce high-performance materials at low cost by improving

processes and thereby overcoming issues related to poor forging and welding possibilities.

Project partners selected promising materials for the casing and mount based on nickel alloys for use in high temperatures. Firstly, they conducted annealing trials to investigate changes in microstructure properties due to time and temperature. The trials were also used to identify the main impact on mechanical properties such as yield strength, elongation and stress rupture.

After designing and simulating the closed die forging process and producing dies, project partners evaluated the impact of the process on the forging microstructure and mechanical properties. Other activities included flow stress measurements at seven different temperatures and two different strain rates, and measurement of heat capacity and thermal conductivity.

Results provided the basis for finite element simulations of material residual stress. In particular, project partners performed simulations with different mesh densities to estimate the residual stress distributions in components of complex geometry. Simulations were then compared with experimental results.

HITNIFO opens the way to developing engines with higher exhaust temperatures and therefore higher efficiencies. Use of the optimised nickel-based alloys should see a decrease in the engine and therefore aircraft weight, and lead to decreased fuel consumption.

HITNIFO

- ★ Coordinated by Boehler Forging in Austria.
- ★ Funded under FP7-JTI.
- ★ http://cordis.europa.eu/result/rcn/170019_en.html

"Results provided the basis for finite element simulations of material residual stress."

“DYNAMIC is expected to have a significant impact because it will develop a roadmap for future research on the economics of climate change impacts and adaptation.”

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ENVIRONMENT AND SOCIETY

ECONOMIC CONSEQUENCES OF CLIMATE CHANGE

Different regions and economic sectors are dealing with the impact of climate change in different ways. A framework to optimise these responses under different scenarios has been developed under the auspices of an EU-funded initiative.

The DYNAMIC (Dynamic feedbacks of climate impacts on current adaptation and mitigation investment choice) project developed and tested a new framework for estimating the impacts of climate change on various sectors of the economy at the global scale. The process involved the creation of a database of relevant climate change impacts and responses.

The project's ultimate aim was to develop new impact assessments capable of being incorporated into the integrated assessment models used in climate policy analysis. Researchers characterised climate change damages within different sectors considering mitigation and adaptation responses. They found that the agriculture and energy sectors had the most data available to allow response modelling for a large number of countries.

Team members were then able to estimate the response of cereal productivity in tropical and temperate regions to

global rain and temperature variations. They also looked into cereal exposure and vulnerability, and the different responses of irrigated versus rainfed grains.

One output of the project's work in the agricultural sector was a database of productivity shocks for different warming scenarios through to 2050. It covers 163 countries and seven cereals (irrigated wheat, rainfed wheat, irrigated rice, rainfed rice, irrigated maize, rainfed maize and rainfed sorghum).

For the energy sector, researchers assessed climate change impacts on the energy demand from different economic sectors (residential, industrial, commercial, agricultural) and on the energy supply from hydropower. Here, the focus was on temperature, humidity and, in the study on hydroelectricity, extreme events such as droughts, as well as changes in runoff.

DYNAMIC is expected to have a significant impact because it will develop a roadmap

for future research on the economics of climate change impacts and adaptation. The project will initiate a process that is ultimately aimed at determining the global damage-adaptation-mitigation relationship, but at the sector level (for example, agriculture and energy).

The main beneficiary of this research is the integrated assessment modelling community. This is because DYNAMIC's ultimate objective is to develop improved estimates of impacts and adaptation, which can be used to inform climate policy analysis and decision makers. The framework will also pave the way for the development of vulnerability maps, thereby directly informing policymakers and practitioners of climate change mitigation.

DYNAMIC

- ★ Coordinated by FEEM in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/151489_en.html

DATA MANAGEMENT FOR WASTEWATER TREATMENT

'Wastewater treatment plants' (WWTPs) must handle large amounts of data from different sources and of varied quality, making it difficult for operators to identify the plant's status. An EU initiative has addressed this problem by enabling all available data to be successfully managed.

The EU-funded DIAMOND (Advanced data management and informatics for the optimum operation and control of wastewater treatment plants) project was established to enhance the operation of WWTPs. This was achieved through the efficient, intelligent and continuous management of available plant data, as well as process performance monitoring and automatic control strategies.

Currently, a number of software tools are used to aid decision-making in the day-to-day running of WWTPs and help maintain them at an optimum level. The information used

"DIAMOND outcomes will enable WWTPs to improve their operations, minimise waste (thereby protecting water quality) and reduce energy consumption."

comes from a range of sources, including online sensors and analysers, laboratory tests, meteorology data and manually collected data.

Complex decisions must therefore be based on a large

number of variables, which come in different formats. Successful operation depends on the reliability and completeness of collected data, together with the quality of the information extracted and its accessibility.

The DIAMOND project involved the standard centralisation of heterogeneous data acquired from different sources, plus effective data processing to detect faulty sensor data. The resulting information was used in tools focused on operational optimisation of the plant.

Project partners developed the advanced data management platform (ADAM tool) to ensure the provision of high-quality data. This tool facilitated the straightforward connection and implementation of advanced process monitoring and control tools, enabling the optimisation of WWTP operations around the world.

The ADAM tool includes additional modules that calculate estimated values for unmeasured parameters and calculate and monitor plant-wide key performance indicators, showing a WWTP's status. Researchers also examined the design,

development and implementation of two advanced plant operation systems based on information provided by the ADAM tool.

The first system was an advanced monitoring system of plant-wide key performance indicators. The second system was an advanced control system based on plant-wide control algorithms, which optimises plant operations according to economic and environmental criteria.

DIAMOND outcomes will enable WWTPs to improve their operations, minimise waste (thereby protecting water quality) and reduce energy consumption. Moreover, the knowledge gained will help Europe become a leader in sustainable wastewater treatment processes.

Potential customers for DIAMOND include public bodies and environmental engineering, automation engineering and sensor manufacturing companies.

DIAMOND

- ★ Coordinated by Mondragón Sistemas de Información in Spain.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/result/rcn/152075_en.html
- ★ Project website: <http://www.diamond-eu.org/>



HOW BIRDS AND MAMMALS PROCESS SOUND

Birds and mammals rely on their sense of hearing to locate prey and escape predators. An EU-funded project set out to explain how sound processing occurs in natural environments.

Previous work in this area used tones or white noises not usually encountered in the natural world. The NONSTATENCODING (Intensity and timing encoding of naturalistic sounds in auditory brainstem neurons of cats and owls) project analysed auditory responses to natural, non-stationary sounds.

The first part of the project involved recording the response of the barn owl's cochlear nucleus to different kinds of sounds. Researchers collected responses to sounds of different intensities from more than 75 cells.

Scientists also analysed *in vivo* (from animals) and *in vitro* (from cultured

cells) auditory nerve data collected by other scientists. From this information, scientists developed a model to explain processing differences between the auditory nerve and the cochlear nucleus.

Their results revealed that the cochlear nucleus processes auditory information more efficiently than the auditory



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nerve does. These differences can be attributed to a single-cell mechanism, called spike threshold adaptation, which filters auditory information more selectively.

These findings were corroborated by information collected from the cochlear nucleus of cats. The cochlear nucleus showed a robust response to auditory information of varying intensities.

NONSTATENCODING results have had a significant impact on how scientists now understand the auditory processing of realistic stimuli. As well as providing fresh scientific insights, project

results will help in the design of improved auditory prosthetic devices and other technological applications.

The project's success clearly demonstrates the need for engineers creating innovative concepts in signal processing and in biomedical devices to cooperate closely with neuroscientists.

