



# research<sup>eu</sup>

RESULTS MAGAZINE

**N°75**  
AUGUST-SEPTEMBER 2018

**SPECIAL FEATURE**

## **A DECADE SINCE DISASTER: LESSONS FROM THE ECONOMIC CRISIS**



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**Published**

on behalf of the European Commission  
by the Community Research and  
Development Information Service (CORDIS) at  
the Publications Office of the European Union  
2, rue Mercier  
2985 Luxembourg  
LUXEMBOURG  
[cordis@publications.europa.eu](mailto:cordis@publications.europa.eu)

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ISSN 1831-9947 (printed Version)

ISSN 1977-4028 (PDF)

Catalogue n° ZZ-AC-18-007-EN-C (printed Version)

Catalogue n° ZZ-AC-18-007-EN-N (PDF)

Luxembourg: Publications Office of the  
European Union, 2018

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# EDITORIAL

*by the editorial team*

## STEPPING OUT FROM THE LONG SHADOW OF THE ECONOMIC CRISIS

In September 2008 the world watched as Lehman Brothers, one of the largest global financial services firms, spectacularly collapsed. Even though the economic clouds had already begun to darken as of 2007, Lehman's demise is now popularly perceived as the 'true' beginning of the worst financial and economic crisis since the 1930s Great Depression, as described by the former head of the US Federal Reserve, Ben Bernanke. Indeed, the unfolding crisis battered almost all major advanced economies into a deep recession. Europe was especially hard hit and out of all EU countries, only Poland managed to achieve positive year-on-year growth in 2009.

**'Even though the economic clouds had already begun to darken as of 2007, Lehman's demise is now popularly perceived as the "true" beginning of the worst financial and economic crisis since the 1930s Great Depression.'**

Then, in 2010, as the tide of the original disaster began to recede, the Euro crisis erupted beginning with the troika's bailout of Greece, followed swiftly by similar financial rescue plans for Ireland, Portugal, Spain and Cyprus. The politics of austerity became entrenched

across Europe as governments attempted to grapple with unsustainable debt piles, with the consequences being a big spike in unemployment levels and widespread social distress.

Since the dark days of 2008-2010, the EU has made good progress in effecting a sustained recovery. However, the crisis casts a long shadow and many deep social and economic challenges remain, from tackling persistent youth unemployment to enacting a fairer tax system, from confronting the recent surge of populist politics across Europe to soothing that lingering fear that we're not really prepared for another major conflagration that could be just around the corner.

With this issue of the research\*eu Results Magazine, on the 10<sup>th</sup> anniversary of Lehman's collapse, we wanted to showcase 14 finished or soon-to-be-finished projects that have delved deep into the causes, consequences and lessons learnt from the crisis. Many of the projects express their hope that their findings can be positively used by policymakers to help address the social challenges still left unresolved by the 2008-2010 crisis, whilst others have devised innovative solutions that will help regulators and policymakers to predict and/or mitigate the effects of a future downturn.

The magazine then continues with our nine regular thematic sections, as well as 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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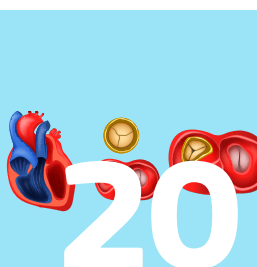
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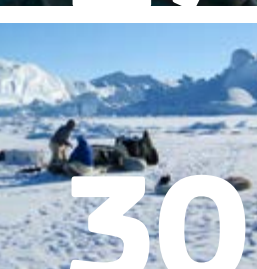
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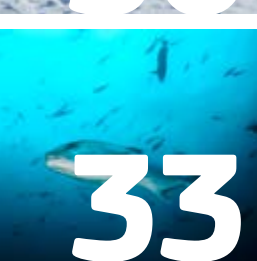
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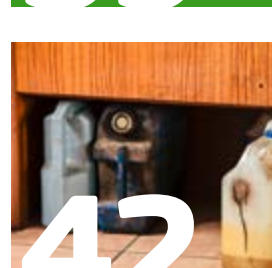
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## SPECIAL FEATURE

# A DECADE SINCE DISASTER: LESSONS FROM THE ECONOMIC CRISIS

## INTERVIEW

## MORE EFFECTIVE TRANSNATIONAL CRISIS MANAGEMENT

With Europe facing transboundary crises on multiple fronts, the EU-funded TransCrisis project has developed a number of policy recommendations for effective crisis management.

Today, crises are rarely contained within national borders. The refugee crisis, the financial crisis, food-related deaths and even volcanic ash clouds – all crises that have far-reaching affects across Europe.

Transboundary crises like these represent the new normal. But does the EU have the capacity to effectively manage them? How coordinated is the response in each case, and how have political leaders fared in the management of these crises? With a re-emergence of nationalist politics, how can the EU navigate complex issues like sovereignty and national identity in a way that is considered legitimate?

The EU-funded TransCrisis (Enhancing the EU's Transboundary Crisis Management Capacities: Strategies for Multi-Level Leadership) project was designed to answer these questions and develop policy recommendations for improving effective and legitimate crisis management across the Continent. Here we sit down with Project Coordinator Martin Lodge to learn more.

### ★ What is a transboundary crisis?

**Professor Martin Lodge:** A transboundary crisis is one that does not respect national jurisdictional boundaries. They usually also involve other types of boundaries, such as those established by organisations, legal frameworks, professional disciplines or Member State policy cleavages. Because of this ambiguity, transboundary crises are particularly challenging for political and administrative systems – especially in the post-financial crisis context of depleted resources.

### ★ Why is the TransCrisis project needed now?

The project comes at a critical time. As some European states are retreating from the European project, TransCrisis was dedicated to examining the social, economic and political consequences of managing transboundary crises. From this research, we aimed to understand how the EU can improve its capacity to manage transboundary crises while maintaining its legitimacy in the eyes of Member States. Of

course, this is no small task, as it is a challenge that relates to the future direction of the European Union itself.

### ★ That sounds ambitious, where do you start?

Our main objective was to identify the individual and organisational leadership strategies needed to successfully address transboundary crises. So, the starting point was to assess the challenges for effective transboundary crisis management in the context and aftermath of the financial crisis. That being said, however, during the course of the project additional contextual conditions had to be considered – most of all, the refugee crisis and Brexit, but also the growing backsliding by Member States.

From here, our research turned to assessing the key tasks associated with effective transboundary crisis management and how these tasks can be executed across levels of government and types of crises. For example, we assessed meaning-making by political leaders during the financial crisis, the presence of crisis management capacities in EU institutions, and the interaction between EU and Member State administrative systems in a variety of policy domains, as well as the deepening impact of backsliding among some Member States. Such activities had to be pursued by developing effective knowledge exchange and dissemination strategies capable of enhancing Europe's capacity for managing transboundary crises.

### ★ You mention backsliding, what do you mean by this?

Backsliding is the intentional moving away from the liberal democratic constitutional norms that the EU is based on. Backsliding can be seen in the growing re-nationalisation of electoral politics and the adoption of policies that retreat from, or even contradict, commonly accepted European constitutional norms that is happening in a variety of Member States. The TransCrisis project identified a number of indicators that reflect on good governance and the fundamental principles of EU membership. These include the rule of law, corruption control, and gender-, disability- and ethnicity-based protections.

We then used this index to explore the nature and prevalence of backsliding among EU Member States. Unfortunately, the evidence is disheartening. To varying degrees, many Member States are backsliding on their commitments. Although Hungary and Poland are particularly prominent, they are far from being alone.

★ **How has the EU been dealing with backsliding?**

Backsliding is a particularly challenging transboundary crisis. Enforcing the EU rulebook could backfire, playing into the hands of nationalist politics and further fanning the flames of disintegration. For example, in late 2017, the European Commission initiated proceedings against Poland. However, our research suggests that it is questionable whether such action will actually discourage other Member States from backsliding themselves. It is also questionable whether other Member States will ever unanimously agree to suspend a state's EU membership.

Overall, we found that backsliding represents a distinct transboundary crisis for the European Union – one that points to a growing tendency among some Member States to wilfully ignore EU laws or to openly challenge them. In doing so, they threaten the very fabric of the Union itself. By being unable to effectively deal with this problem, the EU faces an important juncture if it is to prevent further backsliding on traditional democratic values.

★ **Accepting that we live in an age where scepticism towards transboundary collaboration is an acceptable part of the political debate, what can the EU do?**

Enhancing transboundary crises management capacities is essential to the survival of the European Union. The problem is that EU institutions and Member States are not just disagreeing about the most appropriate ways of responding to transboundary crises, they are even disagreeing on what constitutes a transboundary crisis. There are therefore no easy answers.

To develop effective transboundary management in the context of the EU, it is important to realise that there are no one-size-fits-all answers across all types of transboundary crisis. Instead, we must consider the trade-offs between different models of crisis management in terms of



© Martin Lodge

**PROFESSOR MARTIN LODGE**

appropriate level of government and in terms of how prescriptive common rules are. After all, crisis management requires discretion, as every crisis is different.

In the immediate future, what is necessary is the development of a truly transboundary crisis management capacity at the EU level that goes beyond the current, mostly sectoral (i.e., DG) focus. Second, there needs to be more attention paid to the administrative pre-requisites to ensure effective crisis management, possibly involving 'stress tests' of Member State administrations.

**TransCrisis**

- ★ Coordinated by the London School of Economics and Political Science in the United Kingdom.
- ★ Funded under H2020-SOCIETY.
- ★ <https://cordis.europa.eu/project/rcn/194586>
- ★ Project website: <http://www.transcrisis.eu/>
- ★  <https://bit.ly/2LhSMHv>

## AN INNOVATIVE ANALYSIS ON CONSUMPTION DURING THE GREAT RECESSION

To better understand the Great Recession's effect on household consumption expenditure, researchers with the EU-funded CONSCRISIS project focused their attention on the impact of wealth shocks.

A striking feature of the Great Recession was the fall in – and slow recovery of – household expenditures. The extraordinary duration of this contraction with respect to previous recessions stimulated the interest of scholars and policymakers, including those with the EU-funded CONSCRISIS (Households' Consumption during the Great Recession: A structural analysis on the role of expectations) project.

"Over the last 10 years, several European countries have experienced two important episodes of slowdown in aggregate consumption, the first happening around 2008-2009 and the second in 2011-2012," says project researcher Serena Trucchi. "The main goal of this research was to examine the causes of these extraordinary drops in household consumption expenditure."

The study focused on the role of household expectations regarding

income and the perceived or real persistence of income shocks. By analysing the impact of wealth shocks on both consumption and labour supply, researchers also contributed to our understanding of household behaviour during the Great Recession. "Our results have added to the economic literature on consumption and savings," adds Trucchi. "They also have relevant policy implications, particularly as to contraction in aggregate consumption during the recent financial crisis."



## Household expectations and the persistence of income shocks

The bulk of the CONSCRISIS research was dedicated to investigating the role of subjective income expectations and uncertainty in driving the contraction in household consumption that happened during the recent crisis. The results show a change in the perception of the persistence of income during the recession. "Between 2008 and 2009, the negative shock was perceived to be transitory, while in the second economic downfall respondents revised their expectations about permanent income shocks downward," explains Trucchi. "Furthermore, permanent shocks in the second phase of the recession were perceived to be larger by younger cohorts."

Researchers also observed an increase in the variance of expected income shocks since 2011, with preliminary

results showing a response of consumption to permanent and transitory income shocks.

## Wealth effects on consumption and labour supply

Along with this core research, CONSCRISIS also analysed other aspects of household behaviour, including the impact of wealth shocks on household consumption. Using an Italian micro-dataset and the instrumental variable strategy, the study estimated marginal propensities for households to consume from wealth shocks early in the Great Recession. "Counterfactuals indicate financial-wealth effects were relatively important for consumption falls, at least in Italy, in 2007 and 2008," says Trucchi.

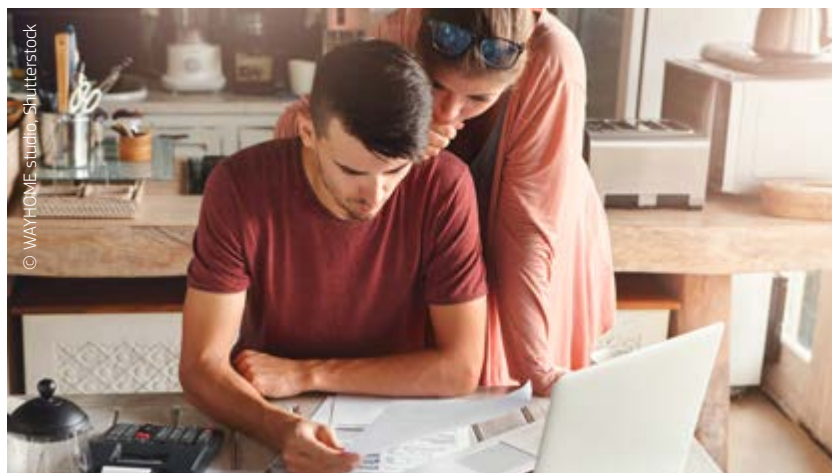
Researchers also looked at whether or not individuals adjust their labour supply when faced with wealth shocks. "Shocks

to asset prices provide a source of exogenous variation to identify the effect of financial losses during the post 2007 financial crisis, and throw this question into sharper focus," adds Trucchi. "The results point to significant effects of wealth on hours of work and on whether or not agents leave their jobs." Trucchi notes that the magnitude of these effects can be substantial on, for example, those individuals who suffered larger wealth losses during the financial crisis.

## Explaining consumption trends

Although the project focused on two European countries, namely the Netherlands and Italy, it sheds light on widespread facts – all of which are relevant to explaining consumption trends in several European countries in the recent past. "We think the project produced some innovative analysis on consumption and, in particular, on the role played by subjective expectations," concludes Trucchi.

The next steps include the publication of articles in academic journals and further dissemination of the project's findings at academic and policy conferences.



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### CONSCRISIS

- ★ Coordinated by University College London in the United Kingdom.
- ★ Funded under H2020-MSCA-IF.
- ★ <https://cordis.europa.eu/project/rcn/195168>

# A POST-CRISIS NEW DEAL FOR EUROPE

After thoroughly analysing the European economy, the EU-funded ISIGrowth project provided a number of policy measures aimed at jump-starting a process of innovation-driven, sustainable and inclusive economic growth.

The 2008 global economic crisis hit Europe hard. The effect was not only immediate, it also exposed many long-term problems that persist even today. As a result of the crisis, Europe must address such challenges as: de-industrialisation and its relative weakness in terms of new technologies and new industries, nearly stagnant wages and a divergence between productivity growth and wage growth, a declining labour share, and a surge in corporate profits against a backdrop of rising inequalities.

Europe's answer to these challenges has been a mix of fiscal austerity and a range of structural reforms. But these short-term solutions do little to remedy long-term problems. According to the EU-funded ISIGrowth (Innovation-fuelled, Sustainable, Inclusive Growth) project, what Europe needs is a New Deal – one that focuses on the de-financialisation of

European economies, achieves inclusive growth and equality through a rebalancing of labour power, and supports innovative industries and sustainable growth.

"The ISIGrowth project provides a thorough diagnosis of the European economy and a comprehensive ensemble of policy measures, all of which aim to jump-start a process of innovation-driven, sustainable and inclusive growth," says Project Coordinator Giovanni Dosi.

## Diagnosing the problem

The ISIGrowth project aimed to provide novel and comprehensive diagnostics of the relationship between innovation, employment dynamics and growth in an increasingly globalised and financial-driven world economy. Based on this diagnosis, researchers then developed a policy toolkit to



help Europe achieve its 2020 objectives for smart, sustainable and inclusive growth.

According to Dosi, the project was very successful at both the scientific and the policy levels. "In both domains, we achieved original and unconventional results, debunking a few of the myths that are all-too-often considered part of our conventional wisdom," he says.

For example, instead of being a self-regulating system, researchers came to the realisation that the economy – when left to itself – either works or doesn't work depending on the balance between a 'Schumpeterian' engine generating and diffusing innovations and a 'Keynesian' one driving demand. "Industrial policies are essential ingredients for both of these engines, especially in the form of mission-oriented programmes addressing such ambitious tasks as climate change and welfare," explains Dosi.

Turning to macro fiscal policies, the project concluded that austerity policies like those favoured in post-crisis Europe are generally doomed to failure. Likewise, structural reforms to the labour market, typically used to promote employment, often have the opposite effect, actually leaving the economy more fragile and prone to crisis. Instead, a policy of steady finance focused on investment and innovation in the real economy can be the best ingredient for growth. But here Dosi warns that the key is to focus the investment on the long term: "The financialisation of the economy that we have seen since the crisis goes against this principle as it is too focused on disruption and short-term gains," he says.

### A new theoretical paradigm

To transform these findings into policy initiatives, the project put considerable focus on dissemination, holding a number of conferences, workshops and discussions with the UK, Italian and European Parliaments, the European Central Bank (ECB), Bundesbank, Bank of Russia and the

Organisation for Economic Co-operation and Development (OECD). Furthermore, the project's co-director, Mariana Mazzucato, was appointed Special Advisor on Mission Driven Science and Innovation to Carlos Moedas, EU Commissioner for Research, Science and Innovation.

"It is my hope that ISIGrowth's contributions will help build a new theoretical paradigm where the economy is rightfully understood as a complex, evolving system with innovation, inclusiveness, redistribution and sustainability at its core," adds Dosi. "This is the starting point for building a New Deal for Europe."

#### ISIGrowth

★ Coordinated by the Sant'Anna School of Advanced Studies in Italy.

★ Funded under H2020-SOCIETY.

★ <https://cordis.europa.eu/project/rcn/194562>

★ Project website:  
<http://www.isigrowth.eu/>

★ <https://bit.ly/2mp4uCO>



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## HOW INNOVATION AND JOB QUALITY IMPACT EACH OTHER

Successful business is all about two things: innovation and job quality – that is, the capacity to attract, utilise and hold on to value-added workers. We also know that the two aspects are closely intertwined. But before the QulnnE project, we knew very little about their complex relationship.

Sure, there is no lack of research touching upon workplace factors that can support, facilitate or even mitigate innovation. Just like it's rather easy to find studies on job quality improvements brought by some innovations. The two cross paths here and there, but there is just no research taking these two multi-dimensional and complex phenomena and theorising their interdependence in a comprehensive and stringent manner.

"The probable reason is that job quality is a very broad area, just like innovation, and it took a comprehensive research programme like Horizon 2020 to fund a project that could simultaneously

encompass technological and non-technological innovation as well as the six basic dimensions of job quality we use in QulnnE," says Prof. Christopher Mathieu, who coordinated the project on behalf of Lund University.

The work performed under QulnnE (Quality of Jobs and Innovation Generated Employment Outcomes) is crucial, as it is hoped to facilitate a more holistic approach to promoting societal goals such as well-being, inclusion and equality, economic and employment growth, improved products and services, sustainable work through improved innovation, and job quality. By focusing on innovation and

job quality while also looking into the employment outcomes of their interplay, the project brings about new scientific understanding, new diagnostic and developmental tools, and evidence-based advice on policies to boost EU growth and strengthen its economy against the risks posed by another major financial crisis.

The QulnnE team looked at three types of innovation – product, process and organisational innovation – and six dimensions of job quality – wages, employment quality, education and training, working conditions, work/life balance, and consultative participation and collective representation. From

thereon, they kept looking for recursive connections. They conducted a qualitative analysis with 58 case studies across eight industries in seven EU states, along with quantitative analyses at the national, industry, firm and individual levels. Finally, they considered innovation policies and company strategies.

*“Left alone, innovation will probably exacerbate disparities. This needs to be understood, and dealt with in a holistic and pro-active manner.”*

“We took the results and developed two tools. The ‘Quinnemap’ compares most EU countries’ performance in a range of dimensions of employment, job quality and innovation with each other. The second tool is a developmental tool which makes project results searchable and readily accessible for policy makers, employers, employees and union officials,” Prof. Mathieu explains.

Among the project’s most interesting findings were the fact that product and, to a lesser extent, process innovation lead to both increased employment and job quality whereas the effects of organisational innovation are more mixed. The team also found that the beneficial impact of innovation is mostly concentrated on high-skill high-qualification employees. There is a ‘Matthew effect’ of innovation which, if unbridled, would lead to increased inequality between workers.

“General positive effects of innovation, in terms of both employment and job quality at the firm level, should continue to be supported. However, left alone, innovation will probably exacerbate disparities. This needs to be understood, and dealt with in a holistic and pro-active manner rather than attempting to deal with the consequences post-factum,” Prof. Mathieu points out.

According to the project results, one type of innovation that should be emphasised is incremental, workplace innovation. Whilst less visible and often not considered significant, it can contribute to more notable

innovations as well as help build an innovation-conducive environment.

Overall, project findings point at the need for innovation policy and job quality to be developed together. They show that virtuous circles can be established through institutional support and management choices that favour learning and engagement. “The most innovative companies focus on employment and job quality, so better employment and job quality are probably not just an effect of innovation but also produce it, as we could show from our case studies. These are the processes, largely in the hands of managers, that policymakers need to promote,” Prof. Mathieu concludes.

#### QuinnE

★ Coordinated by Lund University in Sweden.

★ Funded under H2020-SOCIETY.

★ <https://cordis.europa.eu/project/rcn/194591>

★ Project website: <http://www.quinne.eu/>

## SUSTAINING SOLIDARITY IN EUROPE

The EU-funded SOLIDUS project reviewed acts of solidarity happening across Europe in order to understand their impact and how they benefit European citizens.