NONSTATENCODING

- ★ Coordinated by KUL in Belgium.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/148954_en.html

TREE RINGS REVEAL CLIMATE HISTORIES

An interdisciplinary EU-funded initiative has successfully addressed crucial questions regarding climate change by analysing different tree-ring parameters and applying different statistical approaches.

The aim of the project TREE-RINGS & CLIMATE (Temporal instability of tree-ring/climate relationships: Tree responses to climatic change and implications for paleoclimate research) was to provide a greater understanding of the relationship between tree rings and climate. This important issue has potential implications for the global carbon cycle, forest growth patterns and climate change reconstructions.

Project partners evaluated two areas of uncertainty over time found in Boreal and Iberian forests, termed the divergence problem and climate stress strength. New approaches were used to understand and attribute their causes and their implications for climate research.

The first approach used a network of tree-ring chronologies to assess climate change impacts on forests and assess their response to future climate change conditions. Approach two explored stable isotopes as a possible key to the divergence problem. The third approach developed more reliable reconstructions of past climates using tree-ring parameters (width, density and stable isotopes) and non-tree-ring archives to reduce uncertainties in climate reconstructions.

Results showed that tree-ring analyses can provide a look back in time, from several centuries to millennia, with a resolution at the annual scale. Project partners analysed different tree-ring parameters and applied different statistical techniques to improve tree-ring models and growth model predictions.



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TREE-RINGS & CLIMATE will advance scientific knowledge on the interactions between the biosphere, ecosystems and human activities. By studying interactions between climates and forests, researchers were able to determine forest responses to a changing climate and extract the climate 'signal' contained in tree rings. The project therefore provided valuable expertise on tree growth and how to reduce uncertainties in the reconstruction of past climates.

The project will help to quantify local impacts of climate change in one of the most sensitive regions of Europe (the Iberian Peninsula) and worldwide (Boreal region), supporting further initiatives. In addition, the work conducted on climate change processes and impacts on natural resources will help to identify and assess key drivers and improve understanding of their interactions.

"Results showed that tree-ring analyses can provide a look back in time, from several centuries to millennia."

TREE-RINGS & CLIMATE

- ★ Coordinated by IC3 in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/170026_en.html

IT AND TELECOMMUNICATIONS

NANOTECH TOOLS OPEN MARKET FOR MORE MINIATURE ELECTRONICS

New methods for mass producing ultra-miniature capacitors could lead to new innovations in sectors ranging from medical tools to aeronautics.

In order to develop ultra-miniaturised electronic components, ultra-miniaturised capacitors are required. The two-year EU-funded PICS (Development of innovative ALD materials and tools for high density 3D integrated capacitors) project has developed tools that could soon lead to the mass production of high-density 3D integrated silicon capacitors, creating new opportunities for SMEs to tap into demand for miniaturised high-performance electronics across a range of sectors.

Capacitors are found in electronic components. Their role is to deliver power from a single source (such as a battery) — at the correct voltage level — in order for the component to carry out its different functions. Capacitors also protect electronic components against voltage jumps.

There is increasing demand from numerous high-growth, high-value sectors, such as the medical, automotive, personal electronics and aeronautics sectors, for applications based on smart and miniaturised sensors. These applications require electronic modules where size, reliability and performance are of equal importance.

The key long-term objective of the project, which was completed at the end of August 2015, was to establish a cost-effective industrial solution for developing ultra-miniaturised capacitors. Three SMEs joined forces with two research institutes in order to target the specific needs of end users such as the aeronautics and medical instruments industries. Thanks to these partnerships, financial viability was assured by focusing on the need for mass production.

Nanomedicine is another sector that is rapidly progressing from being primarily research-oriented to delivering measurable results and benefits to patients. The PICS consortium sought to develop high-end integrated capacitors for medical applications, along with the future DRAM market (DRAM is a type of random accessible memory used in various electronic devices such as

PCs, smartphones, music players, laptops, netbooks and tablets). The next step will be to commercially exploit the production innovations developed throughout the project.

A second long-term objective of the project was to boost the potential of European SMEs operating within a high-value sector that promises significant growth potential. All three SMEs involved in PICS have benefited through the development of industry contacts and achieved a better understanding of end-user needs. The project SMEs were also able to outsource some of their research in order to acquire cutting-edge technological know-how, which will enable them to better exploit their findings in the market place.

In terms of technological innovation, the project developed innovative 'Atomic layer deposition' (ALD) materials and tools to facilitate the mass production of high-density and high-voltage capacitors. ALD is a nanotechnology that allows ultra-thin films of just a few nanometres to be deposited in a precisely controlled way. This offers many benefits in semiconductor engineering. The tools developed by the PICS consortium enable 3D structures to be arranged.

A new process for accurately etching nanomaterials was also demonstrated by one of the SMEs, in collaboration with a leading research institute. This technique could be of interest for a number of different applications such as LED lighting and magnetic data storage.

PICS

- ★ Coordinated by IPDIA in France.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/news/rcn/124221_en.html
- ★ Project website:
<http://www.fp7-pics.eu/>

SMART SENSING SYSTEM FOR SINISTER SMELLS

Researchers have created an information system that crowd-sources information about odours that are troubling citizens. The development will help to better mitigate these public annoyances.

Industry and agriculture are responsible for producing unpleasant odours that can trouble citizens in urban areas. It is important, therefore, to understand how citizens are affected by bad smells in their communities.

The EU-funded project OMNISCIENTIS (Odour monitoring and information system based on citizen and technology innovative sensors) has made significant inroads in this regard, with the aim of mitigating odour annoyance.

To begin with, OMNISCIENTIS documented the ideal specifications for odour measurement, dispersion modelling and information technologies. In parallel, the needs and expectations of citizens, regulatory authorities and industrial bodies were taken into consideration.

Citizens provided feedback on odour acceptability levels through smartphones. Over 5 000 observations were made, and this information was combined with measurements from e-noses and odour dispersion models.

Two *in situ* e-nose sensors and a meteorological station were installed as a



pilot in an industrial site in Belgium. Eighteen industrial parameters were collected in real time, and 15 odour field surveys have been conducted to understand odour sources and characteristics.

Based on this data, project members developed a prototype Odour Information System that produces statistics and impact levels for local authorities, and allows citizens to give feedback. The mobile application is

now operational and used by some 20 guards around the Belgian test site.

Researchers adapted an existing pollutant dispersion model to develop a fast odour dispersion modelling system using real-time meteorological and industrial emissions data. The model was validated with the odour emission rates, along with electronic and citizen observations.

The OMNISCIENTIS project has used smart technology to advance odour data collection practices and make it easier for local authorities to manage odour problems. One of the new earth observation systems can be seen in the project video link below.

OMNISCIENTIS

- ★ Coordinated by Spacebel in Belgium.
- ★ Funded under FP7-ENVIRONMENT.
- ★ http://cordis.europa.eu/result/rcn/151373_en.html
- ★ Project website: <http://www.omniscientis.eu>
- ★ <http://bit.ly/1BITGNg>

FREE, OPEN SOURCE SOFTWARE TO SEE EARTH FROM ABOVE

'Earth observation' (EO) satellites populate massive and ever-growing remotely-sensed data archives, but there are no standard tools for extracting and analysing useful information. An EU-funded project has developed free/open source software solutions to fill this gap.

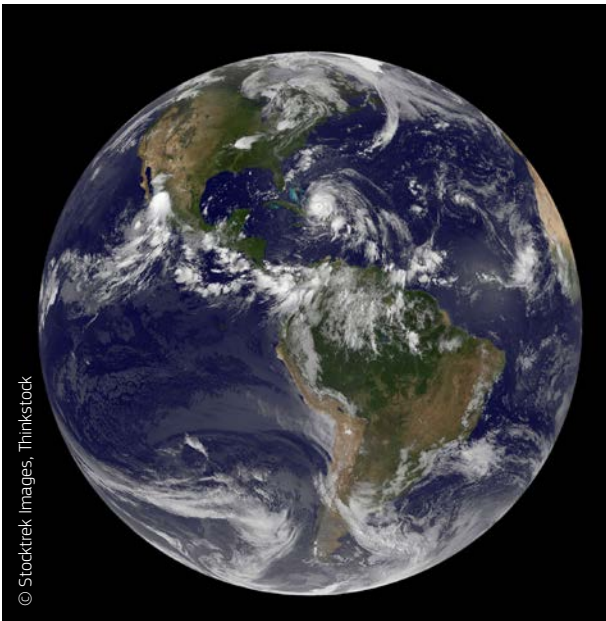
The shortage of widely accepted software tools for effective extraction and analysis of information from the exponentially increasing volume of EO data has led to off-the-shelf solutions. Many in the remote sensing community also design their own tools without sharing them with the wider community. The EU-funded project TOLOMEO (Tools for open multi-risk assessment using Earth observation data) was initiated to promote international cooperation for the development of free/open source software solutions. Partners in Europe and South America joined their efforts to offer the means to analyse and assess multiple risks.

"Researchers have developed tools for assessing human exposure to deforestation risks, earthquake vulnerability, flood vulnerability and many others."

With a focus on robustness, ease of use and adaptability, the TOLOMEO team developed techniques for mapping human settlements. Nowadays, most of the population lives in urban areas, and threats to human lives such as man-made and natural disasters are increasingly perceived as sources of losses in urban areas.

With urban areas and their specific features as input information, researchers have developed tools for assessing human exposure to deforestation risks, earthquake vulnerability, flood vulnerability and many others. The efforts involved gathering sample data to validate the tools developed.

The research work of the TOLOMEO partners has now been completed, and the final version of the tools released to the public. Technical guidelines and connection chains have also been defined for the software parts to create a seamless package.



All of these milestones were accomplished by using the expertise that each of the TOLOMEO partners possessed in software development. In particular, extensive staff exchanges over the lifetime of the project saw vital feedback gathered and used to enhance the tools' designs.

TOLOMEO solutions are expected to help the European remote sensing community to make the most of the wealth of EO data available. Thanks to TOLOMEO, Europe has also established additional channels for continuous cooperation with South America, where Brazil is one of the major players in the exploitation of EO data to support environmental management.

TOLOMEO

- ★ Coordinated by the University of Pavia in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/91703_en.html

THE COMPLEX ROAD TO MORE WIRELESS BANDWIDTH

The increasing demand for wireless devices and equipment is eating up available bandwidth at a faster rate than ever. Improved technologies in the field could help overcome the challenge.

In recent years, the explosion of wireless communication for mobile telephony, radio, television and of course the internet has rendered available bandwidth scarcer than ever. The solution to exploiting bandwidth more efficiently lies in combining modulation and coding — i.e. manipulating the carrier signal in smarter ways. This was the aim of the EU-funded B-FUN (Bit-interleaved coded modulation: Fundamental understandings) project.

Specifically, the project focused on 'Bit-interleaved coded modulation' (BICM), considered the cutting-edge standard in the field. While more research is required to fully unveil the complexities of BICM, the technology has already begun making its way into different communication applications from mobile telephony to digital video broadcasting. Indeed, BICM is expected to become the most popular future telecommunications standard.

achieve the best possible performance. In more technical terms, it exploited mathematical models and simulations to study the asymptotic performance of achievable BICM rates in high and low signal-to-noise ratio environments.

The project team made considerable progress in this respect and disseminated its results through a number of key journals, university talks, global conferences and online sources. Expected benefits include in-depth insight into the latest coding and modulation systems in the tele-

communications industry and improved designs of BICM systems. This is expected to lead to advanced communication systems in order to overcome the decrease in bandwidth and take wireless communication to the next level.

B-FUN

- ★ Coordinated by the University of Cambridge in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/169919_en.html

"The project focused on 'Bit-interleaved coded modulation' (BICM), considered the cutting-edge standard in the field."

In this context, B-FUN evaluated maximum transmission rates in order to improve the design of BICM systems and



INDUSTRIAL TECHNOLOGIES

DESIGNS FOR LHC UPGRADE PRESENT HIGH-TECH OPPORTUNITIES

Completion of the design phase to upgrade the Large Hadron Collider (LHC) is a boost for physicists and a chance for Europe's high-tech sector to capitalise.

Designs to upgrade the LHC in Switzerland in order to boost the accelerator's discovery potential have been completed. Thanks to the EU-funded HILUMI LHC (FP7 High Luminosity Large Hadron Collider Design Study) project, industrial prototypes for various parts of the accelerator can now be developed before the construction phase begins in 2020 or thereabouts, with the end goal of increasing the facility's luminosity by a factor of 10.

Completion of the design phase has created new opportunities for Europe's high-tech industries to bid for contracts worth an estimated EUR 300 million during the second half of this decade. The success of the project has also firmly established the European Research Area as a focal point for global research cooperation and a leader in frontier knowledge and technologies.

The LHC is the world's biggest and most powerful particle accelerator. Built under the Swiss-French border by the European Organisation for Nuclear Research (CERN), the LHC is a giant circular underground tunnel some 27 kilometres long, designed to carry out complicated particle experiments to better understand the universe.

Greater luminosity will enable the accelerator to carry out a larger number of particle collisions, increasing the chances of physicists identifying a particle or process that they have not seen before. Once completed, for example, the High-Luminosity LHC will produce 15 million Higgs bosons per year, compared to the 1.2 million in total created at the LHC between 2011 and 2012. Scientists will also be able to observe rare processes that occur below the current sensitivity level of the LHC.

As a highly complex and optimised machine, the LHC requires an upgrade involving careful study and planning. Starting in November 2011, the HILUMI LHC project brought together a large number of laboratories from CERN's member states, as well as from Russia, Japan and the United States, in order to investigate the potential of new cutting-edge technologies. In total, some 200 scientists from 20 countries collaborated during the four-year design phase, which was officially completed at the end of October 2015.

The upgrade will involve several breakthrough technologies that are currently under development. A total of 1.2 km of the LHC will be replaced, with new

superconducting magnets installed. These will help to focus the beam, increasing the probability of collisions occurring. Brand new superconducting radiofrequency cavities — called crab cavities — will also be used to orientate the beam before collisions in order to increase the length of the area where the beams overlap.

The HILUMI LHC project team also studied cryogenic cooling for different electrical components. A test station for measuring superconducting cable for use in high-current cables was also set up. 'We have to innovate in many fields, developing cutting-edge technologies for magnets, the optics of the accelerator, superconducting radiofrequency cavities and superconducting links,' explains Lucio Rossi, Head of the HILUMI LHC project.

HILUMI LHC

- ★ Coordinated by the European Organisation for Nuclear Research in Switzerland.
- ★ Funded under FP7-INFRASTRUCTURES.
- ★ http://cordis.europa.eu/news/rcn/124266_en.html
- ★ Project website: <http://hilumilhc.web.cern.ch/>

ECO-FRIENDLY ALUMINIUM COATING PROCESS

Hexavalent chromium use has now been highly restricted and in some cases banned given its proven hazards and known carcinogenic activity. Researchers have recently developed a corrosion protection process for the aerospace industry that does not require its use.