Following the financial crisis of 2008 and the era of austerity that followed, Europe is now experiencing a period of political uncertainty. According to a Eurobarometer poll, there has been a steady, continuous decrease in the level of trust that EU citizens have towards government and democratic institutions. In fact, over the last six years, this level of trust has decreased by a remarkable 25 points. This erosion of trust has led to a lively public debate about the European project itself.

According to some social scientists, the economic inequalities and new global order that have emerged since the crisis have contributed to a strong social reaction – one based on solidarity and aimed at achieving a better society for all. The EU-funded SOLIDUS (Solidarity in European societies: empowerment, social justice and citizenship) project analysed these acts of solidarity happening across Europe to understand their impact on employment, health, housing, education and civic engagement.

“Our goal was to understand the social impact of these acts, or how they improved citizens’ lives by, for example, improving access to healthcare or creating jobs,” says SOLIDUS Project Coordinator Marta Soler. To accomplish this, project researchers started by looking at the common elements found among these different solidarity actions. They then used these elements to better understand how actions can have an actual social impact. To see how these elements could be transferred to the EU level, researchers also surveyed European citizens to get their opinions on transnational solidarity.

Although the project’s initial focus was the economic crisis, it expanded its reach to include other developing crises. “The refugee crisis began after the project’s launch, so we adjusted and included solidarity with refugees in





the cases to be analysed in all EU countries involved with the project,” says Soler.

### A diverse range of case studies

In total, the project conducted 64 solidarity case studies in 12 different EU countries. For example, in Greece they studied a project that is helping children suffering from hearing problems integrate into the ‘normal’ community. Likewise, in Hungary, the project studied the work being done by Migszol, an informal, unregistered political grassroots organisation that monitors the country’s asylum-related policies. They played a major role in coordinating the initiatives to help the arriving migrants as they crossed from Serbia into the EU.

From these case studies, researchers concluded that, with economic and social crisis comes an increasing number of solidarity actions, many of which are self-organised by citizens. “In general, Europeans believe that all EU citizens should be entitled to the same level of social security, regardless of which Member State they live in,” says Soler. “This is particularly true in the case of such vulnerable groups as the unemployed, the elderly and the sick.”

Specifically, the project identified a number of factors that facilitate the social and political impact of solidarity

initiatives. These include: internal democracy, transparency, pluralism, recognition, scalability, awareness, preparedness and meaning. According to Soler, these indicators help identify the social and political impact of solidarity initiatives. However, she also notes that there is a need for organisations to collect more data about the improvements their initiatives are bringing to society.

### Best practices in solidarity

Although the project is officially over, work continues. Researchers are now in the process of disseminating a handbook on best practices for achieving social and political impact. “We are also collecting evidence about the impact that our findings are having on these various solidarity actions and the extent to which they are being implemented,” adds Soler.

#### SOLIDUS

- ★ Coordinated by the University of Barcelona in Spain.
- ★ Funded under H2020-SOCIETY.
- ★ <https://cordis.europa.eu/project/rcn/194587>
- ★ Project website: <http://solidush2020.eu>

## INTERVIEW

# TOWARDS A MORE SUSTAINABLE TAXATION POLICY

The EU-funded FairTax project is developing a comprehensive, sustainable tax base reform capable of addressing the economic, social, cultural and environmental dimensions of taxation.

Contemporary tax systems are anything but simple. Globalisation, internationalisation, human and corporate mobility and the establishment of the European Economic and Monetary Union have all brought the features of EU Member State tax systems and the programmes they fund into the policy arena. According to FairTax (Revisioning the ‘Fiscal EU’: Fair, Sustainable, and Coordinated Tax and Social Policies) Project Coordinator and Professor at Umeå University Åsa Gunnarsson, this is partly the result of the 2007 financial crisis and ensuing recessions, but also because governance of the EU and of Member States can be enhanced by tax policies that maximise human well-being in sustainable ways.

The EU-funded FairTax project is a cross-disciplinary research project working to produce recommendations on how fair and sustainable taxation and social policy reforms can increase the economic stability of EU Member States. To learn more, we sat down with Professor Gunnarsson.

### ★ What does the FairTax project hope to accomplish?

**Professor Åsa Gunnarsson:** Our team of researchers, who come from 10 partner universities located in eight countries, are conducting in-depth comparative, interdisciplinary research with the goal of reaching four core outcomes. For example, the EU currently does not harmonise national tax policies for growth or social equality. What FairTax wants to do is identify options for expanding the EU’s legislative competencies and governance mechanisms for supporting the harmonisation of Member State tax and social policies. Likewise, our researchers are also looking for ways to erase some of the inbuilt barriers to the full recognition of treaty-based obligations relating to environmental issues and harmful tax competition. Here we are developing and testing reform options for state-level coordination to create fairer and more sustainable tax and social policy regimes that are binding on both EU members and the EU itself.

Another area of focus is how many Member States place large businesses in a different tax category



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**PROFESSOR ÅSA GUNNARSSON**

than other taxpayers. On this basis, FairTax has taken on the task of recommending strategies for increasing the effectiveness and harmonisation of tax administration and compliance structures within the EU and non-EU areas, including the exchange of administrative innovations across agencies. Last but not least, we also identified an

## SPECIAL FEATURE

opportunity to introduce EU taxes as a solution for funding the EU budget. On this point, the project aims to formulate recommendations for creating true, own-source EU revenue.

Through these four objectives we plan to clearly demonstrate how tax systems must be designed and implemented in such a way that they are perceived as being fair. Otherwise they lose democratic support and fail to be sustainable.

★ **What has been the response of policy makers and other stakeholders?**

The ongoing impact of FairTax is visible from the fact that there is significant interaction going on between the project and national and European policy makers, along with such other stakeholders as tax authorities and NGOs. Take for example the area of gender equality and taxation issues. On this topic, interaction and collaboration with Member State ministries of finance, the European Parliament and the United Nations has been extensive. In fact, when the European Parliament's Committee on Women's Rights and Gender Equality (FEMM) wanted an in-depth analysis of gender justice in taxation, it turned to FairTax to write a report on the topic.

★ **Where are you at in regard to your work on a Common (Consolidated) Corporate Tax Base (CCCTB)?**

We have already quantified the tax revenue effects of adopting a CCCTB in the EU, and this work has been highly visible. For instance, our simulations on different CCCTB variants are of immediate interest for the Commission's ongoing work on introducing a common corporate tax base. Beyond the European institutions, national fiscal

authorities are highly interested since the simulations give an idea of possible revenue consequences.

Our researchers are in close contact with the European Parliament rapporteur responsible for CCCTB legislation. They are also supporting the Czech government in defining its position on CCCTB. Danuše Nerudová, who is leading this line of research, has presented our work at many high-level meetings, including one arranged by the Independent Commission for the Reform of International Corporate Taxation (ICRICT), where FairTax presented CCCTB as a possible candidate for a global reform of corporate taxation.

★ **Of the many accomplishments that the FairTax project has already seen, what are you most proud of?**

The success of the project simply would not be possible if it wasn't for our truly interdisciplinary team being able to apply different disciplinary perspectives and methods to the issues of fairness in taxation. This research infrastructure works well and serves as both a mutual inspiration between disciplines and a basis for the open access of our results. This open access approach could very well serve as a model for future academically successful research.

★ **The project comes to a close in February 2019. What do you hope to accomplish between now and then?**

Our overall goal is to contribute to a more comprehensive view on tax fairness and sustainability. When the project does end, I foresee our legacy being the connection we have made between tax sustainability and the re-emerging policy trends in tax equality and tax equity.

★ **What do you mean by this connection?**

Our research shows that sustainability and fairness are interconnected issues in designing a tax system. For example, from a welfare state perspective, tax sustainability has a strong social pretext as social welfare obligations are distributed over the public budget. This means that when social justice is excluded as a guiding principle for tax policies, the revenue side of public budgets becomes detached from the social programmes that aim to create a more equal distribution of post-tax incomes. Another aspect of the dilemma is that, from a tax base perspective, each welfare state has to identify a sustainable mix of tax bases in order to meet legitimacy demands that always, in one way or another, include the political aspects of social justice, equity or equality.

★ **So, what's the solution?**

A policy that strives towards greater tax fairness can improve the degree of sustainability within a tax system. Remember, taxation has many sources, and the same source is often used as a tax base for several taxes – and any comprehensive tax base approach to national tax systems must consider this complexity.

With this in mind, historically, one-sided tax policies that only promote growth-oriented regulations have been argued to be the efficient way to achieve economic sustainability. However, our research is questioning this policy paradigm. After all, a one-sided tax for growth paradigm can, in the end, actually undermine economic sustainability. This is because there seems to be a correlation between taxing for growth and the economic efficiency driven reforms over recent decades and the increase in income inequalities. What the FairTax project proposes is to replace this historic system with a comprehensive, sustainable tax base reform that addresses the economic, social, cultural and environmental dimensions of taxation.

**FairTax**

- ★ Coordinated by Umeå University in Sweden.
- ★ Funded under H2020-SOCIETY.
- ★ <https://cordis.europa.eu/project/rcn/194581>
- ★ Project website: <http://www.org.umu.se/fairtax/english/>



# EXPLORING THE NEGATIVE CONSEQUENCES OF FINANCIALISATION

Recent history has taught us how the transition from a productivity-based capitalism to a financial capitalism results in more instability, less equitability and a system turning its back on the redistribution of wealth. The FUSION project decrypted this transition and explored its consequences.

Attempts at reform have so far failed to reverse the trend: with each year that passes, economic growth is increasingly driven by financial markets. If anything, the 2007-2008 crisis was a nail in the coffin of the productivity economy: the lower and middle classes keep working more for less, and finance went from a tool used to provide capital for the production economy to an end in itself, where speculators can even make a living off public and private debt.

As Dr Matilde Massó, Marie Curie Research Fellow at the University of Leeds puts it, “financial capitalism is far less equitable and distributive than the productive economy at the heart of the economic growth between 1950 and 1970. Dividends and financial investments rise while salaries and long-term investments in equipment, plant and machinery go down or keep steady.” The result is a growing salary gap between the top and bottom segments of corporations, as well as increasingly precarious employment.

Although this phenomenon had been studied before, most of these efforts failed to provide a systematic explanation of the relationship between financialisation, employment and income distribution. This is due both to the lack of access to reliable information on finance and investment variables from firms and industry, and also to the absence of consensus on how to measure financialisation and what type of indicators can be used to study it from a historical perspective.

Closing this gap was the main purpose of FUSION (The effects of financial capital accumulation on employment and wealth distribution). Working with Dr Mark Davis at the University of Leeds, and focusing on Spain and the UK, Dr Massó aimed to produce a unique and valuable dataset using publically available information. The point was to compare an already finance-led capitalism (the UK) with one seemingly following another trajectory (Spain).

“We have analysed to what extent we could identify a convergent process towards a financial model of capitalism in the UK and Spain, because they are two different models of economic organisation and culture. We focused on non-financial corporations, grouped them by type of industry and offered new insights into the hypothesis of a global convergence towards a financialised model of monetary capital accumulation of NFCs at national and industry level,” Dr Massó explains.

All in all, the project team studied the evolution of balance sheets and capital income accounts for the first 100 indexed companies between 2000 and 2016, in both countries. They found that there was indeed a convergent trend in both countries at industry level, which sees financial capital increase not only when the net profits of companies rise, but also when they collapse in a context of severe economic crisis, precariousness and high unemployment.



“This is a striking finding, as it implies that production has become increasingly dependent on financial income, either as a substitute of, or a supplement to, earnings from the production of goods and non-financial services,” says Dr Massó.

The project also demonstrated how financial capitalism affects industries differently based on their structural characteristics. In the case of the UK, the more financialised the industry, the stronger the negative impact on employment growth and salary. In Spain, however, there is no significant association between those variables, although Dr Massó says this is most likely due to difficulties in separating the effects of the 2007-2008 financial crisis from the net effect produced by the process of financialisation itself.

“We have also seen an inverse and strong relationship between dividends paid and salaries between 2000 and 2016 in both countries. In other words, big corporations are spending more capital on distributing dividends than on salary, even in a context characterised by a severe economic crisis. This has obviously alarming consequences for millions of workers across Europe who can only increase personal debt to deal with the rising cost of living,” says Dr Massó.

In the future, Dr Massó and Dr Davis want to explore new models of money-currency that allow for a more balanced relationship between the process of monetary accumulation and the generation of employment. They have been evaluating the wide range of alternatives given by the maturing European FinTech sector and its potential to offer new models of democratic finance.

## FUSION

- ★ Coordinated by the University of Leeds in the United Kingdom.
- ★ Funded under H2020-MSCA-IF.
- ★ <https://cordis.europa.eu/project/rcn/210305>



# AN EARLY WARNING SYSTEM TO PREVENT POTENTIAL FINANCIAL CRISES

The aftermath of the 2008-2009 financial crisis and subsequent European sovereign debt crisis led to close examination of the role of financial markets in generating and amplifying economic shocks. To avoid such a major crisis happening again, one EU-funded project has designed an innovative Early Warning System (EWS).

The financial crisis wreaked havoc across the world economy and required governments to take significant, in some cases unprecedented, actions to curtail the damage. These included bailing out major financial institutions and injecting billions of euro into recession-hit economies to stimulate growth. The social cost has also been immense, with unemployment, stagnant wages and austerity policies causing misery to millions.

With such heavy costs, the desire to ensure a financial crisis of such scale doesn't happen again is strong. Therefore, the EU-funded EARLINESS.eu (European early warning for systemic risk) project has devised their EWS to allow policymakers and regulators to receive advanced notice of new risks brewing within the financial system.

## Knowing when to sound the alarm

"Systemic events are intimately related to a banking crisis. Even a limited banking crisis may lead to the failure of the involved banks causing a collapse of the entire system," says Marie Curie fellowship recipient Dr Michele Costola, based at the SAFE Research Center, University of Frankfurt. "To cope with the vulnerabilities of the financial system following the crisis, the Basel III framework was implemented to enhance the capital and liquidity rules in the banking sector."

One of the key aspects of the framework is the countercyclical capital buffer (CCB), a key macro-prudential instrument, which aims to create a buffer of capital to

protect the banking system from periods of excessive credit growth that may lead to the formation of systemic risk. "In short, the CCB should mitigate the risk of a credit crunch, which represents a destabilising factor to the real economy by carrying additional credit losses in the banking system," explains Dr Costola. "Knowing when to activate mechanisms such as the CCB is the key conundrum to solve. That's why an EWS, a system that issues a signal in case the likelihood of a crisis crosses a specified threshold, can play a crucial role in this aspect."

## A building block EWS

EARLINESS.eu's EWS is structured in a 'building block' configuration and is meant to have a hierarchical structure. "This is particularly convenient given its modularity and flexibility which easily allows ad hoc interventions, extensions and modifications of the implemented systemic risk measures," says Dr Costola.

The system has three levels – first, it includes 'raw' financial and economic data, specifically financial data at single financial institutions and comprises stock market data (price, market value and trading volume) and balance sheet data (i.e. leverage ratio). The second level of the system concerns the micro and macro systemic risk measures estimated based on the first level data. Micro financial systemic risk measures are used to detect the contribution of a single institution (firm) to a systemic event while macro financial systemic risk measures represent the highest aggregated level of the system. Finally, the third level

analyses the predictive ability of these systemic risk measures (signals) in terms of market and banking crises.

"The aim of this configuration is to have (early) signals of systemic risk by identifying them in terms of source and location," comments Professor Loriana Pelizzon, project supervisor. "The early warning signals can be monitored at global and European levels and for a given source of systemic risk. In this sense, these signals can help to prevent a potential crisis."

For each source of possible systemic risk from within the financial system, the EWS has alternative indicators that may provide a different or similar signal during some phases or may anticipate others, therefore allowing those using the system to always be able to see the bigger picture of the financial system's overall health.

## Next steps

The project team has been eager to engage with policymakers over the viability and usability of their system. Dr Costola spent his secondment period at the relevant policy division of the European Central Bank (ECB) dealing with systemic risk, with which close collaboration continued after his time there. The project also organised an open final workshop in Frankfurt and will be featured as part of ESOF 2018 (European Open Science Forum), the largest interdisciplinary meeting on science and innovation in Europe.

Moving forward, Prof. Pelizzon and Dr Costola will continue their work at SAFE. The EARLINESS.eu project has contributed to the development of the research centre's Systemic Financial Risk Dashboard (SRDB) and the soon-to-be-released Systemic Risk Platform (SFRP).

## EARLINESS.eu

- ★ Coordinated by the University of Frankfurt in Germany.
- ★ Funded under H2020-MSCA-IF.
- ★ <https://cordis.europa.eu/project/rcn/201477>



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## TWO MECHANISMS TO PREVENT A POSSIBLE EMU CRISIS

As much as the EU has been trying to reinvent itself after the economic crisis, a growing number of voices keep pointing at early signs of a new, much worse hit coming up for the euro area and the EU project as a whole. The ADEMU project has brought together the EU's best economists to help policymakers save the day.

**A**DEMU (A Dynamic Economic and Monetary Union) touches upon a very wide spectrum of issues: how to ensure the long-term stability of the European Monetary Union (EMU), how to best build defences against economic shocks, and how to manage interdependence in the euro area. In just three years, their research teams documented the EMU's flaws and came up with innovative solutions at a pivotal moment in EU history.

There is no denying that these last three years have been troublesome. They saw the release of the Five Presidents Report on the EMU Roadmap, Brexit, the banking closure in Greece and the end of its ESM-led financial assistance programme, as well as the rise of Eurosceptic parties in several Member States. This, along with the countermeasures deployed by the EU, made for invaluable research material.

"The 21<sup>st</sup> century crises have been a major lesson on how monetary, fiscal, financial and social factors interact in advanced heterogeneous societies, and in the case of the euro area, in a monetary union. They put existing theories into question and provided new data," says Ramon Marimon, Professor of Economics at the European University Institute and coordinator of ADEMU.

An important part of the ADEMU team's work consisted in helping elucidate these interactions, whereas previous work was either studying these factors separately or not accounting for the heterogeneous internal nature of macroeconomic factors. This allowed the team to better understand how a financial crisis can turn into socio-economic recessions, as well as the causes and effects of sovereign debt crises.

The end game was to help design more resilient policies and institutions. The project's two main proposals – the creation of a European Stability Fund (ESF) for the EMU and a European Unemployment Insurance System (EUIS) for the euro area – are hoped to help avoid a new crisis. "Both are proposals which can be implemented in the current situation without the need to achieve better convergence within the EU or to revise the EU Treaties. They will enhance risk-sharing whilst avoiding permanent transfers," Prof. Marimon explains.

The EUIS surpasses existing unemployment insurance systems and provides better cohesion for the European labour market. The ESF, on the other hand, reconciles two fundamentally opposed views: one that calls for greater risk-sharing within the EU, and one that sees such risk-sharing as counterproductive in light of the inadequate



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domestic fiscal policies and banking oversight posing these risks. This long-term contract will support the implementation of countercyclical fiscal policies, help confront severe crises as well as face the legacy debt and create euro-area safe assets. These are, according to Prof. Marimon, the four main problems currently being faced by the EMU.

"Our work enabled us to identify the three roots of the expansion-crisis-recession sequence," says Prof. Marimon. "The first one emerges when growth expansion has weak fundamentals or leads to important imbalances. The second one is seen when no proper countercyclical fiscal policies are in place, and the third one – the role of expectations – may lead to multiple socio-economic equilibria and recessions, which could have been prevented with proper policies."

Essentially, ADEMU pinpoints some of the political deadlocks slowing down the development of the EMU, and highlights how they can be overcome with proper policy and institutional design. It offers a path forward for the euro area that should inspire EU decision-makers for the years to come.

*"The 21<sup>st</sup> century crises have been a major lesson on how monetary, fiscal, financial and social factors interact in advanced heterogeneous societies, and in the case of the euro area, in a monetary union."*

### ADEMU

- ★ Coordinated by the European University Institute in Italy.
- ★ Funded under H2020-SOCIETY.
- ★ <https://cordis.europa.eu/project/rcn/194576>
- ★ Project website:  
<http://ademu-project.eu/>

## SPECIAL FEATURE

## INTERVIEW

# THE TRUE CONSEQUENCES OF SOCIAL DISINVESTMENT

Five years after its launch, the EU's Social Investment Package (SIP) has left those in need with mixed feelings. A consortium of EU-funded researchers went back to the drawing board to see whether and how policy-makers could change its course. They hope that their work will help strengthen the philosophical, institutional and empirical underpinnings of social investment in Europe.



IDES NICAISE

Looking back, the SIP was an ambitious attempt at revamping social policies, especially after five years of crisis exacerbated by harsh austerity measures. It introduced a new discourse and aimed to legitimise social expenditures by emphasising their productive value: high economic returns to social services such as early childhood education, health care, social housing, and active labour market policies; maintenance of living standards and stabilised economies in times of crisis.

But the truth is that the package only made it halfway through its ambitions. To help future policy, the Re-InVEST (Rebuilding an Inclusive, Value-based Europe of Solidarity and Trust through Social Investments) project highlighted the long-term damage of social disinvestment during the crisis period and aims to identify the boundary conditions and building blocks for a genuine social investment strategy.

★ **Looking back, would you say that the SIP had any positive impact on social investment?**

**Ides Nicaise:** The impact was rather symbolic. It was probably useful in limiting the damage caused by the austerity agenda to European welfare states and boosted the efficiency discourse in social protection, health care etc. But persistent pressure for 'budget

consolidation' made the SIP rather powerless and even increasingly suspected of hijacking social policies in a neoliberal economic agenda. Selectivity, efficiency, profitability and privatisation became the new buzzwords – at the expense of equity, basic rights and social minimum standards.

It therefore comes as no surprise that the Juncker Commission chose a different flagship for their social policies: the European Pillar of Social Rights. I do not mean to say that there is an opposition between these two frameworks. But the SIP is hardly referred to in EU policy documents of the past three years.

★ **So the SIP was doomed to fail?**

It could only be undermined by the contradiction between the macroeconomic policy context and the social investment discourse. You cannot preach social investment without at least telling the Member States where to find the resources for it. The EU budget itself is just marginal: at 1% of European GDP, it cannot have any substantial impact. One can only hope that a sustained recovery will create more room for genuine social investment within Member States. But even the Juncker Investment Fund, which was created to boost the recovery, focused on traditional economic infrastructure and largely bypassed social investment.

★ **How did you aim to help reverse this trend?**

First of all, we pointed at the massive human damage of social disinvestment during the crisis years. Most people think that cutbacks in social expenditure just mean a temporary tightening of belts, or indeed a positive incentive to take up work. The reality at grassroots level is radically different. The 13 local Re-InVEST teams spent many months spelling out the longer-term effects of austerity policies on the lives of the most vulnerable people. They collected

evidence of damage that is often irreparable: newborn babies sleeping in ice-cold shelters, chronically ill people stopping their treatment because their medication became unaffordable, bankrupt parents leaving their children behind and emigrating to find work in other countries, families breaking up, peaking suicides, etc.

If social investment has a high long-term return, brutal social disinvestment can have devastating long-term effects on people's lives. We need to draw lessons from that experience. The social investment agenda should prioritise human rights; the EU should help set social minimum standards in all relevant service sectors; and governments must be made accountable when pushing their austerity policies too far.

In the next phases of our research, we examined the characteristics of sound social investment strategies in various policy domains: social protection, labour market policies, early childhood education, housing, health care, water provision and financial services.

★ **What have been your most important findings so far?**

The research is still ongoing, but I can give some examples. In our study of labour market policies, three teams examined activation measures for young people. This allowed us to draw lessons for the Youth Guarantee (Youth Employment Initiative), which is part of the SIP. In Portugal the scheme was dramatically under-resourced: overburdened employment services imposed low-quality measures that actually kept young job seekers busy in carousels rather than integrating them; youngsters were not even informed about the existence of a 'guarantee scheme', and those who managed to find a job were not lifted out of poverty. In France, things went better thanks to the outsourcing of activation programmes to local NGOs who were more familiar with the target group.





In Switzerland, we analysed an experiment (Scène Active) that was based on the capabilities approach: it combined personality training with skills upgrading, and put a strong emphasis on free commitment of the youngsters. From these examples, we learned that one-size-fits-all programmes can produce adverse effects. Long-term, tailored ones are obviously more expensive, but their net return is far higher.

Another example relates to water provision in Flanders. The present Flemish government reformed the market according to strict ecological criteria: they invested in wastewater management and purification, and raised the price, partly to finance public investment, and partly to encourage more parsimonious water consumption. However, the pre-existing free-of-charge minimum provision was abolished, as well as the social tariffs. The Combat Poverty Service and Samenlevingsopbouw invested in capacity building and knowledge-sharing with groups of vulnerable households, and subsequently engaged in negotiations with providers and the government. Testimonies of 'water-poor' households illustrated that basic human rights are at risk in a market

without social corrections. A new social tariff was introduced, and a guide to good practice was developed to better prevent cut-offs and to foster a more socially responsible attitude among all stakeholders.

#### ★ What are your recommendations?

First of all, lessons need to be drawn from the crisis period. Austerity policies should always be linked to the non-regression principle in human rights: this means that any cutback in social expenditure should be preceded by a social impact assessment, and whenever the basic rights of vulnerable citizens are at risk, mitigation measures must be taken or the austerity measure must be withdrawn altogether.

Secondly, the conceptual framework of the SIP needs to be enriched from a 'human capital' to a 'human rights and capabilities' approach. Basic human rights (to health, education, family life, social participation etc.) are so invaluable that they deserve top priority in the objective function of the SIP.

Thirdly, funding of a large-scale social investment programme needs to be secured. At present, the budgetary and monetary consolidation agenda is

so dominant that it leaves little room for this. We simply need more public revenues. Europe is more than rich enough to afford an ambitious SIP through public funding, provided a coordinated and fair fiscal policy is implemented.

#### RE-INVEST

- ★ Coordinated by KUL in Belgium.
- ★ Funded under H2020-SOCIETY.
- ★ <https://cordis.europa.eu/project/rcn/194582>
- ★ Project website: <http://www.re-invest.eu/>



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## WHY LEFT AND RIGHT STILL MATTERS: PUBLIC OPINION ON INTERNATIONAL BAILOUTS AND AUSTERITY POLICIES

The financial crisis wreaked havoc throughout the world economy and required governments to take significant, in some cases unprecedented, actions to curtail the damage. The EU-funded CRISIS\_POLITICS project has focused on two main types of policy responses to the crisis: the use of international bailouts and the pursuit of domestic austerity programmes.

In Europe, the financial crisis that began with the collapse of Lehman Brothers in September 2008 rapidly led to the European sovereign debt crisis that saw Portugal, Spain, Cyprus, Ireland, and most notably Greece, receive big international bailouts. A prerequisite for receiving these vast sums was a commitment to a programme of economic austerity, with public budgets slashed. Even European countries that did not receive international bailouts, such as the UK, also launched far-reaching austerity policies.

### Understanding public opinion

Both international bailouts and austerity policies, the two main policy responses to the global financial crisis, led to sharp divisions within the general public. These divisions centred on whether these policies were justified, as well as on the question of how best to execute them. The CRISIS\_POLITICS (Sharing the Pain? Mass Politics and the Policy Responses to the Financial Crisis) project set out to offer new and rigorous data-driven analysis on the factors and

dynamics that have shaped public opinion on these important policy debates that continue to this day to shape political discourse in Europe.

"On the basic question of why voters agree to bear the costs of bailing out other countries, we found that people's own economic standing, such as their income bracket or their profession, has very limited explanatory power in accounting for their specific position in the debate," comments project coordinator Professor Yotam Margalit of Tel Aviv University. "In other words, the debate is not simply a reflection of people's material interest and how it would affect their pocket books."

Instead, the project team highlights how social dispositions, such as cosmopolitanism, correlate much more strongly with support for international bailouts. More broadly, they conclude that the bailout debate is best understood as a policy issue that pits economic nationalist sentiments versus greater cosmopolitan affinity. "In short, it's not about distributive lines separating domestic winners and losers," states Prof. Margalit.



### Grexit and left-right surprises

The project also undertook a detailed study on the divisions across Western European countries regarding whether or not to support the exit of Greece ('Grexit') from the European Monetary Union (EMU) and whether to use taxpayer funds to finance the Greek bailout. They found that the key factor explaining the public divide was the traditional split between left and right. "Suffice to say, I was surprised by this," comments Prof. Margalit. "The key question then became how does a political cleavage that tends to delineate debates over domestic policy questions come to structure people's position on a foreign policy issue, namely the possible default and exit of an EMU Member State?"

Probing further, the team's analysis showed that the left-right divide over the Grexit question was not driven by differences in attitudes on redistribution, levels of empathy to the plight of the Greeks or differences in general support of the EU project. Instead, they found that the primary mechanism is that left and right voters have dramatically different expectations about the impact of a Grexit on the European economy as a whole. "Our conclusion is that these expectations largely reflect

differences in core beliefs about the promise of a free-market approach," explains Prof. Margalit. "Those on the right viewed a massive bailout as a case of government intervention in the natural operation of the market, and as such, a course of action that is likely to fail. In contrast, amongst those on the left, there was a much stronger belief that a bailout, i.e., an EU designed large-scale rescue package, would ultimately produce a better outcome than letting the Greeks default."

### Room to manoeuvre

What is surprising, Prof. Margalit reveals, is the fact that there is a substantial level of agreement between left and right voters regarding the composition of austerity policies when they are told that spending cuts are necessary. Using an experimental method called 'choice-based conjoint', the project showed that cuts in pensions create the largest backlash amongst both left and right voters and that income tax increases and cuts in social spending and education are also unpopular. However, divergence occurs around the issues of public sector redundancies (acceptable to the right, unacceptable to the left) and defence spending cuts (acceptable to the left, unacceptable to the right).

"Overall, I think the main takeaway from our research is that in terms of voters' preferences, policymakers actually have more room to manoeuvre in crafting a post-crisis response than what the discussion in the popular media suggests," concludes Prof. Margalit. "The idea that the public is categorically opposed to austerity is very problematic – we've shown that the policies voters are more or less willing to back are actually highly sensitive to specific features of the package on offer. Crafting a policy response that takes account of these specific sensitivities can therefore lead to a policy response that attracts much broader public support than policymakers might think if they relied on the conventional accounts offered in the media's coverage of the debate."

#### CRISIS POLITICS

★ Coordinated by Tel Aviv University in Israel.

★ Funded under FP7-PEOPLE.

★ <https://cordis.europa.eu/project/rcn/186839>

## ECONOMIC CRISIS AND THE LONG SHADOW OF EUROPEAN YOUTH UNEMPLOYMENT

One of the most visible and distressing consequences of the 2008-2009 financial crisis was the marked increase in unemployment across Europe, reaching heights that had not been seen for decades. Young people were particularly hard hit and one EU-funded project has been closely examining the direct consequences of the spike in youth unemployment, a societal challenge that is still being grappled with today.

It has been nearly 10 years since the beginning of the worst economic crisis since the Great Depression. The crisis still casts a long shadow over Europe, and as researchers from the EXCEPT (Social Exclusion of Youth in Europe: Cumulative Disadvantage, Coping Strategies, Effective Policies and Transfer) project discovered, that shadow lies particularly prominently over the continent's young people. The researchers also examined in great detail the direct consequences of youth unemployment.

### Unemployment: Immediate consequences

Based on an analysis of quantitative data from both the EU-28 and Ukraine, the project team found that the immediate consequences of unemployment amongst young people were a general lowering of wellbeing, health and housing autonomy. Whilst the consequences of fixed-term employment were less severe, they were still notable by fostering a worse economic situation compared to youth in permanent employment.

Whilst other factors could help cushion the blow of youth unemployment, such as young people returning to their parents' home, EXCEPT found that in the long run, experiencing unemployment and/or involuntary job loss at a young age negatively affects an individual's wellbeing and health for up to 35 years.

Negative effects are considerably worse for men than for women, especially if job loss occurs at the beginning of their careers. "The health consequences of unemployment, particularly for men,



extend beyond unemployed youth and also affect their partners,” comments project coordinator Professor Marge Unt. “Men’s unemployment deteriorates their female partners’ health, particularly in conservative countries where there is still the societal expectation of the man being the primary breadwinner.”

### Youth experiences in nine countries

EXCEPT has undertaken 386 interviews with youths from nine European countries representing different social welfare regimes, providing an in-depth understanding of how disadvantaged youths perceive their social situation, finding wide divergences across countries. “In Bulgaria, Estonia, Poland and Ukraine, young people complained less about the lack of jobs but more about ‘toxic’ work and ‘harsh’ working conditions,” outlines Prof. Unt. “Whilst in Italy and Greece, there was a much stronger feeling of despair over young people’s career prospects in their home country.” Among unemployed youth, the highest increase in pessimism about being able to make ends meet after the crisis is in Cyprus, Greece and Spain.

However, the findings were not all negative – in Sweden and the UK, where youth unemployment levels are falling, young people reported being more optimistic and hoped for career opportunities that best reflected their qualifications and overall ambitions. Whilst in most EU countries young people have been more at risk of material deprivation after the crisis, this was not the case in ‘new’ Member States such

as Slovakia, Lithuania, Latvia, Poland and Bulgaria, where youth exposure to material deprivation has declined continuously. Overall, unemployment had far less of an impact in countries which saw more youth in higher education, had a less stratified tertiary education system and had a higher generosity of passive labour market policies.

### A better pensions deal for youth

EXCEPT’s findings offer many insights for better policymaking with regards to the youth experience, particularly in an area that may not naturally be associated with young people: pensions. “One of the most innovative parts of our project was to analyse the consequences of labour market vulnerability for old age,” says Prof. Unt. “Youth today know that they need to save more for retirement but many are simply unable to.”

The project argues that as public pensions are still the main source of retired income, universal coverage of public pensions should be reinforced, with periods of unemployment being at least partially considered as contribution years in the calculation of future pension benefits. “Notably the UK’s recent policy initiative to make occupational pensions mandatory at the beginning of a new contract could also be considered in other countries,” says Prof. Unt.

### Moving beyond EXCEPT

The project has been heavily involved in wider policymaking discussions with national and EU stakeholders. These have included several major

publications, as well as attending conferences and meetings that have allowed the project team to make strong connections with high-level officials from relevant national ministries and EU institutions.

Prof. Unt and her team will continue to promote the project’s results and she will be contributing to the work of other relevant EU-funded projects. But having the final word, Prof. Unt argues: “It’s urgent to realise that in order to prevent future youth poverty, changes are needed now at national and at EU level. The threat of limited old age incomes concerns not only vulnerable youth, but also our mobile youth.”

#### EXCEPT

- ★ Coordinated by Tallinn University in Estonia.
- ★ Funded under H2020-SOCIETY.
- ★ <https://cordis.europa.eu/project/rcn/194590>
- ★ Project website: <http://www.except-project.eu>



## INTERVIEW

# CIVIC SOLIDARITY UNDER THE MICROSCOPE

Recent crises have shown how the idea of European solidarity is stronger than the sum of the governments supposed to enact it. The TransSOL project considered the roots of civil society-led solidarity and the conditions that allow it to thrive.

The European migrant crisis that started in 2015, just like the economic crisis that preceded it, has brought the limits of European solidarity into broad daylight. However, where EU integration showed its limits and Member States struggled to agree on sharing the burden, civil society started leading by example. From organising donations to opening their homes to migrants in need, citizens showed initiative while officials seemed reluctant to act.

Seeing civil society getting to grips with such crises is certainly a source of inspiration, but it also calls for a systematic analysis. What makes citizens want to enforce European solidarity? How can we make the most of such willingness? How can governments and EU institutions support and complement civil society initiatives?

The TransSOL (European paths to transnational solidarity at times of crisis: Conditions, forms, role-models and policy responses) project aimed to answer these questions by providing the first rigorous and comprehensive analysis of transnational solidarity in Europe.

#### ★ Why focus this project specifically on times of crisis?

**Christian Lahusen:** A project dealing with European solidarity must address the various crises affecting citizens. The Great Recession, the so-called migrant crisis and Brexit have caused serious problems and conflicts within and between European Member States. We’ve reached a point where the very concepts of European cohesion and solidarity are in crisis.



There is, however, a growing mobilisation of citizens and civil society. The TransSOL project was particularly interested in these civic expressions of European solidarity: we wanted to map and analyse them, and to draw lessons in terms of inhibiting and beneficial factors.

★ **Which aspects of solidarity did you consider and why?**

Our project assumes that solidarity is a multidimensional phenomenon. Painting an adequate picture of European solidarity therefore implies the consideration of its various expressions: charitable and altruistic activities, of course, but also political advocacy.

We could show that solidarity is organised at different levels: individual citizens and interpersonal networks; civil society and organisational networks; and national welfare state and public debates. Besides, in normative terms, we have seen that although solidarity is a universal principle bridging communities, countries and continents, it is often tied back to specific constituencies and communities and therefore limited to members of specific groups such as nation-states or ethnic groups.

Solidarity can indeed be inclusive when involving a fight for the rights of distant groups, but solidarity can also be strongly exclusive, when help and support are restricted to those being part of one's own community. Solidarity is a highly politicised and contentious norm, meaning that we must also analyse the ways solidarity is used by different, possibly opposing groups.

★ **How did you proceed to conduct your research?**

We started by developing research tools to map and analyse solidarity at its various levels of aggregation. We conducted a population survey to investigate individual solidarity, engaged in various organisational surveys to reconstruct inter-organisational fields of solidarity within and between European countries, looked at public debates in the mass media, and mapped the role of solidarity in EU and Member State legal and institutional systems.

Our research compared three issues (disabilities, unemployment and migration/asylum) to unveil the main contentions and conditions surrounding solidarity. The research was conducted in eight European countries (Denmark, France, Germany, Greece, Italy, Poland, Switzerland, the United Kingdom) and at the EU level.

★ **What would you say were your most important findings?**

We found that a considerable proportion of European citizens endorse the idea of inclusive solidarity and are actively involved in individual activities, both within and beyond their country. Moreover, we witnessed an impressive increase in citizen initiatives as a reaction to the various crises of the EU, showing that the general public is committed to acting as a 'fire brigade' in times where governments seem unable to respond appropriately.

However, our data confirmed that people tend to limit solidarity to fellow citizens and to those considered trustworthy and deserving. Besides, whilst we have seen strong moments of public inclusive solidarity during the Great Recession since 2008 and the migrant crisis of 2015, the momentum of public solidarity lacked longevity in both cases and was supplanted by regressive tendencies throughout Europe. Civic solidarity therefore requires supportive institutional responses and public policies.

★ **Can you provide an example of best practice that you think should inspire future European policy?**

Several lessons can be drawn from our evaluation of practices and initiatives of transnational solidarity in collaboration with local activists. We can name the importance of being tied back to a local context and constituency, the ability to nurture a decentralised network of local initiatives and activists, the need for communication and translation activities to master the cultural and linguistic diversity of Europe, the combination of offline and online platforms of communication and coordination, and the use of powerful symbols to convey messages.

★ **How about your recommendations to policymakers?**

In general terms, our analyses show that policymakers need to do their homework: citizens have shown repeatedly that they are able and willing to step in when social problems arise. But inadequate policy responses will necessarily weaken civic solidarity, notably in the long term because of overburden, frustration, counter-mobilisation and/or public defamation. Public inaction might thus threaten the very basis of the European community.

More specifically, we see the need to develop European legislation that promotes the development and long-term sustainability of civil society. The European Charter of Fundamental Rights (Art. 12) explicitly grants the freedom of assembly and association at all levels. However, there is a lack of legal infrastructure to realise this right. There is currently no European legal norm for a 'European association'.

Additionally, we propose to recalibrate the balance between Institutional and Project Funding, given that sustainable and stable public financing of platforms is essential to stabilise the organisation and coordination of cross-national solidarity initiatives.

★ **What do you hope will be the impact of the project?**

We expect three types of impacts. Firstly, we expect that citizens and civil society organisations will make use of the knowledge provided by TransSOL in various respects: draw inspiration from the activities of other citizens and initiatives; learn from the way others have acted and organised locally and transnationally; and find out how to advocate based on empirical evidence presented in TransSOL.

Secondly, TransSOL is raising policy-makers' awareness of the importance of promoting civic solidarity. Additionally, our empirical findings and policy recommendations pave the way for evidence-based policies. Finally, TransSOL brings about valuable scientific knowledge on transnational forms of solidarity. It also encourages further analyses, thus deepening public knowledge over the long term.



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#### TransSOL

- ★ Coordinated by the University of Siegen in Germany.
- ★ Funded under H2020-SOCIETY.
- ★ <https://cordis.europa.eu/project/rcn/194579>
- ★ Project website: <http://transsol.eu>



# THE GREAT RECESSION AND POLITICAL CONFLICT IN EUROPE

The EU-funded POLCON project aims to understand the impact that the Great Recession has had on the development of political conflict in Europe.

In the autumn of 2008, Lehman Brothers went bankrupt and the dominoes that made up our global economic order began to fall. The result was the decade-long economic crisis known as the Great Recession.

Although much of our post-crisis analysis has focused on the economic fallout of the Great Recession, little thought has been given to its political repercussions. But this could be where the real impact is felt, with some observers even wondering whether or not democracy itself can survive its grave economic consequences.

The EU-funded POLCON (Political Conflict in Europe in the Shadow of the Great Recession) project is studying the structuration of political conflict in Europe, based on an analysis of political contestation in the electoral arena, the protest arena and in issue-specific public interactions. The key question being asked is whether the Great Recession and its consequences are changing the long-term trends in the development of political conflict in Europe?

“Our overall guiding hypothesis is that the unfolding of the Great Recession has far-reaching consequences for the development of political conflicts in Europe, which contribute to a fundamental transformation – or realignment – of the traditional political forces,” says Project Coordinator Hanspeter Kriesi.

## Regional differences

To accomplish this, the project is comparing the pre- and post-crisis periods in 27 EU Member States plus Iceland, Norway and Switzerland.

The first step is to gain a broad assessment of the political consequences of the crisis in both the electoral and protest arenas, as well as the relationship between the two. To assess the broad patterns of change in these two arenas, researchers are relying on secondary analysis of the existing data sets and on an innovative, semi-automated protest event analysis based on international news wires.

Although research continues, several interesting insights have already been gained, particularly as to how the



recession impacted various regions differently. “In terms of electoral outcomes and the structuring of conflicts in the party system, the Great Recession has, at best, accentuated the long-term trends in north-western Europe, such as the inexorable rise of right-wing populist parties,” explains Kriesi. “In comparison, in southern Europe, it has had much more disruptive consequences, leading to the rise of left-wing populism and to the profound reconfiguration of party systems.”

According to POLCON research, in central and eastern Europe the Great Recession’s impact on electoral outcomes and party systems has been weak. “In this part of Europe, electoral volatility has decreased and, if anything, party systems that lacked institutionalisation have stabilised,” says Kriesi. “The driver of this reconfiguration of party systems is a political – not an economic – crisis.”