Surface finishing is critical to the stability and performance of numerous metals in a variety of applications. Electroplating using hexavalent chromium has been the treatment of choice for parts in harsh environments, but the aerospace industry must now find an eco-friendly alternative. Europe has led the way both in restricting use to protect health and the environment and in finding alternatives to support the competitiveness of its industries. The EU supported the project VALIDATETSA (Validation of TSA coating technology. Development of procedures and standards manual. Technical and economical study) to strengthen the position of the promising alternative 'Tartaric sulphuric acid anodising' (TSA) for aluminium alloys in the aircraft industry.

"The detailed manufacturing plan and manual of process procedures and standards delivered will enable increased use of lightweight aluminium alloys in harsh environments."

In TSA, tartaric acid is added to sulphuric acid anodising baths, generating a porous film that protects against corrosion resistance. Scientists set out to validate on an industrial scale a novel TSA process, including pre- and post-treatment of aluminium.

Scientists developed pre-treatment procedures for inspection and cleaning of parts before anodising. Process parameters including time, temperature, bath concentrations and electrical parameters for anodisation (electrochemical

conversion to form the porous oxide coating) were then optimised. Post-treatment consisted of hot-water sealing, a critical last step closing the porous aluminium oxide layer after anodising.

In addition to the technical requirements, researchers also conducted economic, safety and risk analyses. The team evaluated chemical usage in light of compliance with the European Commission's Regulation on 'Registration, Evaluation, Authorisation and Restriction of Chemicals' (REACH). It also considered exhaust fumes (especially in the working area), waste and wastewater output. Recycling routes for wastewater and chemicals were also suggested, while risk analysis focused on occupational health risks.

Failure tree analysis, a design review based on failure mode, and a failure modes and effects analysis were performed as well. These enabled identification of potential failure modes and the importance of each.

The detailed manufacturing plan and manual of process procedures and standards delivered will enable increased use of lightweight aluminium alloys in harsh environments without the use of harsh chemicals. This will enhance the competitiveness of EU aerospace manufacturers and environmental and occupational health and safety.

VALIDATETSA

- ★ Coordinated by CEST in Austria.
- ★ Funded under FP7-JTI.
- ★ http://cordis.europa.eu/result/rcn/169956_en.html

RELIABLE SEMICONDUCTOR PACKAGING TECHNOLOGY

An EU-funded project has designed and fabricated reliable power modules that can endure very high temperatures — above 200°C — using 'silicon carbide' (SiC).

Currently, most semiconductors are made out of silicon. However, silicon cannot correctly function above approximately 200°C, and there are some important applications above that range. Offering increased operating temperatures, semiconductors based on SiC have already gained momentum in electric vehicles as well as in energy and aerospace industries.

Overcoming reliability issues of SiC semiconductors and the surrounding package was the aim of the EU-funded project MATPLAN (Construction of bespoke evaluation power modules). To this end, project partners fabricated and tested a sintered SiC power



“The MATPLAN packaging solutions eliminate the need for using unreliable aluminium wire bonds, replacing them with seamless contacting techniques on either side of the active semiconductor.”

module with low stray inductance to see if it met the requirements at high temperatures.

The 10kW SiC power module consisted of four SiC metal oxide semiconductor field-effect transistors and four Schottky barrier diodes. Project

partners implemented a new packaging concept involving silver sintering, a silicon nitride substrate, no wire bonds, no baseplate and a flexible printed circuit board foil with integrated terminals.

By using the newly developed SiC-based chip set and the new packaging technology, the SiC power module proved to successfully operate at 200°C.

Project partners also produced compliant pillars for interconnecting power semiconductors (dies) with a high-voltage circuit breaker — a switch designed to protect circuits from overloads or short circuits.

The MATPLAN packaging solutions eliminate the need for using unreliable aluminium wire bonds, replacing them with

seamless contacting techniques on either side of the active semiconductor. Thus, they provide reliable low-inductance contact with low thermal resistance.

Project packaging solutions are easy to manufacture and come at a low cost compared to current double-sided cooled structures. By making the use of high-temperature semiconductor devices easier, they should find wide application in the aerospace industry.

MATPLAN

- ★ Coordinated by Dynex Semiconductor in the United Kingdom.
- ★ Funded under FP7-JTI.
- ★ http://cordis.europa.eu/result/rcn/170018_en.html

INCREASING CARBON FIBRE USE IN CARS

An EU-funded project has advanced state-of-the-art composite material technology to bring it closer to mass production for automotive applications.



In addition to being lightweight for fuel efficiency, high-performance composite materials for the transport sector should have the potential to be used in fast production processes. Currently, production volumes tend to be limited to a few hundred or a few thousand units per year for aerospace or sports car applications.

The project HIVOCOMP (Advanced materials enabling high-volume road transport applications of lightweight structural composite parts) changed that by developing two new high-volume materials for ‘Carbon fibre-reinforced plastic’ (CFRP) parts for cars and suitcases.

The first system developed involved advanced ‘polyurethane’ (PU) thermoset matrix materials that showed improved mechanical performance and reduced cycle times when compared with the most commonly used epoxy matrix. Replacing this conventional matrix system with PU also enabled fast curing to be combined with high toughness and a high glass transition temperature. Nanoparticles added to PU resulted in further improvements in the

processing — reduced resin viscosity and reaction kinetics — and in the thermal and electrical properties.

Consortium partners built demonstrators using this new material in structural parts of a car. These included the inner bonnet, the rear seat back panel and the B-pillar between the front door and the back door.

Another HIVOCOMP breakthrough was to hybridise ‘Self-reinforced composites’ (SRCs) — ‘polypropylene’ (PP) and polyamide — with carbon fibres. HIVOCOMP followed several strategies to develop two SRC versions. In the first case, a small amount of carbon fibres allowed SRC stiffness to increase without reducing toughness. In the second case, larger amounts resulted in increased toughness, with stiffness remaining high. Reduced production times were achieved through the thermofforming process.

Project partners successfully produced a hybrid SRC suitcase that was found to be 10% lighter than current PP suitcases.

The advanced materials produced in HIVOCOMP result in short cycle times, showing unique promise for cost-effective, higher-volume production of high-performance CFRP parts.

“Project partners successfully produced a hybrid SRC suitcase that was found to be 10% lighter than current PP suitcases.”

HIVOCOMP

- ★ Coordinated by KUL in Belgium.
- ★ Funded under FP7-NMP.
- ★ http://cordis.europa.eu/result/rcn/90405_en.html
- ★ Project website: <http://hivocomp.eu/>
- ★ <http://bit.ly/1lj2xUZ>



FOOD AND AGRICULTURE

3D-PRINTED FOOD TO HELP PATIENTS WITH DYSPHAGIA

Labelled by some as the future of food, 3D-printed meals could soon make it onto our plates. The EU-funded PERFORMANCE project recently presented its vision of this future in Brussels, with a 3D-printed meal for elderly people with swallowing and masticating difficulties.

NASA is not the only organisation in the world interested in food printing. Whilst the concept could indeed be a must-have for astronauts on their future trips to Mars, it also arouses interest in Earth-focused sectors. For food producers, 3D food printing evokes unlimited customisation potential for their products, as well as unique food formulations for specific dietary needs.

The latter was one of the main targets of PERFORMANCE (Development of Personalised Food using Rapid Manufacturing for the Nutrition of elderly Consumers), a EUR 3 million project that developed a novel nutrition concept for elderly people suffering from dysphagia — chewing and swallowing difficulties generally resulting from a stroke or dementia. Many of the

innovative solutions developed as part of PERFORMANCE — from data software for meal details to unique active packaging — are now primed for commercialisation.