Kriesi adds that these electoral results have been confirmed by the project’s analysis of protest event data. “At least with respect to the overall magnitude of protest, the Great Recession did not seem to have any impact at all in

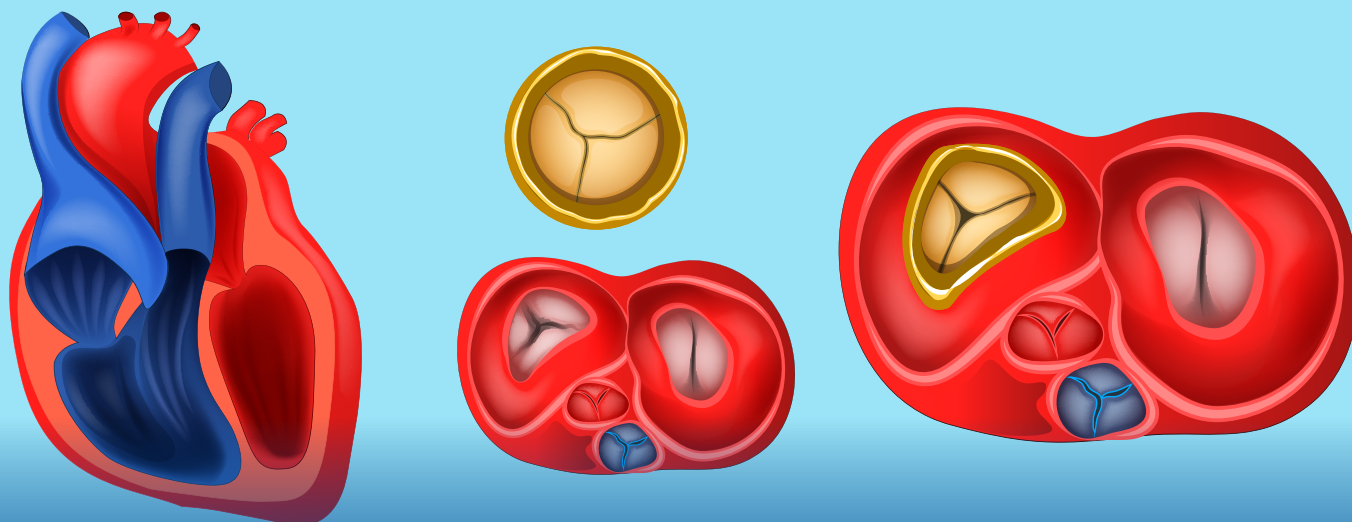
northwest Europe,” he says. “By contrast, all southern European countries experienced a wave of protest during the euro crisis.”

## Don’t jump to conclusions

These findings are important because they remind us that the Great Recession has not had the same impact across Europe. While the south has been hit very hard with important political consequences, the north-west and the east have hardly been affected at all in political terms. “The key takeaway is that we should not generalise too quickly and instead need to examine the political situation in each part of Europe in detail before we draw conclusions,” says Kriesi.

### POLCON

- ★ Coordinated by the European University Institute in Italy.
- ★ Funded under FP7-IDEAS-ERC.
- ★ <https://cordis.europa.eu/project/rcn/188483>
- ★ <https://www.eui.eu/Projects/POLCON>



HEALTH

## OFF-THE-SHELF HEART VALVES

Tissue engineering is gaining ground in the development of prostheses. The IMAVALVE project generated a novel technology with off-the-shelf availability at lower cost to meet the growing clinical need for artificial heart valves.

Current heart valve prostheses enhance survival and quality of life, but associated problems affect 30-35 % of the patients within 10 years after operation. This often translates into serious valve-related morbidity throughout life and a need for reoperation.

Cardiovascular tissue engineering is rapidly moving towards *in situ* approaches where the implanted biomaterial induces regeneration directly in the functional site. The approach relies on the concept that the inflammatory response can be harnessed for tissue regeneration. The implanted biomaterial creates the proper microenvironment to support the interplay between immune cells, stem/progenitor cells and tissue cells, while over time it resorbs into a structure that can repair, remodel and grow.

Given the complexity of cardiovascular tissue, the challenge is to design a biomaterial with immunomodulatory properties capable of instructing new tissue formation. The EU-funded IMAVALVE (Intelligent materials for in-situ heart Valve tissue engineering) project proposed to address this issue by developing intelligent materials that can transform into a novel synthetic heart valve. Delivery of the novel valve occurs through a minimally invasive trans-catheter procedure, eliminating the need for open heart surgery. "The idea was to generate a biomaterial that can gradually transform into a living, durable aortic heart inside a patient's body," explains the project manager Laurens Schrijnemakers.

### New intelligent materials

During the project, researchers designed and characterised a number of polymer materials as well as hydrated gel-like materials. The objective was to combine a relatively slow-degrading elastomeric material with a fast-degrading bioactive

hydrogel material. The former ensures long-term functionality of the valve and supports mature tissue formation, while the hydrogel material controls the early inflammatory response. The chosen materials offered a number of advantages including biocompatibility and tunability with respect to elasticity, stiffness and strength.

Considerable effort also went towards developing a mechanistic understanding of the human host response to the biomaterial. Researchers tested in particular the effect of selected bioactive molecules on the host response and subsequent early tissue formation. They incorporated peptides that can recruit the patient's macrophages and stimulate them towards the tissue-forming fate.

Additionally, the consortium incorporated insight into cardiovascular cell signalling in response to mechanical cues in a computational model and used it to predict the growth and remodelling of the heart valve. Using this model, they found mechanical strain to be a prime factor in valve growth and remodelling with age. Furthermore, computational simulations of tissue engineered heart valves enabled scientists to predict the *in vivo* performance of the implanted structures.

### Towards more efficient valve replacement

Using a catheter delivery system developed during the project, the consortium performed a proof-of-concept *in vivo* study to assess intra-operative handling and valve deployment. Although clinical studies are pending, Dr Schrijnemakers envisages: "the consortium has to perform an extended range of *in vitro* and preclinical studies to test the safety and durability of the valve under a wide range of conditions."



Considering that valve replacement is a common intervention, with over 300 000 annual replacements worldwide, the IMAVALVE technology will offer a significant alternative to existing approaches. Its capacity to grow and adjust to cardiac functional demands overcomes the limitations associated with current prosthetic valves and is suitable for young patients as well. Importantly, the ease of implantation constitutes a significant advantage as it bypasses the need for surgery, improving patient quality of life and reducing health-care costs.

#### IMAVALVE

- ★ Coordinated by Eindhoven University of Technology in the Netherlands.
- ★ Funded under FP7-NMP.
- ★ <https://cordis.europa.eu/project/rcn/110963>
- ★ Project website: <http://www.tue.nl/en/university/departments/biomedical-engineering/research-groups/soft-tissue-engineering-and-mechanobiology/imavalve/>
- ★  <https://bit.ly/2zrGVSp>

## SYNAPTIC MAINTENANCE IN AGEING NEURONS

Ageing is commonly associated with deterioration in brain function and neurodegeneration. Understanding the mechanisms that govern neurodegeneration can help alleviate many age-related symptoms.

Proper brain function depends on the fidelity of synaptic transmission. The failure of neuronal synaptic communication is an early indicator of neurodegeneration. When defective proteins are not cleared away completely, their aggregation leads to improper synaptic function. This suggests a defect in the repair mechanisms but the processes that regulate protein rejuvenation at the synapse remain elusive.

Scientists of the EU-funded HEALTHYSYNAPSES (Molecular mechanisms underlying synaptic maintenance and rejuvenation) project investigated the role of autophagy in neuronal synapses, the cellular mechanisms involved in the degradation of dysfunctional proteins and other cytoplasmic entities. "We worked under the hypothesis that autophagy is central for synapse maintenance and that synaptic autophagy is disrupted during ageing and in neurodegenerative diseases," explains project coordinator Dr Patrik Verstreken.

### Drosophila as a model for studying neuronal synapses

Researchers used *Drosophila melanogaster* as a model organism to screen for novel genes involved in regulating autophagy during ageing. "We had to overcome technical challenges and develop new imaging tools and assays that allowed us to study autophagy at the synapse," points out Dr Vinoy Vijayan, the research fellow who performed the experimental work.

A correlative light and electron microscopy approach was developed that facilitated visualisation of autophagy with unprecedented clarity. This and/or other novel technologies allowed researchers to examine the physiological function of synapses and how levels of autophagy correlate with specific

protein turnover. They observed that autophagy is affected in certain age-related conditions and specific synaptic proteins are responsible for this alteration. Interestingly, the synaptic proteins synaptotagmin and auxilin, which have been implicated in Parkinson's disease, regulate specific autophagy processes at the synapse.

### Autophagy regulation at the synapse

Project researchers conducted a genetic screen of 5000 *Drosophila* mutants and isolated several genes that specifically rescue dysfunctional synaptic autophagy. Through this screen, they have discovered several synaptic genes that are important in regulating synaptic autophagy and maintaining synaptic function.

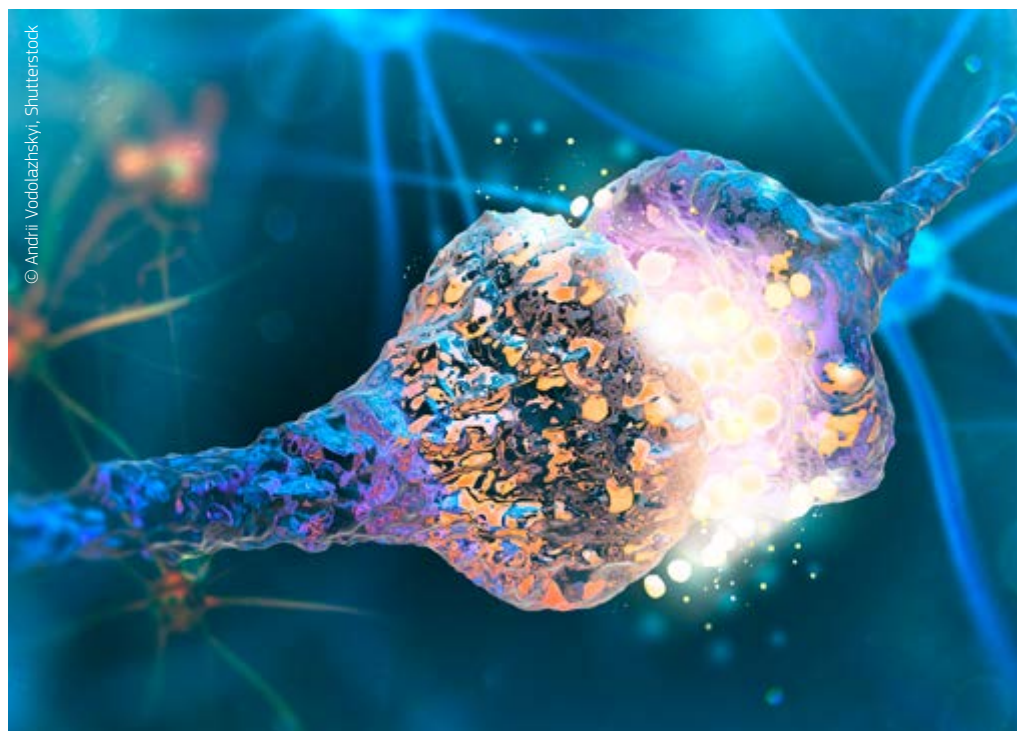
HEALTHYSYNAPSES results showed for the first time that there are

*"We worked under the hypothesis that autophagy is central for synapse maintenance and that synaptic autophagy is disrupted during ageing and in neurodegenerative diseases."*

compartmentalised forms of autophagy in the neuronal network. They provided evidence that both increased and decreased synaptic autophagy seems to be disadvantageous, suggesting that synaptic autophagy is a very tightly regulated process. As a result, modulating autophagy by targeting specific proteins poses a scientific challenge.

### Clinical impact

Autophagy has attracted a lot of clinical interest recently because it could



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potentially be used to treat or alleviate neurodegeneration. In particular, researchers plan to focus on pathways and synaptic proteins with unique roles in modifying synaptic autophagy. Dr Vijayan envisions “follow-up studies on the genes that were identified as part of the HEALTHSYNAPSES genetic screen to develop a thorough understanding of the cellular pathways that regulate autophagy at the synapse.”

Unveiling the mechanisms responsible for synaptic maintenance and health will help formulate strategies for mitigating the undesirable effects of ageing. With millions of Europeans affected by neurodegenerative conditions, restoring synaptic physiology could improve neuronal function and behavioural alterations such as decreased motor function that are seen in neurodegenerative diseases and ageing.

#### HEALTHSYNAPSES

- ★ Coordinated by VIB in Belgium.
- ★ Funded under H2020-MSCA-IF.
- ★ <https://cordis.europa.eu/project/rcn/195708>
- ★ Project website: [http://verstreken.vib.be/index\\_files/Page474.htm](http://verstreken.vib.be/index_files/Page474.htm)

## A MOBILE APPLICATION FOR DIABETES

Diabetes is a chronic disorder affecting millions of individuals worldwide. European scientists plan to improve patients' lifelong adherence to treatment through a mobile application.



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Accumulating evidence underscores the role of mobile-health applications, sensors and telemonitoring in disease management. Especially when it comes to chronic disorders, mobile health interventions promote engagement of patients in their own treatment, improving adherence and reducing relapse. Apart from empowerment, mobile disease management solutions facilitate continuous monitoring of patients, integrating assistance from various healthcare professionals.

The EU-funded MedicSen (A new innovative method for diabetes treatment, the artificial pancreas system) project focused on the management of diabetes by developing a personalised telemedicine approach. “Our long-term goal was to change how diabetes and other chronic diseases are treated. For this purpose, we designed an application that learns from the patient,” explains project coordinator Dr Eduardo Jørgensen.

### The design of the diabetes application

Researchers designed an application that measures various patient parameters such as temperature, blood pressure and heart rate to recommend insulin doses and adapt the therapy on an individual basis. Routine tracking is an inherent part of living with diabetes, and the application promises to facilitate continuous monitoring.

By connecting to third-party wearable devices that patients currently use such as continuous glucose monitors and smartwatches, the application automatically receives information and stores data.

Using a learning algorithm, it accurately predicts glucose levels for the next hour and shows recommended actions to avoid any risk.

The MedicSen technology supports a daily friendly interaction with the patient through voice or written messages to ease treatment adherence. It also acts as a lifestyle and behaviour coaching programme, sending recipes and activity plans specially designed to improve glucose performance on a daily basis. The system learns from the routine of the individual patient, taking into account allergies, previous conditions and type of diabetes to schedule a lifestyle intervention programme.

Available at Google Play, the MedicSen application includes gamification where patients learn more about diabetes. Importantly, the MedicSen system can be connected to a proprietary needle-free drug dispenser that is guided by the algorithm to ensure that the patient automatically receives personalised doses through the skin.

### The impact of mobile diabetes monitoring

For an innovative solution to be successful as a disease management tool and therapeutic intervention, it is important that patients, caregivers and professionals all actively participate in its testing. As such, the next step of MedicSen researchers is to validate the system in clinical environments.

According to the International Diabetes Federation, in 2017 there were over 420 million people between 20 and 79 years old living with diabetes. Apart from the enormous healthcare expenditure, diabetes is associated with high mortality with an estimated 4 million diabetes patients dying in 2017.

The MedicSen system aims to promote the necessary change in the structure of treatment of chronic diseases, leading to a movement towards personalised telemedicine. The long-term plan is to function as a non-invasive artificial pancreas.

With the company winning at the EU-Startups Summit, and the CEO, Dr Jørgensen, being awarded as one of the top EU innovators under 35, the future certainly looks bright. In Dr Jørgensen's own words: "diabetes is the first case study and MedicSen intends to adapt the system to other chronic diseases such as cardiovascular diseases and obesity."

#### MedicSen

- ★ Coordinated by MedicSensors SL in Spain.
- ★ Funded under H2020-LEIT-ICT, H2020-SME and H2020-HEALTH.
- ★ <https://cordis.europa.eu/project/rcn/211250>
- ★ Project website: <https://www.medicсен.com/en/>
- ★ MedicSen application: <https://play.google.com/store/apps/details?id=es.medicсен>
- ★  <https://bit.ly/2zxEq0M>

## NEW TEST SAVES BREAST CANCER PATIENTS UNNECESSARY CHEMOTHERAPY AND HEALTHCARE COSTS

Approximately 1.6 million women were diagnosed with breast cancer worldwide in 2012, and 522 000 died from the disease. Now an EU-supported project has developed a unique and innovative approach to the discovery of biomarkers to categorise early-stage cancer patients.

Breast cancer is the most frequently diagnosed cancer in women, accounting for a quarter of all female cancers. Almost half of women newly diagnosed with breast cancer commonly present with early stage, hormone receptor positive (ER and/or PR+), lymph node negative (LN-) cancer and the usual treatment is to remove the tumour. This surgical intervention is often followed by chemotherapy, which is often a harrowing process.

For 70% of these women chemotherapy is unnecessary, as the cancer will not recur. The OncoMasTR (Novel Prognostic Assay for Early Stage Breast Cancer) project has developed a way of identifying which women actually need the treatment, potentially saving thousands of patients from unnecessary rounds of chemotherapy while also saving healthcare systems the expense of providing the therapy to those who don't need it.

"There are a number of multi-gene prognostic assays on the market, including Oncotype DX (Genomic Health), EndoPredict (Myriad) and MammaPrint (Agendia). However, none of the current solutions on the market completely address the needs of the medical community or those of breast cancer patients," explains CEO Mr Des O'Leary.

The team identified a need for a reliable, more accurate prognostic test for early-stage breast cancer patients. "Our solution is OncoMasTR, a prognostic assay for early stage breast cancer that accurately stratifies patients into high risk and low risk (i.e. will not benefit from chemotherapy) of recurrence."

### A unique and innovative approach to the discovery of biomarkers

OncoMark identified a panel of 10 biomarkers that predict the recurrence of early stage breast cancer, using a bioinformatical approach called ARACNE.

"Under the SME Instrument grant, we developed the OncoMasTR test from the panel of biomarkers we had previously identified. We developed a qRT-PCR assay, measuring the expression levels of the OncoMasTR biomarkers, that we demonstrated to be analytically robust and suitable for deployment in routine clinical laboratories," says Dr Angel Wang, Product Development Manager.

They have validated their test in two large cohorts, demonstrating that the OncoMasTR test accurately stratifies early-stage breast cancer patients into low and high risk of recurrence.

### Next stages

The project has achieved what it set out to do, "the OncoMasTR test will help the clinician to determine a course of treatment for their patients, avoiding unnecessary

chemotherapy for the patient and reducing healthcare costs," Mr O'Leary explains.

OncoMark will CE-mark (self-declaration) the OncoMasTR test in June 2018, allowing the OncoMasTR test to be marketed within the EU for routine use in clinical laboratories.

As the OncoMasTR test contains the smallest signature on the market, 3 genes, the price will be competitive.

Mr O'Leary is delighted at the project's outcome, "Lowering the number of patients receiving cancer-related treatments will reduce the requirements for healthcare services and reduce economic hardship for patients who routinely lose working days due to chemotherapy-induced side effects."

#### OncoMasTR

- ★ Coordinated by Oncomark Limited in Ireland.
- ★ Funded under H2020-SME and H2020-HEALTH.
- ★ <https://cordis.europa.eu/project/rcn/200007>
- ★ Project website: <https://sites.google.com/a/oncomark.com/oncomastr/>





SOCIETY

# WORKING TOWARDS SUSTAINABLE PEACE

Researchers with the EU-funded WOSCAP project are contributing to a European Union that is better equipped to reduce violent conflicts worldwide.

Recently, the European Union has struggled with its capacity to prevent and deal with violent conflicts and instability both at home and worldwide. Frequent challenges include the reactive nature of the EU's interventions, insufficient ability to anticipate crises, and the perceived gap between its short-term actions and long-term commitment to peacebuilding.

Responding proactively to these shortcomings, the EU-funded WOSCAP (Whole-of-Society Conflict Prevention and Peacebuilding) project has developed practical approaches and tools to help the EU better fulfil its peacebuilding mission. Using a Whole-of-Society Approach, the project brought together research institutes, universities, think tanks and organisations to bridge the gap between research and practice. "The project aimed to enhance the EU's capabilities for implementing conflict prevention and peacebuilding interventions using comprehensive, sustainable and innovative civilian means," explains Project Coordinator Gabriëlla Vogelaar.

## An inclusive approach

What stands out about the WOSCAP approach to conflict prevention is its use of local ownership and inclusivity as the building blocks of sustainable peace. "We believe that the inclusion of local researchers is at the heart of peacebuilding," says Vogelaar. "As such, successful peacebuilding and conflict prevention is not in the hands of policy makers alone but should directly involve those who are affected by the conflict."

To start, researchers compared the EU's ambitions and policies with how they are actually implemented in practice. This meant reviewing the EU's past and ongoing interventions in Ukraine, Mali, Georgia and Yemen, along with the cases of Sri Lanka, Kosovo, Afghanistan and Guatemala/Honduras. "These conflicts were chosen as they are at the top of the international agenda," adds Vogelaar.

Based on this research, the project issued recommendations for improving policies and actions for inclusive conflict prevention and peacebuilding. This was shared through 26 research reports, 15 policy meetings and interactions with over 300 stakeholders.

## Already having an impact

According to Vogelaar, these articles and meetings have significantly enhanced the EU's performance in the areas of multi-track diplomacy, security sector reform and governance reform. For example, one article on security sector reform (SSR) will likely feed into the EU's own SSR policy that is currently being developed. Likewise, the articles on multi-track diplomacy and the use of the decentralisation process have already contributed to a better understanding of some of the pertinent challenges and opportunities for EU engagement in these areas.

"By demonstrating the ambiguities of EU engagement with different levels of peace negotiation and mediation, we contributed to the emerging academic literature on EU mediation," adds Vogelaar.

Vogelaar notes that the project's impact even extends beyond the EU. At a recent conference, the WOSCAP recommendations were noted as being highly relevant to the current discussions on the UN's sustaining peace agenda.

## WOSCAP

- ★ Coordinated by the Global Partnership for the Prevention of Armed Conflict in the Netherlands.
- ★ Funded under H2020-SECURITY.
- ★ <https://cordis.europa.eu/project/rcn/194904>
- ★  <https://bit.ly/2KPxC48>

# EXPOSING STATE CRIMES AND HUMAN RIGHTS ABUSES THROUGH ARCHITECTURE

A multidisciplinary research team is harnessing modern technology to provide new types of evidence on war crimes and human rights violations.

Civilian casualties of conflict in urban areas are on the rise. This is because the traditional conception of an arena of war no longer applies. Today, most conflicts take place in cities – urban battlefields that are data- and media-rich environments. With partial funding from the EU through the FAMEC (Forensic Architecture: The Media Environments of Conflict) project, the independent agency Forensic Architecture (FA) is harnessing the potential of today's technological advancements to investigate state crimes and human rights abuses committed in cities and buildings.

In the past, evidence of war crimes and human rights violations was based on interviews conducted long after the event. But modern technology has changed this. With the widespread use of digital recording equipment, satellite communication, remote sensing technology and the internet, vast amounts of data are now available to provide novel types of evidence when crimes are perpetrated.

In an interview given to 'Architectural Record', FA founder and director Eyal Weizman explains the role that architecture plays in his agency's work. "[A]rchitecture is a place we depart from; it's more like an airport than a prison. To provide architectural evidence of, say, a destroyed building in Syria, we are often unable to actually go on-site. We need to locate, verify, analyse, and stitch together user-generated content in order to make a narrative."

FA uses the images uploaded by people at the site of a conflict to recreate the crimes it's investigating. To achieve this, it uses models, drawings, maps, web-based interactive cartographies, films and animations that require the wide-ranging expertise of its team. FA has developed a new tool that makes it possible to map complex events such as conflicts, protests or crises as they unfold, using photography and satellite imaging. Called PATTRN, it's an open-source platform that allows its users to share and collate first-hand reports of conflicts and to make sense of scattered information.



The researchers investigate violent events around the world to provide new kinds of evidence for international prosecution teams, political organisations, non-governmental organisations and international institutions such as the UN. The FA team's projects include researching torture centres in Cameroon, counter-investigating a secret agent's testimony in relation to the murder of a young man of Turkish origin in Germany, and recreating a secret Syrian detention centre based on descriptions by its survivors. Another investigation concerns the murder of six people and disappearance of 43 students in Mexico when local police attacked a school.

FA's investigations range from events within war zones to politically and racially motivated violence that occurs outside the scope of military conflict. Its work has made it possible to contest accounts of events given by state authorities. This has led to official inquiries and tribunals.

"We think that there's great importance in finding new ways of producing solid evidence on which to base our discussions and our political decisions," says Weizman. "We plan to continue to use

*"FAMEC is further developing the field of forensic architecture by exploring new modes of documentation and analysis and how they have changed the relationship between conflict and built spaces."*

architecture as an off-place to understand, analyse and intervene in political situations worldwide."

FAMEC is further developing the field of forensic architecture by exploring new modes of documentation and analysis and how they have changed the relationship between conflict and built spaces. FA will be carrying out new forensic work in Syria, Israel, Palestine and Brazil, in collaboration with leading human rights organisations.

## FAMEC

- ★ Hosted by Goldsmiths College in the United Kingdom.
- ★ Funded under H2020-ERC.
- ★ <https://cordis.europa.eu/project/rcn/205891>



## NEW RESEARCH REVEALS MECHANISMS BEHIND THE PRINCIPLE OF DIVIDE AND RULE

The perception of an external enemy or threat can help strengthen group cohesion – a factor that has been exploited by leaders over the ages. Now an EU project has investigated that phenomenon to contribute to a better understanding of power structures in colonial settings and the mechanisms of political communication at large.



**D**ivide and rule – a principle as old as human conflict itself. But how in practice does that actually work and what are the implications now? One EU-supported project considered the case of the Spanish colonial Philippines, taking chronicles and reports from the 17<sup>th</sup> and 18<sup>th</sup> centuries as its sources, to get a clearer idea of how threat perception can be fostered and used. It took a look at the root of what is still known as the ‘Moro problem’. This refers to clashes between Muslim and Christians in the southern Philippines.

As one of the researchers on the Phil-Threats (The Representation of External Threats in the Configuration of Spanish Power in the Philippines (1600-1800)) project, Dr Eberhard Crailsheim, explains, “Our research shows how the representations of the ‘Moro threat’ contributed to the cohesion of the diverse colonial society in the Philippines, and in the Spanish Empire at large. We applied a broad array of methods to show how the ‘creation’ of an enemy helped the Spanish ruling elite in Manila to unite the relevant actors (clerics, soldiers, bureaucrats and Christianised natives) and reinforce the colonial order in this Pacific Archipelago.”

The work carried out by the Phil-Threats project was developed in collaboration between Dr Eberhard Crailsheim as researcher and Dr María Dolores Elizalde as supervisor at the Spanish National Research Council, Madrid. It focussed on cultural aspects of political history. By doing so, the project managed to challenge older studies on political power. It stresses the importance of ‘soft factors’, such as perceptions and internal communication that need to be taken into consideration.

“We asked ourselves how colonial dominance was impacted by the integration of local elites and the military power of Spain, along with how propaganda was applied,” says Dr Crailsheim.

Studying such a broad range of factors required an interdisciplinary approach, as it took ideas from sociology and political sciences into consideration for the historical analysis. “More precisely,” says Dr Crailsheim, “key findings from conflict sociology as well as recent concepts from the security studies, in particular securitisation theories, were applied. This made the project a possible role model for other historians working on external threats.”

Their analysis was published in several articles and will appear, in particular, in two chapters of their forthcoming book ‘Representations of External Threats in History (Medieval World to 19<sup>th</sup> Century)’, which will be published later this year by Brill in the book series ‘The History of Warfare’.

### Framing such a diversity of sources

The approach the project used built upon the combination of recent international studies from various fields and disciplines. The theoretical framework developed mainly around the cultural history of politics, addressing the question of if and/or how political actions/communication produce, change, maintain or destroy certain (cultural, social, political) structures.

As Dr Crailsheim explains, the notion of a ‘knowledge-policy’ was particularly powerful as it claimed the authority to interpret essential values. The colonial government, and especially the Catholic Church, had a strong influence in the definition of what was considered ‘good’ or ‘normal’. By way of this truth- or knowledge-policy, it also determined who was ‘good’ and ‘bad’, and who then had to be perceived as a threat.

Phil-Threats has contributed to a better understanding of power structures in colonial settings and the mechanisms of political communication at large. The research was conducted in such a way that it makes it possible for later researchers to extrapolate the results and make comparisons with other colonial and postcolonial settings.

#### Phil-Threats

- ★ Coordinated by the Spanish National Research Council in Spain.
- ★ Funded under MSCA-IF.
- ★ <https://cordis.europa.eu/project/rcn/194873>
- ★ Project website: <http://ih.csic.es/en/research-project/The-Representation-of-External-Threats>



ENERGY

# THE KEYS TO SUCCESSFUL BIOMETHANE PRODUCTION

Food waste conversion to biomethane is now within the reach of four cities across Europe, thanks to work conducted under the Bin2Grid project.

The 88 million tonnes of food wasted every year in the EU cost the trifling sum of EUR 143 billion. With that in mind, it's easy to understand why food waste valorisation has become a political priority. New concepts and technologies keep emerging on a regular basis, notably thanks to EU funding under Horizon 2020.

Bin2Grid (Turning unexploited food waste into biomethane supplied through local filling stations network) is one of these initiatives. For two years, the project promoted the segregated collection of food waste, its conversion to biogas and the latter's upcycling into biomethane. The point? Supplying local fuelling stations in the cities of Zagreb, Skopje, Malaga and Paris, and helping make biomethane a more sustainable alternative to fossil fuels.

"None of these target cities had implemented the concept of waste-to-biofuel prior to Bin2Grid," says Bojan Ribić, coordinator of the project on behalf of Zagreb City Holding. Drawing inspiration from pioneer cities like Barcelona, Lille and Vienna, consortium members recommended specific activities to decision-makers, issued reports, guidelines and feasibility studies, and provided examples of best practices.

In Paris, for instance, the project found that biogas implementation had been accelerating lately, pushed by national objectives and ambitions to ban diesel fuel altogether.

However, the consortium deplored among other things the limited number of refuelling stations, their lack of interoperability, limited car buying options, and higher maintenance cost. They concluded that new partnerships between stakeholders to better balance supply and demand – along with other measures such as a favourable tax regime – could considerably boost the sector, and worked hard to make them happen.

"The concrete implementation of our proposed solutions at the local level was one of the main challenges we had to face. To overcome this challenge, we included all relevant value chain stakeholders in the development of our concepts, from inception phase until the end of the project," Ribić points out.

Two key sectors were specifically targeted: waste management and renewable energy production, with the aim of bridging existing gaps between the two. The consortium analysed existing technologies related to bio-waste separation and treatment, biogas production and upgrade, as well as biomethane utilisation. Then, they investigated possible economic tools to increase the profitability of the proposed concept.

"Our dedicated tools can assist stakeholders in the setup of sustainable waste management combined with renewable energy production in local communities. One example is an Excel-based benchmark tool which compares organic waste in the biomethane value chain with other waste treatment value

chains such as landfilling, composting and incineration. This tool was already applied to seven cities," Ribić explains.

Moreover, the project's biomethane tool – which provides an idea of economic conditions around biogas production, gas upgrading and utilisations of biomethane – can be used to estimate investments in, and operating and initial costs of, different facilities.

All in all, the project has significantly contributed to ongoing discussions on how to make the waste sector more sustainable at the international, EU, national and local levels. Now that it has come to an end, consortium members plan to keep disseminating project outcomes and results. "We strongly believe that our proposed concept is the most sustainable solution regarding the management of biowaste and its usage as a biofuel," Ribić says.

## Bin2Grid

- ★ Coordinated by Zagreb City Holding in Croatia.
- ★ Funded under H2020-ENERGY.
- ★ <https://cordis.europa.eu/project/rcn/194456>
- ★ Project website: <http://www.bin2grid.eu/>
- ★  <https://bit.ly/2AWzDHc>

# EXPANDING THE POTENTIAL OF CONCENTRATED SOLAR POWER

Through networking, joint research activities and facilitating transnational access to research infrastructure, the EU-funded SFERA-II project has increased the scientific and technological knowledge base in the field of concentrating solar systems.



Concentrated Solar Power (CSP) is a very promising source of renewable energy. Although its primary use is for generating bulk electricity, other applications are being developed, including for the production of hydrogen and solar fuels, water treatment and research in advanced materials. However, in order for these applications to move from the drawing board to market-ready solutions, additional testing and research is required.

The EU-funded SFERA-II (Solar Facilities for the European Research Area-Second Phase) project set out to develop common performance testing guidelines, evaluate the necessary improvements for reaching ultra-high flux distributions, accelerate aging testing, and establish guidelines to set up new test facilities for thermal energy storage materials and systems – all of which are related to concentrated solar power technologies.

“Through coordinated integration of their complementary strengths, efforts and resources, the SFERA-II project has increased the scientific and technological knowledge base in the field of concentrating solar systems,” says Project Coordinator Isabel Oller.

## Networking, joint research and transnational access

The project organised its work around three areas: networking, joint research activities and transnational access to research infrastructure. For example, under networking, the project organised a number of specific training courses for industrial technicians and researchers. As to the second area, the project created a specific joint working group charged with identifying and developing products and processes suitable for commercial exploitation. “Scientific and technological excellence have been strengthened due to an envisaged harmonisation and the effective use of large-scale infrastructures, as well as the establishment of virtual working groups and an extended dissemination strategy,” says Oller.

According to Oller, it was the third area of focus that proved the most challenging. “There was some difficulty attracting industry to take part in experimental research and development at our facilities,” she says. To overcome this challenge, project researchers worked with industry partners to identify

barriers and implement solutions that took into account commercial and industrial needs.

## Key outcomes

These three actions resulted in the creation of a unified, virtual European Laboratory for Concentrating Solar Systems. “The easily accessible platform is available to all researchers, from both academia and industry, and serves as the structural nucleus for growing demand in this field,” explains Oller.

Other key outcomes include cementing cooperation between academia and the European CSP industry, the development of joint calibration procedures and the opening of new facilities for testing and calibrating sensors. Standardisation of the measurement of different parameters and characterisation of heat transfer fluids and heat storage materials, as well as the elaboration of a complete database of these results, have also been addressed.

In the end, SFERA-II successfully provided and improved the research tools best-suited for the scientific and technological CSP community. It also helped strengthen European industry by stimulating technology transfer via the use of world-class R&D facilities. Last but not least, SFERA-II increased awareness about possible CSP applications, including the creation of new synergies with other scientific disciplines.

Even with the project now officially closed, the website remains operational and serves as a place for researchers, technicians and industry to learn about the successes of the SFERA-II project. To continue to build on these successes, project researchers are currently in the process of launching a proposal for a SFERA-III project.

## SFERA-II

- ★ Coordinated by the Centre for Energy, Environmental and Technological Research in Spain.
- ★ Funded under FP7-INFRA.
- ★ <https://cordis.europa.eu/project/rcn/110563>
- ★ Project website: <https://sfera2.sollab.eu/>



# CROWDFUNDING A PERFECT SOLUTION TO BOOST RENEWABLE ENERGY PROJECTS

A new financial model promises to increase funding for renewable energy projects exponentially. Crowdfunding platforms have already produced impressive results in propagating renewable energy in northern Europe.

**T**he shift to renewable energy systems (RESs) in Europe is losing steam due to tighter financing. Enter CrowdFundRES (Unleashing the potential of Crowdfunding for Financing Renewable Energy Projects), an EU-funded project focused on speeding up renewable energy growth by leveraging crowdfunding to finance renewable energy projects.

“The project is aimed at both individual retail investors who want to invest even small amounts in renewable energy projects and RES project developers who face financing challenges through conventional avenues,” says project coordinator Pablo Alonso from WIP Renewable Energies. CrowdFundRES also targeted high-quality renewable energy crowdfunding platforms which facilitate transactions between citizens and project developers.

## New guidelines to help RES crowdfunding

To achieve its aims, the project first researched the public perception of crowdfunding and its challenges across Europe with respect to renewable energy through detailed surveys, case studies and workshops. “We developed and applied guidelines that support better practices in crowdfunding such projects, in addition to supporting the relevant market, regulatory framework and policymakers,” highlights Alonso. The project team then vigorously promoted the crowdfunding concept and its advantages to stakeholders and funders.

One of the project's key outcomes is the ‘Guidelines for Investors in Clean Energy Projects via Crowdfunding’, which frees investors from having to research and analyse potential renewable energy investments. CrowdFundRES has also articulated guidelines for crowdfunding platforms and RES project developers, along with an eBook that helps platforms, investors, developers and policymakers to exploit crowdfunding as a mechanism to deliver new market access to investors of sustainable projects and improve policy.

## Western Europe is already benefiting

By showing how crowdfunding can finance renewable energy projects, CrowdFundRES deliverables will contribute to increasing the share of renewable electricity, heating and cooling. The project has successfully analysed 18 crowdfunding renewable electricity project campaigns run by the crowdfunding platforms involved, resulting in 110 MW of additional installed capacity. “One such project showed energy savings of 37% and around 270 tons in CO<sub>2</sub> reductions each year,” reveals Alonso. “Overall, around EUR 29.5 million has been successfully crowdfunded through these project campaigns,” he adds.

At least 30 new crowdfunding platforms will emerge across the project's six target countries – Belgium, Germany, France, the Netherlands, Austria and the United Kingdom – helping to realise more than 300 MW of new renewable

energy projects by 2020. The figure is expected to grow exponentially as crowdfunding expands to other countries and involves larger projects.

## People power advances renewable energy

In France alone, incentive schemes supported by the project may have an immense impact. The French Ministry of Energy is offering a new incentive to sell electricity at a higher price of around 5% for 20 years if RES developers use a crowdfunding platform to co-finance 40% of its equity to ‘local’ investors for at least three years. It is expected that around 8 GW of renewable capacity will be built between 2018 and 2021. This means that French citizens could contribute up to EUR 300 million to the roll-out of renewables.

“This financing model can be a very useful tool in building public support for RES projects,” clarifies Alonso. “If citizens are involved with renewable energy development through crowdfunding, they will accept renewable energy infrastructure in their areas more easily and will develop a sense of ownership,” he explains.

Other project impacts and benefits include reduced time for investment authorisations, as well as improved policy, regulatory and market operations for crowdfunding in target countries. Overall, the project reached 660 000 people, including crowdfunding experts, renewable energy developers and professionals, NGOs, environmental organisations, policymakers and the wider public.

It is more than likely that the successes of the platforms will be replicated in other EU countries, breathing new life into renewable energy projects. With or without state funding, renewable energy is here to stay.



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### CrowdFundRES

- ★ Coordinated by WIP in Germany.
- ★ Funded under H2020-ENERGY.
- ★ <https://cordis.europa.eu/project/rcn/194428>
- ★ Project website: <http://www.crowdfundres.eu>
- ★  <https://bit.ly/2L8ATHw>



ENVIRONMENT

# THE HIGH COST OF ARCTIC CHANGE

Nowhere on Earth are the effects of climate change more apparent than in the Arctic. Temperatures are rising at more than double the global average rate, causing rapid loss of sea ice along with shifts in atmospheric and oceanic conditions.

Changes to the Arctic are setting off complex chain reactions with environmental, social and economic impacts extending beyond the region. Predicting and anticipating their effects is a formidable task, requiring the coordinated efforts of a broad range of expertise, as well as the involvement of indigenous and local communities.

The EU-funded ICE-ARC (Ice, Climate, and Economics – Arctic Research on Change) project aimed to provide a holistic understanding of the impact of Arctic change. The goal was to quantify the global economic and societal costs of responding to it or failing to respond to it.

Researchers focused on cross-discipline collaborations by uniting economists, social scientists and natural scientists and involving indigenous communities in the region, to directly assess the social and economic impact of Arctic sea-ice loss. “Understanding the full extent of Arctic change requires an enormous volume of highly diverse information,” explains project coordinator Dr Wilkinson. “ICE-ARC is responding to this need through multidisciplinary research that blends together societal needs with technology, observations and models.”

## Accurate prediction tools benefit society

Scientists deployed nearly 50 robotic platforms from a dozen expeditions across the Arctic Ocean. Data from these systems, which was collected and transmitted year-round, were fed into ICE-ARC's regional oceanic and atmospheric model systems in order to improve our understanding of key Arctic processes. This led to refined mathematical algorithms within global climate models which in turn contributed to more accurate climate predictions.

To assess the global cost of Arctic change, ICE-ARC combined the latest sea ice and permafrost simulations from state-of-the-art climate models with current environmental and socio-economic information to produce a more accurate integrated assessment model of the costs associated with Arctic change.

Results showed that the acceleration of climate change, driven by thawing Arctic permafrost and melting sea ice, could cause up to USD 130 trillion worth of extra economic losses globally under the current business-as-usual trajectory over the next three centuries. If global warming is limited to 1.5° C, the additional cost will be reduced to under USD 10 trillion.

## Co-production of knowledge

“Nobody better understands or is more sensitive to changes in the Arctic than the people who live there,” comments Dr Wilkinson. “Hence, ICE-ARC worked with the indigenous people of Northwest Greenland to identify trends and to appreciate the impact Arctic climate change is already having on the region, especially within a context of socio-economic transition.” New knowledge and understanding across these diverse sectors was achieved through dedicated meetings and workshops with Arctic communities.

The team disseminated the knowledge gained via high-impact scientific papers and educational programmes, dedicated roundtables with industry, high-level sessions and discussions to policy makers, and through wide-reaching public outreach events including school visits.

## Challenges and lessons learned

ICE-ARC delivered a much-improved understanding of the effects and long-term implications of Arctic change, but it has also made clear the scale of the challenges facing our planet. Dr Wilkinson concludes: “We need to continue to strengthen the links between science, policy and society. Cross-sectorial programmes like ICE-ARC provide these connections, enabling policy-makers to develop evidence-based policies that address the dual goals of climate change mitigation, as well as to exploit the economic growth opportunities that a low-carbon society offers.”

The work of ICE-ARC will be followed up by the EU Arctic Cluster – a collaboration of the EU-funded Arctic programmes, led by the EU-PolarNet – see #EUArcticCluster.

### ICE-ARC

- ★ Coordinated by the Natural Environment Research Council in the United Kingdom.
- ★ Funded under FP7-ENVIRONMENT.
- ★ <http://cordis.europa.eu/project/rcn/110891>
- ★ Project website: <http://www.ice-arc.eu/>

## EROSION-RISK TOOLS DEVELOPED FOR FIRE-AFFECTED VOLCANIC TERRAIN

Volcanic regions have high fertility soils that are susceptible to erosion caused by environmental disturbances, such as wildfires. Better understanding the soil behaviour has enabled improved erosion risk assessment and cost-effective stabilisation treatments.