The PERFORMANCE concept

Unlike current dysphagia diets, which are mostly based on purée and pre-mashed food and result in loss of appetite, eventually leading to malnutrition, the PERFORMANCE concept replicates the look and taste of 'real' food and can do this for each patient's needs. The project team explains that 'puréed and strained food is brought back into its original shape, providing the same texture and look, and provides additional health benefits.'

The food is enriched with specific nutrients based on each patient's size,

weight, gender and deficiencies. The nutrients can also be adjusted to ensure that the diet is always well-balanced. This process is fully automated, thanks to an algorithm created by German IT company Sanalogic: it monitors the nutritional status of each patient and automatically enriches the meals of subsequent orders on a weekly basis. The project team predicts that the full personalisation of food, which has now been advanced by the work of PERFORMANCE, will be an automatic reality in an era of Industry 4.0.

The best-possible clone

Getting as close to the original food shape was one of the main challenges faced by the project team. 'Printed puréed food needs to be firm after printing, but liquid enough to dispense

from the printing heads,' explains Pascal de Grood, founder and CEO of project partner Foodjet. 'We use a printing technology based on jet printing. A gelling agent supports the shaping of the puréed and strained food. On the one hand the gelling agent needs to be compatible with the printing system, while on the other hand the printing system must support food matrices such as meat, carbohydrates and vegetables.' The system uses only natural ingredients along with a natural texturiser to make the printed meal as close as possible to the real thing.

"The PERFORMANCE concept is already being tested by the target market — consumer tastings were carried out in care homes just last month."

Every detail has been taken into account, even beyond the food itself. To avoid the hot and cold spots resulting from food heating in a microwave, the Danish Technological Institute and Italian partners FEMTO and the University of Pisa developed 'active packaging' — a split

plate with perforated microwave reflectors placed on top and underneath it.


Putting the PERFORMANCE taste to the test

The PERFORMANCE concept is already being tested by the target market — consumer tastings were carried out in care homes just last month. Project manager Sandra Forstner from biozoon food innovations presented some preliminary results at the final project conference: 'This week we went back to nursing homes to prove and validate the concept, and we have had some positive preliminary results so far.' The tastings tested the whole PERFORMANCE system — from ordering personalised meals using the specially developed software to the production and delivery of prototype food products which were reheated and served in the care home. Preliminary results show a generally positive reaction to the meal's shape, appearance and taste: 54% of respondents rated the meal's texture as good, 79% found meals equally heated and 43% would choose the PERFORMANCE meal in the case of swallowing or chewing difficulties.

In terms of commercialisation, project coordinator Matthias Kück, also from biozoon, acknowledges that 3D food

printing has some way to go until it becomes a viable commercial process; however, he notes that the PERFORMANCE team is working on 'making the necessary breakthrough'. Although this means that it may be some time before the entire PERFORMANCE concept can be implemented, the individual solutions developed won't be back on the shelf gathering dust — quite the opposite in fact. Kück assured participants at the final conference, 'Even if PERFORMANCE is not implemented on the market immediately, you can expect many of the products developed within PERFORMANCE to be commercialised as single stand-alone solutions very soon.'

PERFORMANCE

- ★ Coordinated by biozoon in Germany.
- ★ Funded under FP7-KBBE.
- ★ http://cordis.europa.eu/news/rcn/124181_en.html
- ★ Project website: <http://www.performance-fp7.eu/>
- ★  <http://bit.ly/2OKmR1W>

SMARTSOIL TOOLBOX TO IMPROVE SOIL CARBON MANAGEMENT

The SMARTSOIL team presented its innovative new approach to assessing the impact of carbon management on crop yields and soil carbon at its recent final conference in Brussels, Belgium.

After four years of research and development, the results of the EU-backed SMARTSOIL (Sustainable farm Management Aimed at Reducing Threats to SOILs under climate change) project are now available online within the project ToolBOX. This online repository, primarily aimed at agricultural advisors and advanced farmers, offers new ways of identifying management options to optimise crop yields and soil carbon for specific farming systems, soils and climates.

Through the Decision Support Tool, for example, users can explore how changes in crop management have affected soil carbon, crop yield and economics in six case study areas. In the video library, they can browse a range of videos demonstrating and promoting better soil carbon management. They can also peruse six real-life cases from different bio-geographic and socio-economic agricultural areas across Europe to learn about different methods of 'Soil organic carbon' (SOC) management.

The SMARTSOIL team went for the ToolBOX concept in order to encourage a wide audience to use the project's results. Project coordinator Professor Jørgen E. Olesen from Aarhus University notes, 'We hope that this way of



integrating results will be attractive to a wider range of stakeholders, and support local and regional soil management. The aim is to improve soil management for efficient fertility building and for enhancing soil carbon stocks.' The tools will be complemented by policy recommendations, which were being tweaked by project participants at the

“Our main hope here is to get this issue much better integrated in both the agricultural (food security) and the climate change (for example at COP21) agenda.”

recent final conference in Brussels. The hope is that these recommendations will have an impact at all levels — from EU to local. ‘We aim for the policy recommendations to address the issue of the declining soil carbon stocks in arable soils, and our main hope here is to get this issue much better integrated in both the agricultural (food security) and the climate change (for example at COP21) agenda.’

The results are supported by a long list of scientific publications, demonstrating the detailed research carried out by project partners over the past four years. Farmers and other likely end-users have been consulted by the SMARTSOIL team throughout the project, and the overall response to the outcomes has been positive, says Professor Olesen. However, the team anticipates that the tool will still evolve

as it is tried and tested in the coming months: ‘We think that further testing and adjustment even after the end of the project will be necessary. We have developed the tool so that it can also be integrated into advisory systems of individual EU Member States.’

The team is now busy finalising the remaining deliverables of the project and the scientific papers. However, even after the completion date has passed, SMARTSOIL will continue working to ensure that the results have an impact ‘on the ground’, as Professor Olesen concludes. ‘Now we will seek to work with farmers, agricultural advisors and other actors to make our results more operational.’

SMARTSOIL

- ★ Coordinated by Aarhus University in Denmark.
- ★ Funded under FP7-KBBE.
- ★ http://cordis.europa.eu/news/rcn/124182_en.html
- ★ Project website: <http://smartsoil.eu/>

RESFOOD DELIVERS SOLUTIONS FOR A SUSTAINABLE AND SAFE FOOD CHAIN

The RESFOOD project recently presented its range of innovative solutions — from biosensing methods for bacteria detection to improved extraction techniques from food by-products — that aim to help boost efficiency and close water, energy and materials cycles in the European food chain.

led by project coordinator TNO in the Netherlands, the EU-backed RESFOOD (Resource Efficient and Safe Food Production and Processing) project has succeeded in developing an impressive suite of solutions and novel approaches across crop cultivation, fresh food processing and waste valorisation that the team hopes will impact on the European food sector in the near future. From cutting-edge techniques for microbial profiling of water to the creation of two pilot plants for fresh-cut vegetables which treat and reuse water, RESFOOD’s range of ready-to-market technological solutions, practices and strategies were presented at its recent final conference in Brussels.

Closing the water cycle in horticulture and food processing

On average, 44% of the total water abstraction in Europe is used for agriculture. Within the RESFOOD project, ICT solutions were developed to address this issue. Tested in southern Spain and presented at the conference, the team says that these solutions will make it possible to reduce the water use per ton of product in soil-based systems by over 40%, without having an effect on the production. Additionally, at Vezet, one of



the biggest fresh-cut vegetable processing companies in the Netherlands, the RESFOOD team showed that it is possible to recycle 50% of the wash water — after treatment by UF and UV disinfection — without impacting on the quality of the product. This solution was tested at full scale on a production line with different types of vegetables.