Volcanic regions are frequently highly populated, steep and prone to wildfires. These areas are also often beset by torrential rainfall, and as wildfires remove protective vegetation they experience severe water erosion, landslides and floods. Collectively, these pose a significant threat to property, infrastructure and, ultimately, lives.

The EU-funded FireAndRiskPrevention (When the smoke clears: predicting and preventing catastrophic erosion and flooding after wildfires in volcanic terrains) project has tested and implemented urgently-needed erosion-risk tools in the Canary Islands, Spain. These tools were developed to support land managers in the design of effective mitigation plans and protocols to reduce fire-induced hydrologic and erosion risks. After further customisation, the tools are intended to be useful for other vulnerable and remote regions of volcanic origin around the world.

### Tools forged by field, laboratory and modelling efforts

The FireAndRiskPrevention project team started by collating existing knowledge and approaches. Then with the help of local stakeholders they identified critical gaps for improved runoff-erosion processes, in fire-affected volcanic terrain.

The next step proved to be perhaps the most challenging as Marie-Curie Fellow Dr Jonay Neris Tomé recalls, “We had to opportunistically ‘chase’ suitable fires for field data.”

However, due to their fragile soil structure and subsequent rapid changes in physical and hydrologic properties after environmental disturbances, volcanic soils behave very differently from other soil types.

Therefore, the main challenge that land managers face when designing post-fire mitigation actions in volcanic areas is that existing models used to predict runoff-erosion have not been tested specifically for volcanic soils but rather imported from other terrains. Additionally, mitigation interventions



themselves have been developed and tested in very different terrain, often using materials not readily available in volcanic areas.

Once the suitably burned areas were identified, as Dr Neris Tomé explains, “We modified an existing and widely-used erosion-risk model, the ‘Water Erosion Prediction Project’ of the US Forest Service, to develop tools adapted to the distinctive response of volcanic soils to the impact of fire. We found that these tailored local mitigation treatments – for example using local pine needles as mulch – performed best for this terrain type in reducing runoff and erosion.”

### Cost-effective future proofing

The tools developed by the FireAndRiskPrevention project are currently supporting the Spanish Cabildo de Tenerife management body in designing risk reduction mitigation actions in response to the recent (April 2018) Tenerife fire that affected nearly 400 hectares of land.

The benefits of these project tools are likely to be significant as project coordinator Professor Stefan Doerr explains, “Our project insights could have supported effective mitigation plans on the Canary Island of La Palma after the wildfire and subsequent rainstorms in

2009 and 2016. Direct costs of the post-fire debris flows were EUR 20 million in 2009, and the investment in restoration of EUR 5 million after the 2016 fire still failed to prevent major runoff events and so severely affected infrastructure. It is very likely such events will occur again.”

More broadly, FireAndRiskPrevention contributes to several of the EU’s policies, especially the Energy, Climate Change and Environment policy with the project focus on soil conservation in vulnerable fire-affected volcanic regions combined with adaptation to increased wildfires and runoff-erosion due to climate change.

Looking to the future, Professor Doerr says, “The team are working to identify, evaluate and model other sources of risk. For example, we are modelling in a spin-off project the risk of wildfire ash entering the stream network and so impacting water quality, fresh-water supply and aquatic ecosystems.”

#### FireAndRiskPrevention

- ★ Coordinated by Swansea University in the United Kingdom.
- ★ Funded under H2020-MSCA-IF.
- ★ <https://cordis.europa.eu/project/rcn/195199>
- ★ Project website: <https://www.facebook.com/FireAndRiskPrediction/>



# NEW TECHNIQUE SHEDS LIGHT ON THE ABOVE GROUND BIOMASS OF TROPICAL RAINFORESTS

A new technique integrating satellite data and information on the shape of the landscape could help scientists to map the structural variables of rainforests. Developed by a Brazilian biologist, the methodology is providing new insights on the relationship between topography and biomass.

A Brazilian scientist, working with a research team at Leicester University in the UK, has developed a way of combining satellite data with information on the shape of the landscape to improve our knowledge of the structure and floristics of the Amazonian rainforest.

As part of the MF-RADAR (Multi-frequency RADAR imaging for the analysis of tropical forest structure in the Amazon) project, Marie Skłodowska-Curie fellow Polyanna da Conceição Bispo has used the method to map and quantify different variables of structure and species composition of the Tapajós National Forest in Northern Brazil. This new information improves the uncertainty in estimations of variables that were previously hard to map and will be of interest to other scientists who study the carbon cycle in tropical regions.

"The Amazon can be seen as the lungs of the world because it generates a lot of oxygen and is very important for the global water cycle," says Heiko Balzter, MF-RADAR project coordinator and professor of physical geography at Leicester University, "but while the Amazon has been mapped for a long time, we still don't know how much biomass is stored in the trees so we don't know how much carbon they stock."

## Integrating is innovative

MF-RADAR brings together geomorphometry, or the science of quantitative land-surface analysis, with satellite remote sensing techniques from Synthetic Aperture Radar (SAR) in an integrated fashion, which is highly innovative.

In order to do so, Dr Bispo worked intensively on SAR and Light Detection and Ranging image processing as well as integrating datasets on the Amazonian rainforest from multi-frequency radar in the X, C and L bands. Her two-year fellowship included leading fieldwork in Tapajós and undertaking secondments at the European Space Agency, the German Aerospace Centre and Oxford University. During this time, she built a network for knowledge sharing which continues to benefit the 25-plus researchers of Leicester University's Centre for Landscape and Climate Research group to this day.

Her achievements include exploring to what extent forest attributes – especially abundance, richness and above ground biomass – are determined by spatial or environmental factors, in this case represented by geomorphometry.

## Biomass and topography

"We found that even in areas with not too much variation of terrain, 27% of the distribution of above ground biomass in tropical forests can be explained by geomorphometric factors and 15% by spatial and geomorphometric factors together: so topography can explain a big percentage of its distribution. Tropical forests are really complex and other factors such as soil, precipitation and temperature can play an important role in the forest structure and floristic distribution too," she said, adding that this was the first time a scientist had used this integrated method in order to explore these variables.

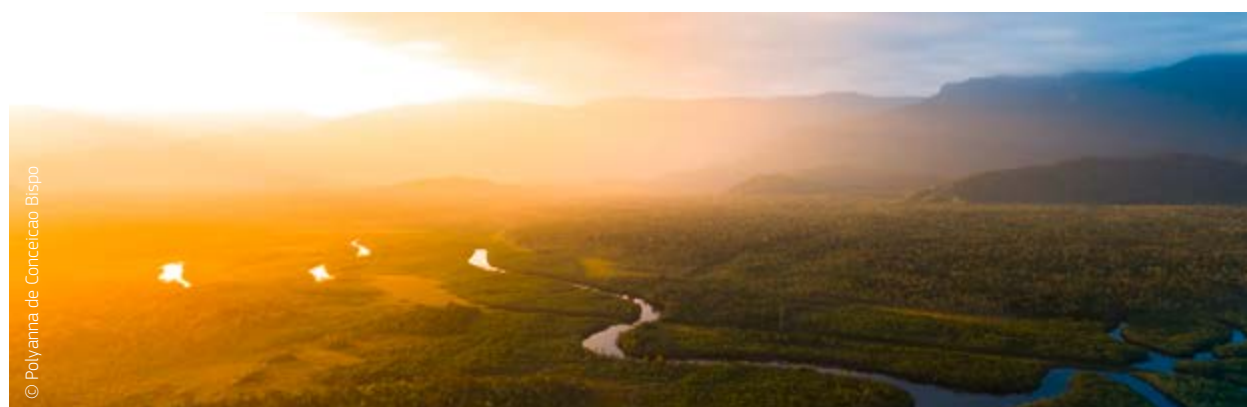
Integrating geomorphometry with SAR multifrequency data allowed Dr Bispo to shed new light on the distribution of different forest structure attributes including basal area, diameter at breast height and above ground biomass as well as forest species composition.

The MF-RADAR team published several "articles on some of our findings on the relation between topography and floristics – which group or community of plants you find where – and what the relationship is between the abundance, richness and species composition of the forest and its topography," says Dr Bispo.

Demonstrating and validating this integrated approach will open up plenty of new avenues for scientists to explore, Dr Bispo believes. "I think that multi-frequency integration will surely continue especially as we will be seeing a lot of new missions and datasets, such as TanDEM-L and the BIOMASS SAR, which will allow us to get information from the biomass," she says.

## MF-RADAR

- ★ Coordinated by Leicester University in the United Kingdom.
- ★ Funded under H2020-MSCA-IF.
- ★ <http://cordis.europa.eu/project/rcn/197284>
- ★ Project website: <https://www2.le.ac.uk/departments/geography/research/projects/mf-radar/mf-radar>





## AQUATIC RESOURCES

# FISHING FOR NEW WAYS TO EXPAND THE EU'S AQUACULTURE INDUSTRY

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The EU-funded DIVERSIFY project is contributing to the sustainable expansion of the Europe's aquaculture industry by promoting species diversification and product development.

Currently, aquaculture in Europe is unable to meet the growing demand for aquatic products. In fact, the European aquaculture sector only provides an insufficient 10% of the EU's total seafood consumption. Seeing an opportunity to help increase the sector's market share, the EU-funded DIVERSIFY (Exploring the biological and socio-economic potential of new/emerging candidate fish species for the expansion of the European aquaculture industry) project is working to expand the EU's aquaculture industry. To do this, it is revolutionising scientific techniques and methodologies that will optimise the rearing and production of new or emerging finfish species, along with establishing a range of marketing initiatives aimed at attracting consumers.

"The objective of the DIVERSIFY project is to promote the species diversification of the European aquaculture industry, thus contributing to its sustainable expansion," says Project Coordinator Dr Constantinos C. Mylonas.

## Six promising species

The project identified six new or emerging finfish species: meagre, greater amberjack, wreckfish, Atlantic halibut, grey mullet and pikeperch. "Because these species are either large or fast-growing, they are ideal candidates for processing into a range of products, providing consumers with both a greater diversity of choice and new value-added products," explains Dr Mylonas.

However, before these new products could be launched, researchers first had to resolve such production bottlenecks as reproduction control, larval rearing methods, optimisation of recirculation aquaculture system rearing, feeding methods, and identifying major pathogens. For example, in the case of greater amberjack, researchers had to develop innovative methods for controlling their reproduction in captivity, the on-demand production of fertilised eggs, and the production of large numbers of juvenile fish. "We are finally at the stage that, after decades of interest and scattered efforts for commercialising this species in Europe, we can now proceed with industrial production and marketisation," says Dr Mylonas.

Another example can be seen in the project's success in taking the meagre from being an emerging species to a viable market

option for the aquaculture sector. Having confirmed that the available captive broodstocks are adequate for breeding selection programmes, researchers developed the husbandry and molecular tools needed to implement this selection at farm level.

In addition to its species-specific research, the project also includes a socioeconomic component. Here, researchers are looking at market opportunities for the new species and developing business models based on consumer studies and online marketing tests, among other tools. So far, insights have been generated to identify the most promising ideas for new fish products from the project species for the European market.


## Objectives met

Being in the last year of the project, DIVERSIFY has produced an array of important scientific knowledge that is helping European aquaculture diversify its production and increase its market share. "The DIVERSIFY project has already achieved almost all that it has promised and has demonstrated that diversification is not only possible, but a necessity for European aquaculture," says Dr Mylonas.

Despite this success, work remains for the diversification of EU aquaculture. The consortium is now turning its attention towards the future, identifying the research needed to address additional production bottlenecks and perhaps study other new and emerging species. But whatever lies ahead, DIVERSIFY's goal has been achieved: to provide the necessary tools to diversify the European aquaculture industry and ensure food security, sustainable production and high-quality seafood at an affordable price.

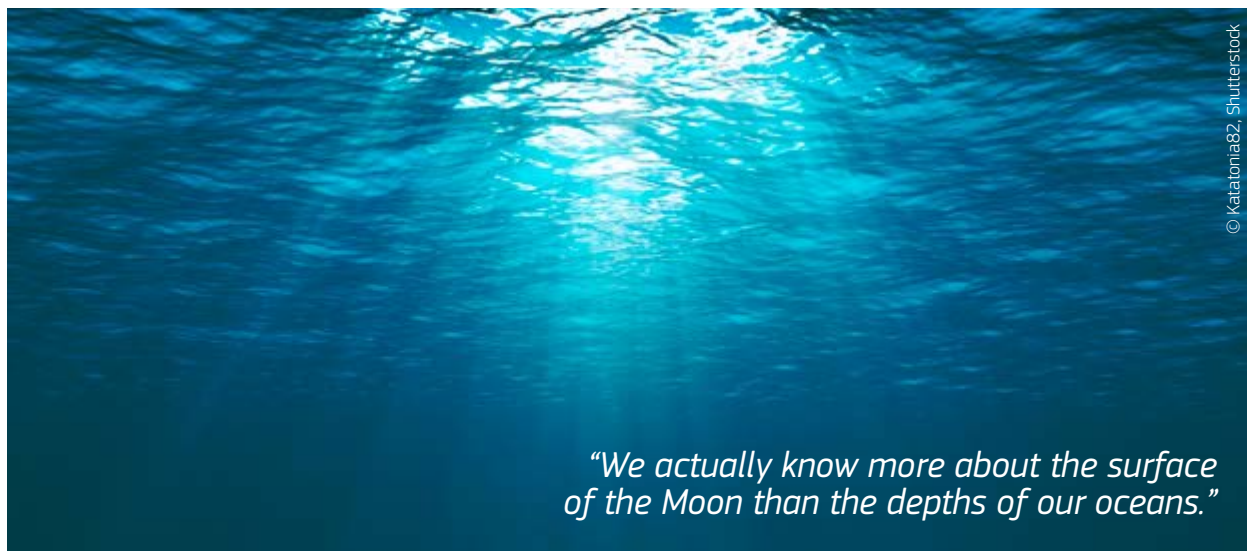
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### DIVERSIFY

- ★ Coordinated by the Hellenic Centre for Marine Research in Greece.
- ★ Funded under FP7-KBBE.
- ★ <https://cordis.europa.eu/project/rcn/111185>
- ★ Project website: <https://www.diversifyfish.eu/>
- ★  <https://bit.ly/2FN00T2>

# NEW PLATFORM FOR PLUMBING THE SEA DEPTHS

An EU-funded project successfully established a new and easily accessible internet platform for providing bathymetric products derived from current and upcoming Copernicus and other satellite missions.



*"We actually know more about the surface of the Moon than the depths of our oceans."*

**B**athymetry is the measure of water depth, the underwater equivalent to topography. Just as topographic maps represent the altitude of Earth's surface at different geographic points, bathymetric maps represent the sea depth depending on geographic coordinates. Up-to-date bathymetric data is vital for producing navigation products such as nautical charts for facilitating safe and efficient navigation of ships. In addition, it underpins almost every other activity associated with the sea, including port and offshore construction, maritime defence and security, coastal zone management, fishery, cruising and tourism.

The EU-funded BASE-platform (Bathymetry Service Platform) project addressed the lack of available up-to-date, high-resolution bathymetric data in many areas of the world. With the increasing number of Earth observation satellites, just like ESA's Sentinel fleet, ocean imagery data is now widely available. BASE-platform's ambition was to use this satellite data for creating bathymetric maps and supplying them to end users.

## Harmonised bathymetric data

Partners from five different countries combined their expertise to create an advanced commercial platform for a broad range of users that derives images from multiple remote sensing technologies to create bathymetric products. These include optical, synthetic aperture radar and altimetry satellites, where each technology applies to a different depth range. Additional input is gathered from crowd-sourced echo sounding data provided by a large number of ships and boats.

While all of these technologies have been used separately before, BASE-platform refined methods and tools for merging these data sources, thus allowing for wide data coverage and high accuracy. "Within the project, existing data generation processes have been automated to become part of a processing chain that requires minimal human intervention. The BASE-platform data portal is a cost-efficient bathymetric product that provides high-resolution

data," says Dr Stefan Wiehle. Data was also integrated with tidal modelling for reducing depths to local chart datums.

## Exploring the seas in-depth

To date, less than half of the coastal waters are deemed to be adequately surveyed to modern standards or have not been surveyed at all. The picture gets worse when considering that 80% of oceans still remain unexplored, and there is an enormous amount we do not know about them. "We actually know more about the surface of the Moon than the depths of our oceans," Dr Wiehle points out.

Sea depths had already been measured by the ancient Greeks and Romans, but bathymetric charts only became frequently produced from the middle of the 19<sup>th</sup> century onwards. Over this period, methods and equipment for depth measurements have evolved tremendously, from single lead line depth soundings to modern multibeam sonars. However, "Depending on the source, bathymetric data can either be of little value to users as it comes in low-resolution and some depths may have been calculated with interpolation, or be too expensive to obtain," explains Dr Wiehle.

BASE-platform addresses the need to provide the maritime and other industries with accurate bathymetric data at substantially lower costs than data from multibeam surveys. The new bathymetric data portal provides high-accuracy data on a global scale covering the whole range of sea depths and is ideal for oil and gas exploration, fishing or coastal engineering. A major achievement, satellite-derived optical bathymetry data has already been included in official sea charts.

### BASE-platform

- ★ Coordinated by the German Aerospace Center in Germany.
- ★ Funded under H2020-LEIT-SPACE.
- ★ <http://cordis.europa.eu/project/rcn/200490>
- ★ Project website: <http://base-platform.com/>

# SUSTAINABLE EXTRACTION OF RAW MATERIALS FROM OCEANIC DEPTHS

Renewable technologies like wind turbines, solar panels, and electric cars require large amounts of 'strategic metals'. Although these metals are critical to the future of Europe's economy, there is the risk of a supply shortage arising from growing demand, which terrestrial mining cannot meet.

Deep-sea mineral deposits comprise an alternative source of raw materials for Europe's renewable energy sector. Increasing commodity prices mean that the idea of sourcing metals from the ocean floor is now becoming more attractive to investors. However, the extreme conditions found in the ocean depths pose major technical and environmental challenges that are entirely different to land-based mining.

The EU-funded BLUE MINING (Breakthrough Solutions for the Sustainable Exploration and Extraction of Deep Sea Mineral Resources) project addressed challenges associated with the extraction of deep sea minerals, ranging from their discovery and assessment, to exploitation technologies and the necessary legal and regulatory framework. "The consortium provided breakthrough solutions for a sustainable deep-sea mining value chain by developing the technical capabilities to adequately and cost-effectively discover, assess and extract deep sea mineral deposits at depths of up to 6 000 m," says project coordinator Dr Jort van Wijk.

Researchers aimed to conduct more reliable and accurate exploration surveys for seafloor massive sulphides (SMS), extinct SMS deposits (eSMS) and sea floor manganese nodules (SMnN). New sensor technologies were then developed to rapidly find deep sea deposits and more accurately assess their dimensions.

## New tools and sensors

New geophysical tools, improved predictive mapping techniques and sampling enabled fast and reliable mapping and modelling of potential resources. The team has developed approaches on how to measure sustainable mining operations by indicators and how to foster positive responsible behaviour of entrepreneurs by incentives. Further developed tools allow for spatial management and control of seafloor areas and the sustainable use of their resources. These tools can be used as a

blueprint for mining feasibility studies of deep sea minerals.

During research voyages, scientists tested a new combined self-potential/magnetic sensor mounted on a deep-towed system, using the results to create the largest autonomous underwater vehicle-based map of the ocean floor. "Our new model indicates that many of the smaller deposits are likely to be more economically viable than estimates based on the volume of the mound alone would suggest," claims the project's principal investigator Dr Bramley Murton.

BLUE MINING developed and validated computer codes through laboratory experiments and conducted detailed simulations of riser dynamics and slurry transport processes. According to van Wijk, "These tests are necessary for validating decision support tools and to provide an impression of the problems expected when transferring large amounts of slurry at sea."

## Minerals transported from the ocean floor

Researchers devised a configuration of riser pipes and underwater pumping technology to move mineral resources from the seafloor to the surface over a distance up to 6 000 m. "Vertical hydraulic transport was tested and monitored on a purpose-built rig having

a riser of 125 m in length, making it the largest vertical transport test rig in Europe for deep-sea mining," claims van Wijk. "Ship-to-ship transfer technology was also developed for transferring the mined material from the mining vessel to the carrier-vessel."

The design of the vertical transport system paid special attention to the booster stations, resulting in the development and testing of a special deep-sea motor prototype. "The motor is filled and cooled with water due to its open structure, therefore it does not require any lubricants, minimising the environmental impact of the motor," van Wijk points out.

BLUE MINING will ensure access to raw materials, thereby decreasing EU dependency on resource imports and strengthening Europe's mining sector and their technology providers. It will also enable the EU to become a global leader in technology associated with the exploration and sustainable extraction of deep-sea minerals.

### BLUE MINING

- ★ Coordinated by IHC MTI BV in the Netherlands.
- ★ Funded under FP7-NMP.
- ★ <https://cordis.europa.eu/project/rcn/111346>
- ★ Project website: <http://www.bluemining.eu/>





INDUSTRY

# A NEW, DIGITISED ERA FOR EUROPEAN MANUFACTURING

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Manufacturing in the EU is heading to another level that will make it more competitive than ever, thanks to better service models and to innovations such as digitisation, Big Data and the Internet of Things.