Water-efficient washing machine for fresh-cut food

Among the other solutions presented at the conference was the water-efficient

washing machine for fresh-cut food, developed by project partner Kronen in Germany on the basis of research into decontamination strategies by CNTA in Spain. Charged with the aim of producing a mechanical washer that prioritised food safety, energy and water saving, the Kronen team researched and developed its water-efficient washing machine prototype that has now been tested at VEGA MAYOR SL, a leading fresh-cut produce processor in Spain. The demonstration showed promising results — the new machine reduced water consumption from 1.8 litres/kg

to 1.3 litres/kg. Eric Lefebvre from Kronen pointed to areas of future research for optimising the prototype, 'We now want to use the results of this innovation to save energy also on smaller washing machines. We plan to reduce the water consumption, taking the water from the outfeed belt and bringing it back into the machine. Also, we'd like to carry out tests on other products such as baby leaf and spinach.'

Optical biosensing methods for rapid monitoring of bacteria

Food and water safety has been one of the focuses of RESFOOD partner Technion in Israel over the course of the project. Speaking at the conference, Prof. Ester Segal from Technion presented the new optical biosensing system for rapid and onsite detection of bacteria in water that has been developed. The prototype system has proved robust and performed well during two

rounds of pilot tests. The results of the second demonstrations are currently being processed and analysed in order to further optimise the performance of the biosensors. Prof. Segal's team has already been contacted by different industries interested in applying these technologies.

IS-Pro kit for microbial profiling of water

Also exploring bacteria in water, over in the Netherlands, RESFOOD partners Microbiome developed the IS-Pro kit. Over the three years of the project, the team honed a process called IS profiling, which uses differences in DNA, analysed by 'Polymerase chain reaction' (PCR) to detect all bacteria. Speaking at the conference, Martine Bos from Microbiome noted that the team is currently working on getting the necessary certification in order for the kit, along with a portable water

filtering device — also developed during the project — to go on the market in 2016.

Other RESFOOD solutions range from optimised irrigation management and improved technologies for water reuse and nutrient recovery to more environment-friendly extraction techniques of valuable materials from food by-products. Tests in real-case scenarios have been performed across the board in RESFOOD to assess the potential application of solutions for the European food industry.

RESFOOD

- ★ Coordinated by TNO in the Netherlands.
- ★ Funded under FP7-ENVIRONMENT.
- ★ http://cordis.europa.eu/news/rcn/124263_en.html
- ★ Project website: <http://www.resfood.eu>

FEED INNOVATIONS OFFER MORE EFFICIENT, ECOLOGICAL MEAT PRODUCTION

Innovative feed additives can help drive efficient pig and broiler chicken production and might even help reduce emissions, say EU researchers.

Bioactive substances such as essential oils and spices all have potential beneficial effects on gut function. By combining these bioactive substances with enzymes, the EU-funded ECO FCE (A whole-systems approach to optimising feed efficiency and reducing the ecological footprint of monogastrics) project has developed feed that can have beneficial effects on pigs and chickens and help farmers achieve cost efficiencies. This could make a significant impact on farm budgets as feeding accounts for around 70% of animal production costs.

The ECO FCE scientists found that improved 'Feed conversion efficiency' (FCE) of farm animals could be achieved in pigs by adding enzymes that specifically target galactosides in feed materials. The team also found that phosphorus has a positive effect on bone mineralisation. These results were presented at an industry workshop during the Annual European Federation of Animal Science (EAAP) Conference in Warsaw, Poland in August 2015.

In addition, the project has shown that phytogenic feed additives — non-antibiotic growth promoters derived from herbs and spices — can improve nutrient digestibility while at the same time reduce the formation of noxious and greenhouse gases like ammonia and methane. This could have significant long-term implications in helping agriculture meet the growing need for more environment-friendly meat production. While intensive production will continue to play a key role in feeding a growing global population, it must be made sustainable.

The ECO FCE project team is confident that further potential lies in combining feed enzymes with active plant ingredients because different combinations can have different synergistic effects. A number of further feeding studies with pigs and broiler chickens are therefore planned using different combinations. A particular emphasis will be placed on evaluating the effects of adding enzymes and bioactive substances to lower-quality diets.

The project has also genotyped around 1 000 animals in each of the two species, to help correlate results and improve the selection of breeding stock with superior feed use



efficiency. Initial results from this exercise indicate the existence of a number of genetic markers which may be of use.

In addition, the project has carried out a major search of literature in order to create an ECO FCE electronic database of information on dietary, genetic and gut factors affecting FCE in pigs and broiler chickens. As part of this literature reviewing process, a horizon-scanning exercise was carried out and revealed some interesting findings.

For example, researchers found that a derivative of Stevia has been shown to improve the daily gain, feed intake and

feed use efficiency of pigs, and that as the dose increased, so too did the performance of the pigs. Furthermore, broilers offered a diet


with *Capsicum frutescens* (chilli) demonstrated improved performance and showed that final body weight was significantly

increased. The horizon-scanning report will be made available on the ECO FCE website.

The project, which started in 2013, is due for completion in 2017. The final results will further contribute to improving industry knowledge on how to optimise feeding strategies for pigs and broiler chickens and minimise agriculture's ecological footprint.

"The project has also genotyped around 1 000 animals in each of the two species."

ECO FCE

- ★ Coordinated by Queen's University Belfast in the United Kingdom.
- ★ Funded under FP7-KBBE.
- ★ http://cordis.europa.eu/news/rcn/124202_en.html
- ★ Project website: <http://www.eco-fce.eu/index.html>
- ★  <http://bit.ly/1WPC4tV>

NEW NITRITE SENSOR MAKING WAVES IN EUROPE'S AQUACULTURE SECTOR

A fully automatic sensor that measures nitrogen levels in recirculated water could increase productivity and safety in European aquaculture.

The sensor was developed through the EU-funded AQUALITY (Multi-sensor automated water quality monitoring and control system for continuous use in recirculation aquaculture systems) project and is the first to have been designed specifically with aquaculture in mind. Fish farmers have until now had to rely on monitoring tools designed for general water management, which often lack the accuracy needed to ensure the welfare of fish.

Most importantly, the development of this new tool means that the sector can now tap into growing demand for land-based closed-containment aquaculture, or recirculated aquaculture systems. These systems use minimal water and allow the farms to be sited anywhere, even in urban spaces.

Expansion of this sector will depend however on continued improvements to the design and optimisation of both build and operating costs. For example, this method of fish production relies on the recirculation of water,



which must be precisely monitored. Ensuring water quality means that fish are comfortable and are much more likely to grow optimally.

The sensor developed by the AQUALITY team has been calibrated in particular to measure the nitrogen compound nitrite. This is because all recirculating aquaculture systems have bio-filters, which convert nitrogen-based waste products to nitrites and nitrates. High levels of nitrite and ammonia indicate that the bio-filter is not functioning optimally, and could lead to potentially toxic nitrogen compounds in the water.

The innovation, developed by partners in the Netherlands and tested by experts in Denmark, is an important component of AQUALITY's open standardised technology platform, which is capable of measuring eight parameters simultaneously. This enables aquaculture staff to receive continuous online measurements not only of nitrite, but also of total nitrogen compounds, pH, salinity, oxygen level, carbon dioxide level, total gas saturation and temperature. These levels are fed in real time direct to their monitoring screens.