In the face of Asian competition and cheaper labour abroad, Europe's manufacturing industry must stay ahead of the game and remain competitive by offering superior value and services. The EU-funded PSYMBIOSYS (Product-Service SYMBIOTic SYStems) project worked on revolutionising the product-service engineering environment through better intelligence technologies.

"PSYMBIOSYS overcomes key obstacles that hamper service innovation in the EU," explains project coordinator Sergio Gusmeroli. The obstacles cover issues such as becoming more service-oriented, embracing the digital world, mediating between product push and market sentiment, and enhancing value chains through better IT architectures.

## A new paradigm for pre-production and post-production

The pre-production phase (product ideation, design and engineering) and the post-production phase (training, diagnosis and maintenance) of the product value chain are increasingly gaining extraordinary importance for the manufacturing industry. "Services are now permeating the whole product life cycle, in particular at the pre- and post-production phases where they play a pivotal role towards achieving success for the manufacturer," says Gusmeroli.

In this vein, advanced services based on artificial intelligence can significantly benefit consumer goods such as clothing and furniture. "In pre-production phases this could involve analysing consumer behaviour, digitising showrooms and adopting immersive technologies such as augmented or virtual reality to add value and improve user experiences," illustrates

Gusmeroli. "On the post-production side, the Internet of Things and Big Data technologies can support remote monitoring, diagnosis, training, and predictive maintenance for machinery, vehicles and robots," he adds.

Another key barrier that PSYMBIOSYS examined was how the design and manufacturing of a product could change according to whether the product is sold or leased to the customer. "Products that aren't wholly owned by users and whose maintenance, retrofitting and/or leasing depend on the manufacturer may be more durable and of better quality," concedes Gusmeroli. "PSYMBIOSYS aims to reconcile design and manufacturing with cost and quality in order to maximise benefits for the user," he underlines.

## Leveraging the internet into manufacturing

In parallel, service innovation, i.e. value co-creation with a customer, requires carefully listening to customers' needs and requirements. "Sometimes manufacturers must adopt solutions that aren't optimal from a traditional professional engineering viewpoint, but that meet the users' tastes and preferences," says Gusmeroli. "In the consumer goods sector, the wisdom of the crowd and the voice of consumers often emerge in social networks, where AI-based tools can extract opinions and feelings about the product," he adds.

It is worth noting that the PSYMBIOSYS IT architecture and product service interoperability components contribute to the FIWARE for INDUSTRY (F4I) initiative, part of the FIWARE open-source foundation for building advanced software solutions and applications in three domains: Smart City, Smart Agrifood and Smart Industry.

"PSYMBIOSYS supports implementation of the F4I reference architectures, and in particular its components for product-service Internet of Things brokering, event processing and semantic interoperability," clarifies Gusmeroli.

This is particularly important as manufacturers are increasingly following the whole life cycle of their products by means of internet-based technologies such as the Internet of Things. It ties in with the 6P model (Product, Process, Platform, People, Performance, Partnership) of digital transformation which has been embraced by the project.

In short, PSYMBIOSYS promotes service innovation for manufacturing industries, based on a complete 6P digital

transformation. By balancing between dependable traditional manufacturing models and high-tech innovations, the project is destined to take European manufacturing to new heights.

#### PSYMBIOSYS

- ★ Coordinated by Milan Polytechnic in Italy.
- ★ Funded under H2020-LEIT-ADVMANU.
- ★ <https://cordis.europa.eu/project/rcn/193420>
- ★ Project website: <http://www.psymbiosys.eu>

## COOPERATIVE FOUNDRIES OFFER SMES SMALL-BATCH PRODUCTION

How can SMEs get products out of the lab and into the market, when they only need small lot-size manufacturing? One project found a solution by creating a collaborative small quantities test bed.

In pursuit of product commercialisation, European small and medium-sized enterprises (SMEs) are faced with a conundrum. While they need manufacturing facilities to provide electronic components and systems, their markets are usually quite niche and so production tends to be of small lot-sizes. Over the last few years, Smart Systems Integration (SSI) has helped get a diverse range of innovations out of the lab and to market. Now it also addresses the challenge of small lot-size production at reasonable cost.

The EU-funded SMARTER-SI (Smart Access to Manufacturing for Systems Integration) project was set up to test a new concept for distributed small lot production – the Cooperative Foundry Model (CFM). The systems comprised of 'building blocks' of electronic components and functional parts with high Technology Readiness Levels (TRLs) contributed by participating Research and Technology Organisations (RTOs). This modular arrangement offers adaptive production solutions for SMEs.

### Lowering entry barriers to market for SMEs

SSI refers to the range of functional systems, such as sensing and data communications, based on microsystems technology (e.g. sensors, actuators, electronics). These are combined for a variety of solutions, such as energy management. Systems are usually embedded into the natural, built and social environment. They are considered 'smart' as they rely on feedback loops, data-sets and algorithms to enable autonomous operation.



*"The idea for a Community Foundry Model was triggered by some research projects which despite their success, did not result in marketable products."*

SSI offers SMEs increased access to options for design, prototype manufacturing, testing and first production. SMARTER-SI sought to maximise this potential with a cooperative approach which pulled the resources of RTOs.

As project coordinator Dr Rainer Guenzler explains, "The idea for a CFM was triggered by some research projects which despite their success, did not result in marketable products. The problem being that most SMEs do not need large quantities of hardware systems for their products, and commercial foundries cannot justify producing small quantities."

The SMARTER-SI CFM combines the expertise of six internationally recognised RTOs, offering SMEs a technological access point for small lot manufacturing of systems (up to a few hundred units) selectable from a catalogue. These building blocks are technological modules such as sensor chips, which are interoperable and can be combined into fully functional systems.

The project team designed a test bed for 11 Application Experiments (AEs) to be trialled using the building blocks. The project succeeded in all cases in delivering dozens of systems to the SMEs, who were in turn able to beta test them amongst their own customers.

As Dr Guenzler elaborates, "This is perhaps the most important step to reach the marketplace. To highlight one example: the clutch-brake smart sensor which monitors abrasion not only saves costs and allows predictive maintenance but also demonstrates how machinery can benefit from digitalisation."

### Capitalising on Europe's research excellence

The SMARTER-SI project aligns with the 'Smart Anything Everywhere' European Commission initiative, established to enable SMEs to meet their digital transformation challenges. The approach exploits the modular, multi-disciplinary and multi-scaled nature of SSI to




realise and improve a range of innovative products and commercial opportunities. The CFM reduced the time from idea to product by a factor of two.

In the case of industrial automation, it has been estimated that the value added by SSI represents approximately 10% of the EUR 113 billion global market. Europe is in pole position to leverage its leading RTO research, development

and production facilities to win a significant share of this.

Looking to the future, Dr Guenzler says, "We've had so many promising results from the AEs, such as a device to check food for toxins and allergens. To take these forward, the SMEs will now go into small lot manufacturing. For some, this will happen in the coming months while others will need more time."

#### SMARTER-SI

- ★ Coordinated by Hahn-Schickard in Germany.
- ★ Funded under H2020-LEIT-ICT.
- ★ <https://cordis.europa.eu/project/rcn/194220>
- ★ Project website: <https://smartanythingeverywhere.eu/cluster-projects/smarter-si/>
- ★  <https://bit.ly/2NL5T28>

## LIGHTWEIGHT, POROUS MATERIALS SET TO BENEFIT NUMEROUS APPLICATIONS

From providing better treatment and outcomes in healthcare to promoting sustainability by lowering carbon footprints and limiting the consumption of raw materials, the EU-funded NANOGROW project is helping advanced materials realise their full potential.

Although advanced materials are widely recognised as being a key enabling technology, they first need to be more fully developed. Here, the NANOGROW (Growing Synthetic Load-Bearing Materials: Nano-Scale Fabrication of Bio-Inspired Materials for Macro-Scale Structural and Biomedical Applications) project has developed a novel strategy for producing highly porous, lightweight advanced materials featuring a controlled pore structure, mechanical properties and additional functionality.

To develop this material, researchers utilised a technique to 'grow' polymer nanocomposites as conformal coatings onto porous substrates, such as open-cell foams. The coating was deposited using layer-by-layer assembly, which sequentially deposits thin layers of alternating materials. "By using this technique to deposit alternating layers of nano-clay and polymer, we created highly reinforced nanocomposites having a brick-and-mortar structure, along with high mechanical strength and stiffness," says Project Researcher Andrew Hamilton.

Researchers also explored the use of mechanical loading as a processing parameter to target more deposition of thicker coatings in regions subjected to higher loading. "By adjusting the thickness, composition and processing parameters of the coatings, we produced customised materials suitable for use with a diverse range of targeted applications, including porous scaffold materials for tissue engineering and lightweight porous structures for aerospace and transport applications," says Hamilton.

### Advanced materials, practical applications

In healthcare, the porous materials developed by NANOGROW are being used as engineered tissue scaffolds that repair widespread damage too large for the natural healing process to address. For example, in our bone structure, such critical sized defects can be caused by traumatic injuries or when surgically re-sectioning bone tumours. In these cases, scaffold materials are used as a stand-in for the damaged bone and to guide the healing process.

"The scaffold material must provide sufficient porosity to allow cells to migrate into the scaffold, where they attach, grow and deposit new bone, but they should also provide sufficient mechanical support to the healing tissue and, as much as possible, enable normal functionality and activity," says Hamilton. "The high mechanical properties of the brick-and-mortar nanocomposites utilised in NANOGROW help achieve combinations

of higher porosity and mechanical properties than can be achieved with traditional porous scaffold materials."

According to Hamilton, the combination of high porosity and high mechanical properties can also improve efficiency in applications where weight is critical, such as airplanes and spacecraft. "Here, providing a required level of mechanical support in a particular part by using materials with given mechanical properties and high porosity – and thus lower weight – can improve fuel efficiency and range, while also reducing fuel consumption and CO<sub>2</sub> emissions," he says.

### Continuing to grow

The NANOGROW project has successfully established novel material systems and fabrication techniques with the potential to spur further innovation. Even though the project is now complete, Hamilton says that many of the NANOGROW researchers continue to advance the techniques and material systems developed during the project. "I am proud that the researchers who worked on NANOGROW continue to use the techniques and ideas from this project in the work that they are conducting in new research roles," he adds.

#### NANOGROW

- ★ Coordinated by the University of Southampton in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <https://cordis.europa.eu/project/rcn/186809>







INFORMATION AND COMMUNICATION TECHNOLOGY

# AN EXOSKELETON FOR PARAPLEGICS

Robotic devices are increasingly being used to assist patients with impaired motor functions. Through a novel adaptable exoskeleton, the Symbitron project hopes to revolutionise rehabilitation of patients.

Spinal cord injury (SCI) can lead to paraplegia, the loss of movement in the lower part of the body. Recent research efforts to treat SCI and restore partial movement have resulted in the development of assistive exoskeletons. Considering that active recruitment of the neuromuscular system in SCI patients could promote motor recovery, exoskeletons must be responsive to both the user and the environment.

The EU-funded Symbitron (Symbiotic man-machine interactions in wearable exoskeletons to enhance mobility for paraplegics) project was a four-year initiative that aimed to develop a safe, bio-inspired, personalised wearable exoskeleton. "Our main aim was to enable SCI patients to walk without additional assistance, by complementing their remaining motor function," explains project coordinator Prof. Herman van der Kooij.

## A patient-centred design

The Symbitron exoskeleton was based on a fully customised solution that complements the unique remaining capacities of each individual patient. The design was unique as it replicated physiological neuromuscular functionality while seamlessly integrating residual human functionality.

Researchers employed dynamic models of lower limb muscles to assist the gait of SCI subjects by recreating human behaviour via joint kinematics, kinetic measures and muscle activations. The models were based on clinical data measured from healthy subjects and SCI patients. The generated exoskeleton controller required very few inputs from joint angles, stance and swing detection to simulate walking at different speeds and terrains. It also demonstrated

robustness against perturbations and environmental disturbances.

Alongside extensive optimisation of the design and control, considerable emphasis was put on the bi-directional symbiotic man-machine interaction of the wearable exoskeletons. The modular exoskeleton can be modified to the size and capacities of different subjects using different configurations, namely only ankle support, ankle-knee support or ankle-knee-hip support. It is also possible to support only one or both legs. Furthermore, the electronic and mechanical modularity is automatically recognised by the respective software to adapt performance to the specific needs of the user.

## Clinical impact

To provide clinical proof of concept for safety and functionality of the system, the Symbitron consortium developed a training environment and training protocols for SCI patients and their clinicians. The project employed incomplete SCI subjects that needed only support at the ankle or at the ankle and knee, and complete SCI subjects that needed full support of both legs.

"Clinical tests showed that hardware and software could be adjusted to the specific characteristics of these subjects providing a proof of the feasibility of our unique approach," emphasises Prof. van der Kooij. Importantly, the biologically inspired controllers – in contrast to conventional approaches – allowed for variable gait patterns in terms of speed and step length.

The results were very promising, with all incomplete SCI subjects improving their walking speed and/or balance during training, and two complete SCI subjects walking again. In some cases, a rehabilitation effect was seen after training with the Symbitron devices even when the subjects did not use the device. Psychometric analysis also validated patient satisfaction and motivation for further improvement.

Prof. van der Kooij is hopeful that “although clinical results are still preliminary, training with the Symbitron devices seems to improve the walking of subjects who have some

remaining function left.” This suggests that the support offered by the Symbitron approach could extend beyond SCI subjects, such as for the rehabilitation of stroke survivors.

#### Symbitron

- ★ Coordinated by the University of Twente in the Netherlands.
- ★ Funded under FP7-ICT.
- ★ <https://cordis.europa.eu/project/rcn/110314>
- ★ Project website: <http://www.symbitron.eu/>

## THE NEW ERA OF DIGITAL PAPER

What if there was a way to invisibly encode data onto paper? An EU-developed printed antenna circuit with flexible thin-film chip makes it possible.

Everything is slowly becoming digitised, even playing cards and product packaging. For some time, it has been possible to print radio antenna circuits onto cardboard, enabling an individual item to be scanned and tracked.

Using conventional technologies, a metal oxide near-field communications (NFC) circuit would be printed on a plastic substrate, creating a three-layer (paper-plastic-paper) sandwich. However, this structure would be conspicuously thick when used on playing cards. Conventional silicon chips such as on credit cards would be even thicker, and also prohibitively expensive to produce.

### Thinner NFC antennas

The EU-funded PING (Printed Intelligent NFC Game cards and packaging) project has developed a better kind of NFC antenna. The project's new NFC tags consist of a printed antenna with a flexible thin-film chip. The antenna is printed directly onto one of the paper layers, eliminating the third plastic inner layer. This guarantees the same look and feel as a normal playing card.

The tags do not include batteries. Instead, the chip gets the necessary energy from the signal it receives from the device reader. The main application is contactless scanning and reading.

“The most common example of an existing NFC application is a ski pass,” says Sophie De Schepper, PING project coordinator. “You walk up to the terminal and an NFC reader detects the presence of the NFC tag. The reader verifies it based on the dates coded onto the chip, and decides to let the skier pass through or not.” It is no longer necessary to place a wallet against a scanner.

PING applications include casino- and other game-cards. In a casino, each card would be individually identified. As the dealer deals, dedicated readers in the table record each card, making cheating impossible. This method also eliminates the complicated network of hidden television cameras necessary to broadcast professional poker matches. The combination of NFC tags and scanners means that the computer system constantly updates and broadcasts the players' hands for the benefit of TV viewers.

A different use involves product packaging. Suppose a shopper with a food allergy is in a supermarket holding a certain food packet that includes a PING tag. The packet is scanned with an NFC-enabled smartphone. Then the phone's screen flashes a red warning, advising not to buy the item. “The phone compares the tag information against medical data stored on the smartphone, and informs you that the product contains ingredients to which you are allergic,” explains De Schepper.

A second gaming application concerns collectible cards. The project enriched the card-trading experience. Phone-scanning automatically updates an online collection for sharing or competing with others.

### Game changer

The project's technology is a game changer. PING NFC tags will cost less than half of a conventional NFC tag. Also, the fact that the tags are so thin (less than 25 µm) and flexible means that they can be included in almost anything, without having to redesign existing products.

For this work, PING won the European Commission's Innovation Product Award. The next phase for the project will involve upscaling the processes needed for full production capacity. So far, the marketplace has shown considerable interest.

No doubt, embedded NFC chips will become common in future. Soon everything that needs to be tracked or individually identified may include one of PING's printed tags. They could revolutionise document authentication.

#### PING

- ★ Coordinated by Cartamundi Turnhout in Belgium.
- ★ Funded under H2020-LEIT-ICT.
- ★ <https://cordis.europa.eu/project/rcn/194190>
- ★ Project website: <http://www.pingproject.eu/>



# SMALL AND FLEXIBLE EUROPEAN COMPUTER SOLUTION FOR THE CYBER-PHYSICAL AGE

In the cyber-physical age, objects and people will become parts of the same digital network while exchanging information, whether for homes or cars. An EU initiative researched new software/hardware architectures to address the scientific and technological challenges for cyber-physical systems (CPSs).



The cyber-physical age is upon us, where humans interact much more frequently with systems and the Internet to make homes, offices, factories and cars smarter. The challenge is to make these systems faster, cheaper and more energy-efficient so applications and services remain innovative and accessible.

The EU-funded AXIOM (Agile, eXtensible, fast I/O Module for the cyber-physical era) project set out to address such scientific and technological challenges by developing new software/hardware architectures for CPSs. "CPSs need to react in real time, provide enough computational power for assigned tasks, consume the least possible energy, scale up through modularity, allow for ease of programmability and exploit existing standards at minimal costs," says project coordinator Prof. Roberto Giorgi.

Often endowed with control, monitoring and data gathering functions, CPSs need to comply with essential requirements like safety, privacy, security and near-zero power consumption, as well as size, usability and adaptability constraints.

AXIOM defined a simple but powerful architecture that can potentially be deployed in CPSs. It will include not only classical embedded system components and the possibility of connecting to the Internet, but also the option of easily building CPSs from two or more boards without changing development tools.

## Small and flexible

The platform has several advantages compared to existing ones. The 10x15 cm board can be added to or easily programmed. "We aim at providing more performance or redundancy by simply adding more AXIOM boards," explains Prof. Giorgi. "A large apartment may use two such boards as an edge computer for controlling the smart home, while a larger building may use 10 of them. Similarly, the board can scale from one to more boards when simpler or more sophisticated needs for video surveillance exist."

The board can work on open-source software and easily interacts with the cyber-physical worlds. The platform can be powered by a laptop-style power adapter that consumes less than 20 W at full speed. More boards can be easily interconnected by just using inexpensive USB-C cables and without the need for any other external components.

## Smarter homes and living

CPSs are increasingly embedded in all types of artefacts making smarter, more intelligent, energy-efficient and comfortable transport systems, cars, factories, hospitals, offices, homes, cities and personal devices. AXIOM can do that, Prof. Giorgi says. The project group is currently looking at a partner to commercialise an optimised model based on the concept board, one that can be deployed economically on a larger scale.

"We designed a real hardware board and its software to allow users to build a competitive and innovative system of small size, small power, easy extensibility and easy programmability," concludes Prof. Giorgi. "All these features are not so common all together in other systems."

AXIOM was part of the EU's focus on reinforcing European industrial strengths as well as exploring new markets. This will provide citizens and businesses with a wide range of innovative applications and services.

### AXIOM

- ★ Coordinated by the University of Siena in Italy.
- ★ Funded under H2020-LEIT-ICT.
- ★ <https://cordis.europa.eu/project/rcn/194328>
- ★ Project website: <http://www.axiom-project.eu/>



SECURITY

# ANTICIPATING A NEW FORM OF TERRORISM AND HELPING FIRST RESPONDERS TAKE ACTION

Terrorism is evolving, and the internet makes it ever more possible for people to create their own weapons in the privacy of their own homes. To help address the balance and deal with this hard-to-identify threat, one EU project has developed an app to help emergency services recognise what they may come across.

Europe has experienced a number of terrorist attacks involving explosives over the last 15 years. The bombings in Madrid 2004, London 2005 and Oslo 2011 are some of the most notable at the start of this period, and the bombings in Brussels and Manchester two of the more recent. Legislators are reacting to this situation and researchers can help them in their work by providing scientific-based recommendations for regulations and alternative methods to counter the threat posed by home-made explosives (HMEs).

The EU-funded EXPEDIA (EXplosives PrEcursor Defeat by Inhibitor Additives) project has been doing just that, as Senior Scientist Dr Patrik Krumlinde explains, "We set out to increase the understanding of how terrorists create HMEs, what chemicals they start from and where they find them in the open market." The project wanted to establish how easily an HME can be created, what basic equipment is necessary and what chemical knowledge is needed by the terrorist.

In order to do so, EXPEDIA's team looked at the different types of recipes and methods used to prepare HMEs to establish their availability. The project partners have also assessed the equipment and the level of training and knowledge of the perpetrator that is required to prepare the material. "We have also carried out detonation tests in order to evaluate the efficiency and power of the HMEs produced by following different recipes," says Dr Krumlinde.

The work is already having an impact. The project has, on request, provided recommendations to the EC for the upcoming revision of the precursor regulation No 98/2013. In the proposal currently adopted by the EC, three out of four new regulations are in line with the recommendations made by the EXPEDIA consortium.

"We have also showed that it would be possible to increase the difficulty of using some common precursor materials in production of HMEs by the use of additives, which EXPEDIA refers to as 'inhibitors'," adds Dr Krumlinde.