Indeed, by coupling these measuring tools with an intelligent control

"The sensor developed by the AQUALITY team has been calibrated in particular to measure the nitrogen compound nitrite."

system that is automatic and contains built-in knowledge of specific farmed species, the project team has attempted to make accurate and efficient fish farming as user-friendly and automated as possible. Database and training material to improve best practice among fish farmers has also been developed.

The technology pioneered by the AQUALITY project should help European aquaculture to increase efficiencies and increase its share of the global fish market. EU aquaculture currently produces around 1.3 million tonnes a year, with a value of some EUR 2.9 billion, and employs about 65 000 people. However, this level represents just 18% of EU fish production and only 2% of world aquaculture production.

The three-year AQUALITY project was officially completed at the end of November 2014. The project platform was presented during the Aquaculture Europe conference in Rotterdam in October 2015. The next step will be to take the sensor prototype towards commercialisation and market it to the aquaculture industry.

AQUALITY

- ★ Coordinated by Eurofish in Denmark.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/news/rcn/124262_en.html
- ★ Project website:
<http://www.aqualityproject.com/>

HIGH-TECH SUSTAINABLE FOOD PACKAGING

EU researchers have developed an advanced food packaging system that reduces food waste and contamination, and limits the future environmental costs of packaging materials.

Global food wastage is estimated at 10% of total food produced, and a large part of this is caused by food spoilage in shops. Innovative packaging may hold the answers to reducing this waste and extending the shelf life of fresh foods.

The ISA-PACK (A flexible sustainable active and intelligent packaging

technology platform enabling enhanced shelf life, quality and safety of fresh food produce) project aimed to develop sustainable and intelligent packaging for perishable fresh food produce. Efforts focused specifically on packaging fresh steak, extending the shelf life and quality, enhancing safety and reducing food and packaging waste.

First, the project successfully tested biopolymers produced by bacteria from biological waste as a replacement for currently used plastic films. They also incorporated antimicrobial compounds for longer shelf life, and scaled up that process to industrial scale.

“The project successfully tested biopolymers produced by bacteria from biological waste as a replacement for currently used plastic films.”


Another major aspect of ISA-PACK led to the creation of printable sensors to monitor freshness and temperature over time. These were tested and validated on a meat packaging production line and through consumer surveys. One of the sensors was patented.

Finally, the project completed a life-cycle assessment as well as an economic and societal assessment for the products developed during its lifetime. This innovative packaging system reduces wastage, increases shelf life and improves food safety for European consumers.

ISA-PACK

- ★ Coordinated by the UK Materials Technology Research Institute in the United Kingdom.
- ★ Funded under FP7-KBBE.
- ★ http://cordis.europa.eu/result/rcn/151390_en.html
- ★ Project website:
<http://www.isapack.eu>





“The study of ACCRETION STATES’ scientists was based on observations of more than 10 black holes and 50 neutron stars.”

PHYSICS AND MATHEMATICS

STUDYING THE END POINTS OF STELLAR EVOLUTION

Neutron stars and black holes are unique laboratories for studying matter in its most extreme conditions. To better understand their properties, EU-funded astrophysicists addressed multi-wavelength observations with fundamental physics in conditions not reproducible in terrestrial experiments.

Strong gravity and extreme magnetic fields turn neutron stars and black holes into unrivalled test beds of particle physics, general relativity and magneto-hydrodynamic phenomena. The EU-funded project ACCRETION STATES (Multiwavelength spectral timing of black holes and neutron stars: A new step in our understanding of accretion processes) focused on a process that powers these astrophysical sources: accretion.

Accreting neutron stars and black holes are among the brightest sources in the X-ray sky. X-ray observations of neutron stars allowed astrophysicists to look into the behaviour of matter under the most extreme conditions of density and magnetic field strength. However, accreting black holes were the only astrophysical places where they could study phenomena occurring within a few gravitational radii from their source.

The study of ACCRETION STATES’ scientists was based on observations of more than 10 black holes and 50 neutron stars. This is the largest available sample of observations and is expected to provide a reference point for classifying their behaviour into distinct accretion ‘states’. Distinguished by different spectral and temporal properties, these states reflect the geometry and radiative efficiency of accretion flows.

During the so-called hard state, observed in the initial rise of accretion, the X-ray spectrum is dominated by Compton emission and shows high variability. It precedes a soft state of roughly constant luminosity. As thermal accretion dominates, the luminosity of the source slowly decays until a reverse transition to the hard state occurs. This behaviour, known as hysteresis, was found to be common among both neutron star systems and systems harbouring black holes.

These findings have been described in numerous publications in peer-reviewed journals and presented at international scientific conferences. The ACCRETION STATES project has advanced our empirical understanding of changes in the X-ray spectra of the end points of stellar evolution as well as some of the underlying theories for this origin.

ACCRETION STATES

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

★ Funded under FP7-PEOPLE.

★ http://cordis.europa.eu/result/rcn/170016_en.html

THINKING ABOUT NUMBERS

Are natural numbers real or human constructs? An EU study aimed to bridge the divide between philosophical and cognitive viewpoints via re-examination of certain arguments and new collaborative discussion.



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Natural numbers are ordinary integers, or counting numbers; it is debated whether zero should be included. Philosophy and psychology clash about whether the set is merely a product of the human mind.

The EU-funded NUMBERS (Number cognition and philosophy of arithmetic) project aimed to reconcile the conflict and find common ground. To do so, the team proposed a revised understanding of the issue, to be illustrated via a case study of fruitful collaboration. Finally, the group planned an exploration of the commonalities between the fields. The project ran for two years to October 2014.

Initial work involved revisiting the relevant concepts as understood by various disciplines. Such a review included viewpoints from the philosophy of mathematics and cognitive studies. A journal paper described the problem and constraints, while a second paper (in preparation) suggests reconsidering certain historical objections to psychological research methods. The team also considered whether one particular mathematical function is an example of a Carnapian explication.

Researchers studied examples of fruitful interaction between the disciplines.

The phase yielded several papers considering constraints and correctness of certain methods, which have been either submitted or accepted. Preliminary work was started on the computable features of natural numbers, as well as on several other collaborations.

The final aspect involved fostering collaboration between major players in both fields. The project facilitated this through a series of reciprocal international visits and workshops.

NUMBERS produced a new conceptual viewpoint regarding the divide between cognitive and philosophical fields. The project also helped to advance the careers of project researchers.

NUMBERS

- ★ Coordinated by Lund University in Sweden.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/170010_en.html

IMPROVED ULTRASHORT-PULSE OPTICAL LASERS

Cost-efficient, easy-to-fabricate 'Mode-locked fibre lasers' (MLFLs) deliver ultrashort pulses and are important in applications from communications to medical imaging. Novel stabilisation technologies will ensure the robustness of the generated pulses.

Fibre lasers relying on optical fibres with a doped optical fibre as the gain media have shown tremendous progress in recent years. Ensuring the very high stability of the characteristics of the generated pulses is integral to many applications. The EU-funded training project HARMOFIRE (Harmonic mode-locked fibre lasers) was launched to train a promising young researcher in fibre laser development with a focus on cost-effective stabilisation. Activities combined both experimental and theoretical approaches.

Harmonic mode locking is an advanced technique that enables delivery of very high pulse repetition rates. Multiple ultrashort pulses are circulated in the laser resonator with constant temporal spacing to overcome the limits of the resonator regarding the repetition rate of a single pulse.

Novel harmonic MLFLs with a 'carbon nanotube' (CNT) saturable absorber and highly erbium-doped gain fibre were designed and fabricated. CNT saturable absorbers were widely used in mode-

locking applications, demonstrating fast responses and broadband operation. The polarisation insensitivity of CNT-based saturable absorbers makes

them useful for the study of polarisation attractors in mode-locked lasers.