As one of the results of the project, EXPEDIA has created a European guide for first responders with basic instructions on how to interpret findings on a crime scene, when suspected bomb factories have been encountered. This comes in the form of an application for smart phones, intended for use by police and rescue services to help them identify clandestine laboratories.

But why an app? "At first, we intended to develop a pamphlet but mid-way in the project we changed our focus to smart phones. Even though it is not the case today, it is probably only a matter of time before smart phones are in the hands of every police and rescue service workforce. It has a great potential to be an important tool in their ordinary, day-to-day work but also in these special cases when they can use our guide to identify possible bomb factories and can put the emergency services in direct contact with experts," Dr Krumlinde says.

The project surmounted several challenges to get to the point at which it was able to contribute to the general public's safety. Dr Krumlinde describes finding suitable inhibitors intended for use with certain materials that can be used to make bombs, as one of the greatest challenges they had to deal with. "Most of the precursors are widely used in society and it is necessary to find additives that do not have a negative environmental impact due to, for example, toxicity, while making sure adding them doesn't push up the price."

The team have found some promising inhibitors but only one out of three is good enough for implementation at this

stage – the others need more research. Dr Krumlinde feels the biggest challenge in general within the area of security of explosives, is to turn the research results into products or regulations that can have a positive influence and impact on society. The project has done well on that front.

And the most significant outcome? He is clear on that, “Together with organisations throughout Europe, we are collecting information and are collaborating around these questions so that we can support the police, rescue services and legislators in their work for a safer and more secure society.”

This cooperation, made possible through funding to the project, was key to its success, and that success is continuing, as Dr Krumlinde explains. “We are involved in several

ongoing, security-related projects so the work carries on. At the moment we are working on establishing a European network of experts within this area and are evaluating EU-funded project results to identify future research initiatives.”

#### EXPEDIA

- ★ Coordinated by the Swedish Defence Research Agency in Sweden.
- ★ Funded under FP7-SECURITY.
- ★ <https://cordis.europa.eu/project/rcn/191144>
- ★ Project website: <http://expedia-fp7.eu/>

## GAMMA PROJECT HANDS OVER THE KEYS TO FUTURE AIR TRAFFIC MANAGEMENT

The Single European Sky (SES) considerably improved air traffic management (ATM) in Europe, whilst SESAR brought together some 3 000 experts to focus on the new generation of ATM. Recently, the GAMMA project went a step further by addressing remaining security issues in new global ATM scenarios.

**G**AMMA (Global ATM security management) pretty much picks up on the work on ATM security developed by SESAR1. Taking advantage of the methodological framework it laid out, the project assesses ATM security from a system-to-system perspective, explores technological and operational opportunities, and proposes a security solution of its own.

“GAMMA has adopted innovative technologies, which were in turn applied to a range of different applications in the ATM security domain. But I would say that the most innovative aspect of the project lies in how these diverse applications are brought together to enable new and innovative concepts for the collaborative management of ATM security,” explains Giuliano d’Auria, coordinator of the project on behalf of Leonardo – the Italian high-tech company formerly known as Finmeccanica.

GAMMA’s methodology followed a well-defined activity flow, starting from threat assessment and continuing with architecture definition, prototypes design and validation exercises. A total of seven prototypes were developed. They were first validated in stand-alone configuration to assess their individual performance, before being geo-integrated in a set of prototypes for complex environments so as to validate scenarios involving the collaborative principles set out by the project.

“Stand-alone validations had demonstrated that the prototypes were capable of enhancing the security of the specific ATM system as well as supporting the

implementation of broader collaborative principles for managing ATM security,” d’Auria explains. “Stakeholders and experts involved in a validation exercise applying the GAMMA concept to civil military scenarios, for example, recognised that the system enables an early reaction of the military to hijacking events, saving valuable time for the scrambling of fighters.”

Measurements performed during the exercise revealed a reaction time saving of almost four minutes, according to d’Auria. Validation carried out on another exercise involving information sharing at a European level demonstrated that the GAMMA setup can ensure the activation of countermeasures in less than two minutes.

All in all, GAMMA’s ATM security solution manages to build upon the principles and concepts of security management in a collaborative multi-stakeholder environment whilst taking into account current International and European legal frameworks and the constraints imposed by the respect of national sovereignty.

The vision of collaborative ATM security management is widely accepted as a principle guiding the implementation of an ATM Security Framework in Europe. As d’Auria points out, GAMMA contributes to discussions over the future shape of ATM Security Management by showing how to build upon these generally accepted principles, exploring their technological and operational implications and opportunities.

“The roadmap for collaborative management of ATM Security is still being

laid out by European institutions and stakeholders. GAMMA contributes to this roadmap by providing concrete evidence of how the system could work and highlighting opportunities,” he says.

Many of GAMMA’s prototypes fit within a definite international roadmap for enhancing the security of the specific application. The road ahead for these prototypes is therefore well defined, according to d’Auria. For other prototypes where the roadmap is still being developed, he insists that further work is required to influence the definition of the future security framework.

#### GAMMA

- ★ Coordinated by Leonardo in Italy.
- ★ Funded under FP7-SECURITY.
- ★ <https://cordis.europa.eu/project/rcn/110049>
- ★ Project website: <http://www.gamma-project.eu>





FUNDAMENTAL RESEARCH

# USING GRAPHENE AS A SUPERCHARGED MAGNIFYING GLASS

© GRASP

The complex interactions between graphene and light are now much better understood thanks to work under the GRASP project. The outcomes of the four-year research lay the groundwork for future technologies exploiting nonlinear optical effects.

Besides their importance in the understanding of fundamental physics, nonlinear optical effects are also key to important applications such as quantum computing, biomedicine or all-optical switching. But there are still many obstacles to exploiting their full potential, one of them being the actuation of nonlinear optical effects at ultra-low powers and on chip-scale devices.

"This is indeed one of the outstanding challenges in optics," says Prof. Dr Darrick Chang, Group Leader on Theoretical Quantum-Nano Photonics at ICFO. "Realising nonlinear optical effects typically requires large laser intensities, and the resulting power consumption – or the size of the power sources required – often makes it impractical to realise on small scales, such as for portable devices."

The ultimate goal would be to see nonlinear effects at the level of single quantum particles of light, and pursuing this objective is well worth the trouble. It would notably enable the best possible performance and wide deployment of classical nonlinear devices, whilst facilitating disruptive quantum information protocols that cannot be realised on classical platforms.

It was with this objective in mind that the GRASP (Graphene-Based Single-Photon Nonlinear Optical Devices) project kicked off in 2014. "The goal of the project was to investigate whether a relatively new and exotic material – graphene – could allow pulses of light to interact with each other at much lower power," he explains. The graphene path is fundamentally new in nonlinear optics, but Prof. Dr Chang and his team believed that the material's unique properties

would allow even single particles of light to attain the required intensities to actuate nonlinear processes.

"One of the unique properties of graphene, which was both theoretically predicted and then experimentally observed, was that it could effectively focus or spatially confine light to extremely small length scales. We could use the analogy of a magnifying glass, which makes it possible to focus light from the sun into a small spot, making the light intense enough to even burn a piece of paper," Prof. Dr Chang explains.

In this analogy, graphene could be considered as a supercharged magnifying glass. It can squeeze light into a space millions of times smaller than the best magnifying glasses or lenses money could ever buy, and the resulting intensities would be high enough to actuate nonlinear optical processes.

The GRASP project was able to observe nonlinear effects originating from this magnifying-glass effect for the first time. This is particularly remarkable, considering that graphene is just a single atom thick, whereas standard nonlinear optical devices involve bulky materials. Whilst the ultimate goal of developing a completely new generation of technology based on nonlinear optical devices that can operate at ultra-low powers is still far away, the consortium's work is an important step in this direction.

"Of course much more work must be done for graphene to become a mature technology for nonlinear optics. But we developed a lot of important building blocks that set the ground for further work. This includes seeing nonlinear optical effects



in graphene due to strong light confinement for the first time, learning to fabricate graphene with higher material quality, constructing new devices that can confine fields not millions, but billions of times better than the best lenses, and getting a better understanding of the complex interactions between graphene and light,” Prof. Dr Chang says.

Whilst it’s probably too early to guess concrete routes toward commercialisation, the use of graphene for widely deployable, chip-scale classical and quantum nonlinear optical technologies is now much more conceivable. Which explains why Prof. Dr Chang intends to pursue his work:

“Having established the important building blocks needed, our goal is to continue along this exciting line of research, and begin to put these building blocks together, and realise basic but real devices in the coming years,” he says.

#### GRASP

- ★ Coordinated by the Institute of Photonic Sciences in Spain.
- ★ Funded under FP7-ICT.
- ★ <https://cordis.europa.eu/project/rcn/110793>
- ★ Project website: <http://www.grasp-fet.eu>

## TINY QUANTUM DEVICE TO REDEFINE AMPERE

EU-funded scientists have succeeded in redefining the ampere in terms of fundamental constants of physics. Based on the electron charge, the newly developed microscopic device has been reported as the most accurate technique for making measurements of tiny currents to date.

Over the last few decades, the need for increasingly high accuracy and reliable measurements has determined a shift towards standards based on fundamental quantities of nature.

Within the EU-funded SINHOPSI (Single-Hole Pumping in Silicon) project, researchers from the University of Cambridge, the National Physical Laboratory and Hitachi Ltd have joined forces in creating novel quantum technology critical in creating a new standard for electrical current based on electron charges. Experimental demonstrations advanced the state-of-the-art of both accurate electric current generation and single-charge remote sensing.

“Quantum-based systems are acknowledged as the most stable and reliable metrological tools as they can be strongly intertwined with fundamental constants through their mathematical description,” notes Dr Alessandro Rossi.

### Moving away from physical artefacts

The international system of units (SI) defines seven quantities that are considered to be the building blocks of physics. This system is evolving and changing as new knowledge and measurement needs arise. “We are currently in the middle of a revolution in metrology science, where all seven base units – the metre, kilogram, second, Kelvin, ampere, mole and candela – will ultimately be anchored to unvarying constants of nature,” says Dr Rossi. “These definitions should be stable over time, universally reproducible and not based on objects that change shape, lose integrity or change characteristics over time.”

Most SI base units now have a clear physical definition, just like the metre which is defined by the distance light travels in a given time. However, the definition of the ampere is prone to instability. At the moment, one ampere is defined as the constant current flowing in two narrow, infinitely long parallel conductors placed one metre apart in a vacuum that produces a force equal to  $2 \times 10^{-7}$  Newtons between them per metre of length. “This nineteenth-century formulation is, however, cumbersome, inaccurate and impossible to implement in a real experiment without making compromising approximations,” notes Dr Rossi.

### Novel transistor-like device

To redefine the ampere, scientists have now turned to a new approach based on manufacturing nanometre-size quantum electronic devices and operating them at near-absolute zero temperatures. These devices are called single-electron pumps (SEPs) as they precisely emit one electron at a time and promise higher accuracy and

stability for electric current generation than any other device.

The most reliable type of these devices makes use of electrostatically defined quantum dots, which are small regions of a semiconductor material where individual electrons can be trapped and released at will. For manufacturing the SEP, SINHOPSI scientists used silicon nanotransistors which have a cutting-edge advantage over competitive technologies. “The novelty of these devices relies on the ability to carefully fine-tune the size of the quantum dot resulting in a marked enhancement in terms of electric current accuracy,” explains Dr Rossi.

SINHOPSI has developed and tested the most accurate SEPs based on silicon nanoelectronics to date. In particular, scientists have reported that these newly developed devices are three times as accurate as those that set the previous world record, while they maintain the accuracy at a level of three parts per million. “If we consider what this means at the level of single electrons, we can say that every second, we



manage to trap and transfer 1 billion electrons with an error of 270 electrons or less. No other electronic system is this accurate,” notes Dr Rossi.

### Aerosol counting

Besides the far-reaching implications stemming from the redefinition of the ampere unit, the novel pump could

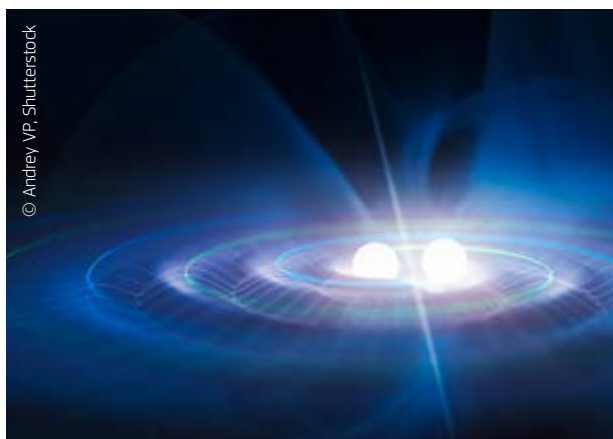
prove useful in a number of areas including the determination of radioactivity levels in ionisation chambers and counting aerosol particles in the air. In both cases, the newly developed stable reference current sources developed in SINHOPSI can significantly improve the accuracy and availability of small-current calibration capability.

### SINHOPSI

- ★ Coordinated by the Chancellor, Masters and Scholars of the University of Cambridge in the United Kingdom.
- ★ Funded under H2020-MSCA-IF.
- ★ <https://cordis.europa.eu/project/rcn/194984>

## EUROPEAN EXCELLENCE IN GRAVITATIONAL WAVE RESEARCH

Young European researchers have helped track down the cosmic neighbourhood of two merging black holes as well as a pair of colliding neutron stars millions of light-years away. This marks the beginning of a new era in deciphering the fundamental physics phenomena hidden in the catastrophic events involving massive bodies.



Gravitational waves are one of the most remarkable predictions of Einstein's theory of general relativity. These waves are ripples in the curvature of spacetime caused by the acceleration of objects in the Universe and are hard to detect. To be detectable, gravitational waves need to be generated from extremely dense, massive objects moving at very high speeds.

Thanks to a new generation of detectors – the US-based Laser Interferometer Gravitational-Wave Observatory (LIGO) and the Europe-based Virgo detector – the gravitational wave signals emitted by the coalescence of two black holes and of a colliding pair of neutron stars have been detected. This is a cornerstone result in physics, opening a new era: gravitational wave astronomy.

Funded by the EU, GRAWITON (Gravitational Wave Initial Training Network) was a visionary initial training network that first predicted the need to train young researchers so that they can lead future developments in this exciting new field. Thirteen early-stage researchers received training for three years and a good fraction of them signed the detection papers, underlying their contribution to the discoveries.

### A cosmic success

The study of gravitational waves is a field that has been recently impressively expanded thanks to the LIGO and Virgo detectors that enable scientists to gain new insight on the cosmos. “The detection of gravitational waves caused by the merger of two black holes with equivalent masses of 29 and 36 times the mass of the Sun marked the beginning

of the experimental physics involving gravitational waves and the astrophysics of stellar-mass black holes,” said project coordinator Michele Punturo.

Two years later, the Virgo and LIGO interferometers detected the gravitational wave emitted by the coalescence of two neutron stars, pointing at the source in the sky and giving astronomers access to the observation emitted in that spectacular collision. The observations have given scientists the unprecedented opportunity to solve a decades-long mystery of where half of all elements heavier than iron are produced and identify the causes of gamma-ray bursts. “With this detection is born what is called ‘multi-messenger’ astronomy, cosmology and astrophysics” said Punturo. “It is the first time that an astronomical event has been viewed in both gravitational and electromagnetic waves – our cosmic messengers.”

The results from these exciting discoveries are co-signed by researchers whose PhDs have been funded by GRAWITON. Researchers stemming from France, Germany and Italy contributed to the data analysis and technological developments necessary for the breakthroughs. In particular, they had the opportunity to engage with complex optical apparatuses, high-power and low-noise lasers, highly reflective coatings, and simulation and modelling work.

“Gravitational wave interferometers are the most sensitive detectors in the world, capable of sensing the ephemeral passage of a gravitational wave. The wave generates length variations between the two orthogonal arms of Virgo or LIGO of the order of  $10^{-19}$  m, 10 000 times smaller than the radius of a proton,” explains Punturo. GRAWITON researchers pioneered data analysis methods to extract the signal from the background noise.

GRAWITON successfully contributed to the gravitational wave science field. Scientists are now able to ‘see’ and ‘hear’ the cosmic events to better understand them. This will give them the opportunity to further understand the workings of the Universe.

### GRAWITON

- ★ Coordinated by the European Gravitational Observatory in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ <https://cordis.europa.eu/project/rcn/110302>
- ★ Project website: <http://www.grawiton-gw.eu/>

# EVENTS

SEPT.  
10

## Dublin, IRELAND

### WORKSHOP

#### PAP 2018: PERSONAL ANALYTICS AND PRIVACY

The EU-funded SoBigData project will be organising a workshop in Dublin, Ireland, on 10 September, 2018.

The purpose of this workshop is to encourage principled research that will lead to the advancement of personal data analytics, personal services development, privacy, data protection and privacy risk assessment. Submitted papers will address important issues related to personal analytics, personal data mining and privacy in contexts where real individual data are used to develop data-driven services, for carrying out social studies aimed at understanding society today, and for publication purposes.

The PAP 2018: PERSONAL ANALYTICS AND PRIVACY workshop is being held in conjunction with the European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML-PKDD), which will take place 10-14 September 2018.

For further information, please visit:

<http://sobigdata.eu/events/international-workshop-personal-analytics-and-privacy-pap2018>

SEPT.  
18-21

## Antwerp, BELGIUM

### CONFERENCE

#### INSPIRE HACKATHON 2018

The EU-funded DataBio project will be co-organising a hackathon in Antwerp, Belgium, on 18-21 September, 2018.

This is the third year the INSPIRE Hackathon will be held, and is being organised as part of the INSPIRE Conference 2018. The Hackathon will follow the motto of the INSPIRE Conference: 'Make it work together'. In its capacity as one of the key organisers, the DataBio project will support the Hackathon with data and big data technologies.

The main theme of INSPIRE Hackathon 2018 is to easily integrate INSPIRE, GEOSS and COPERNICUS data with data from other domains using web APIs, and to create value added applications. Its main objective is collaboration and sharing experiences in the domain of spatial data and services and the linking of these to other domains.

The first phase will commence before the INSPIRE Conference with the creation of teams that will work on certain projects. The Hackathon finale will take place during the workshop at the INSPIRE Conference 2018 on 19 September at 2 p.m.

For further information, please visit:

<http://www.plan4all.eu/inspire-hackathon-2018/>

SEPT.  
25

## Brussels, BELGIUM

### CONFERENCE

#### I3U FINAL CONFERENCE

The EU-funded I3U project will be organising its final conference in Brussels, Belgium, on 25 September, 2018.

The I3U project is hosting a final conference where it will present its results, consider how successful the Innovation Union has been in encouraging and strengthening innovation and research in Europe, and discuss where EU innovation policy is headed. The public event will feature sessions on transferring good ideas to market and how to govern innovation.

The main objective of the Innovation Union is to strengthen the European innovation potential. It has set both general objectives and specific associated (policy) commitments aimed at stimulating innovation. Speakers at the I3U final conference will present assessments of the Innovation Union commitments and of the Innovation Union as a whole.

For further information, please visit:

<http://www.i3u-innovationunion.eu/event/i3u-final-conference/>

## EVENTS

For more forthcoming events:

<http://cordis.europa.eu/events>

SEPT.

27-28

## Cernobbio, ITALY

### CONFERENCE

#### WMF2018 ANNUAL MEETING

The EU-funded World Manufacturing Forum 2018 (WMF2018) project will be organising its annual meeting in Cernobbio, Italy, on 27-28 September, 2018.

At the upcoming WMF2018 Annual Meeting, participants will explore the direction the manufacturing industry is taking, the level of technological innovation and the skills the new workforce will need to acquire. This will help primary stakeholder groups to embrace the Sustainable Development Goals of the 2030 global industrial agenda.

Against this backdrop, the project's mission is to facilitate dialogue and activities towards a shared common vision to resolve global manufacturing challenges through cooperation and collaboration, considering the different perspectives of stakeholders from industry, academia and government. The WMF2018 Annual Meeting's organisers have invited speakers from Europe, China, Japan, South Africa, South Korea, the United States and many other countries.

During the two-day Annual Meeting in Cernobbio, Italy, international leaders will highlight the role of manufacturing through to 2030 and how digital transformation contributes to economic well-being and societal advancement.

For further information, please visit: <https://www.worldmanufacturingforum.org/annual-meeting>



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# research<sup>eu</sup> Results Pack

**CORDIS** brings you the latest results from EU-funded research and innovation projects through our theme-specific Results Packs, including scientific breakthroughs and exciting new products and technologies.



## Organoids

This Results Pack highlights five EU-funded projects and their scientific advances in organoid technology and how they can be used as *in vivo*-like models. The aim is to spearhead their potential use in infection models and toxicity screening, and to test pharmaceutical molecules, personalised medicine and regenerative medicine / organ replacement. **For further information please go to:** [https://cordis.europa.eu/article/id/401007-organoids-mini-organs-in-a-dish-for-disease-research-and-new-cures\\_en.html](https://cordis.europa.eu/article/id/401007-organoids-mini-organs-in-a-dish-for-disease-research-and-new-cures_en.html)



## Heritage at Risk

Our latest pack showcases 11 projects that are all working towards the preservation and deeper understanding of our cultural heritage, to conserve sites and support research in the field. **For further information please go to:** [https://cordis.europa.eu/article/id/400947-heritage-at-risk-eu-research-and-innovation-for-a-more-resilient-cultural-heritage\\_en.html](https://cordis.europa.eu/article/id/400947-heritage-at-risk-eu-research-and-innovation-for-a-more-resilient-cultural-heritage_en.html)



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