The team went on to study in detail polarisation dynamics of vector soliton molecules in this paradigm. Solitons are pulses with a precise balance of non-linear and dispersive effects such that the temporal and spectral shape of the pulses was preserved even over long propagation distances. Further, the solitons can exhibit bound states with fixed and discrete phase separations. Vector solitons with various polarisation attractors with up to 11th harmonic mode locking were observed (harmonics are integer multiples of the original frequency of the light).

Integration of a mode-coupling mechanism (tilted fibre Bragg gratings) into the laser cavity stabilised the repetition rate and improved the noise performance of the lasers when operating in the high harmonic (more than 5) range. It enabled stable harmonic operation for 16 hours at the 19th harmonic with pulse repetition at 460 MHz.

Stabilised MLFLs and high flexibility in the generation of dynamic polarisation states will enable important innovation in communications, atoms and nanoparticles trapping, and control of magnetisation. HARMOFIRE's outcomes are therefore expected to find widespread application.

HARMOFIRE

- ★ Coordinated by Aston University in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/169925_en.html

"Vector solitons with various polarisation attractors with up to 11th harmonic mode locking were observed."

EVENTS

JANUARY
04 ▶ 06

Haifa, ISRAEL

WORKSHOP

FIRST BIOSTRUCT-X MEDITERRANEAN MACROMOLECULAR CRYSTALLOGRAPHY WORKSHOP

The 'First BIOSTRUCT-X Mediterranean Macromolecular Crystallography Workshop' will be held from 4 to 6 January 2016 at the Technion – Israel Institute of Technology in Haifa, Israel. BIOSTRUCT-X is an FP7-funded project aiming to provide a consolidated platform that brings together all relevant methods in structural biology — creating a single gateway to Europe's leading synchrotron facilities and associated infrastructures, ultimately to the benefit of the overall user community.

This workshop, hosted by the Technion Center for Structural Biology (TCSB) jointly with the BIOSTRUCT-X Team and the Weizmann Institute of Science, will introduce researchers in the field of macromolecular crystallography to data collection and data processing, experimental phasing (SAD, MAR), structure refinement and analysis. It will consist of a combination of lectures and practical hands-on tutorials, including data collection from our state-of-the-art Rigaku FR-X diffractometer.

The modern infrastructure for macromolecular X-ray crystallography and protein characterisation at the Technion Center for Structural Biology (TCSB) will be available for workshop participants through the workshop.

For further information, please visit:
<http://tcsb-biox-wksp.net.technion.ac.il/>

JAN.
24 ▶ 29

JANUARY
11 ▶ 12

Freising, GERMANY

CONFERENCE

MANAGING THE EFFECTS OF MULTIPLE STRESSORS ON AQUATIC ECOSYSTEMS UNDER WATER SCARCITY — FIRST GLOBAQUA CONFERENCE

The GLOBAQUA project is organising an International Conference in Freising, Germany, from 11 to 12 January 2016.

GLOBAQUA deals with the management of the effects of multiple stressors on aquatic ecosystems under water scarcity. With its partner projects MARS and SOLUTIONS, it has assembled multidisciplinary teams of scientists in the fields of hydrology, chemistry, ecology, ecotoxicology, economy, sociology, engineering and modelling to study the interaction of multiple stressors within the framework of strong pressure on water resources.

This interdisciplinary conference is a platform for exchange and discussion of innovative scientific findings and methods in aquatic ecosystems research. It focuses on novel methods of environmental monitoring and modelling of various scopes, scales and structural complexity to improve process understanding in the interconnectivity and feedback mechanisms of climate (regional), land use (regional), economy, hydrology and hydraulics (catchment and river), water quality (river), biology and aquatic ecosystems (reach scale).

For further information, please visit:
<http://www.bildungszentrum-freising.de>

JANUARY
22

Venice, ITALY

WORKSHOP

WORKSHOP: LIFECYCLE IMPACTS OF COPPER NANOMATERIALS RELEASED FROM TIMBER PRESERVING IMPREGNATION

The SUN project is holding an international workshop to discuss the lifecycle impacts of copper nanomaterials at the University of Ca' Foscari in Venice, Italy, on 22 January 2016.

The event, which has been organised in conjunction with the ECONANOSORB FP7-funded project, brings together experts from Europe, Russia and the USA. They will examine the work of both projects, especially in relation to the release, fate, exposure effects, lifecycle impacts and health risks of copper nanomaterials.

In addition to attracting specialists from research and academic institutions, the workshop is expected to provide valuable information for industry and governmental organisations.

For further information, please visit:
<http://www.sun-fp7.eu/category/news/events/>

EVENTS

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

Venice, ITALY

TRAINING SESSION

SECOND SUSTAINABLE NANOTECHNOLOGY SCHOOL.

The Second Sustainable Nanotechnology School – a SUN, MODENA COST and ECONANOSORB training school – will be held from 24 to 29 January 2016 in Venice, Italy.

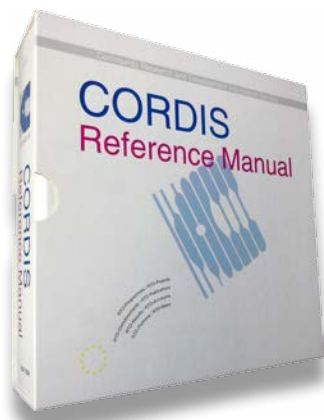
The FP7-funded SUN (Sustainable Nanotechnologies) project, one of the event sponsors, is the first to address the entire lifecycle of nanotechnologies to ensure holistic nanosafety evaluation. The project will incorporate scientific findings from over 30 European projects, national and international research programmes and transatlantic co-operations into tools and guidelines for sustainable manufacturing, easily accessible by industries, regulators and other stakeholders.

The Sustainable Nanotechnology School offers a practical approach for understanding the environmental, health and safety implications of manufactured nanomaterials to foster their sustainable applications. The school aims to transfer state of the art knowledge on relevant topics from key experts to the new generation of nano environmental, health and safety (EHS) professionals. The event is especially designed for personnel from research and academic institutions as well as from industry, governmental agencies and hospital departments.

For further information, please visit: <http://www.sun-fp7.eu/events/upcoming-events/2nd-nanoschool/>



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25 years of CORDIS

It's already been **25 years** since the ESPRIT conference in November 1990, where the European Commission officially launched CORDIS — a new Community Research & Development Information Service — after

two years of intensive work. The new service, which aimed at the “dissemination and optimisation of the results of activities in Community research, technological development and demonstration,” has kept evolving since then.

The initial three R&D databases for Programmes, Projects and Publications brought together the information from various Commission sources into a single point of access for a public audience. By 1993, six additional databases had been added: Results, Acronyms, COMdocuments, Contacts, Partners and News, along with an offline CD-ROM.

CORDIS continued to adapt to new technologies and extend its services, pioneering the EU institutions' first permanent website in 1994. As part of the VALUE and then the Innovation programmes, CORDIS followed its guiding principles of dissemination and exploitation of knowledge, delivering web services like the Technology Marketplace and printed publications like the CORDIS focus Newsletter and its RTD Results Supplements (now the *research*eu results magazines*). After more than 30 years of European Union research funding, CORDIS now holds over 5300 projects from Horizon 2020, with plans to publish a broader range of project deliverables and to build a basis for linked open data. A new multilingual added-value service will be launched soon, bringing together the most promising research outputs as 'Results Packs' to the specialised audiences who can exploit them.

True to the vision of the European Commission more than a quarter of a century ago, CORDIS will continue to be at the heart of the EU's research results.

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